

Supplementary material: Densest plane group packings of regular convex polygons

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I. EXACT DENSITIES OF THE DENSEST PLANE GROUP PACKINGS OF A DISC

Using differences between the densest plane group packing configurations of n -gons with 6-fold, 8-fold, and 12-fold rotational symmetries, we acquired the exact densities of the densest plane group packings of a disc.

Comparing the densest $p2/p2gg/pg/p3/p1$, $p6$, $p3m1$, $p31m$ and $p6mm$ packings of a hexagon and computing ratios of respective densities, the relationship between these packing densities for all n -gons with 6-fold rotational symmetry is given by

$$\rho(\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}) = \frac{7}{6}\rho(\mathcal{K}_{p6_{\max}}) = \frac{3}{2}\rho(\mathcal{K}_{p3m1_{\max}})$$

and

$$\rho(\mathcal{K}_{p31m_{\max}}) = \frac{3}{2}\rho(\mathcal{K}_{p6mm_{\max}})$$

where $\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}$, $\mathcal{K}_{p6_{\max}}$, $\mathcal{K}_{p31m_{\max}}$, $\mathcal{K}_{p3m1_{\max}}$ and $\mathcal{K}_{p6mm_{\max}}$ are densest $p2/p2gg/pg/p3/p1$, $p6$, $p31m$, $p3m1$ and $p6mm$ packing configurations of n -gons with 6-fold rotational symmetry, $\rho(\cdot)$ is the packing density.

Similarly, comparing the densest $p4mg/c2mm/pm/p2mm$ and $p4mm$ packing configurations of an octagon, the relationship between packing densities for all n -gons with 8-fold rotational symmetry is given by

$$\rho(\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}) = \frac{3 + 2\sqrt{2}}{4}\rho(\mathcal{K}_{p4mm_{\max}})$$

where $\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}$ and $\mathcal{K}_{p4mm_{\max}}$ are densest $p4mg/c2mm/pm/p2mm$ and $p4mm$ packing configurations of n -gons with 8-fold rotational symmetry.

Lastly, comparing the densest $p2/p2gg/pg/p3/p1$, $p2mg/cm/p4$, $p4mg/c2mm/pm/p2mm$ and $p31m$ packing configurations of a dodecagon, the relationship between packing densities for all n -gons with 12-fold rotational symmetry is given by

$$\begin{aligned} \rho(\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}) &= \frac{3 + 2\sqrt{3}}{6}\rho(\mathcal{K}_{p2mg/cm/p4_{\max}}) = \frac{2\sqrt{3}}{3}\rho(\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}) = \\ &= \frac{2 + \sqrt{3}}{3}\rho(\mathcal{K}_{p31m_{\max}}) \end{aligned}$$

where $\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}$, $\mathcal{K}_{p2mg/cm/p4_{\max}}$, $\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}$ and $\mathcal{K}_{p31m_{\max}}$ are densest $p2/p2gg/pg/p3/p1$, $p2mg/cm/p4$, $p4mg/c2mm/pm/p2mm$ and $p31m$ packing configurations of n -gons with 12-fold rotational symmetry.

Combining all of the above, the relationships between packing densities of densest plane group packings of n -gons with 24-fold rotational symmetries are

$$\begin{aligned}\rho(\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}) &= \frac{3+2\sqrt{3}}{6}\rho(\mathcal{K}_{p2mg/cm/p4_{\max}}) = \frac{2\sqrt{3}}{3}\rho(\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}) = \\ &= \frac{7}{6}\rho(\mathcal{K}_{p6_{\max}}) = \frac{2+\sqrt{3}}{3}\rho(\mathcal{K}_{p31m_{\max}}) = \frac{3}{2}\rho(\mathcal{K}_{p3m1_{\max}}) = \frac{3\sqrt{3}+2\sqrt{6}}{6}\rho(\mathcal{K}_{p4mm_{\max}}) = \\ &= \frac{2+\sqrt{3}}{2}\rho(\mathcal{K}_{p6mm_{\max}})\end{aligned}$$

where $\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}$, $\mathcal{K}_{p2mg/cm/p4_{\max}}$, $\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}$, $\mathcal{K}_{p6_{\max}}$, $\mathcal{K}_{p31m_{\max}}$, $\mathcal{K}_{p3m1_{\max}}$, $\mathcal{K}_{p4mm_{\max}}$ and $\mathcal{K}_{p6mm_{\max}}$ are densest $p2/p2gg/pg/p3/p1$, $p2mg/cm/p4$, $p4mg/c2mm/pm/p2mm$, $p6$, $p31m$, $p3m1$, $p4mm$ and $p6mm$ packings of n -gons with a 24-fold rotational symmetry.

Consequently, since the disc contains a 24-fold rotational symmetry and the densest packing of a disc has a density of $\frac{\sqrt{3}}{6}\pi$, the exact optimal plane group packing densities of a disc are the following,

$$\begin{aligned}\rho(\mathcal{K}_{p2/p2gg/pg/p3/p1_{\max}}) &= \frac{\sqrt{3}}{6}\pi = 0.9068996\dots, \\ \rho(\mathcal{K}_{p2mg/cm/p4_{\max}}) &= (2-\sqrt{3})\pi = 0.8417872\dots, \\ \rho(\mathcal{K}_{p4mg/c2mm/pm/p2mm_{\max}}) &= \frac{\pi}{4} = 0.7853981\dots, \\ \rho(\mathcal{K}_{p6_{\max}}) &= \frac{\sqrt{3}}{7}\pi = 0.7773425\dots, \\ \rho(\mathcal{K}_{p31m_{\max}}) &= \frac{2\sqrt{3}-3}{2}\pi = 0.7290091\dots, \\ \rho(\mathcal{K}_{p3m1_{\max}}) &= \frac{\sqrt{3}}{9}\pi = 0.6045997\dots, \\ \rho(\mathcal{K}_{p4mm_{\max}}) &= (3-2\sqrt{2})\pi = 0.5390120\dots, \\ \rho(\mathcal{K}_{p6mm_{\max}}) &= \frac{2\sqrt{3}-3}{3}\pi = 0.4860060\dots\end{aligned}$$

II. CONTACT EDGE LENGTH - PACKING DENSITY RELATIONSHIP IN THE DENSEST $p2$, $p2gg$, pg PACKINGS OF A 9-GON, 15-gon, 21-GON, AND 39-GON

We computed the ratio of the total contact edge length of an n -gon in a plane group configuration with its neighboring polygons to the circumference of the n -gon for n equal to 9, 15, 21 and 39. Since our method obtains only approximations of optimal plane group configurations, the possible contact edges do not touch, although the Euclidean distance between neighboring polygons is smaller than 10^{-7} . Therefore, to compute an approximation to the length of a contact edge segment between two n -gons in a plane group packing, we orthogonally project the vertex of the neighboring polygon onto the relevant contact edge and compute the Euclidean distance between this projection and the corresponding vertex. The values of contact ratios are presented in Table I.

The contact edge length with neighboring n -gons decreases by the transition to a higher density configuration. This is not the case, for instance, when compared to the densest configuration of a dodecagon. The ratio of total contact edge length in the $p2/p2gg/pg/p3/p1$ configurations is $\frac{1}{2}$, presented in IV H 1/IV H 2/IV H 3/IV H 4/IV H 5, and the lower density $p2mg/cm/p4$ configurations is $\frac{1}{3}$, presented in IV H 6/IV H 7/IV H 8. Contrary to the enneagon where the transition from the $p2$ configuration to the lower density $p2gg$ configuration increases the length of edge contact.

	9-gon	15-gon	21-gon	39-gon
$p2$.2308835289	.135157084784	.0958958287	.0513838186
$p2gg$.2313262045	.135276771678	.0959451687	.0513925594
pg	.2315309020	.135304484961	.0959525664	.0513931528

TABLE I: Ratios of approximations of the total contact edge segment length with neighboring polygons to the circumference of a 9-gon, 15-gon, 21-gon, and 39-gon in their corresponding densest $p2$, $p2gg$, and pg configurations.

III. DENSITIES OF DENSEST PACKINGS OF REGULAR n -GON

Below we list densities of all plane group packings obtained by the Entropic Trust Region Packing Algorithm (ETRPA). Densities are truncated to the seventh decimal place. Each table entry links to the corresponding structure in Section IV.

	3-gon	4-gon	5-gon	6-gon	7-gon	8-gon	9-gon	10-gon
p2	0.9999999	0.9999999	0.9213106	0.9999999	0.8926905	0.9061636	0.9010300	0.9137199
p2gg	0.9999999	0.9999999	0.9213106	0.9999999	0.8926906	0.9061636	0.8998911	0.9137199
pg	0.9999999	0.9999999	0.9213106	0.9999999	0.8926906	0.9061636	0.8986088	0.9137199
p3	0.6666666	0.7737684	0.8704800	0.9999999	0.8808500	0.8766506	0.8877354	0.8877506
p1	0.6666666	0.9999999	0.8172559	0.9999999	0.8601909	0.9054206	0.8877354	0.9137199
p2mg	0.9999999	0.9999999	0.8541019	0.8571428	0.8422610	0.8655534	0.8341984	0.8372213
cm	0.9999999	0.9999999	0.8541019	0.8571428	0.8422610	0.8655534	0.8341984	0.8372213
p4	0.7128127	0.9999999	0.8421137	0.8177689	0.8421945	0.8503106	0.8303053	0.8300404
p4gm	0.6961524	0.9999999	0.7111904	0.7461338	0.7647735	0.8284270	0.7659323	0.7720563
c2mm	0.6666666	0.9999999	0.7171403	0.7499999	0.7625321	0.8284270	0.7669742	0.7725424
pm	0.4999999	0.9999999	0.6909830	0.7499999	0.7382504	0.8284271	0.7571216	0.7725424
p2mm	0.4999999	0.9999999	0.6909830	0.7499999	0.7382504	0.8284270	0.7571216	0.7725424
p6	0.9999999	0.7219358	0.7593302	0.8571428	0.7574012	0.7643882	0.7853528	0.7693214
p31m	0.7499999	0.6632301	0.7016619	0.7199999	0.7208406	0.7156544	0.7341084	0.7165394
p3m1	0.9999999	0.4974226	0.5385407	0.6666666	0.5719655	0.5798083	0.6304149	0.5888775
p4mm	0.5773502	0.4999999	0.5553763	0.5214872	0.5144618	0.5685424	0.5244326	0.5331442
p6mm	0.4999999	0.4641016	0.4937279	0.4799999	0.4902521	0.4823532	0.4894056	0.4830540

	11-gon	12-gon	13-gon	14-gon	15-gon	16-gon	17-gon	18-gon
p2	0.9076487	0.9282031	0.9043705	0.9074654	0.9047150	0.9090171	0.9069216	0.9162218
p2gg	0.9076648	0.9282032	0.9043705	0.9074655	0.9040306	0.9090171	0.9069216	0.9162218
pg	0.9076648	0.9282032	0.9043705	0.9074655	0.9023533	0.9090171	0.9069216	0.9162218
p3	0.8989629	0.9282032	0.9000514	0.8972213	0.9001741	0.8995067	0.9034831	0.9162218
p1	0.8891279	0.9282032	0.8938363	0.9074655	0.9001741	0.9090171	0.8994794	0.9162218
p2mg	0.8311609	0.8615612	0.8330633	0.8382374	0.8399388	0.8485635	0.8421519	0.8434670
cm	0.8279530	0.8615612	0.8321287	0.8382375	0.8399388	0.8485635	0.8421519	0.8434670
p4	0.8378042	0.8615612	0.8369105	0.8352788	0.8376586	0.8461384	0.8419033	0.8394577
p4gm	0.7762833	0.8038475	0.7766280	0.7786977	0.7802879	0.7956494	0.7804339	0.7813710
c2mm	0.7757095	0.8038475	0.7769742	0.7788232	0.7800620	0.7956494	0.7805888	0.7814167
pm	0.7665507	0.8038475	0.7719371	0.7788232	0.7753030	0.7956494	0.7775467	0.7814167
p2mm	0.7665508	0.8038475	0.7719372	0.7788232	0.7753031	0.7956494	0.7775467	0.7814167
p6	0.7729348	0.7956027	0.7725425	0.7732666	0.7799769	0.7742598	0.7753610	0.7853329
p31m	0.7218280	0.7461339	0.7220589	0.7238032	0.7308747	0.7258340	0.7273516	0.7282552
p3m1	0.5916426	0.6188021	0.5953579	0.5966415	0.6135979	0.5985185	0.5992167	0.6108145
p4mm	0.5424065	0.5358983	0.5414412	0.5360762	0.5338570	0.5460474	0.5350076	0.5372502
p6mm	0.4775021	0.4974226	0.4799512	0.4845448	0.4872498	0.4851838	0.4867589	0.4855035

	19-gon	20-gon	21-gon	22-gon	23-gon	24-gon	25-gon	30-gon
p2	0.9059592	0.9073386	0.9057786	0.9078962	0.9068302	0.9121152	0.9064263	0.9102293
p2gg	0.9059592	0.9073386	0.9053663	0.9078962	0.9068303	0.9121152	0.9064263	0.9102293
pg	0.9059592	0.9073386	0.9052376	0.9078962	0.9068303	0.9121152	0.9064263	0.9102293
p3	0.9037971	0.9021808	0.9034922	0.9030030	0.9050054	0.9121152	0.9051366	0.9102292
p1	0.9008436	0.9073386	0.9034922	0.9078962	0.9028456	0.9121152	0.9034167	0.9102293
p2mg	0.8418991	0.8457107	0.8405228	0.8406806	0.8392954	0.8466283	0.8395230	0.8423912
cm	0.8418991	0.8457107	0.8405228	0.8406806	0.8386501	0.8466283	0.8391618	0.8423912
p4	0.8417746	0.8436777	0.8397147	0.8393389	0.8407273	0.8466283	0.8406152	0.8409576
p4gm	0.7821347	0.7919222	0.7822096	0.7827111	0.7831353	0.7899149	0.7831787	0.7839575
c2mm	0.7820237	0.7919222	0.7822918	0.7827316	0.7830728	0.7899149	0.7832274	0.7839634
pm	0.7791172	0.7919222	0.7802593	0.7827316	0.7811158	0.7899149	0.7817747	0.7839634
p2mm	0.7791172	0.7919222	0.7802593	0.7827316	0.7811158	0.7899149	0.7817747	0.7839634
p6	0.7752395	0.7753641	0.7786384	0.7757193	0.7762202	0.7818130	0.7761683	0.7801966
p31m	0.7278774	0.7269891	0.7299648	0.7266241	0.7272264	0.7332016	0.7272552	0.7287441
p3m1	0.6002951	0.6007165	0.6091508	0.6013927	0.6016664	0.6080768	0.6021181	0.6068195
p4mm	0.5401484	0.5379203	0.5399421	0.5378373	0.5368321	0.5421119	0.5371682	0.5383827
p6mm	0.4866096	0.4854864	0.4866432	0.4854253	0.4840900	0.4888010	0.4841886	0.4858294

	35-gon	36-gon	37-gon	39-gon	42-gon	55-gon	89-gon	Disc
p2	0.9068346	0.9092088	0.9067154	0.9065732	0.9085948	0.9068258	0.9068831	0.9068996
p2gg	0.9068346	0.9092088	0.9067154	0.9064331	0.9085948	0.9068258	0.9068831	0.9068996
pg	0.9068346	0.9092088	0.9067154	0.9064117	0.9085948	0.9068258	0.9068831	0.9068996
p3	0.9060691	0.9092088	0.9061077	0.9059168	0.9085948	0.9065451	0.9067687	0.9068996
p1	0.9051474	0.9092088	0.9053157	0.9059168	0.9085948	0.9061845	0.9066281	0.9068996
p2mg	0.8407000	0.8439306	0.8407669	0.8414747	0.8420952	0.8418053	0.8417961	0.8417872
cm	0.8400339	0.8439306	0.8405866	0.8414747	0.8420952	0.8418053	0.8417961	0.8417872
p4	0.8413071	0.8439306	0.8412738	0.8411836	0.8413652	0.8417912	0.8417900	0.8417872
p4gm	0.7843952	0.7873979	0.7844080	0.7845862	0.7846644	0.7849845	0.7852317	0.7853981
c2mm	0.7843774	0.7873979	0.7844231	0.7845734	0.7846659	0.7849798	0.7852327	0.7853981
pm	0.7835509	0.7873979	0.7837454	0.7839107	0.7846659	0.7846505	0.7851126	0.7853981
p2mm	0.7835509	0.7873979	0.7837454	0.7839107	0.7846659	0.7846505	0.7851126	0.7853981
p6	0.7768400	0.7793218	0.7768246	0.7777029	0.7787955	0.7771135	0.7772614	0.7773425
p31m	0.7282187	0.7308653	0.7282273	0.7292870	0.7288748	0.7288691	0.7289534	0.7290091
p3m1	0.6033352	0.6061392	0.6034684	0.6059109	0.6057298	0.6040880	0.6044043	0.6045997
p4mm	0.5393467	0.5386784	0.5393115	0.5382560	0.5386916	0.5386322	0.5388275	0.5390120
p6mm	0.4851807	0.4872435	0.4852676	0.4861913	0.4859165	0.4860784	0.4860337	0.4860060

IV. STRUCTURES

Here we present structural parameters and visualizations of respective configurations of all plane group packings obtained by ETRPA. Structural parameters are given by the *Plane group*, *Primitive cell basic vectors* \mathbf{b}_1 and \mathbf{b}_2 (denoted by a blue parallelepiped), the position of *Centroid in Cartesian coordinates* of n -gon whose centroid lies in the fundamental domain, and *Angle of rotation* of n -gon whose centroid is positioned in the fundamental region in radians. Vertices of an n -gon are given by $\mathbf{v}_i = [\cos(\frac{i2\pi}{n}), \sin(\frac{i2\pi}{n})]$ for $i = 1, \dots, n$.

A. 3-gon

1. *Plane group*: $p2$

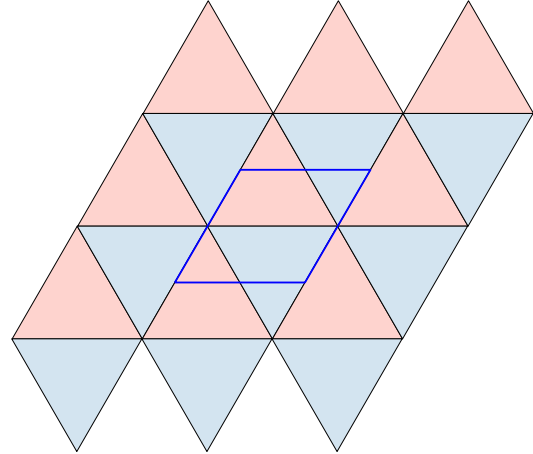
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.732054664127251	0.871769719259841
\mathbf{b}_2	0	1.499996771062300

Centroid in Cartesian coordinates:

	x	y
	0.578307995580721	1.541069701737172

Angle of rotation: 1.570801394549727



2. *Plane group*: $p2gg$

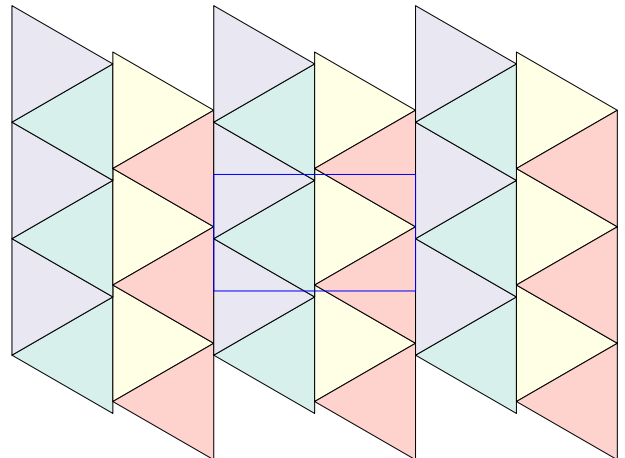
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000174813824	0
\mathbf{b}_2	0	1.732050809551244

Centroid in Cartesian coordinates:

	x	y
	1.000000072888529	0.777568229861278

Angle of rotation: 3.141592641118869



3. *Plane group: pg*

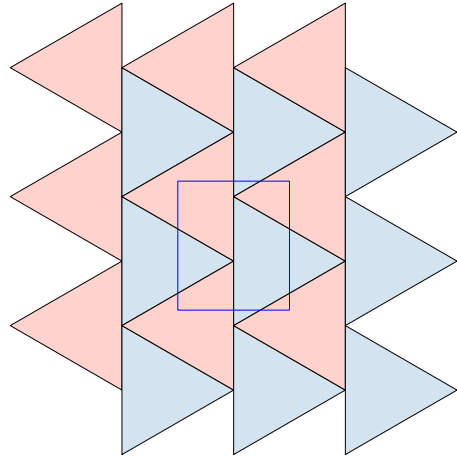
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.500000011391519	0
\mathbf{b}_2	0	1.732050868687100

Centroid in Cartesian coordinates:

	x	y
	0.250000002737028	0.433012717171775

Angle of rotation: 5.235987759413908



4. *Plane group: p3*

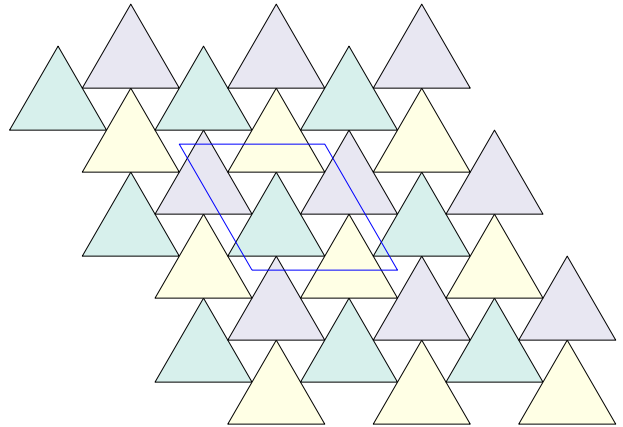
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.598076265225636	0
\mathbf{b}_2	-1.299038132612817	2.250000046654798

Centroid in Cartesian coordinates:

	x	y
	0.433012725998312	0.750000008323458

Angle of rotation: 5.759610390313656



5. *Plane group: p1*

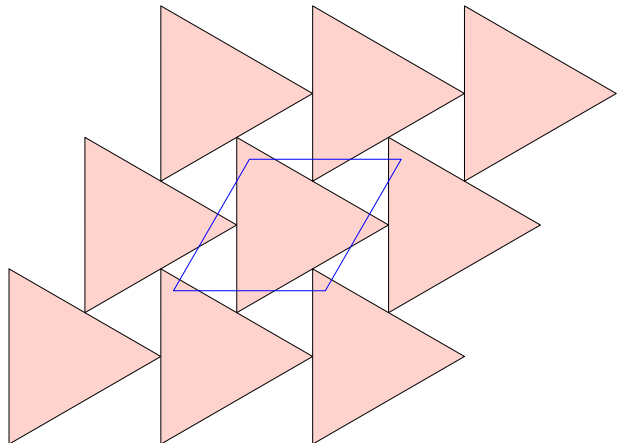
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.500000062752839	0
\mathbf{b}_2	0.749999934206041	1.299038160047087

Centroid in Cartesian coordinates:

	x	y
	1.124999998479440	0.649519080023544

Angle of rotation: 2.094484526779645



6. Plane group: $p2mg$

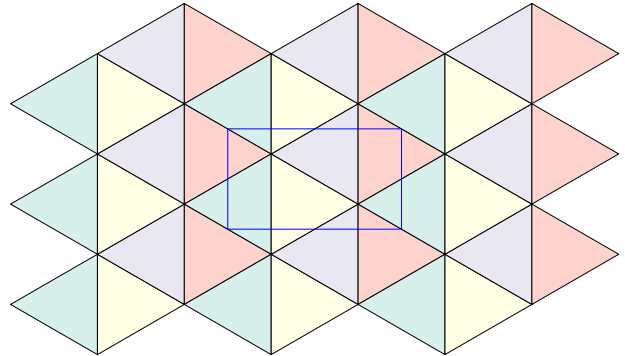
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000126340250	0
\mathbf{b}_2	0	1.732050827579175

Centroid in Cartesian coordinates:

	x	y
	0.249999997394745	0.433012705681525

Angle of rotation: 3.141592615130523



7. Plane group: cm

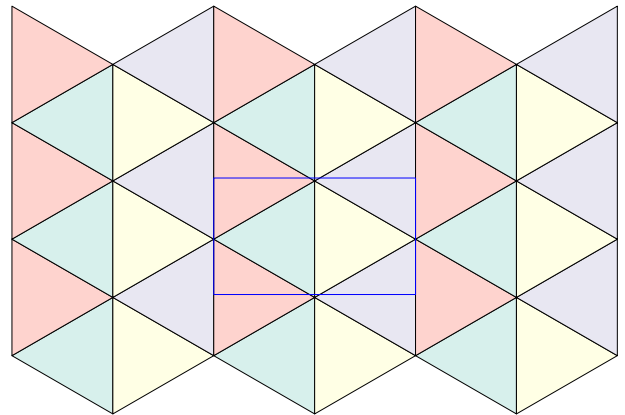
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000122782969	0
\mathbf{b}_2	0	1.732050825930738

Centroid in Cartesian coordinates:

	x	y
	1.000000042522176	0.822955729772510

Angle of rotation: 3.141592660429894



8. Plane group: $p4$

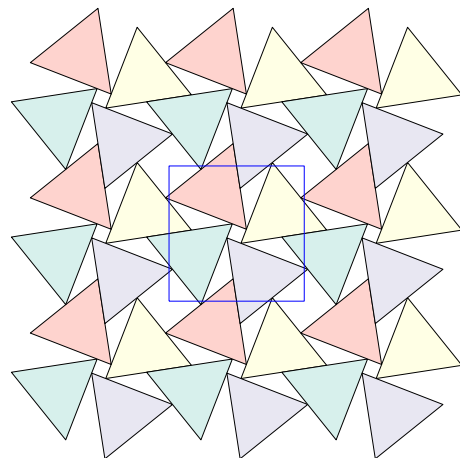
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.699934335624956	0
\mathbf{b}_2	0	2.699934335624956

Centroid in Cartesian coordinates:

	x	y
	0.484415611632117	0.918774002816642

Angle of rotation: 0.676640257502641



9. Plane group: $p4gm$

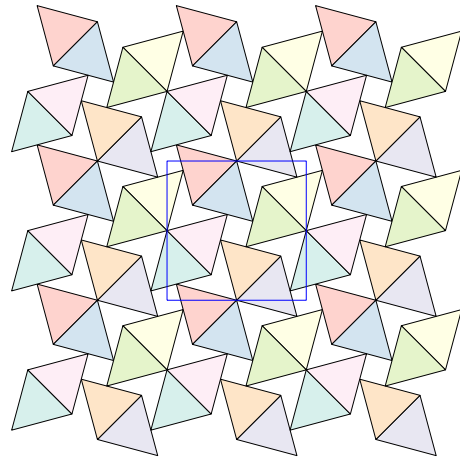
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.863703328854887	0
\mathbf{b}_2	0	3.863703328854887

Centroid in Cartesian coordinates:

	x	y
	0.258819052313545	0.965925824847282

Angle of rotation: 3.926990818636206



10. Plane group: $c2mm$

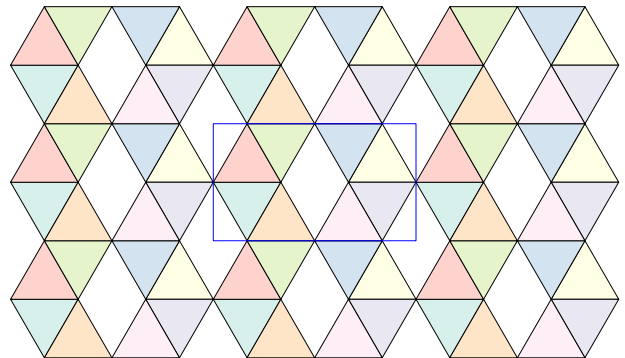
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.196152436458361	0
\mathbf{b}_2	0	3.000000211642944

Centroid in Cartesian coordinates:

	x	y
	0.866025418629238	1.000000077648594

Angle of rotation: 2.617993854891568



11. Plane group: pm

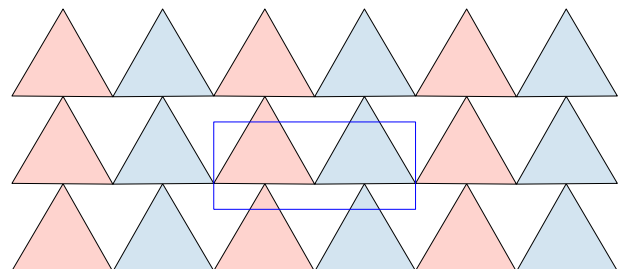
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464001626103967	0
\mathbf{b}_2	0	1.500043540199171

Centroid in Cartesian coordinates:

	x	y
	0.869801868852596	0.750021770099586

Angle of rotation: 1.563193315381721



12. *Plane group: p2mm*

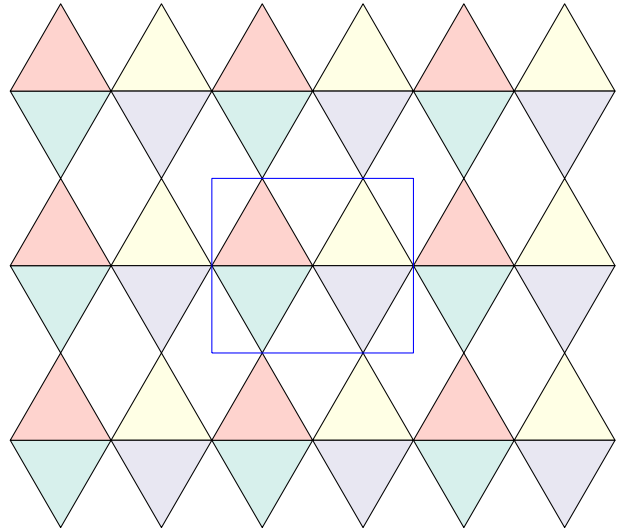
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464101697007052	0
\mathbf{b}_2	0	3.000000140431124

Centroid in Cartesian coordinates:

	x	y
	0.866025422611054	1.000000050105634

Angle of rotation: 0.523598793128504



13. *Plane group: p6*

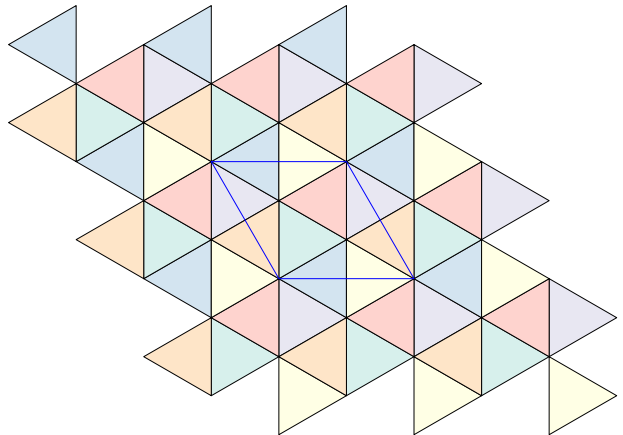
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000056024389	0
\mathbf{b}_2	-1.500000028012194	2.598076259871860

Centroid in Cartesian coordinates:

	x	y
	0.500078817059582	0.865979906092736

Angle of rotation: 6.283021982886768



14. *Plane group: p31m*

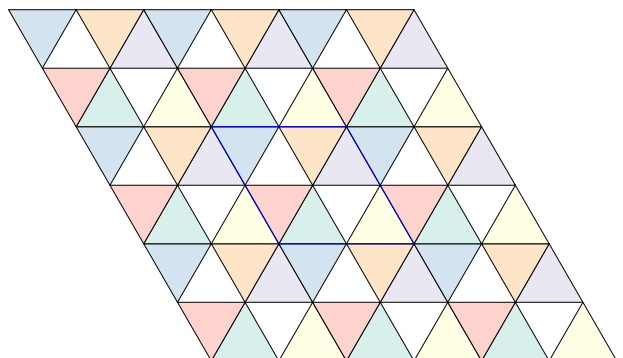
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464101638671587	0
\mathbf{b}_2	-1.732050819335793	3.000000020380897

Centroid in Cartesian coordinates:

	x	y
	0.866025420166207	0.500000005087125

Angle of rotation: 1.570796324775318



15. Plane group: $p3m1$

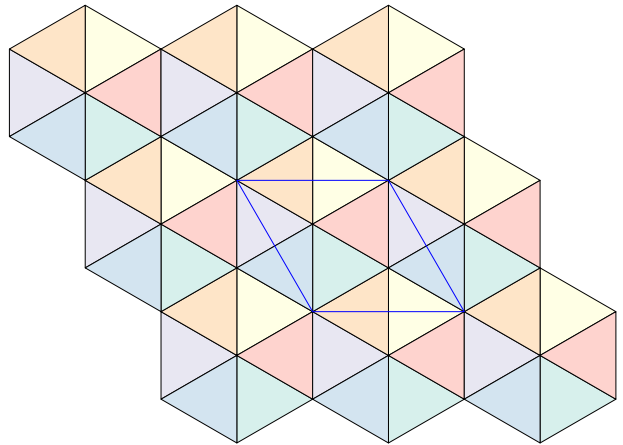
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000079190813	0
\mathbf{b}_2	-1.500000039595406	2.598076279934572

Centroid in Cartesian coordinates:

	x	y
	0.500000012703953	0.866025431882348

Angle of rotation: 2.094395111397714



16. Plane group: $p4mm$

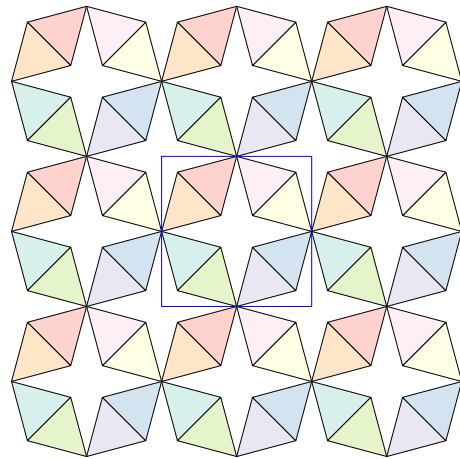
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.242640743276048	0
\mathbf{b}_2	0	4.242640743276048

Centroid in Cartesian coordinates:

	x	y
	0.707106788340787	1.414213579373973

Angle of rotation: 0.261799384707106



17. Plane group: $p6mm$

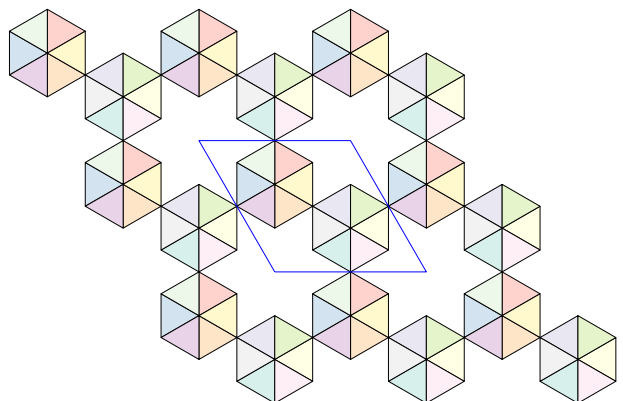
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.000000596109944	0
\mathbf{b}_2	-3.000000298054970	5.196152938952987

Centroid in Cartesian coordinates:

	x	y
	0.707106788340787	1.414213579373973

Angle of rotation: 1.047197621741836



B. 4-gon

1. *Plane group: p2*

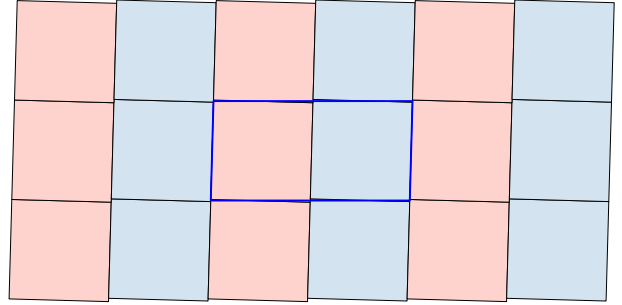
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.829478966206794	0.038555008405850
\mathbf{b}_2	0	1.413687918186191

Centroid in Cartesian coordinates:

	x	y
	0.707369736370937	0.712187714572175

Angle of rotation: 2.328928628751931



2. *Plane group: p2gg*

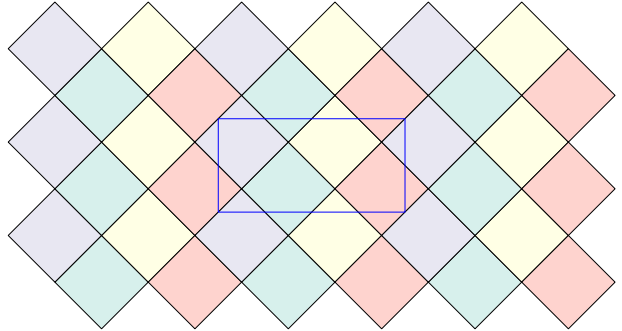
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000010837952	0
\mathbf{b}_2	0	2.000000072557344

Centroid in Cartesian coordinates:

	x	y
	1.500000008955462	0.500000017879697

Angle of rotation: 1.570796313668263



3. *Plane group: pg*

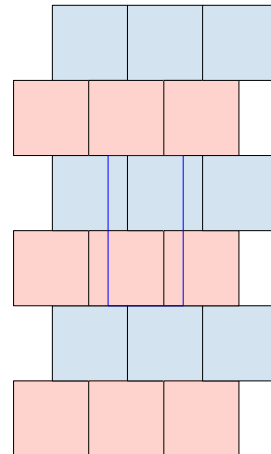
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.414213565119419	0
\mathbf{b}_2	0	2.828427133511594

Centroid in Cartesian coordinates:

	x	y
	0.342011517459552	0.707106783377899

Angle of rotation: 3.926990815103176



4. *Plane group: p3*

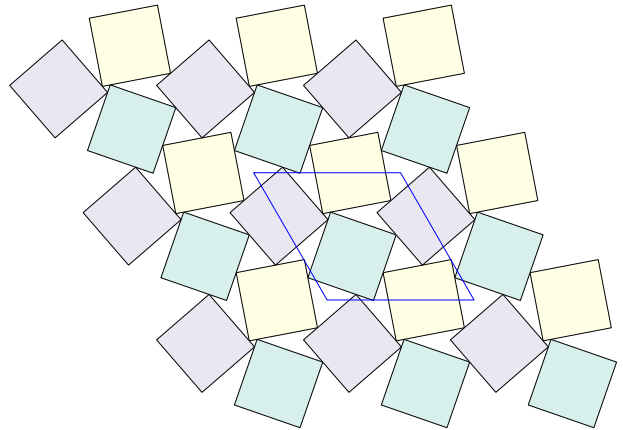
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.992297629721817	0
\mathbf{b}_2	-1.496148814860908	2.591405763023055

Centroid in Cartesian coordinates:

	x	y
	0.507595232387572	0.889422587348308

Angle of rotation: 5.164185002090380



5. *Plane group: p1*

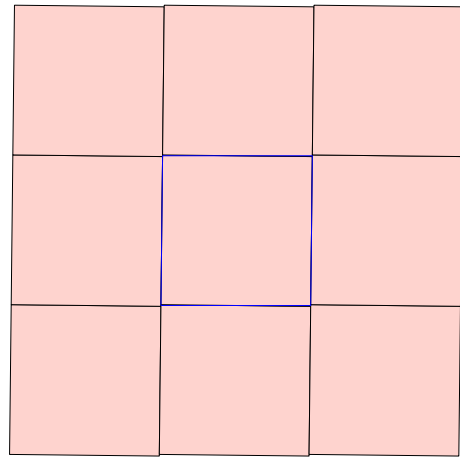
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.414298099106132	0
\mathbf{b}_2	0.015459993810209	1.414129061477749

Centroid in Cartesian coordinates:

	x	y
	0.714879046458170	0.707064530738875

Angle of rotation: 0.774465492628377



6. *Plane group: p2mg*

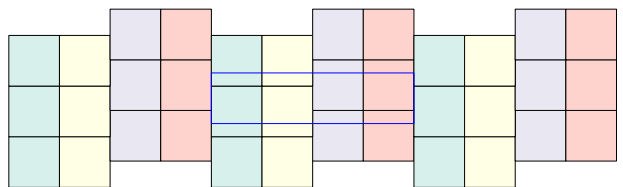
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.656854417744033	0
\mathbf{b}_2	0	1.414213582950587

Centroid in Cartesian coordinates:

	x	y
	0.707106794409848	0.340323014793764

Angle of rotation: 2.356194489373898



7. Plane group: cm

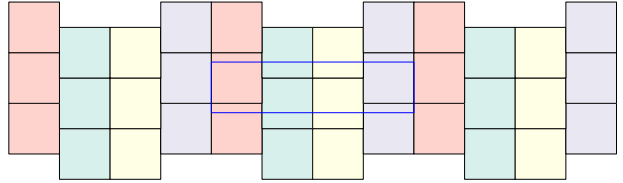
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.656854499657404	0
\mathbf{b}_2	0	1.414213578067497

Centroid in Cartesian coordinates:

	x	y
	2.121320434858687	0.261504082066899

Angle of rotation: 0.785398142492933



8. Plane group: $p4$

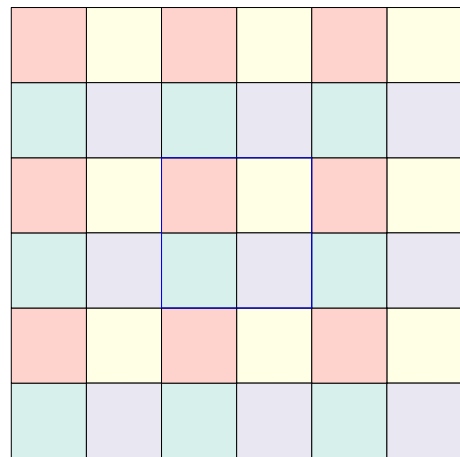
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.828427163677219	0
\mathbf{b}_2	0	2.828427163677219

Centroid in Cartesian coordinates:

	x	y
	0.707151701736066	0.707061887589447

Angle of rotation: 2.356281886651553



9. Plane group: $p4gm$

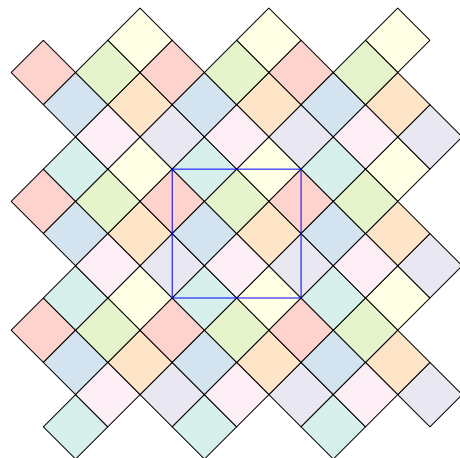
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000031449110	0
\mathbf{b}_2	0	4.000000031449110

Centroid in Cartesian coordinates:

	x	y
	1.000000002542284	0.000000000150361

Angle of rotation: 1.570796317053623



10. *Plane group: c2mm*

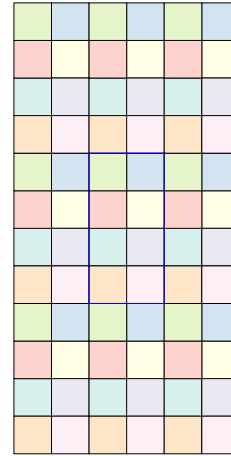
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.828427195895911	0
\mathbf{b}_2	0	5.656854476455810

Centroid in Cartesian coordinates:

	x	y
	0.707106798066733	2.121320441464502

Angle of rotation: 5.497787136540866



11. *Plane group: pm*

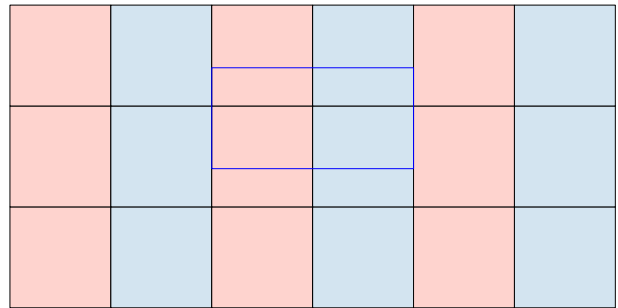
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.828427234089367	0
\mathbf{b}_2	0	1.414213568277401

Centroid in Cartesian coordinates:

	x	y
	0.707106821682035	0.707106784138700

Angle of rotation: 5.497787128115839



12. *Plane group: p2mm*

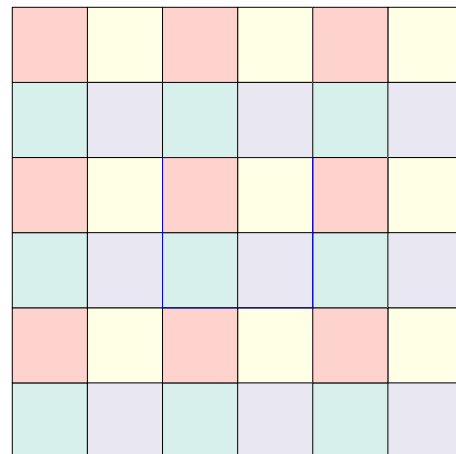
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.828427192341928	0
\mathbf{b}_2	0	2.828427177631510

Centroid in Cartesian coordinates:

	x	y
	0.707106803312154	0.707106792534859

Angle of rotation: 2.356194497591504



13. Plane group: $p6$

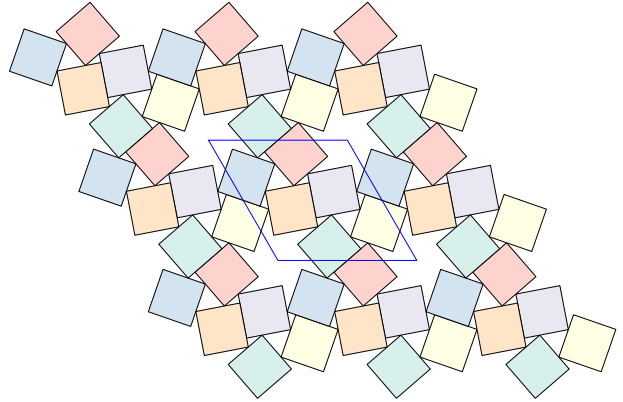
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.381027870903599	0
\mathbf{b}_2	-2.190513935451798	3.794081430890169

Centroid in Cartesian coordinates:

	x	y
	1.618987612823752	0.440500752471854

Angle of rotation: 4.640490545664980



14. Plane group: $p31m$

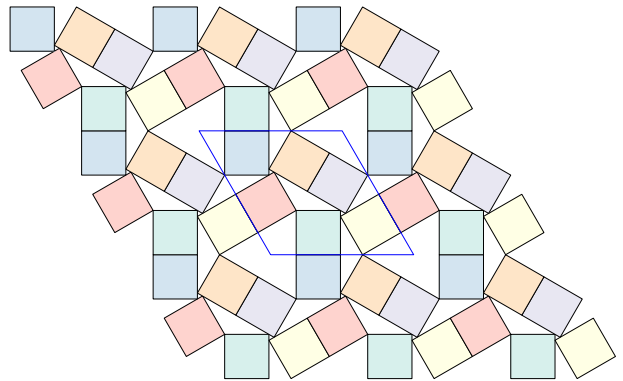
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.570810102206228	0
\mathbf{b}_2	-2.285405051103113	3.958437664385140

Centroid in Cartesian coordinates:

	x	y
	1.523603368567147	0.707106784458924

Angle of rotation: 0.785398159820106



15. Plane group: $p3m1$

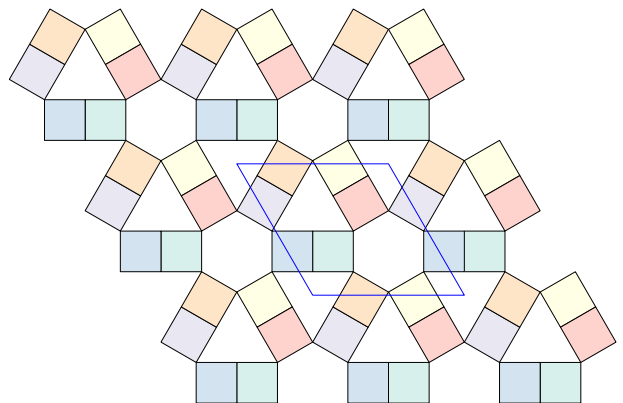
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.277916918444723	0
\mathbf{b}_2	-2.638958459222360	4.570810130436812

Centroid in Cartesian coordinates:

	x	y
	0.707106788634550	1.523603385216857

Angle of rotation: 2.356194488074428



16. Plane group: $p4mm$

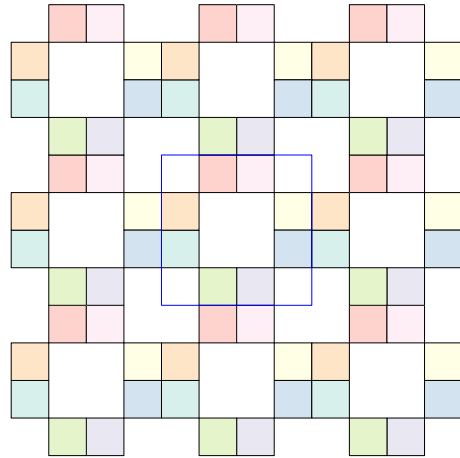
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.656854315866337	0
\mathbf{b}_2	0	5.656854315866337

Centroid in Cartesian coordinates:

	x	y
	0.707106789729968	2.121320359058381

Angle of rotation: 5.497787155770071



17. Plane group: $p6mm$

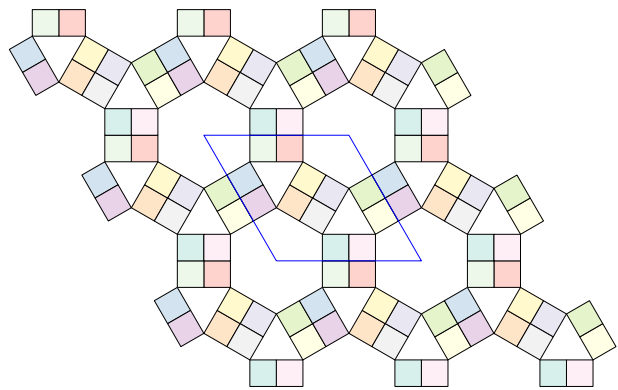
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.727406667709716	0
\mathbf{b}_2	-3.863703333854856	6.692130479609871

Centroid in Cartesian coordinates:

	x	y
	0.707106789729968	2.121320359058381

Angle of rotation: 3.926990820334113



C. 5-gon

1. Plane group: $p2$

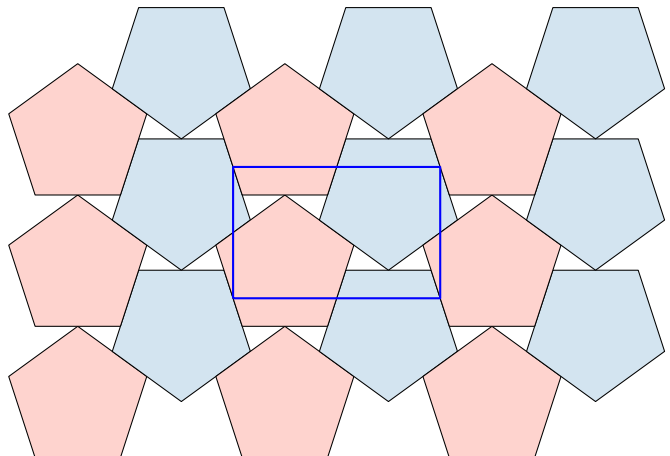
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.853169717563768	0.000087790374721
\mathbf{b}_2	0	1.809017029247722

Centroid in Cartesian coordinates:

	x	y
	0.713244767688129	0.422767657451180

Angle of rotation: 2.827575570970296



2. *Plane group: p2gg*

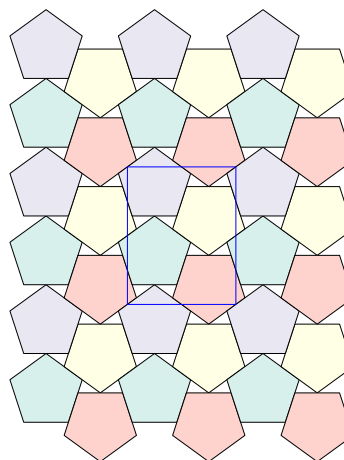
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.853169552200760	0
\mathbf{b}_2	0	3.618033991275143

Centroid in Cartesian coordinates:

	x	y
	0.713292388220592	1.327254249122619

Angle of rotation: 5.340707511608822



3. *Plane group: pg*

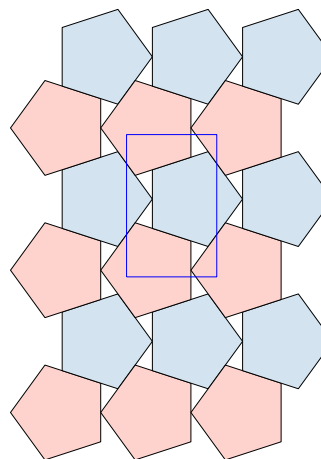
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.809017034559926	0
\mathbf{b}_2	0	2.853169711121135

Centroid in Cartesian coordinates:

	x	y
	0.481762771139908	0.713292427780284

Angle of rotation: 1.884955528038158



4. *Plane group: p3*

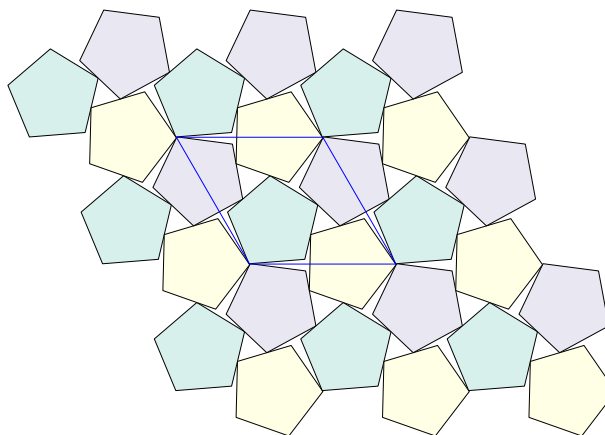
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.076019468603351	0
\mathbf{b}_2	-1.538009734301675	2.663911002346012

Centroid in Cartesian coordinates:

	x	y
	0.508932520080042	0.859237983362696

Angle of rotation: 0.393973112004319



5. *Plane group: p1*

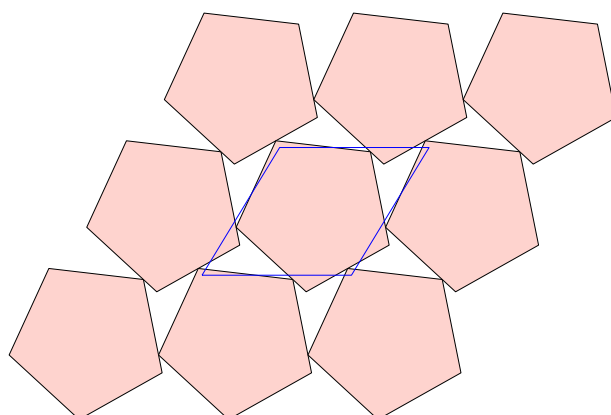
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.845077779786094	0
\mathbf{b}_2	0.958353814585321	1.576788869625786

Centroid in Cartesian coordinates:

	x	y
	1.401715797185707	0.788394434812893

Angle of rotation: 0.826350395508615



6. *Plane group: p2mg*

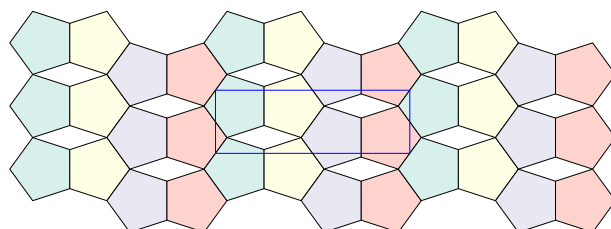
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.854102038288313	0
\mathbf{b}_2	0	1.902113063209010

Centroid in Cartesian coordinates:

	x	y
	0.654508501379331	1.426584807313462

Angle of rotation: 1.884955577724339



7. *Plane group: cm*

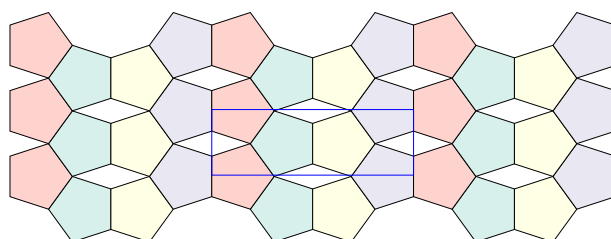
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.854102011683961	0
\mathbf{b}_2	0	1.902113042079954

Centroid in Cartesian coordinates:

	x	y
	2.118034004131153	0.913509452928882

Angle of rotation: 3.141592656196142



8. Plane group: $p4$

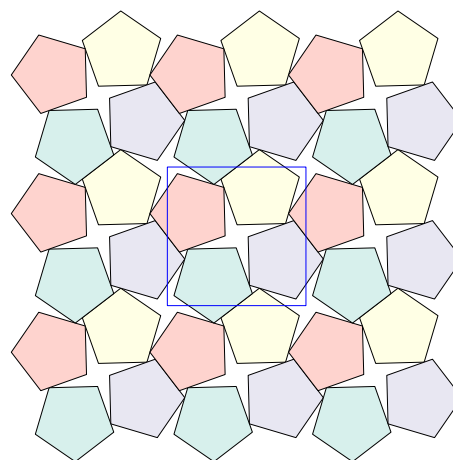
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.360607481481140	0
\mathbf{b}_2	0	3.360607481481140

Centroid in Cartesian coordinates:

	x	y
	1.103014262778938	0.576772897394668

Angle of rotation: 5.995212739643393



9. Plane group: $p4gm$

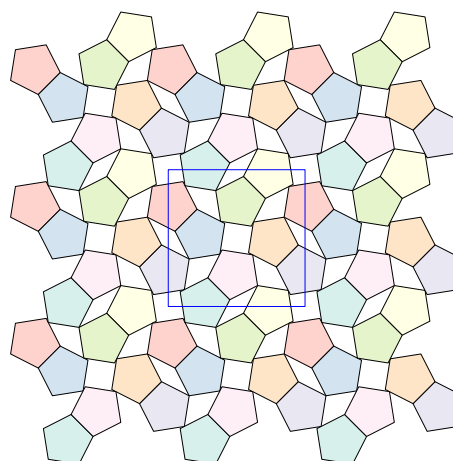
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.171603350795412	0
\mathbf{b}_2	0	5.171603350795412

Centroid in Cartesian coordinates:

	x	y
	1.341241685794242	0.100437094845020

Angle of rotation: 1.413716792534836



10. Plane group: $c2mm$

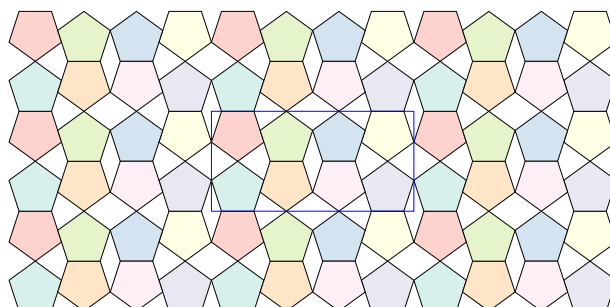
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.330937663390571	0
\mathbf{b}_2	0	3.618034022776668

Centroid in Cartesian coordinates:

	x	y
	0.951056532045272	0.809017004625800

Angle of rotation: 2.827433400969311



11. Plane group: pm

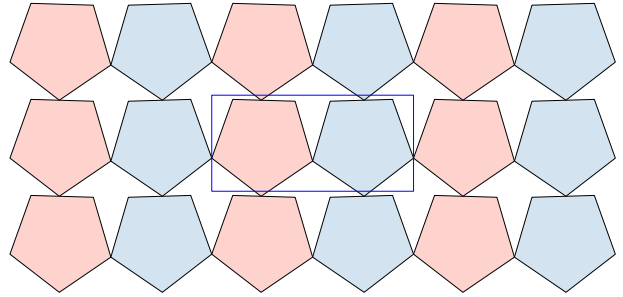
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.802588610924009	0
\mathbf{b}_2	0	1.809795985716668

Centroid in Cartesian coordinates:

	x	y
	0.959712868544787	0.904897992858334

Angle of rotation: 5.939684559420934



12. Plane group: $p2mm$

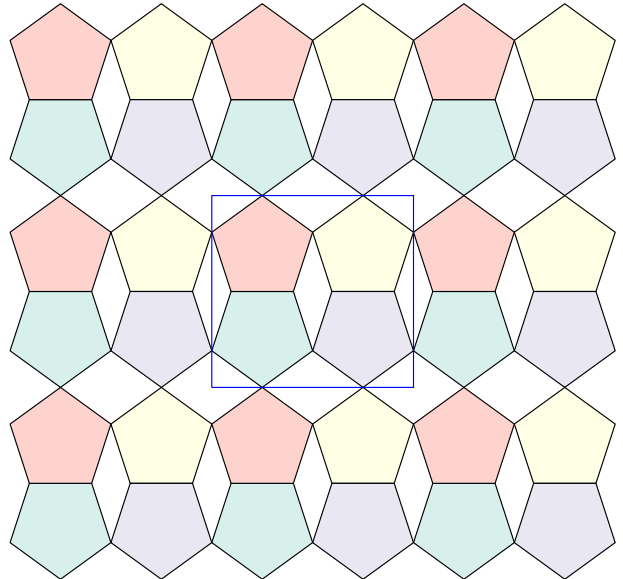
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.804226066603898	0
\mathbf{b}_2	0	3.618033998947890

Centroid in Cartesian coordinates:

	x	y
	0.951056516407077	1.000000002800487

Angle of rotation: 4.712388981814767



13. Plane group: $p6$

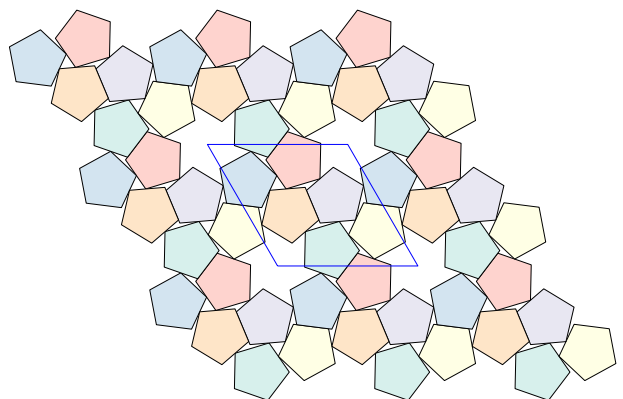
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.657663588020433	0
\mathbf{b}_2	-2.328831794010215	4.033654989507473

Centroid in Cartesian coordinates:

	x	y
	1.717798849181887	0.533057148786231

Angle of rotation: 5.005147898733882



14. Plane group: $p31m$

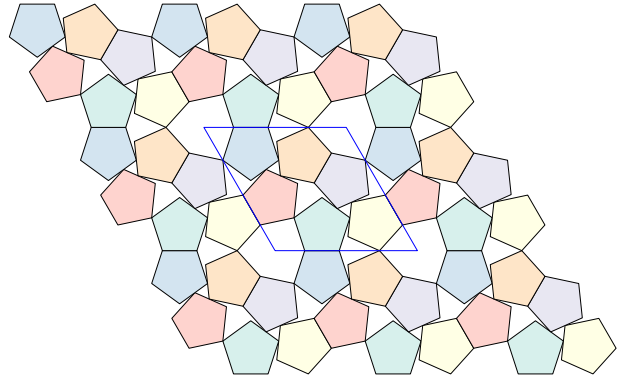
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.845287106235420	0
\mathbf{b}_2	-2.422643553117709	4.196141722629065

Centroid in Cartesian coordinates:

	x	y
	1.596553749852049	0.809017002349738

Angle of rotation: 4.084070449974694



15. Plane group: $p3m1$

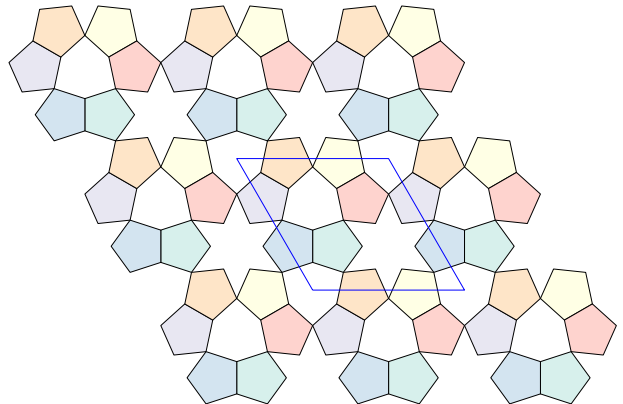
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.530624488521877	0
\mathbf{b}_2	-2.765312244260937	4.789661305852263

Centroid in Cartesian coordinates:

	x	y
	0.809017026832416	1.596553769452413

Angle of rotation: 2.513274147841204



16. Plane group: $p4mm$

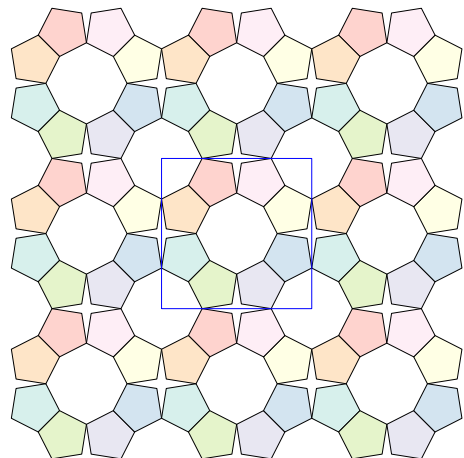
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.852271763851806	0
\mathbf{b}_2	0	5.852271763851806

Centroid in Cartesian coordinates:

	x	y
	0.891006519940804	2.035129347375315

Angle of rotation: 6.126105691049754



17. *Plane group: p6mm*

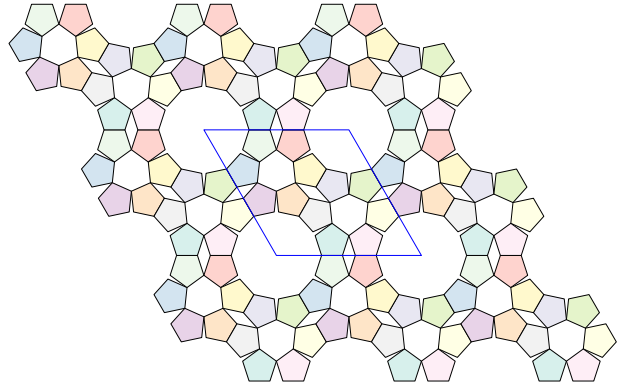
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	8.168731781170084	0
\mathbf{b}_2	-4.084365890585040	7.074329239194600

Centroid in Cartesian coordinates:

	x	y
	0.891006519940804	2.035129347375315

Angle of rotation: 4.084070415394535



D. 6-gon

1. *Plane group: p2*

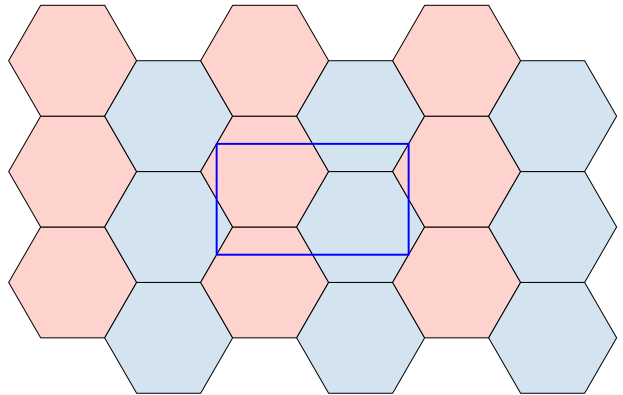
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000031664221	0.000000006586421
\mathbf{b}_2	0	1.732050819214243

Centroid in Cartesian coordinates:

	x	y
	0.750000011205558	1.299038117002689

Angle of rotation: 4.188779339435778



2. *Plane group: p2gg*

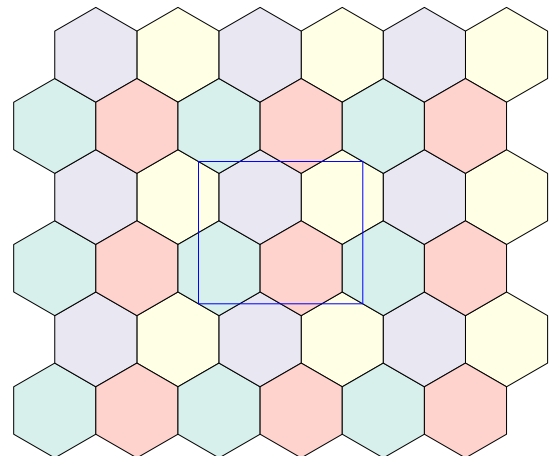
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464101647749085	0
\mathbf{b}_2	0	3.000000247602561

Centroid in Cartesian coordinates:

	x	y
	0.433012651627345	0.750000050731991

Angle of rotation: 1.570796322055658



3. *Plane group: pg*

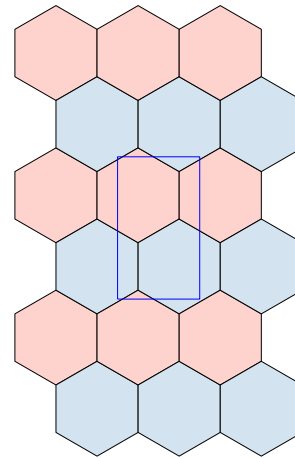
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.732050870139968	0
\mathbf{b}_2	0	3.000000160129144

Centroid in Cartesian coordinates:

	x	y
	0.433012712159061	0.750000040032286

Angle of rotation: 4.712389057811720



4. *Plane group: p3*

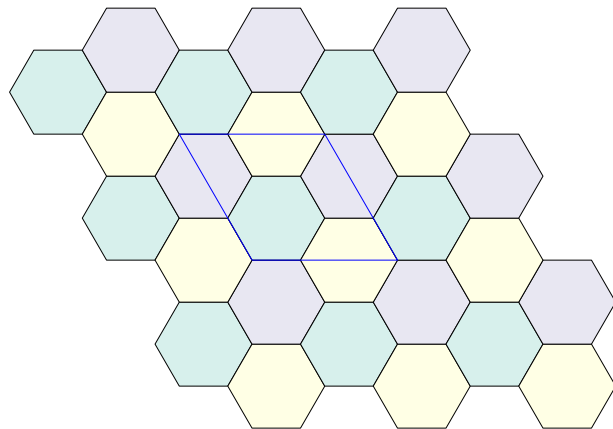
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.000000099291452	0
\mathbf{b}_2	-1.500000049645725	2.598076297342236

Centroid in Cartesian coordinates:

	x	y
	0.500000028370695	0.866025411120670

Angle of rotation: 3.141395567695372



5. *Plane group: p1*

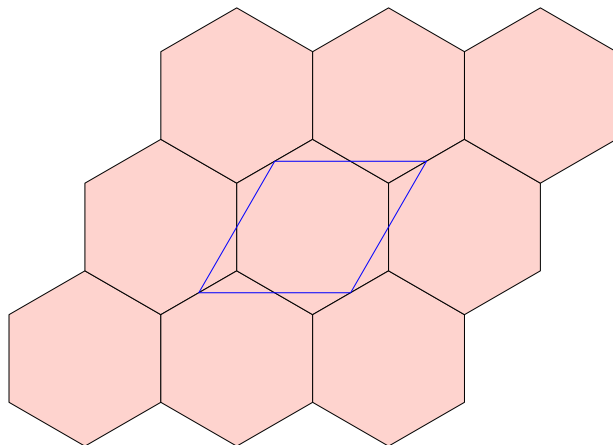
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.732050813953312	0
\mathbf{b}_2	0.866025403972591	1.500000007849975

Centroid in Cartesian coordinates:

	x	y
	1.299038108962951	0.750000003924988

Angle of rotation: 1.570739976938569



6. Plane group: $p2mg$

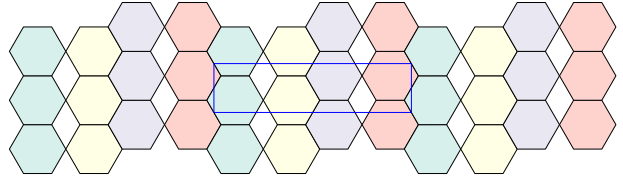
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.999999977103099	0
\mathbf{b}_2	0	1.732050884658535

Centroid in Cartesian coordinates:

	x	y
	0.750000034862040	0.433012721761753

Angle of rotation: 5.236281075429178



7. Plane group: cm

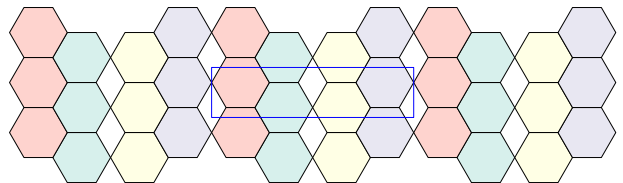
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.000000412262729	0
\mathbf{b}_2	0	1.732050809274001

Centroid in Cartesian coordinates:

	x	y
	2.500000149129693	0.343683060330572

Angle of rotation: 3.141592614333120



8. Plane group: $p4$

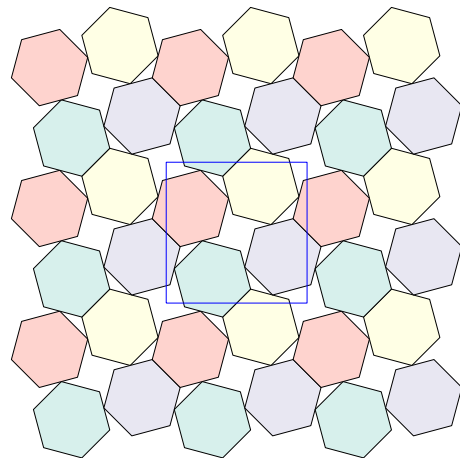
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.564844823241603	0
\mathbf{b}_2	0	3.564844823241603

Centroid in Cartesian coordinates:

	x	y
	1.170052475704811	0.612374938572454

Angle of rotation: 1.832658173890164



9. Plane group: $p4gm$

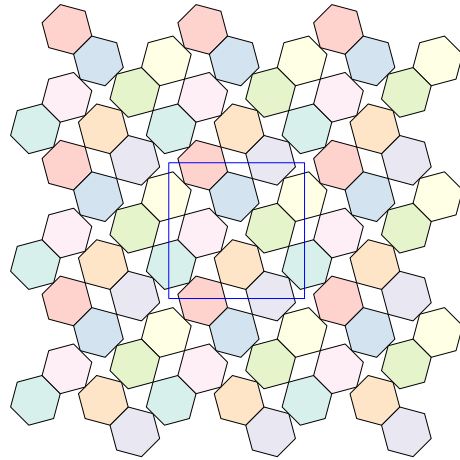
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.277916934487840	0
\mathbf{b}_2	0	5.277916934487840

Centroid in Cartesian coordinates:

	x	y
	0.094734318683273	1.319479222063923

Angle of rotation: 0.261799402452915



10. Plane group: $c2mm$

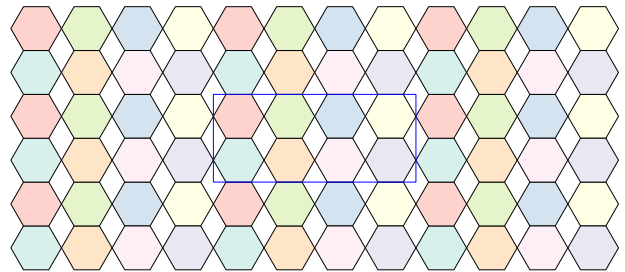
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.999999894306732	0
\mathbf{b}_2	0	3.464101880215969

Centroid in Cartesian coordinates:

	x	y
	1.000000020173294	0.866025470388271

Angle of rotation: 5.235987658456064



11. Plane group: pm

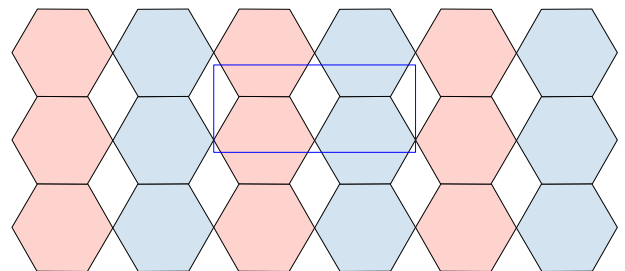
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.999939071362554	0
\mathbf{b}_2	0	1.732077256249754

Centroid in Cartesian coordinates:

	x	y
	0.999984741322883	0.866038628124877

Angle of rotation: 2.088869901973284



12. *Plane group: p2mm*

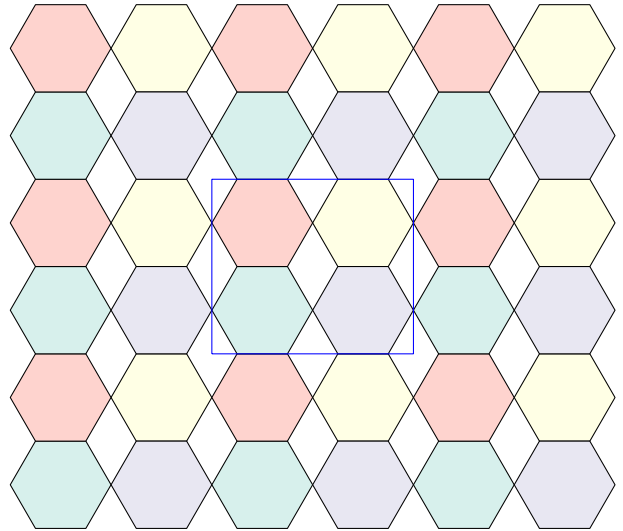
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000006207872	0
\mathbf{b}_2	0	3.464101655601797

Centroid in Cartesian coordinates:

	x	y
	1.000000000767525	0.866025408773443

Angle of rotation: 5.235987754426538



13. *Plane group: p6*

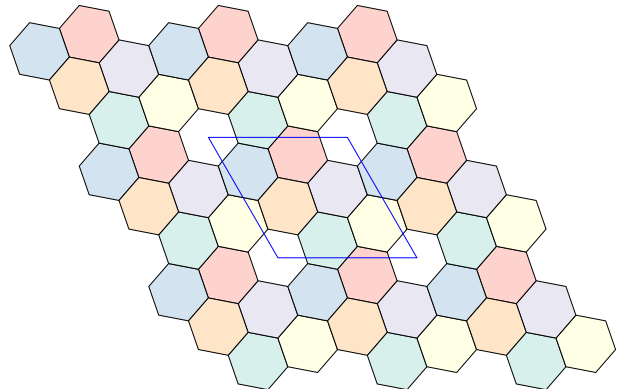
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.582575724277368	0
\mathbf{b}_2	-2.291287862138683	3.968626991990075

Centroid in Cartesian coordinates:

	x	y
	1.636634183816576	0.566946715440973

Angle of rotation: 6.092983871455917



14. *Plane group: p31m*

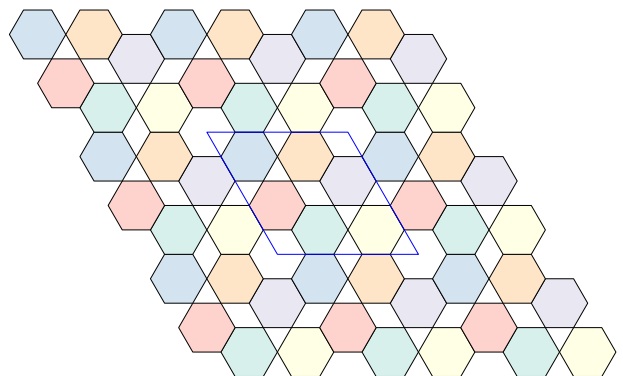
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.000000046187666	0
\mathbf{b}_2	-2.500000023093832	4.330127058921886

Centroid in Cartesian coordinates:

	x	y
	1.500000045001535	0.866025430705616

Angle of rotation: 5.235987795342878



15. Plane group: $p3m1$

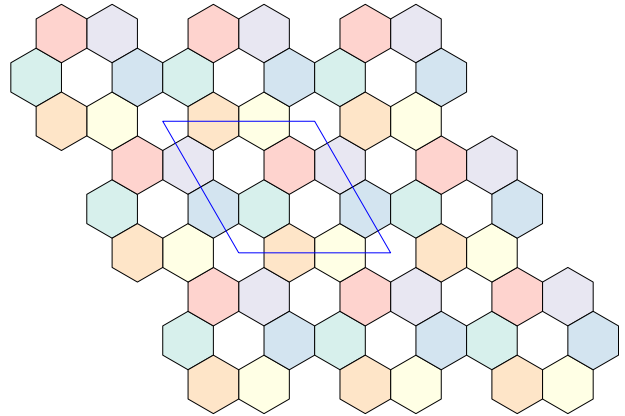
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.196152481797737	0
\mathbf{b}_2	-2.598076240898867	4.500000051174399

Centroid in Cartesian coordinates:

	x	y
	0.866025422646030	1.500000016598778

Angle of rotation: 3.665191434570438



16. Plane group: $p4mm$

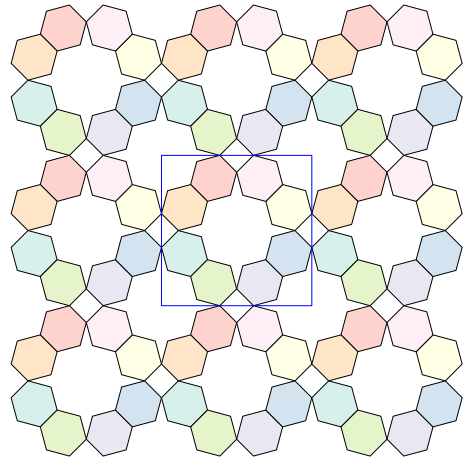
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.313193094307743	0
\mathbf{b}_2	0	6.313193094307743

Centroid in Cartesian coordinates:

	x	y
	0.965925827862777	2.190670713443004

Angle of rotation: 2.879793260800513



17. Plane group: $p6mm$

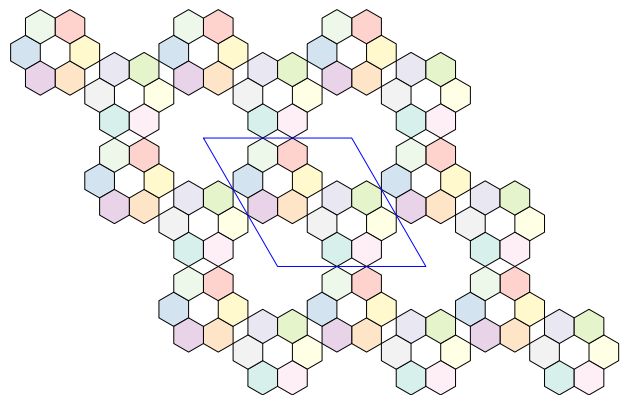
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	8.660254129247098	0
\mathbf{b}_2	-4.330127064623547	7.500000079157071

Centroid in Cartesian coordinates:

	x	y
	0.965925827862777	2.190670713443004

Angle of rotation: 5.759586526990915



E. 7-gon

1. *Plane group: p2*

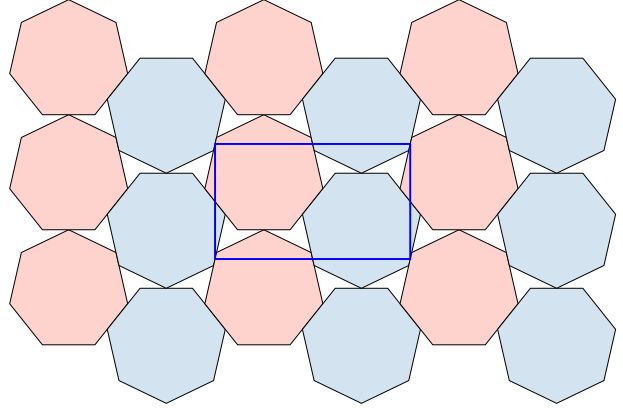
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.225040892314197	0.000037260087379
\mathbf{b}_2	0	1.900968883998618

Centroid in Cartesian coordinates:

	x	y
	0.806220130823141	1.384517403833213

Angle of rotation: 2.468243344127150



2. *Plane group: p2gg*

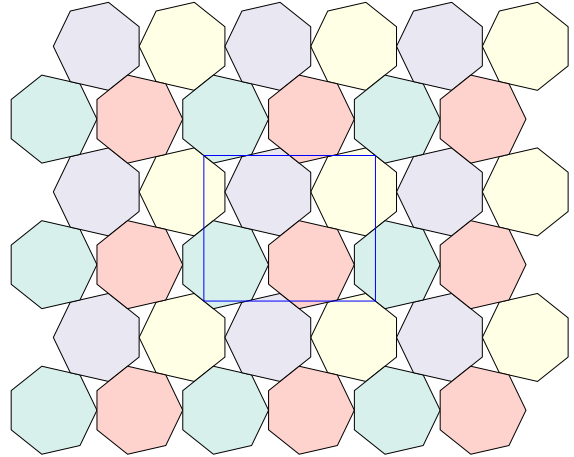
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.801937752699750	0
\mathbf{b}_2	0	3.225040644220464

Centroid in Cartesian coordinates:

	x	y
	0.434023653471857	0.806260191065796

Angle of rotation: 4.487989474701779



3. *Plane group: pg*

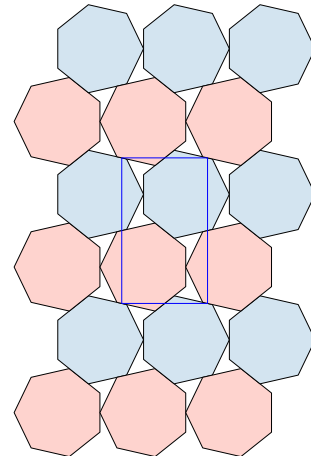
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.900968869107766	0
\mathbf{b}_2	0	3.225040605856132

Centroid in Cartesian coordinates:

	x	y
	0.516460813349945	0.806260151464033

Angle of rotation: 0.448798955031562



4. *Plane group: p3*

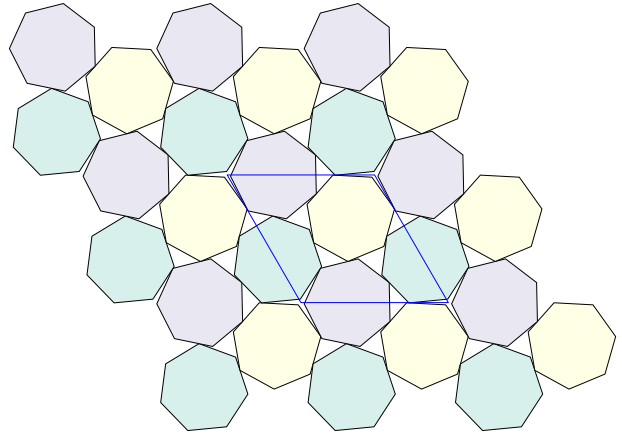
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.280461361355785	0
\mathbf{b}_2	-1.640230680677892	2.840962875067393

Centroid in Cartesian coordinates:

	x	y
	-0.531418393068667	0.932275301317482

Angle of rotation: 1.667101744733371



5. *Plane group: p1*

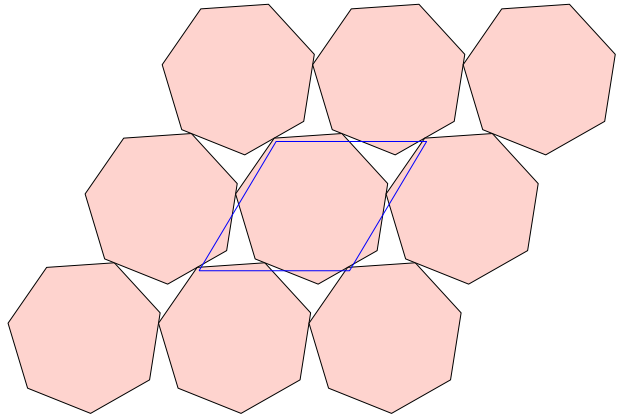
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.924465289531983	0
\mathbf{b}_2	0.985726041670483	1.653012879232704

Centroid in Cartesian coordinates:

	x	y
	1.455095665601233	0.826506439616352

Angle of rotation: 1.189972750506638



6. *Plane group: p2mg*

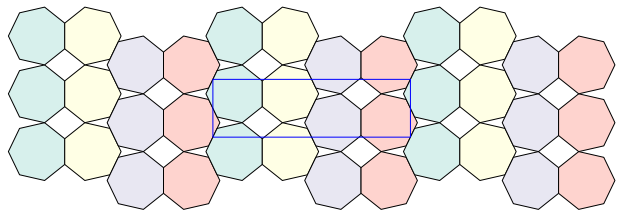
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.664874554805350	0
\mathbf{b}_2	0	1.949855815901653

Centroid in Cartesian coordinates:

	x	y
	0.765249751373432	1.462391830109013

Angle of rotation: 0.448798924939887



7. Plane group: cm

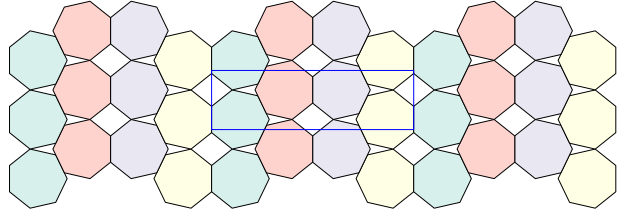
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.664874820556054	0
\mathbf{b}_2	0	1.949855821488762

Centroid in Cartesian coordinates:

	x	y
	0.900968934449232	0.332422968139895

Angle of rotation: 5.385587381177514



8. Plane group: $p4$

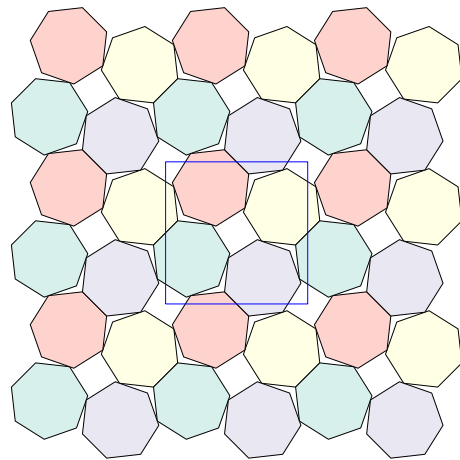
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.605075732777687	0
\mathbf{b}_2	0	3.605075732777687

Centroid in Cartesian coordinates:

	x	y
	0.637081309781562	1.165456779383331

Angle of rotation: 1.009799950204024



9. Plane group: $p4gm$

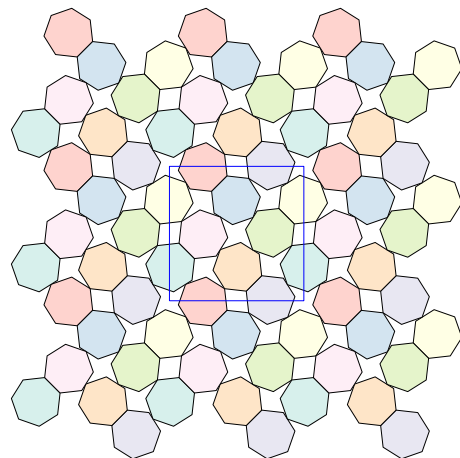
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.350189391189850	0
\mathbf{b}_2	0	5.350189391189850

Centroid in Cartesian coordinates:

	x	y
	0.052296870040252	1.348635292602259

Angle of rotation: 0.336599202073442



10. Plane group: $c2mm$

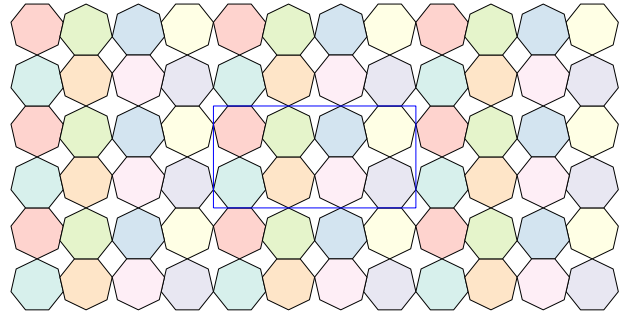
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.551061452802569	0
\mathbf{b}_2	0	3.801937925920952

Centroid in Cartesian coordinates:

	x	y
	0.974927972780209	0.900968960275769

Angle of rotation: 6.058785918156082



11. Plane group: pm

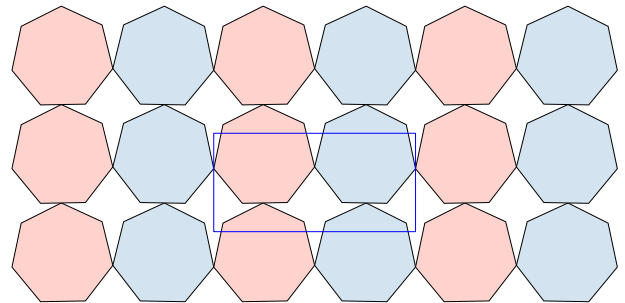
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.899132951997838	0
\mathbf{b}_2	0	1.901251004224665

Centroid in Cartesian coordinates:

	x	y
	0.970949879421173	0.950625502112333

Angle of rotation: 3.383219936997482



12. Plane group: $p2mm$

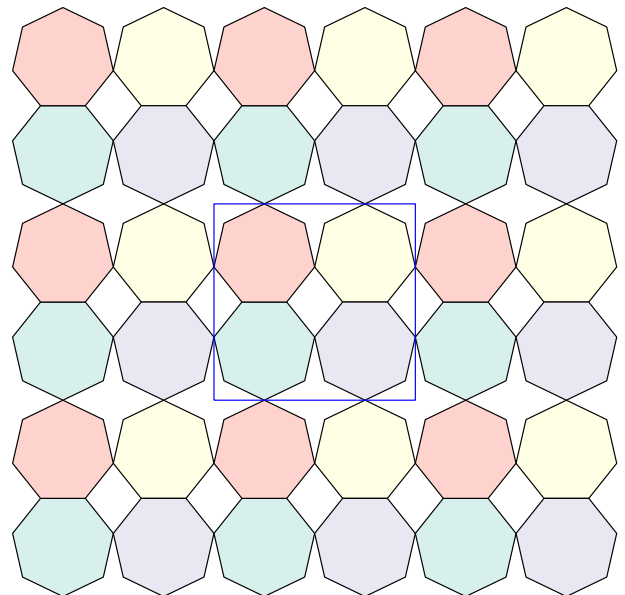
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.899711651134991	0
\mathbf{b}_2	0	3.801937757988691

Centroid in Cartesian coordinates:

	x	y
	0.974927915424223	1.000000004749338

Angle of rotation: 1.121997388285458



13. Plane group: $p6$

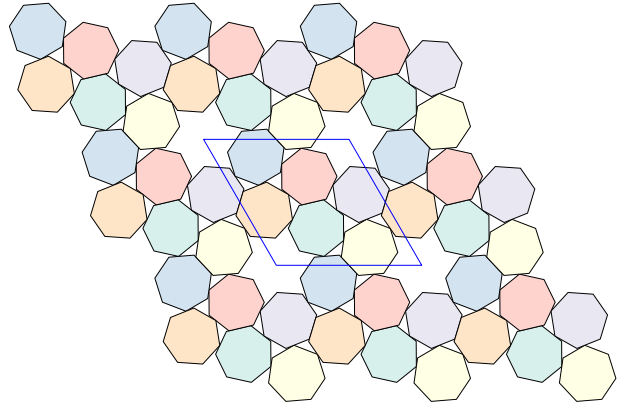
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.003085215287757	0
\mathbf{b}_2	-2.501542607643877	4.332798893737535

Centroid in Cartesian coordinates:

	x	y
	1.413047934031493	1.278989756407881

Angle of rotation: 1.353498495906416



14. Plane group: $p31m$

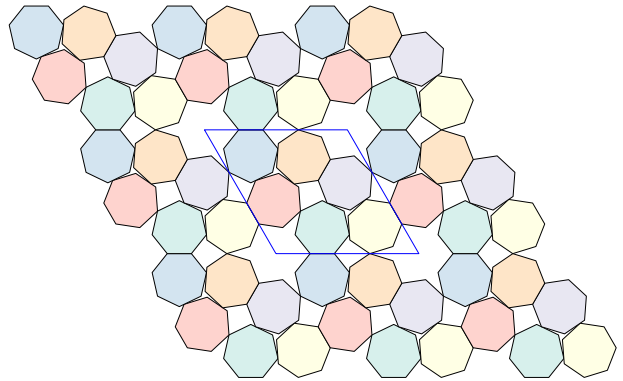
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.128392614137012	0
\mathbf{b}_2	-2.564196307068505	4.441318284423139

Centroid in Cartesian coordinates:

	x	y
	1.661978300302467	0.900968901110842

Angle of rotation: 2.468394256077259



15. Plane group: $p3m1$

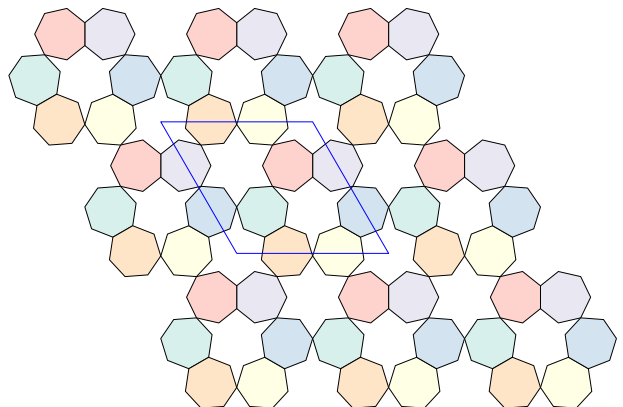
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.757261595055838	0
\mathbf{b}_2	-2.878630797527918	4.985934797550874

Centroid in Cartesian coordinates:

	x	y
	0.988830907252767	1.611251138778532

Angle of rotation: 3.889590980101022



16. Plane group: $p4mm$

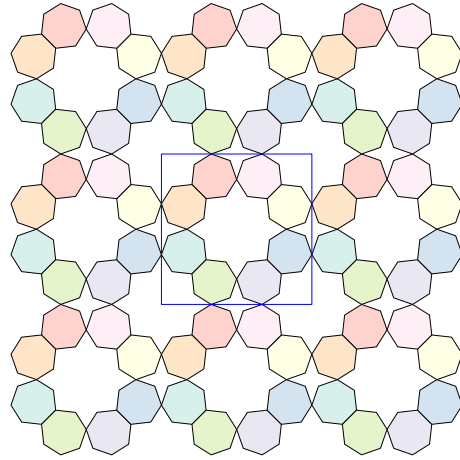
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.523174362043361	0
\mathbf{b}_2	0	6.523174362043361

Centroid in Cartesian coordinates:

	x	y
	0.993712359978236	2.267874978155865

Angle of rotation: 0.560998451200861



17. Plane group: $p6mm$

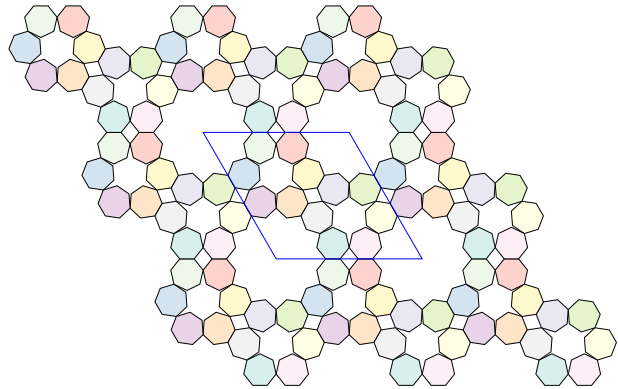
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	8.794399114269568	0
\mathbf{b}_2	-4.397199557134782	7.616173043976813

Centroid in Cartesian coordinates:

	x	y
	0.993712359978236	2.267874978155865

Angle of rotation: 6.058786217633203



F. 8-gon

1. Plane group: $p2$

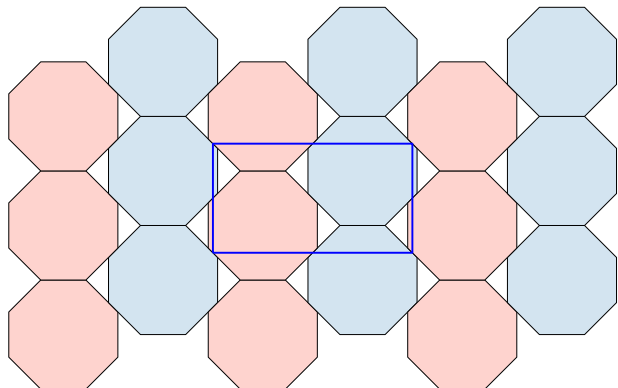
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.378492794482934	0
\mathbf{b}_2	0	1.847759065022574

Centroid in Cartesian coordinates:

	x	y
	0.844623198620733	0.461939766255643

Angle of rotation: 3.534291735288518



2. **Plane group: $p2gg$**

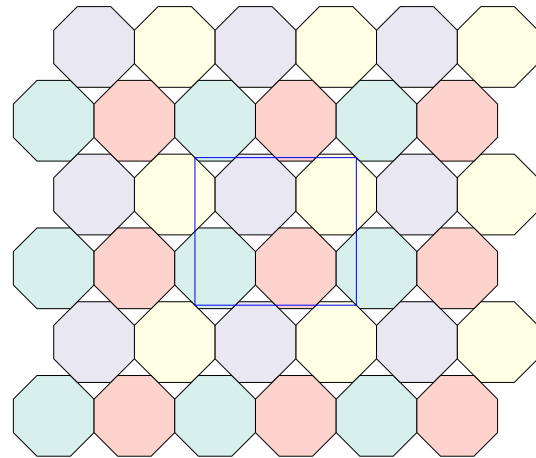
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.695518140108192	0
\mathbf{b}_2	0	3.378492790152977

Centroid in Cartesian coordinates:

	x	y
	0.461939767575188	0.844623197602074

Angle of rotation: 3.534291734806677



3. **Plane group: pg**

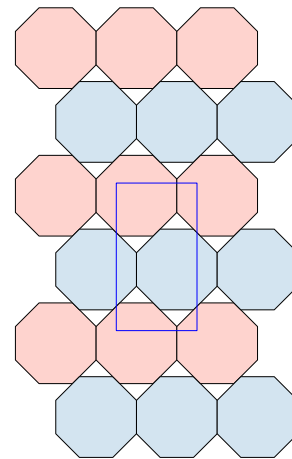
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.847759065412752	0
\mathbf{b}_2	0	3.378492796032766

Centroid in Cartesian coordinates:

	x	y
	0.461939766188336	0.844623199008191

Angle of rotation: 5.105088063994797



4. **Plane group: $p3$**

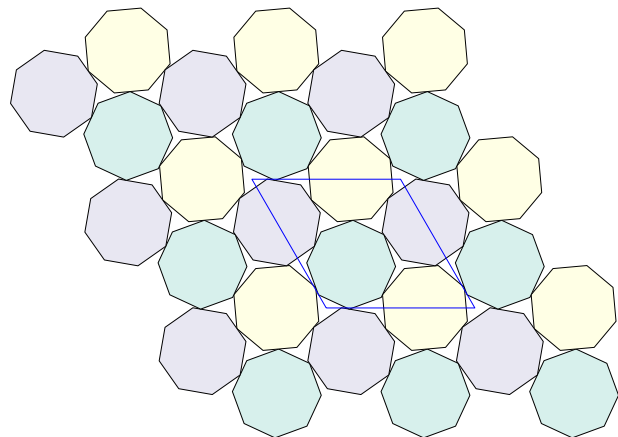
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.343139706925096	0
\mathbf{b}_2	-1.671569853462547	2.895243914597597

Centroid in Cartesian coordinates:

	x	y
	0.560681808849748	0.972605388183820

Angle of rotation: 3.099781981886370



5. **Plane group: $p1$**

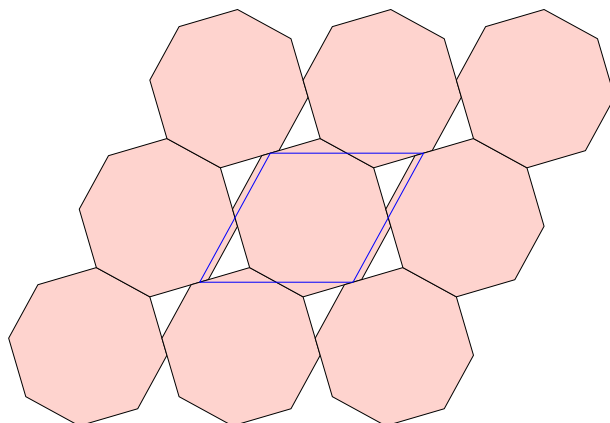
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.925455796370940	0
\mathbf{b}_2	0.886740726821263	1.621081323938007

Centroid in Cartesian coordinates:

	x	y
	1.406098261596102	0.810540661969003

Angle of rotation: 4.604739814779260



6. **Plane group: $p2mg$**

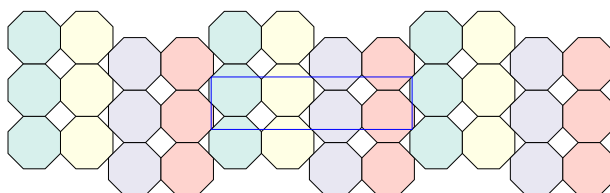
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.074011032766542	0
\mathbf{b}_2	0	1.847759065553654

Centroid in Cartesian coordinates:

	x	y
	0.844623220827156	1.385819301775687

Angle of rotation: 0.392699080091888



7. **Plane group: cm**

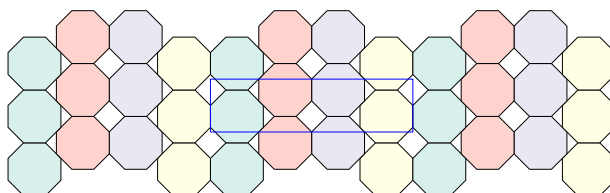
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.074011436223021	0
\mathbf{b}_2	0	1.847759100714880

Centroid in Cartesian coordinates:

	x	y
	0.923879540576059	0.544306737472754

Angle of rotation: 1.178097242427558



8. *Plane group: p4*

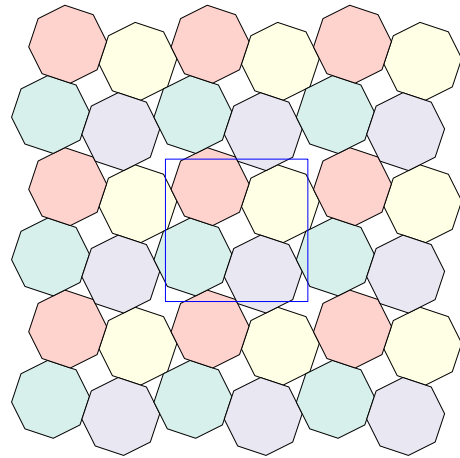
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.647654373156552	0
\mathbf{b}_2	0	3.647654373156552

Centroid in Cartesian coordinates:

	x	y
	0.703605961701268	1.142715185547142

Angle of rotation: 3.212579024983580



9. *Plane group: p4gm*

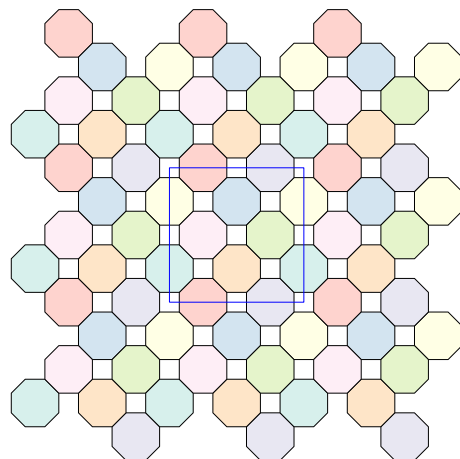
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.226251945077746	0
\mathbf{b}_2	0	5.226251945077746

Centroid in Cartesian coordinates:

	x	y
	0.000000006523115	1.306562970836307

Angle of rotation: 1.178097197436916



10. *Plane group: c2mm*

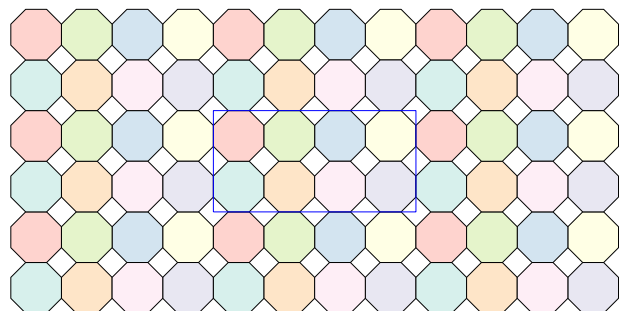
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.391036332365159	0
\mathbf{b}_2	0	3.695518246554292

Centroid in Cartesian coordinates:

	x	y
	0.923879547802932	0.923879558716265

Angle of rotation: 2.748893561506398



11. Plane group: pm

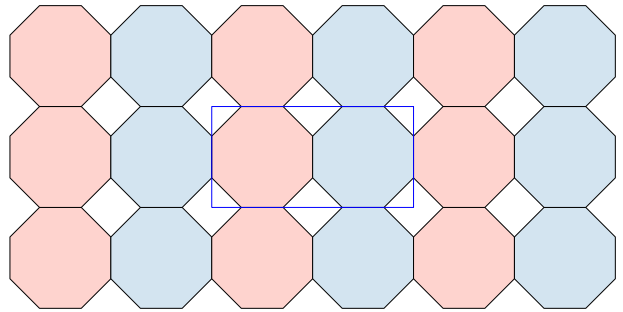
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.695518238436287	0
\mathbf{b}_2	0	1.847759090749571

Centroid in Cartesian coordinates:

	x	y
	0.923879560983792	0.923879545374786

Angle of rotation: 4.319689909377925



12. Plane group: $p2mm$

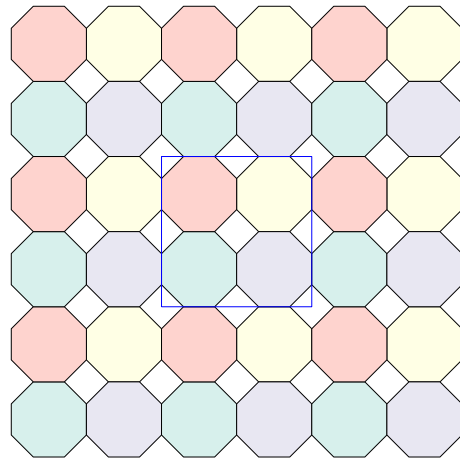
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.695518170287850	0
\mathbf{b}_2	0	3.695518152191696

Centroid in Cartesian coordinates:

	x	y
	0.923879547991177	0.923879538624900

Angle of rotation: 5.890486237118071



13. Plane group: $p6$

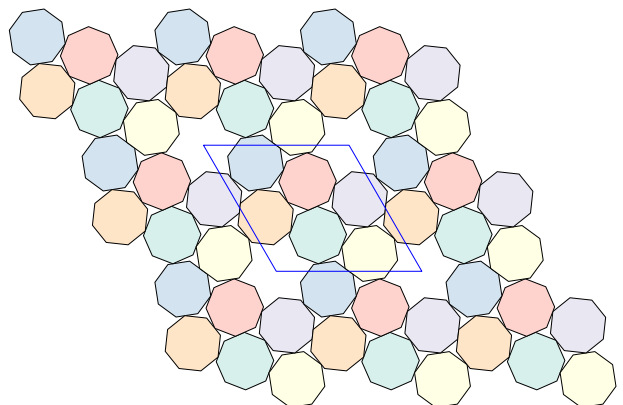
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.063208426010927	0
\mathbf{b}_2	-2.531604213005462	4.384867121580886

Centroid in Cartesian coordinates:

	x	y
	1.443651109837273	1.261147100575279

Angle of rotation: 5.520383231919140



14. Plane group: $p31m$

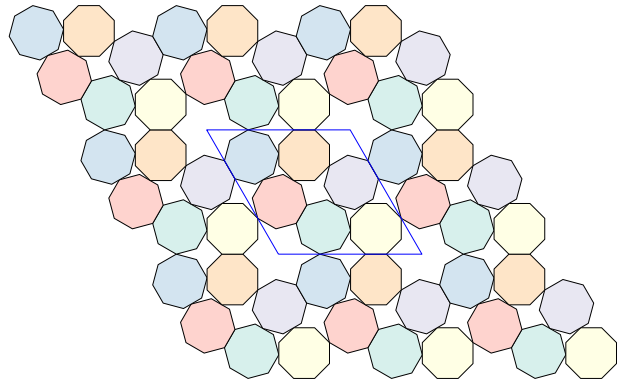
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.232763577982915	0
\mathbf{b}_2	-2.616381788991456	4.531706190531159

Centroid in Cartesian coordinates:

	x	y
	1.639215161665139	0.991444861334736

Angle of rotation: 5.366887440029078



15. Plane group: $p3m1$

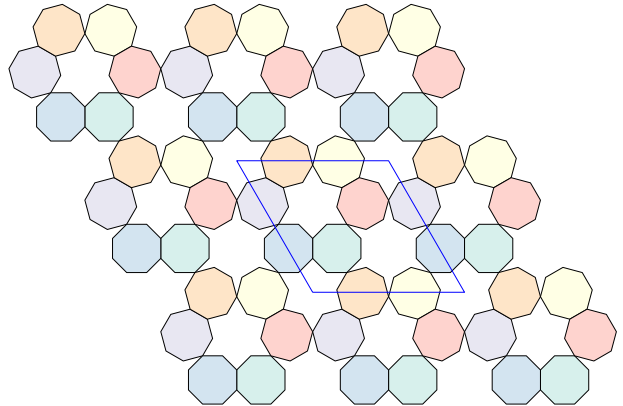
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.813538581867289	0
\mathbf{b}_2	-2.906769290933643	5.034672097778032

Centroid in Cartesian coordinates:

	x	y
	0.923879554944646	1.678224026204002

Angle of rotation: 3.534291683496556



16. Plane group: $p4mm$

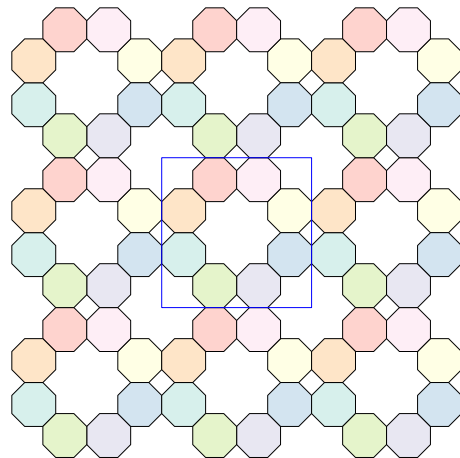
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.308644129299077	0
\mathbf{b}_2	0	6.308644129299077

Centroid in Cartesian coordinates:

	x	y
	0.923879533503687	2.230442518496741

Angle of rotation: 1.963495407814765



17. *Plane group: p6mm*

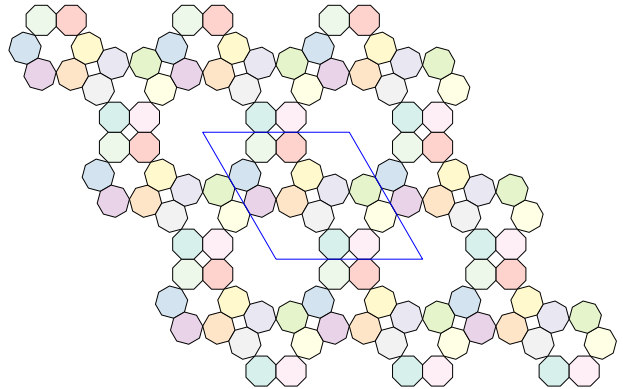
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.013951165718108	0
\mathbf{b}_2	-4.506975582859052	7.806310697984236

Centroid in Cartesian coordinates:

	x	y
	0.923879533503687	2.230442518496741

Angle of rotation: 1.963495398317015



G. 9-gon

1. *Plane group: p2*

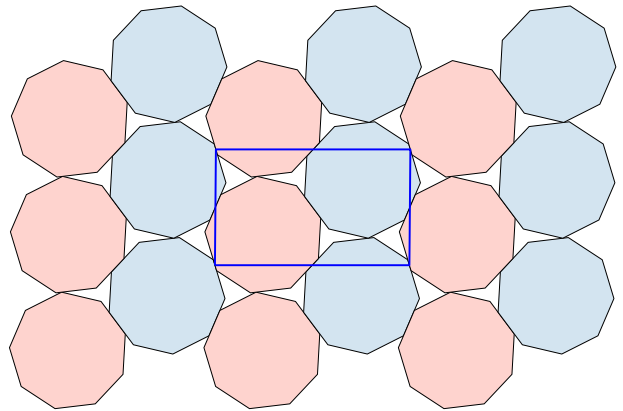
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.283699003570834	0.016217053465249
\mathbf{b}_2	0	1.955273009142822

Centroid in Cartesian coordinates:

	x	y
	0.824450705342716	0.510932912492456

Angle of rotation: 0.990966311319552



2. *Plane group: p2gg*

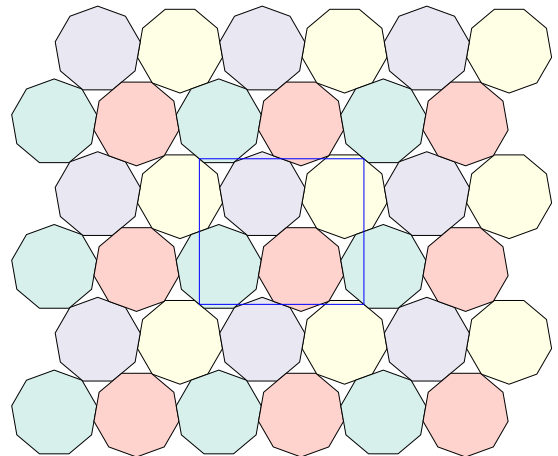
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.812062979996432	0
\mathbf{b}_2	0	3.372795038023615

Centroid in Cartesian coordinates:

	x	y
	0.449087872485539	0.849852139573945

Angle of rotation: 5.061454863383484



3. *Plane group: pg*

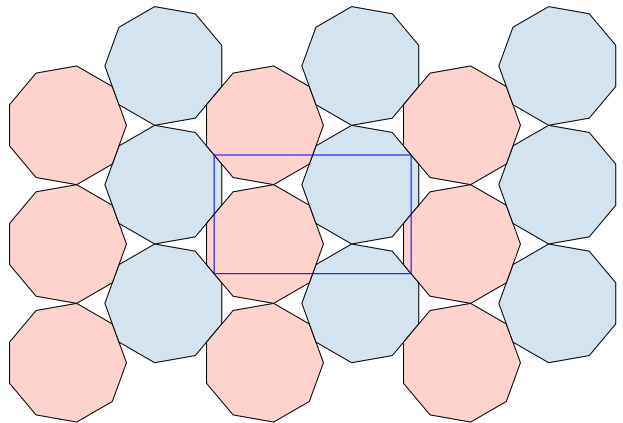
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.268570668831133	0
\mathbf{b}_2	0	1.969615516438104

Centroid in Cartesian coordinates:

	x	y
	0.813505688730587	0.492403879109526

Angle of rotation: 6.283185304141162



4. *Plane group: p3*

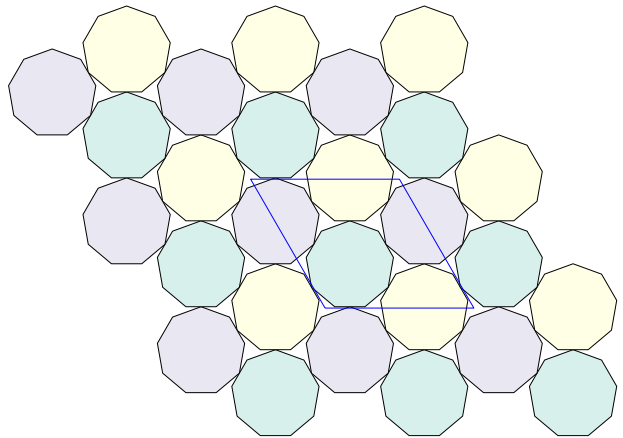
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.359646213729538	0
\mathbf{b}_2	-1.679823106864768	2.909538968817984

Centroid in Cartesian coordinates:

	x	y
	0.559941035768344	0.969846323303714

Angle of rotation: 2.268768865300865



5. *Plane group: p1*

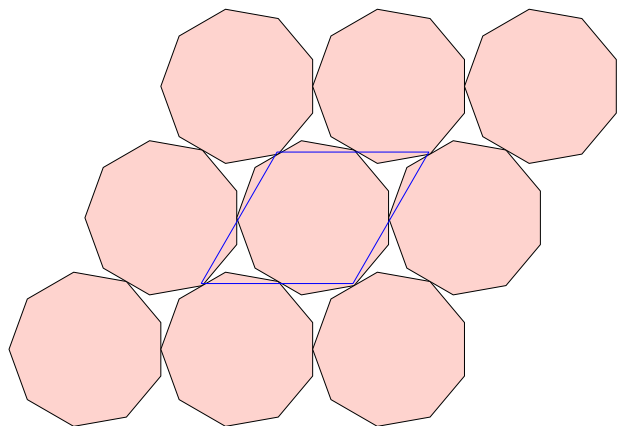
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.939692621528021	0
\mathbf{b}_2	0.969846311914716	1.679823087061118

Centroid in Cartesian coordinates:

	x	y
	1.454769466721368	0.839911543530559

Angle of rotation: 2.443436342207785



6. Plane group: $p2mg$

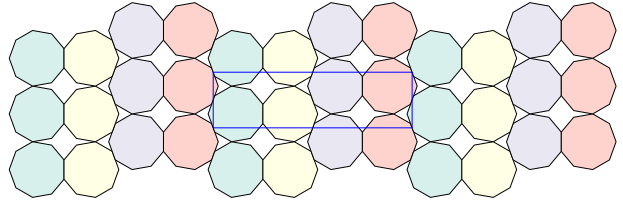
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.041889218325095	0
\mathbf{b}_2	0	1.969615480898399

Centroid in Cartesian coordinates:

	x	y
	0.820779649689612	0.492403926713774

Angle of rotation: 1.745329152489883



7. Plane group: cm

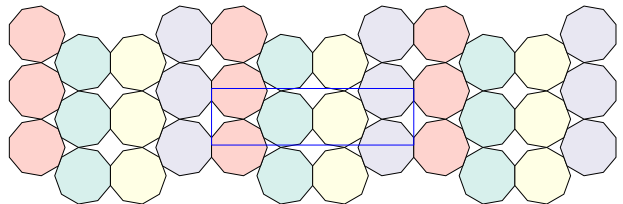
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.041889155745254	0
\mathbf{b}_2	0	1.969615496582043

Centroid in Cartesian coordinates:

	x	y
	2.581251943125121	0.901103472848836

Angle of rotation: 5.235987724689378



8. Plane group: $p4$

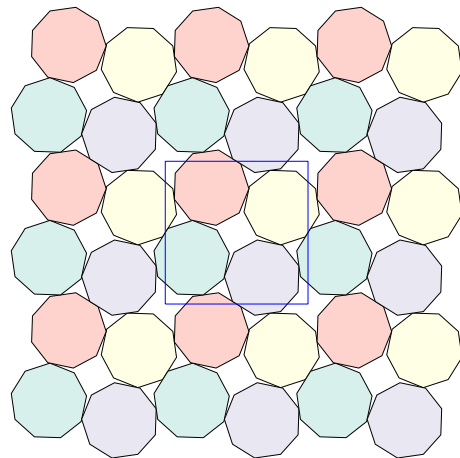
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.732940607118927	0
\mathbf{b}_2	0	3.732940607118927

Centroid in Cartesian coordinates:

	x	y
	0.684439714957289	1.187801402502493

Angle of rotation: 2.235822608071418



9. Plane group: $p4gm$

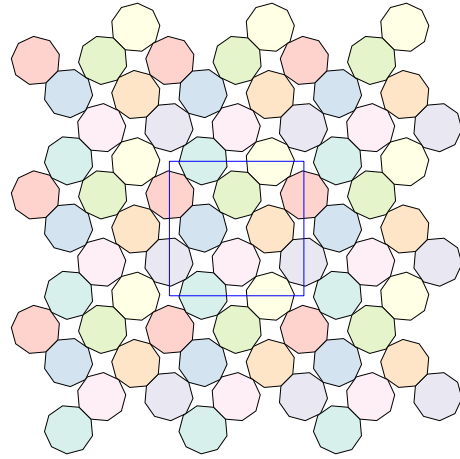
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.496545116693645	0
\mathbf{b}_2	0	5.496545116693645

Centroid in Cartesian coordinates:

	x	y
	1.387445229995112	0.031901206690769

Angle of rotation: 0.436332434545406



10. Plane group: $c2mm$

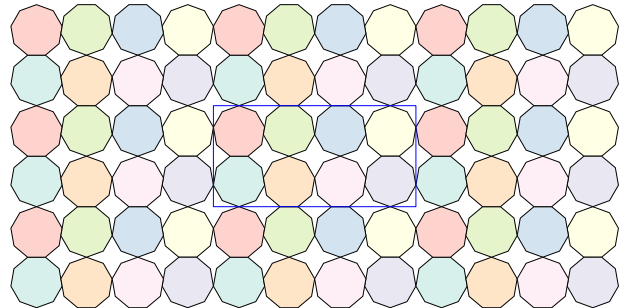
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.777254362972863	0
\mathbf{b}_2	0	3.879385292052434

Centroid in Cartesian coordinates:

	x	y
	0.984807777883876	1.000000000784860

Angle of rotation: 4.014257334557936



11. Plane group: pm

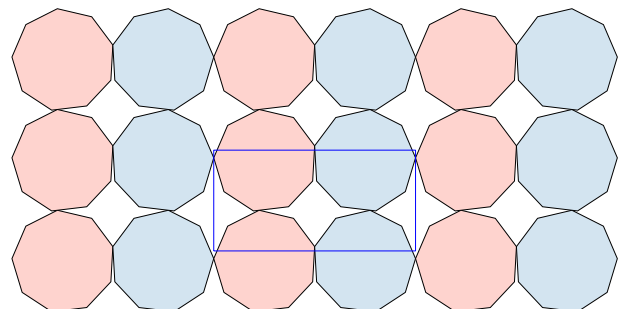
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.911556440736797	0
\mathbf{b}_2	0	1.953416101331090

Centroid in Cartesian coordinates:

	x	y
	0.998436461851671	0.976708050665545

Angle of rotation: 5.180060190990844



12. *Plane group: p2mm*

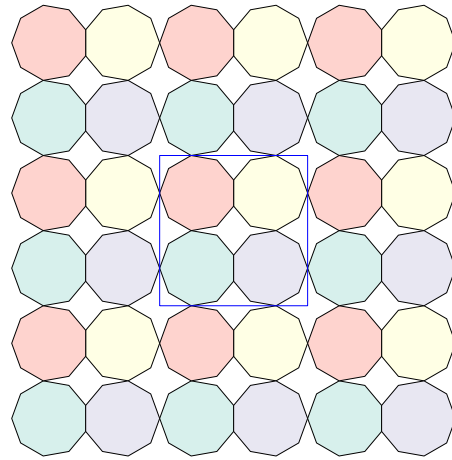
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.879385251809065	0
\mathbf{b}_2	0	3.939231017633207

Centroid in Cartesian coordinates:

	x	y
	1.000000000138345	0.984807755396188

Angle of rotation: 5.934119462151640



13. *Plane group: p6*

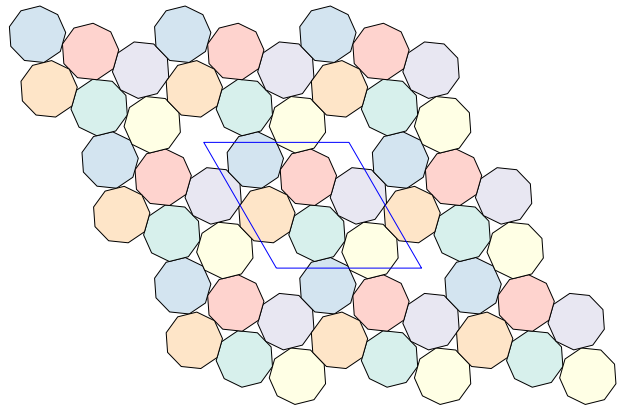
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.051471527234470	0
\mathbf{b}_2	-2.525735763617234	4.374702669078827

Centroid in Cartesian coordinates:

	x	y
	1.429618697911154	1.225239860902079

Angle of rotation: 5.306861093179244



14. *Plane group: p31m*

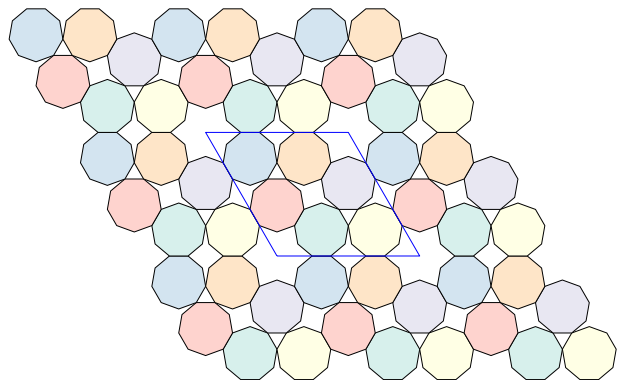
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.224806282966286	0
\mathbf{b}_2	-2.612403141483142	4.524814970901351

Centroid in Cartesian coordinates:

	x	y
	1.627595378689549	0.939692630550561

Angle of rotation: 1.570796301286056



15. Plane group: $p3m1$

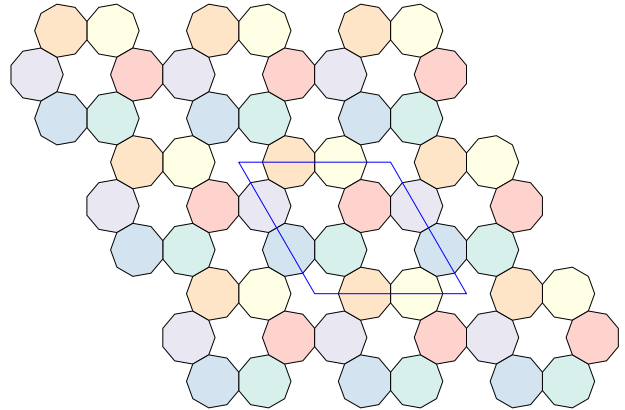
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.638155755172525	0
\mathbf{b}_2	-2.819077877586261	4.882786114472843

Centroid in Cartesian coordinates:

	x	y
	0.939692626189794	1.627595374505760

Angle of rotation: 5.585053610273534



16. Plane group: $p4mm$

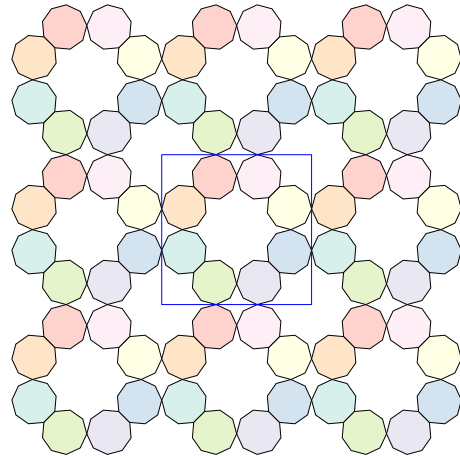
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.642630987048604	0
\mathbf{b}_2	0	6.642630987048604

Centroid in Cartesian coordinates:

	x	y
	0.996194704415468	2.325120780045008

Angle of rotation: 0.261799429128328



17. Plane group: $p6mm$

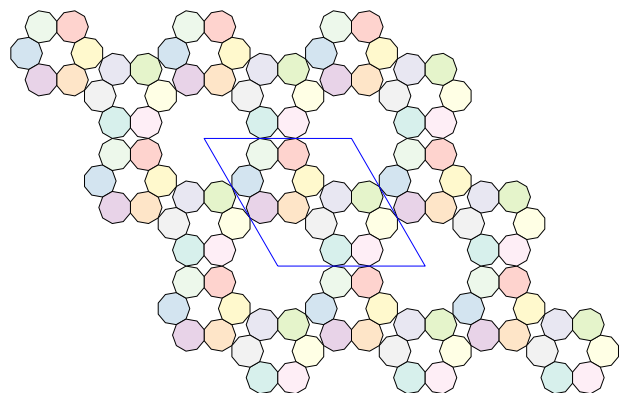
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.049629908076524	0
\mathbf{b}_2	-4.524814954038260	7.837209395241705

Centroid in Cartesian coordinates:

	x	y
	0.996194704415468	2.325120780045008

Angle of rotation: 4.537856054832007



H. 10-gon

1. *Plane group: p2*

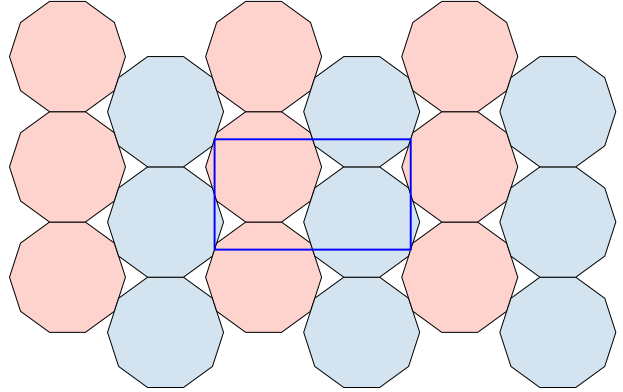
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.381966043019716	0.000022914422719
\mathbf{b}_2	0	1.902113040172108

Centroid in Cartesian coordinates:

	x	y
	0.845491507436605	1.426590501307895

Angle of rotation: 6.283156780150132



2. *Plane group: p2gg*

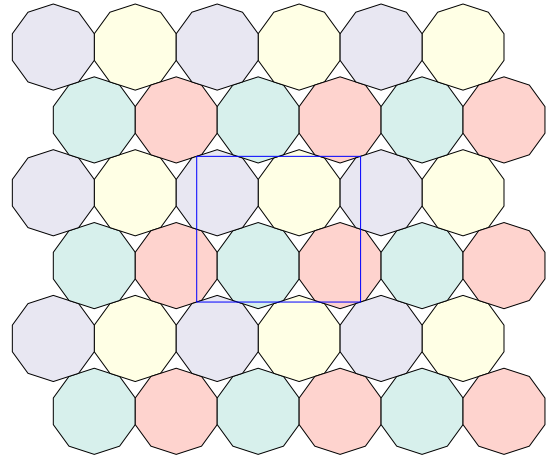
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.804226114465178	0
\mathbf{b}_2	0	3.381966053204507

Centroid in Cartesian coordinates:

	x	y
	1.426584781682892	0.845491516356783

Angle of rotation: 5.340707503111481



3. *Plane group: pg*

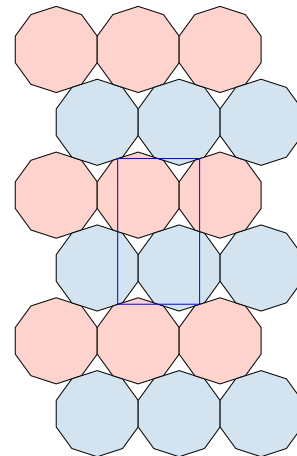
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.902113039064416	0
\mathbf{b}_2	0	3.381966020601089

Centroid in Cartesian coordinates:

	x	y
	0.475528257497089	0.845491505150272

Angle of rotation: 0.314159261858885



4. **Plane group: $p3$**

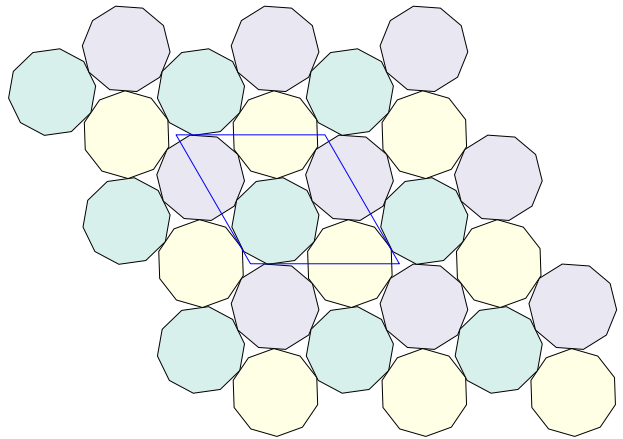
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.386446016219809	0
\mathbf{b}_2	-1.693223008109904	2.932748278590964

Centroid in Cartesian coordinates:

	x	y
	0.566781235172975	0.972704832464972

Angle of rotation: 3.280297958298238



5. **Plane group: $p1$**

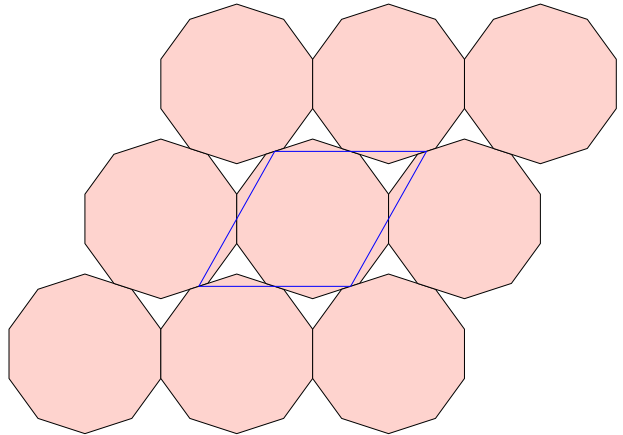
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.902113036358176	0
\mathbf{b}_2	0.951110841814038	1.690983010126465

Centroid in Cartesian coordinates:

	x	y
	1.426611939086107	0.845491505063232

Angle of rotation: 2.199158807196031



6. **Plane group: $p2mg$**

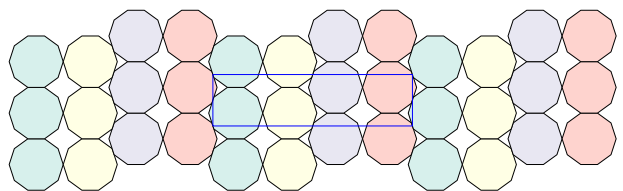
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.381966138899676	0
\mathbf{b}_2	0	1.902113087531544

Centroid in Cartesian coordinates:

	x	y
	0.845491557588457	0.475396046664880

Angle of rotation: 1.256850992239909



7. Plane group: cm

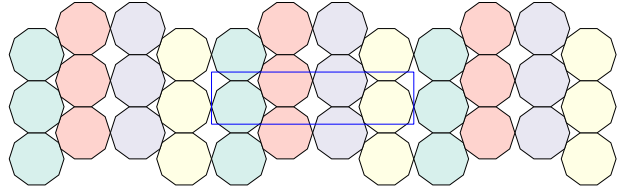
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.381966091884928	0
\mathbf{b}_2	0	1.902113056983769

Centroid in Cartesian coordinates:

	x	y
	1.000000005467720	0.635740901488017

Angle of rotation: 3.769911231479684



8. Plane group: $p4$

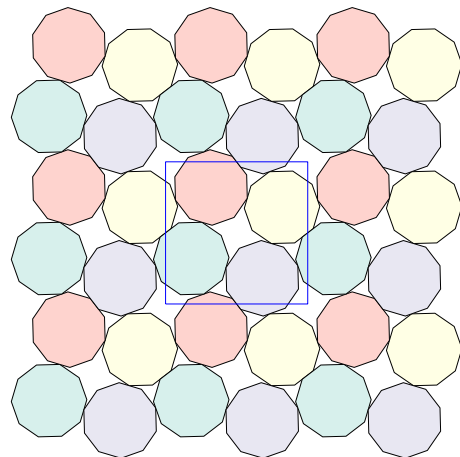
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.763350793468099	0
\mathbf{b}_2	0	3.763350793468099

Centroid in Cartesian coordinates:

	x	y
	0.679582100760681	1.204366734739915

Angle of rotation: 3.167836127348832



9. Plane group: $p4gm$

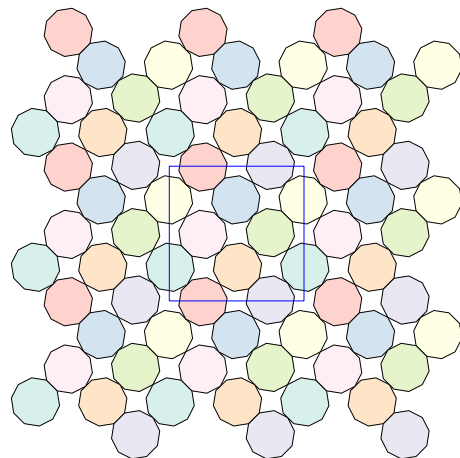
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.518421195551328	0
\mathbf{b}_2	0	5.518421195551328

Centroid in Cartesian coordinates:

	x	y
	0.034608265646753	1.379605298647260

Angle of rotation: 4.869468623676132



10. *Plane group: c2mm*

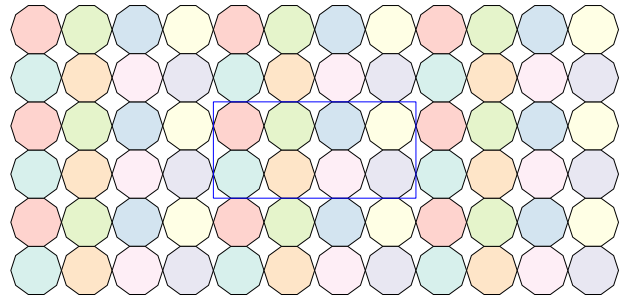
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.999999719580138	0
\mathbf{b}_2	0	3.804226387625798

Centroid in Cartesian coordinates:

	x	y
	1.000000001539335	0.951056602471115

Angle of rotation: 1.884955833255335



11. *Plane group: pm*

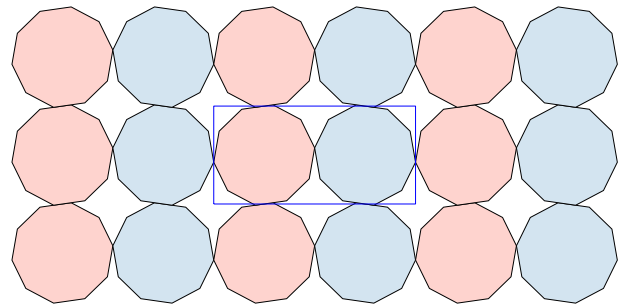
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.960038116302917	0
\mathbf{b}_2	0	1.921307812957478

Centroid in Cartesian coordinates:

	x	y
	0.990009529280106	0.960653906478739

Angle of rotation: 4.539701660660766



12. *Plane group: p2mm*

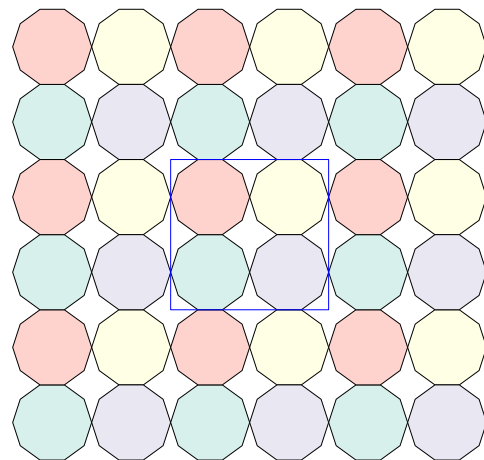
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000017982158	0
\mathbf{b}_2	0	3.804226111520822

Centroid in Cartesian coordinates:

	x	y
	1.000000005194386	0.951056531046779

Angle of rotation: 5.654866775147927



13. Plane group: $p6$

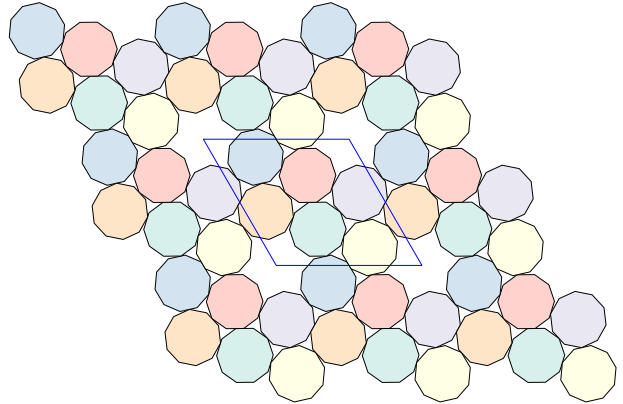
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.144589649226979	0
\mathbf{b}_2	-2.572294824613488	4.455345328277038

Centroid in Cartesian coordinates:

	x	y
	1.467359177213557	1.278736020250058

Angle of rotation: 5.038628994770773



14. Plane group: $p31m$

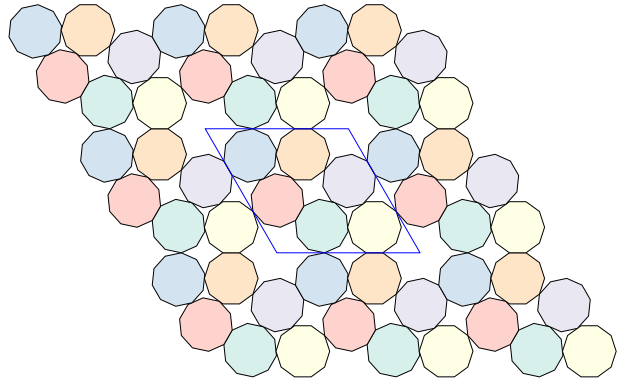
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.330704299303394	0
\mathbf{b}_2	-2.665352149651695	4.616525343259664

Centroid in Cartesian coordinates:

	x	y
	1.672372975795644	0.994521904531402

Angle of rotation: 0.418878987320896



15. Plane group: $p3m1$

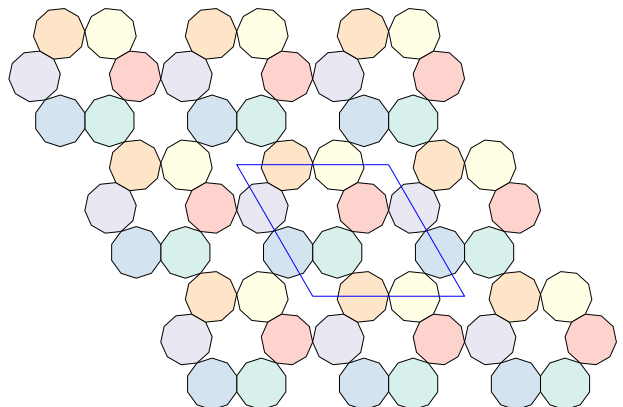
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.880200671965297	0
\mathbf{b}_2	-2.940100335982647	5.092403161272274

Centroid in Cartesian coordinates:

	x	y
	0.951056524479143	1.697467728325431

Angle of rotation: 0.314159252628583



16. Plane group: $p4mm$

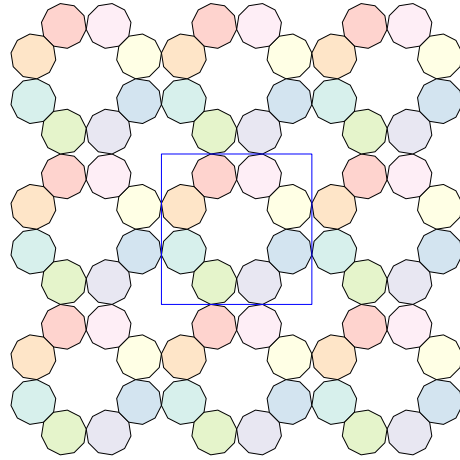
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.640747494649911	0
\mathbf{b}_2	0	6.640747494649911

Centroid in Cartesian coordinates:

	x	y
	0.987688377517915	2.332685409189812

Angle of rotation: 2.042035208693866



17. Plane group: $p6mm$

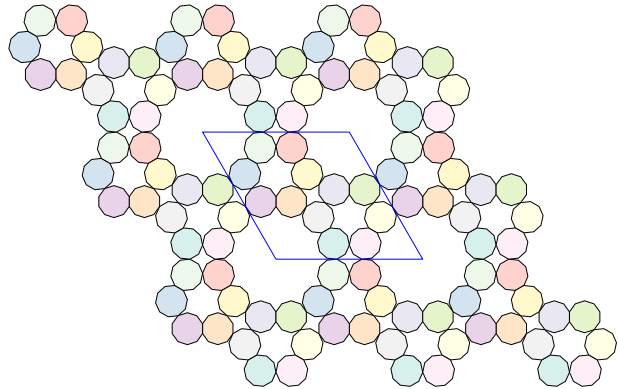
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.181672607071764	0
\mathbf{b}_2	-4.590836303535880	7.951561726955845

Centroid in Cartesian coordinates:

	x	y
	0.987688377517915	2.332685409189812

Angle of rotation: 1.151917321253639



I. 11-gon

1. Plane group: $p2$

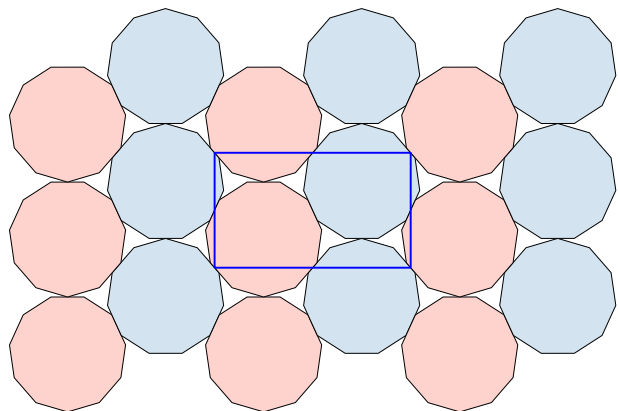
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.343786153387847	0.000176139144074
\mathbf{b}_2	0	1.959499833146323

Centroid in Cartesian coordinates:

	x	y
	0.836068378229633	0.500529826318750

Angle of rotation: 1.286019450774016



2. **Plane group: $p2gg$**

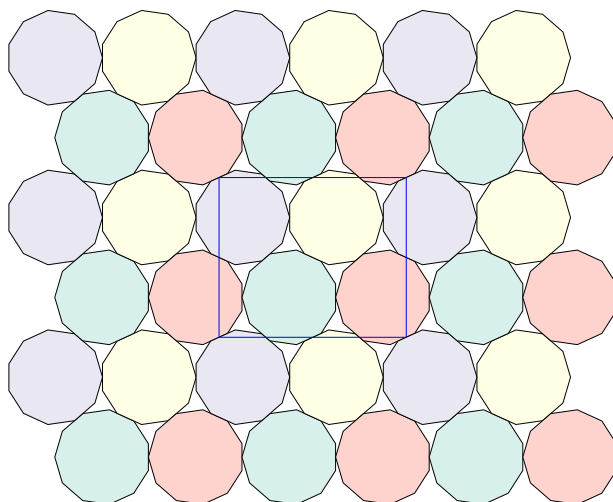
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.918986002176241	0
\mathbf{b}_2	0	3.343738461394267

Centroid in Cartesian coordinates:

	x	y
	1.480212951218651	0.835934678812678

Angle of rotation: 1.427996271545279



3. **Plane group: pg**

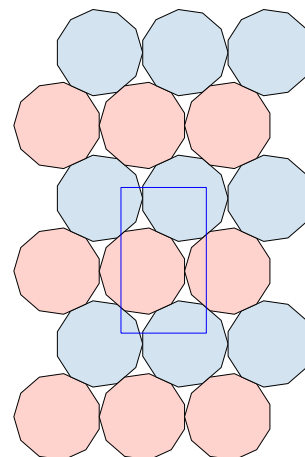
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.959492983107013	0
\mathbf{b}_2	0	3.343738309633539

Centroid in Cartesian coordinates:

	x	y
	0.500466394423389	0.835934577408385

Angle of rotation: 3.712791275943873



4. **Plane group: $p3$**

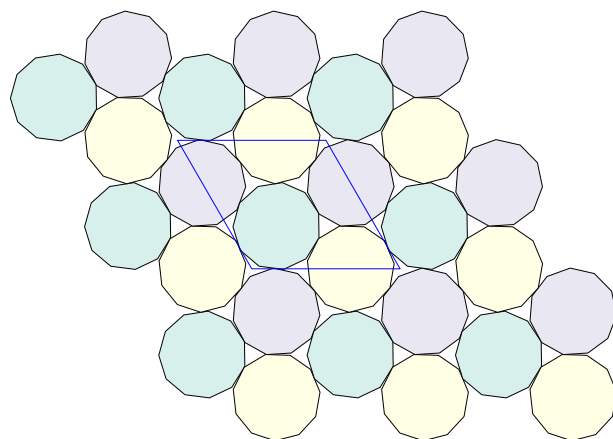
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.385011801467703	0
\mathbf{b}_2	-1.692505900733851	2.931506212181158

Centroid in Cartesian coordinates:

	x	y
	0.570931929134453	0.974212472655312

Angle of rotation: 0.300564978441231



5. *Plane group: p1*

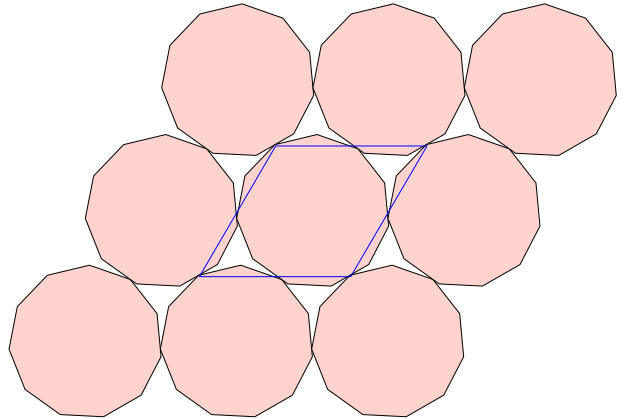
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.967937822497343	0
\mathbf{b}_2	0.992412815072570	1.699400978046011

Centroid in Cartesian coordinates:

	x	y
	1.480175318784957	0.849700489023005

Angle of rotation: 3.805465906219352



6. *Plane group: p2mg*

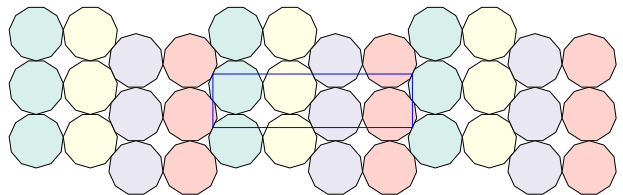
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.303023378832862	0
\mathbf{b}_2	0	1.959492997133916

Centroid in Cartesian coordinates:

	x	y
	0.835954819965561	1.480226597818409

Angle of rotation: 3.570135090267216



7. *Plane group: cm*

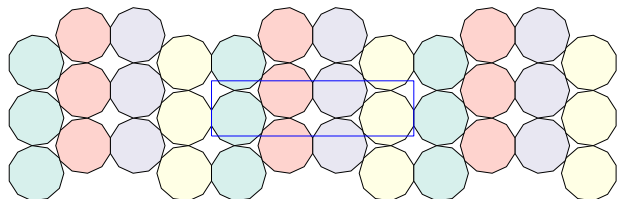
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.256696347343007	0
\mathbf{b}_2	0	1.979642880241989

Centroid in Cartesian coordinates:

	x	y
	0.959492984938219	0.643964539344198

Angle of rotation: 4.569589332374485



8. *Plane group: p4*

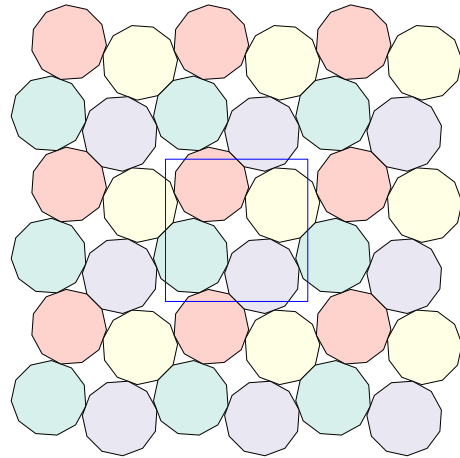
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.767857536768388	0
\mathbf{b}_2	0	3.767857536768388

Centroid in Cartesian coordinates:

	x	y
	0.678473756482486	1.205474522528120

Angle of rotation: 0.928308883371885



9. *Plane group: p4gm*

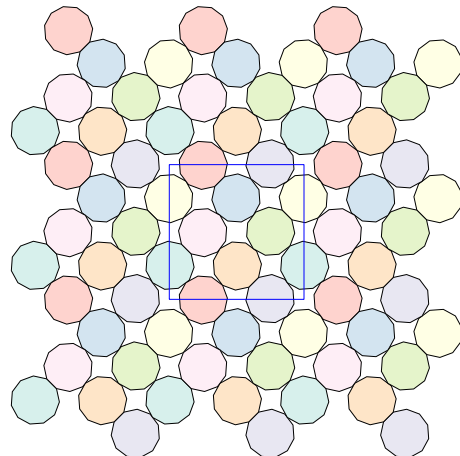
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.535675354929882	0
\mathbf{b}_2	0	5.535675354929882

Centroid in Cartesian coordinates:

	x	y
	0.021445476416675	1.389464162341129

Angle of rotation: 5.069388225611794



10. *Plane group: c2mm*

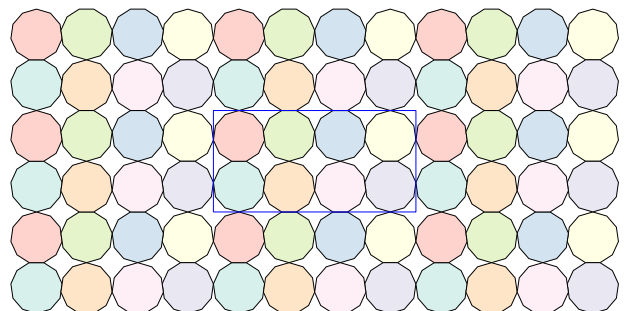
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.825076952571632	0
\mathbf{b}_2	0	3.918986244260036

Centroid in Cartesian coordinates:

	x	y
	0.989821491940747	1.000000077379320

Angle of rotation: 5.854786283899450



11. Plane group: pm

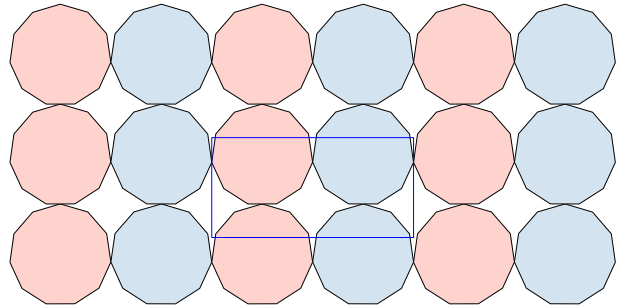
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.959270052038444	0
\mathbf{b}_2	0	1.959500776317411

Centroid in Cartesian coordinates:

	x	y
	0.989415912326359	0.979750388158705

Angle of rotation: 5.572008947095054



12. Plane group: $p2mm$

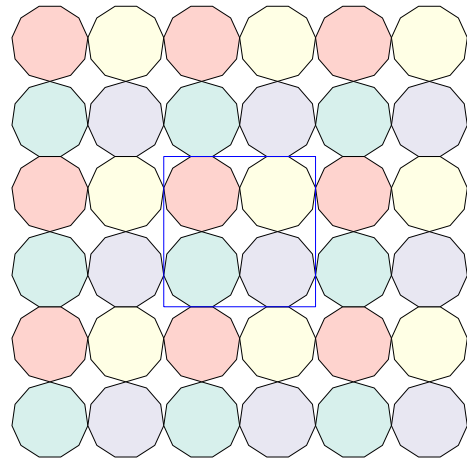
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.959285923686607	0
\mathbf{b}_2	0	3.918986421809130

Centroid in Cartesian coordinates:

	x	y
	0.989821451095850	0.959493078141971

Angle of rotation: 2.141995137023344



13. Plane group: $p6$

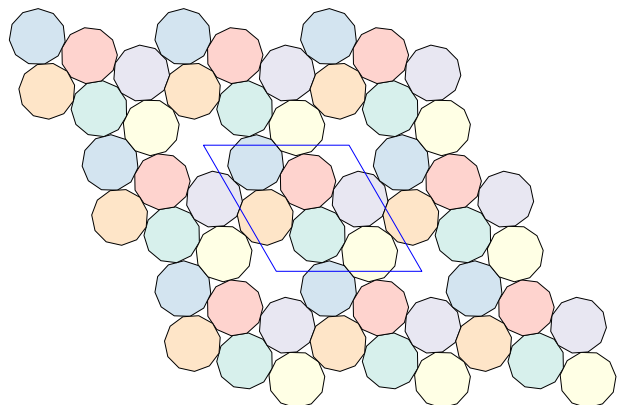
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.162673137644905	0
\mathbf{b}_2	-2.581336568822451	4.471006088636004

Centroid in Cartesian coordinates:

	x	y
	1.471146856536580	1.292771964908186

Angle of rotation: 3.731823145171212



14. Plane group: $p31m$

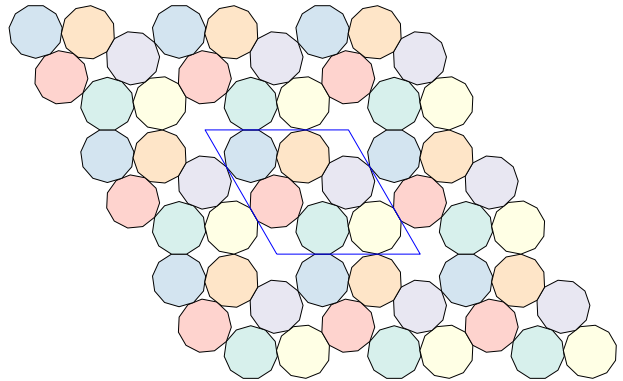
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.342311397470941	0
\mathbf{b}_2	-2.671155698735469	4.626577385136981

Centroid in Cartesian coordinates:

	x	y
	1.703435513205986	0.959492977417724

Angle of rotation: 5.569186989024043



15. Plane group: $p3m1$

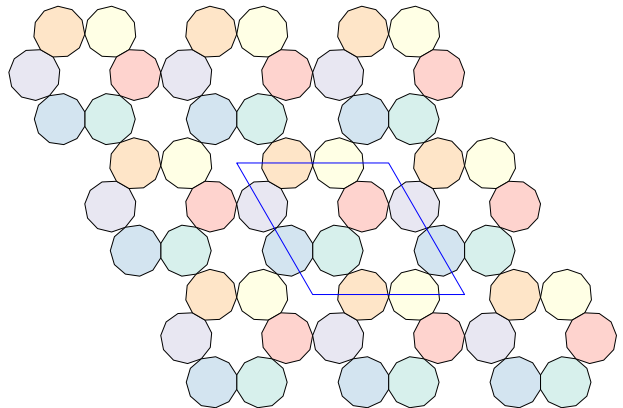
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.900874118399645	0
\mathbf{b}_2	-2.950437059199821	5.110306891068196

Centroid in Cartesian coordinates:

	x	y
	0.959493206887645	1.703435632665379

Angle of rotation: 0.571198657169831



16. Plane group: $p4mm$

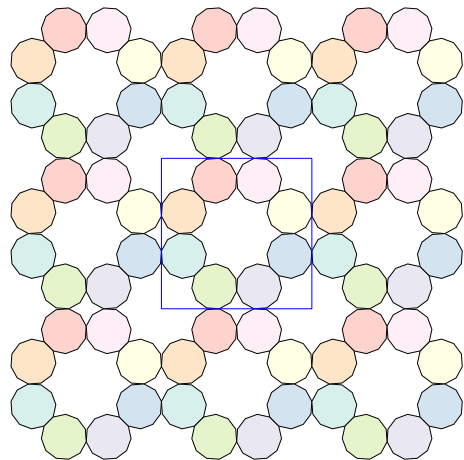
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.622443929710041	0
\mathbf{b}_2	0	6.622443929710041

Centroid in Cartesian coordinates:

	x	y
	0.977147042973893	2.334075137523429

Angle of rotation: 5.212188014705637



17. *Plane group: p6mm*

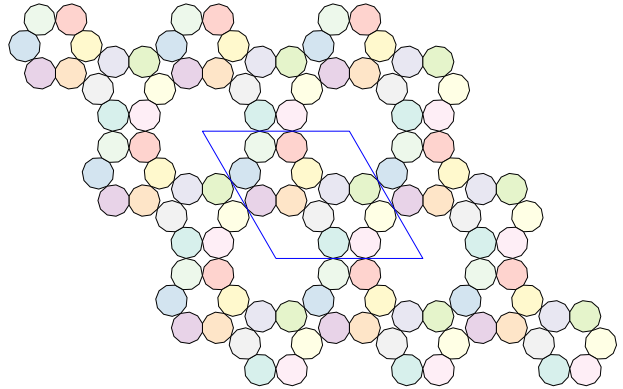
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.289094471023546	0
\mathbf{b}_2	-4.644547235511771	8.044591790059963

Centroid in Cartesian coordinates:

	x	y
	0.977147042973893	2.334075137523429

Angle of rotation: 1.808795728369189



J. 12-gon

1. *Plane group: p2*

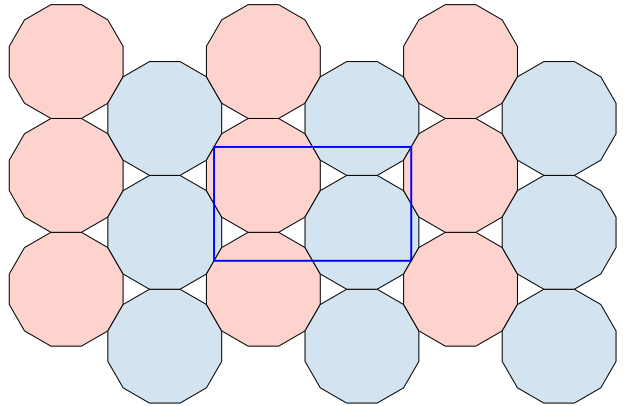
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.346065318898009	0.000000000455899
\mathbf{b}_2	0	1.931851712012376

Centroid in Cartesian coordinates:

	x	y
	0.836516329764995	1.448888784320775

Angle of rotation: 2.879545214208555



2. *Plane group: p2gg*

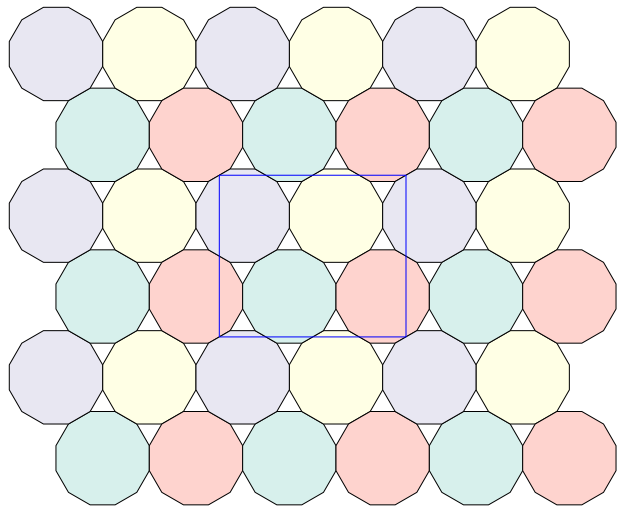
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.863703309168048	0
\mathbf{b}_2	0	3.346065318654980

Centroid in Cartesian coordinates:

	x	y
	1.448888717112911	0.836516342665556

Angle of rotation: 3.926990815799506



3. *Plane group: pg*

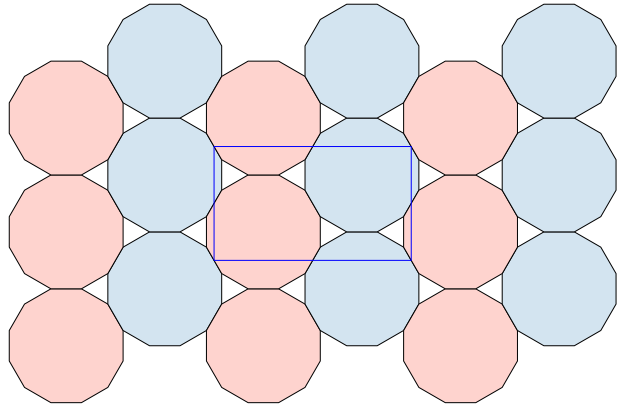
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.346065226588553	0
\mathbf{b}_2	0	1.931851661128059

Centroid in Cartesian coordinates:

	x	y
	0.836516306748476	0.482962915282015

Angle of rotation: 0.261799388308937



4. *Plane group: p3*

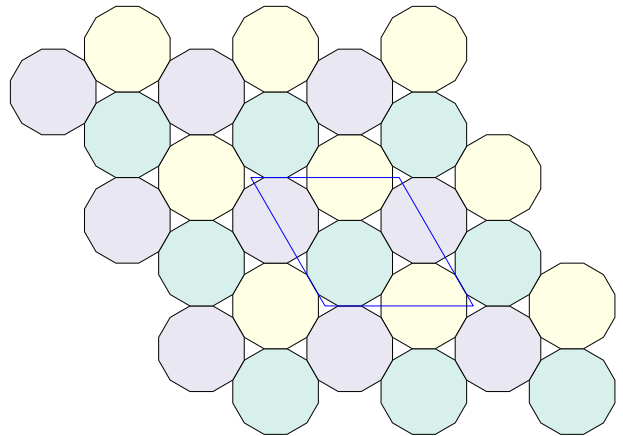
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.346065231699221	0
\mathbf{b}_2	-1.673032615849610	2.897777493371390

Centroid in Cartesian coordinates:

	x	y
	0.557677537756910	0.965925832256507

Angle of rotation: 5.497706735765036



5. *Plane group: p1*

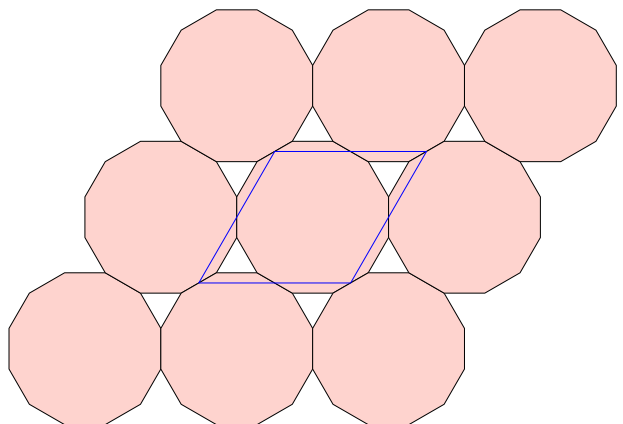
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.931851653676513	0
\mathbf{b}_2	0.965925827808096	1.673032608886504

Centroid in Cartesian coordinates:

	x	y
	1.448888740742305	0.836516304443252

Angle of rotation: 4.450618921476945



6. Plane group: $p2mg$

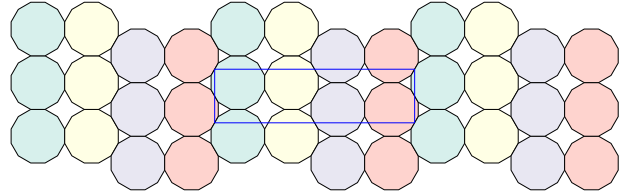
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.209768719764828	0
\mathbf{b}_2	0	1.931851669949718

Centroid in Cartesian coordinates:

	x	y
	0.836516315400705	1.448888758357886

Angle of rotation: 2.356194611363942



7. Plane group: cm

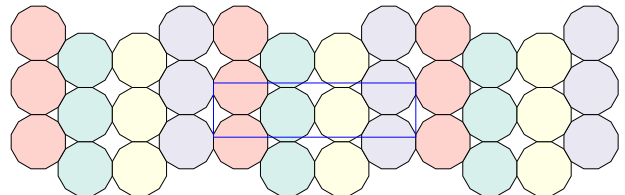
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.209768801009001	0
\mathbf{b}_2	0	1.931851653112127

Centroid in Cartesian coordinates:

	x	y
	2.638958541849998	0.805314123550778

Angle of rotation: 6.021385943482940



8. Plane group: $p4$

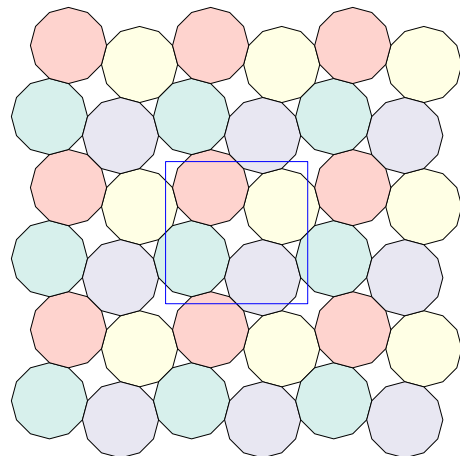
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.732050834282968	0
\mathbf{b}_2	0	3.732050834282968

Centroid in Cartesian coordinates:

	x	y
	0.683012707307515	1.183012711216797

Angle of rotation: 1.047304292413701



9. *Plane group: p4gm*

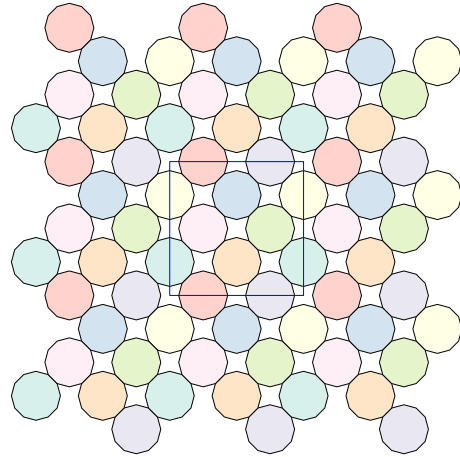
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.464101748997384	0
\mathbf{b}_2	0	5.464101748997384

Centroid in Cartesian coordinates:

	x	y
	0.000000000058300	1.366025414771173

Angle of rotation: 2.094395093520689



10. *Plane group: c2mm*

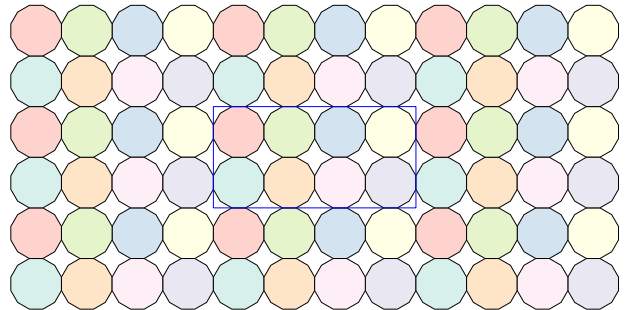
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.727406709584786	0
\mathbf{b}_2	0	3.863703424529382

Centroid in Cartesian coordinates:

	x	y
	0.965925838666484	0.965925861366055

Angle of rotation: 5.497787119564352



11. *Plane group: pm*

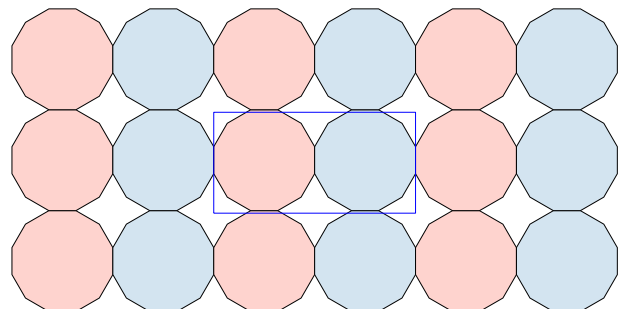
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.863703323157683	0
\mathbf{b}_2	0	1.931851653802800

Centroid in Cartesian coordinates:

	x	y
	0.965925832404037	0.965925826901400

Angle of rotation: 2.879793259577074



12. *Plane group: p2mm*

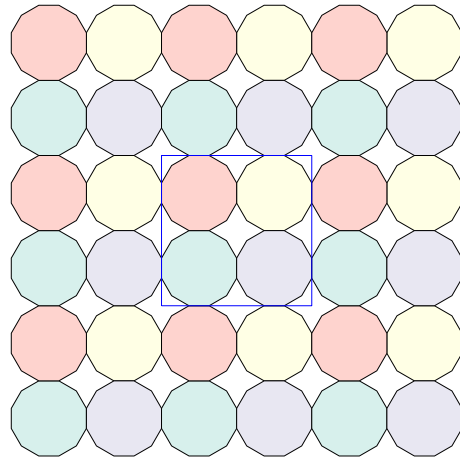
Primitive cell basic vectors:

x	y
\mathbf{b}_1 3.863703337371145	0
\mathbf{b}_2 0	3.863703393311271

Centroid in Cartesian coordinates:

x	y
0.965925830596199	0.965925832293344

Angle of rotation: 6.021385930701390



13. *Plane group: p6*

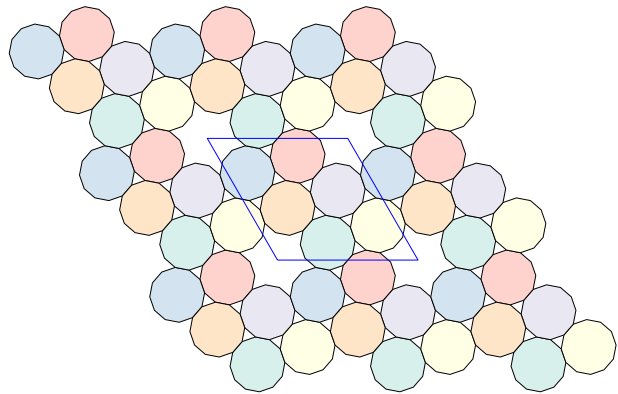
Primitive cell basic vectors:

x	y
\mathbf{b}_1 5.111199049380833	0
\mathbf{b}_2 -2.555599524690415	4.426428220562675

Centroid in Cartesian coordinates:

x	y
1.825428232122667	0.632346888460395

Angle of rotation: 0.595244839429454



14. *Plane group: p31m*

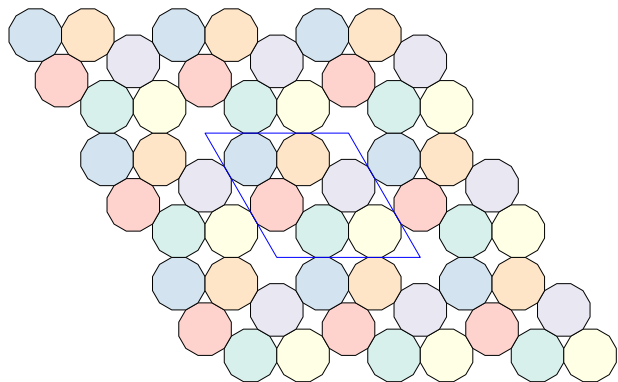
Primitive cell basic vectors:

x	y
\mathbf{b}_1 5.277916914299525	0
\mathbf{b}_2 -2.638958457149761	4.570810126846965

Centroid in Cartesian coordinates:

x	y
1.673032631797970	0.965925832836417

Angle of rotation: 1.308996916798983



15. Plane group: $p3m1$

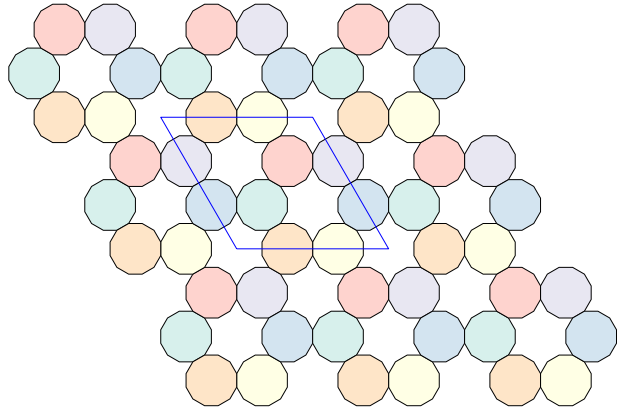
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.795555029354123	0
\mathbf{b}_2	-2.897777514677060	5.019097884451339

Centroid in Cartesian coordinates:

	x	y
	0.965925834881377	1.673032618028527

Angle of rotation: 4.450589584314643



16. Plane group: $p4mm$

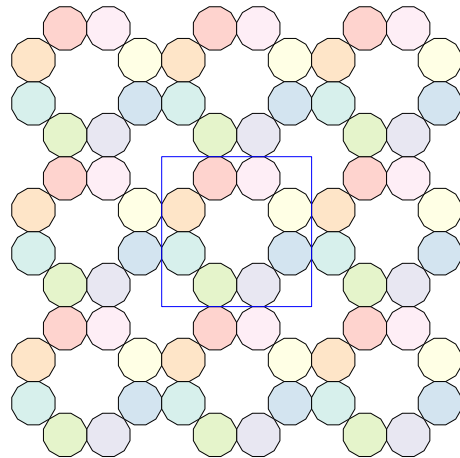
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.692130459829976	0
\mathbf{b}_2	0	6.692130459829976

Centroid in Cartesian coordinates:

	x	y
	0.965925828841277	2.380139393159387

Angle of rotation: 4.974188370026474



17. Plane group: $p6mm$

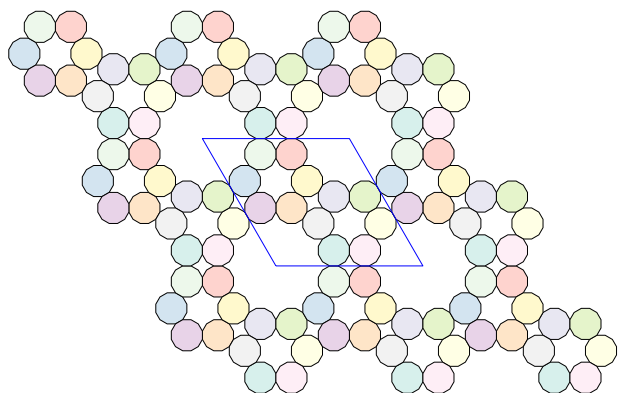
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.141620263200098	0
\mathbf{b}_2	-4.570810131600047	7.916875379681872

Centroid in Cartesian coordinates:

	x	y
	0.965925828841277	2.380139393159387

Angle of rotation: 3.403392048362107



K. 13-gon

1. *Plane group: p2*

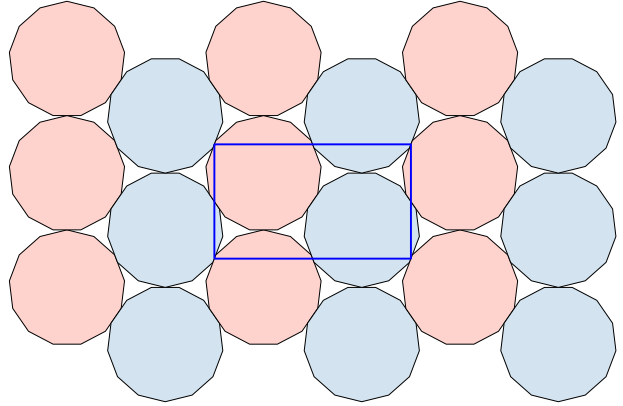
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.389358282102503	0.000000240360673
\mathbf{b}_2	0	1.970941821843249

Centroid in Cartesian coordinates:

	x	y
	0.847339074557834	1.467097575774939

Angle of rotation: 1.570792923770691



2. *Plane group: p2gg*

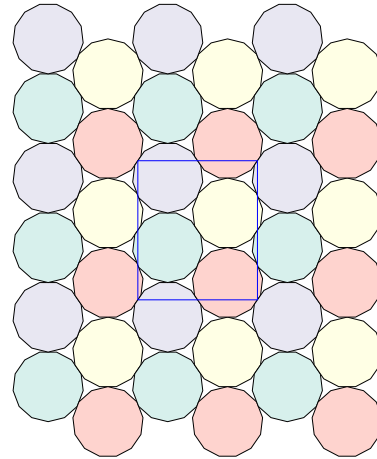
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.389358154570514	0
\mathbf{b}_2	0	3.941883636777910

Centroid in Cartesian coordinates:

	x	y
	0.847339486559973	1.489315252065628

Angle of rotation: 1.329135792533551



3. *Plane group: pg*

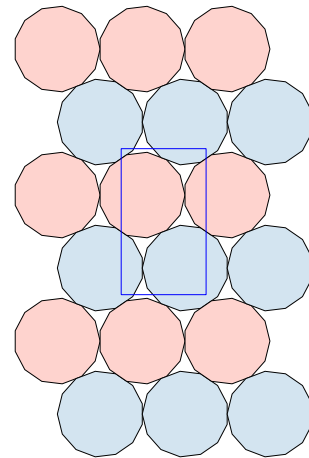
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.970941848765227	0
\mathbf{b}_2	0	3.389357943578137

Centroid in Cartesian coordinates:

	x	y
	0.481626636767365	0.847339485894534

Angle of rotation: 2.899931779694625



4. *Plane group: p3*

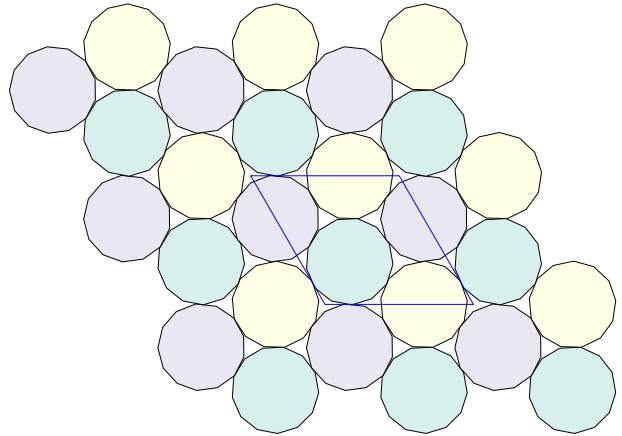
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.409694691964930	0
\mathbf{b}_2	-1.704847345982464	2.952882222390586

Centroid in Cartesian coordinates:

	x	y
	0.563715076962043	0.988286012563864

Angle of rotation: 4.282013264316364



5. *Plane group: p1*

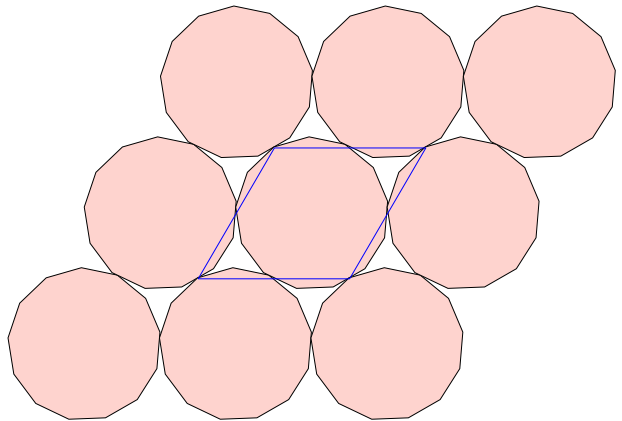
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.977702767853526	0
\mathbf{b}_2	0.995537334616787	1.708789916132377

Centroid in Cartesian coordinates:

	x	y
	1.486620051235157	0.854394958066188

Angle of rotation: 2.575559923343531



6. *Plane group: p2mg*

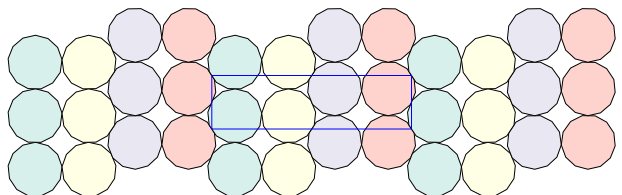
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.357731905198206	0
\mathbf{b}_2	0	1.971268020197567

Centroid in Cartesian coordinates:

	x	y
	0.844695652176853	0.483105262654742

Angle of rotation: 3.002569864504453



7. Plane group: cm

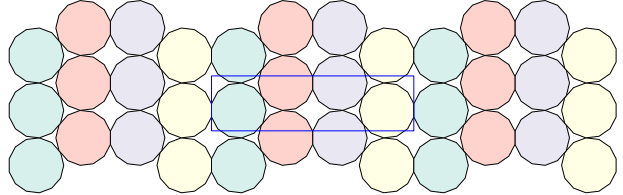
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.313500029500706	0
\mathbf{b}_2	0	1.985417738138907

Centroid in Cartesian coordinates:

	x	y
	0.970941831808117	0.738695862612537

Angle of rotation: 1.933287735266669



8. Plane group: $p4$

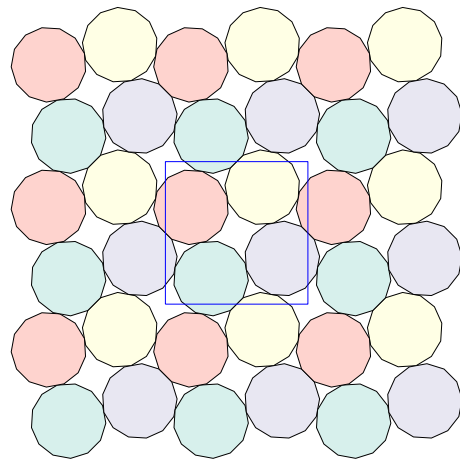
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.799656263058914	0
\mathbf{b}_2	0	3.799656263058914

Centroid in Cartesian coordinates:

	x	y
	1.213258495699664	0.686549551288762

Angle of rotation: 5.739335603831816



9. Plane group: $p4gm$

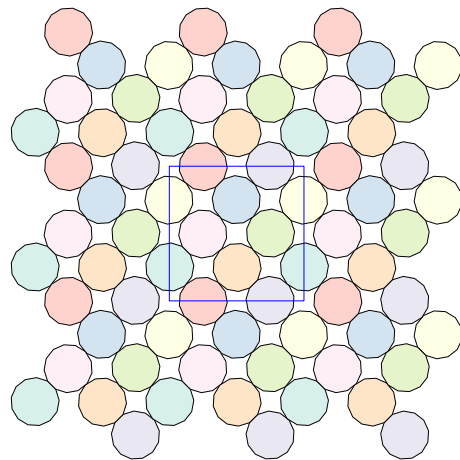
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.578177062476777	0
\mathbf{b}_2	0	5.578177062476777

Centroid in Cartesian coordinates:

	x	y
	0.015391610281016	1.400577785736628

Angle of rotation: 2.960346917458244



10. Plane group: $c2mm$

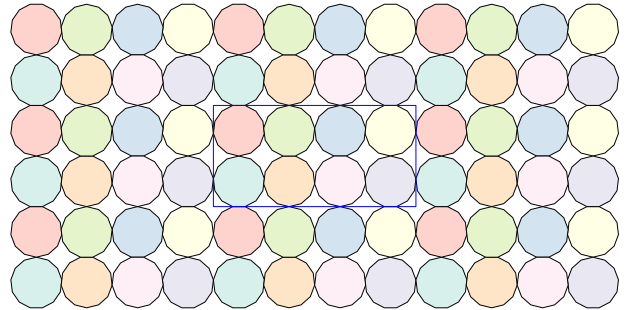
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.890185014481297	0
\mathbf{b}_2	0	3.941884085078860

Centroid in Cartesian coordinates:

	x	y
	0.992708915687246	0.970941889009615

Angle of rotation: 5.437372026106639



11. Plane group: pm

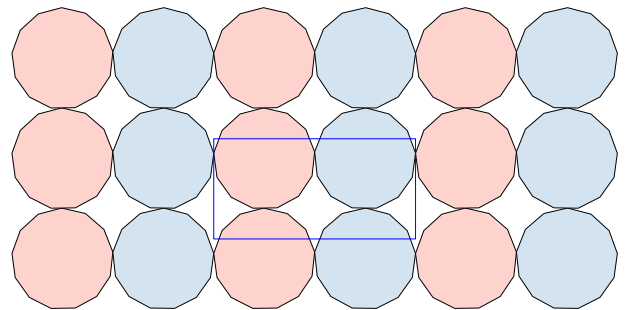
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.970438250546060	0
\mathbf{b}_2	0	1.971139032405931

Centroid in Cartesian coordinates:

	x	y
	0.994314537996888	0.985569516202966

Angle of rotation: 3.034907492357713



12. Plane group: $p2mm$

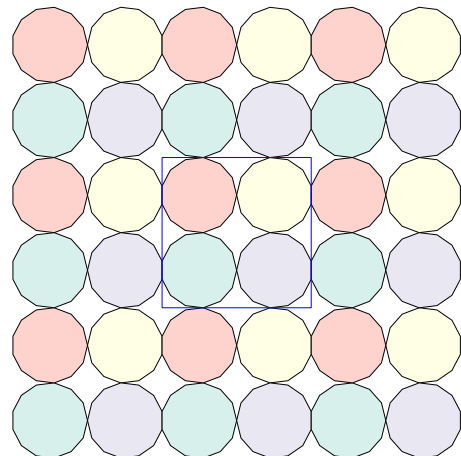
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.941883950071129	0
\mathbf{b}_2	0	3.970835639540623

Centroid in Cartesian coordinates:

	x	y
	0.970941880669521	0.992708934177553

Angle of rotation: 1.933287759437111



13. Plane group: $p6$

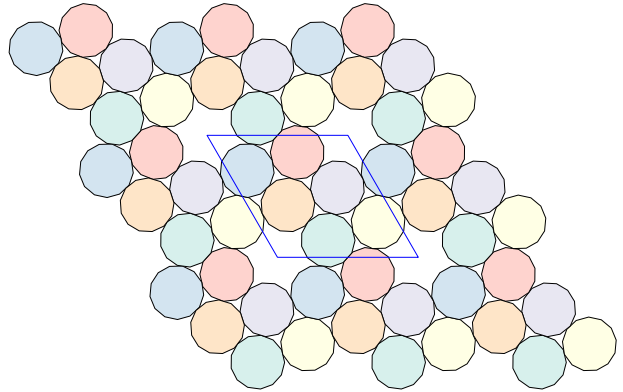
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.204786722839932	0
\mathbf{b}_2	-2.602393361419965	4.507477523259338

Centroid in Cartesian coordinates:

	x	y
	1.866920498453319	0.634328656520829

Angle of rotation: 1.438777774498517



14. Plane group: $p31m$

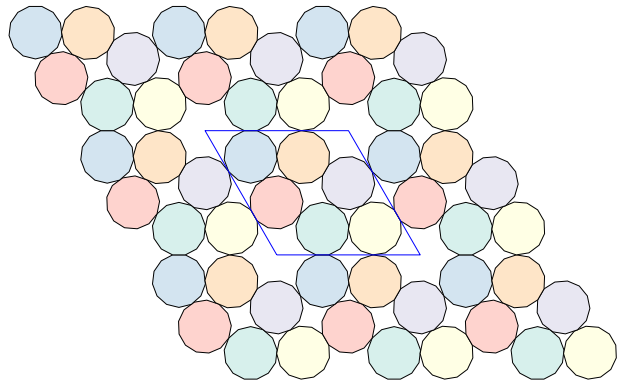
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.383662615165897	0
\mathbf{b}_2	-2.691831307582947	4.662388590138233

Centroid in Cartesian coordinates:

	x	y
	1.711529857798221	0.970941960501466

Angle of rotation: 4.470728379482405



15. Plane group: $p3m1$

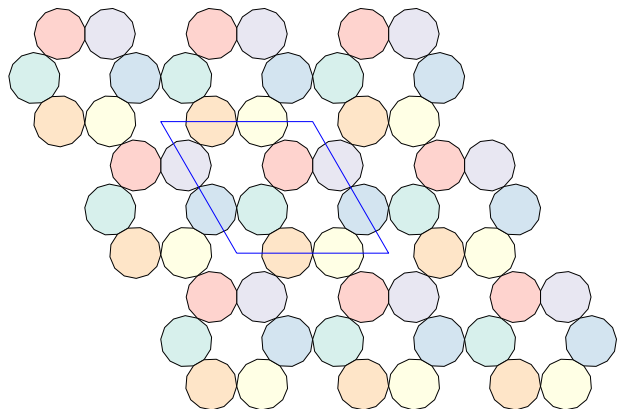
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.928913055608781	0
\mathbf{b}_2	-2.964456527804389	5.134589322986425

Centroid in Cartesian coordinates:

	x	y
	0.996757317284427	1.696625205058557

Angle of rotation: 2.094395035798003



16. Plane group: $p4mm$

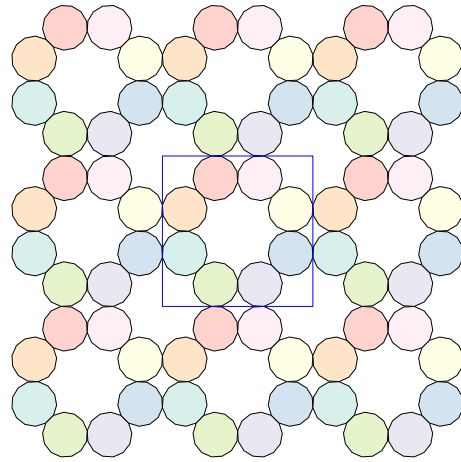
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.680718407017383	0
\mathbf{b}_2	0	6.680718407017383

Centroid in Cartesian coordinates:

	x	y
	0.983620015382452	2.356739235169845

Angle of rotation: 6.222769963374580



17. Plane group: $p6mm$

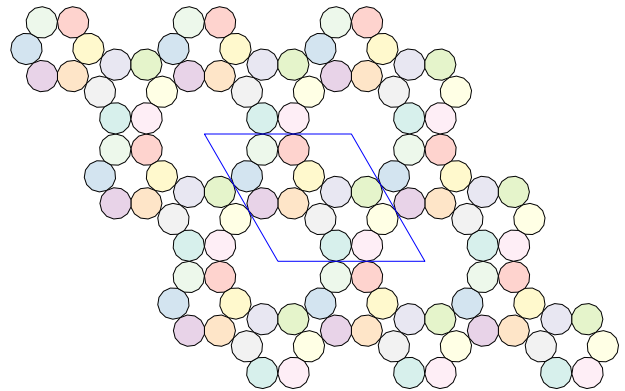
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.338574773012056	0
\mathbf{b}_2	-4.669287386506026	8.087442988568938

Centroid in Cartesian coordinates:

	x	y
	0.983620015382452	2.356739235169845

Angle of rotation: 5.235987427103169



L. 14-gon

1. Plane group: $p2$

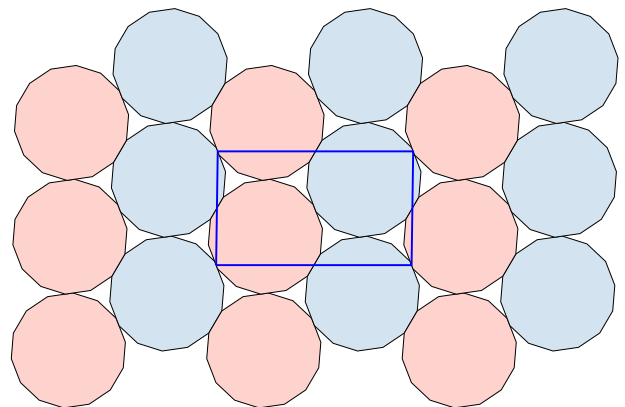
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.391156188735905	0.027898706163371
\mathbf{b}_2	0	1.973892578763112

Centroid in Cartesian coordinates:

	x	y
	0.847789040709180	0.500447832434469

Angle of rotation: 5.977104885100436



2. **Plane group: $p2gg$**

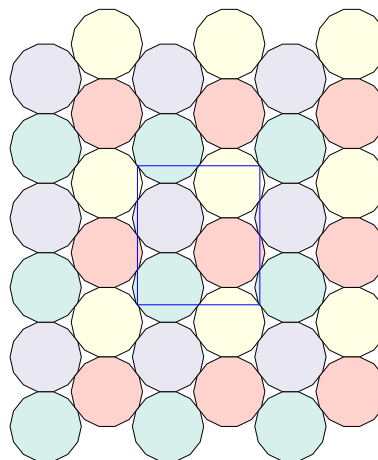
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.432960299144867	0
\mathbf{b}_2	0	3.899711699258401

Centroid in Cartesian coordinates:

	x	y
	0.858240063677719	0.487463968108189

Angle of rotation: 5.385587393160204



3. **Plane group: pg**

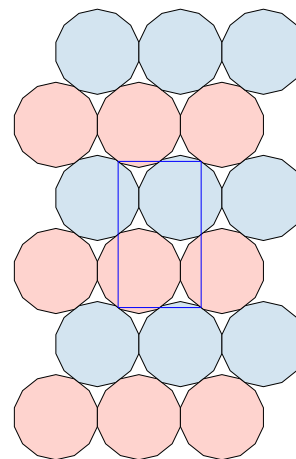
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.949855825600259	0
\mathbf{b}_2	0	3.432960299082113

Centroid in Cartesian coordinates:

	x	y
	0.487463953826475	0.858240074770528

Angle of rotation: 5.609986855635708



4. **Plane group: $p3$**

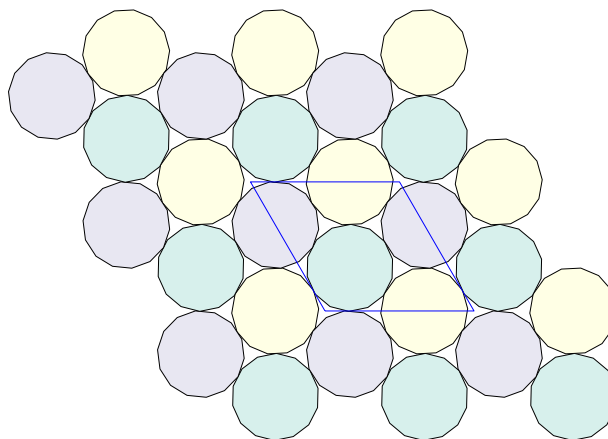
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.424374135349682	0
\mathbf{b}_2	-1.712187067674841	2.965594993275197

Centroid in Cartesian coordinates:

	x	y
	0.572001817387444	0.991017755959821

Angle of rotation: 4.239213694222204



5. Plane group: $p1$

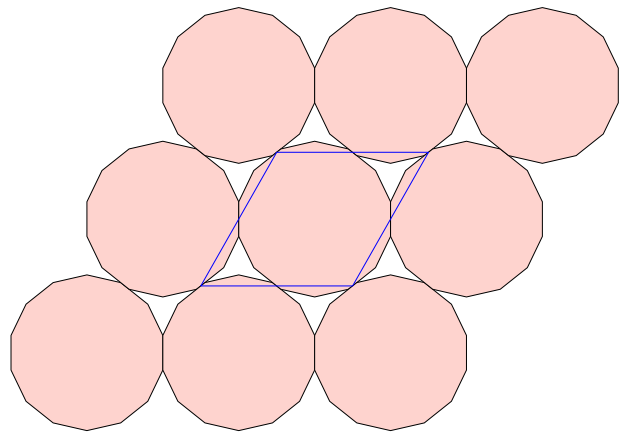
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.949855843171860	0
\mathbf{b}_2	0.974995179547959	1.716480149737386

Centroid in Cartesian coordinates:

	x	y
	1.462425511359909	0.858240074868693

Angle of rotation: 1.570660162175880



6. Plane group: $p2mg$

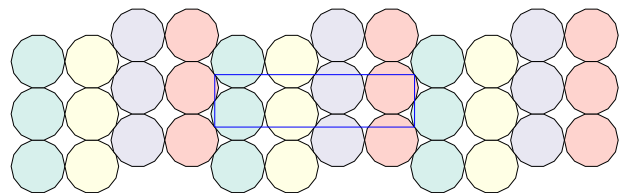
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.432959959397977	0
\mathbf{b}_2	0	1.949856098216819

Centroid in Cartesian coordinates:

	x	y
	0.858240129377100	0.487333215927527

Angle of rotation: 2.692264049741839



7. Plane group: cm

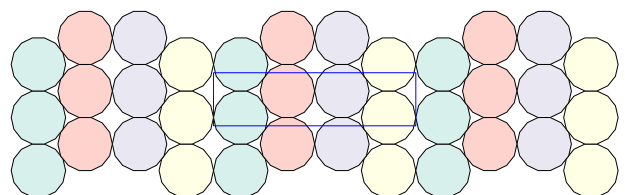
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.432960361161280	0
\mathbf{b}_2	0	1.949855825522594

Centroid in Cartesian coordinates:

	x	y
	1.000000000808797	0.304516397278473

Angle of rotation: 1.795195729466033



8. *Plane group: p4*

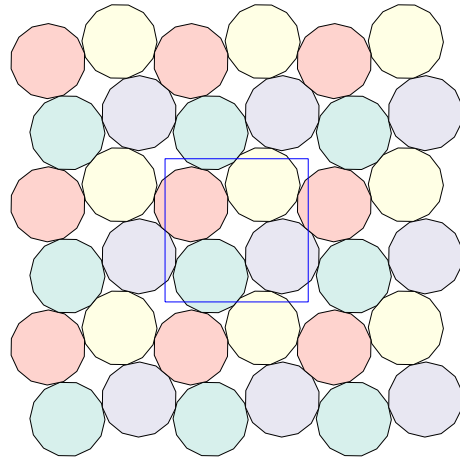
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.813730042656754	0
\mathbf{b}_2	0	3.813730042656754

Centroid in Cartesian coordinates:

	x	y
	1.2136576376669491	0.691824749874912

Angle of rotation: 5.369623652470880



9. *Plane group: p4gm*

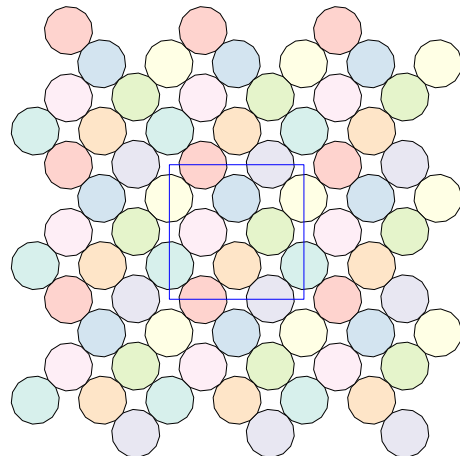
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.585939729799801	0
\mathbf{b}_2	0	5.585939729799801

Centroid in Cartesian coordinates:

	x	y
	0.017728634665057	1.396484932190712

Angle of rotation: 2.356194552403649



10. *Plane group: c2mm*

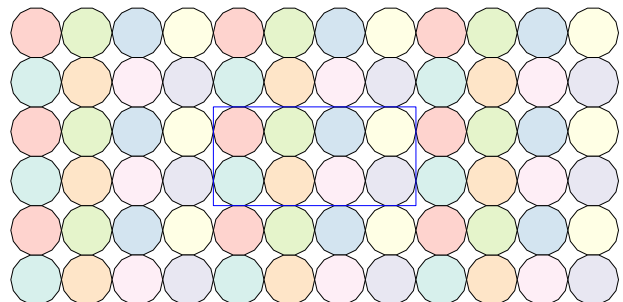
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	8.000000060652690	0
\mathbf{b}_2	0	3.899711794257747

Centroid in Cartesian coordinates:

	x	y
	1.000000008750168	0.974927942837132

Angle of rotation: 5.834386313887816



11. Plane group: pm

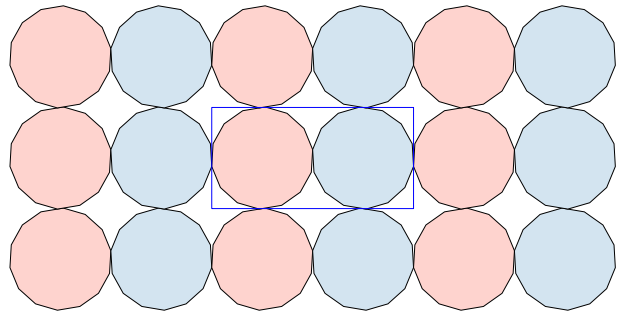
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.944896422313638	0
\mathbf{b}_2	0	1.977092038133894

Centroid in Cartesian coordinates:

	x	y
	0.986224105185093	0.988546019066947

Angle of rotation: 5.102966922858000



12. Plane group: $p2mm$

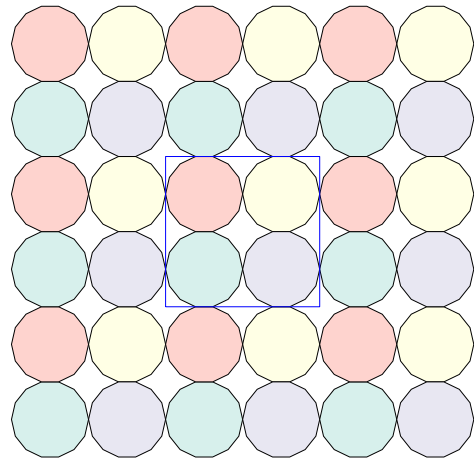
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000109514646	0
\mathbf{b}_2	0	3.899711720805159

Centroid in Cartesian coordinates:

	x	y
	1.000000024529042	0.974927931605460

Angle of rotation: 3.141592626569074



13. Plane group: $p6$

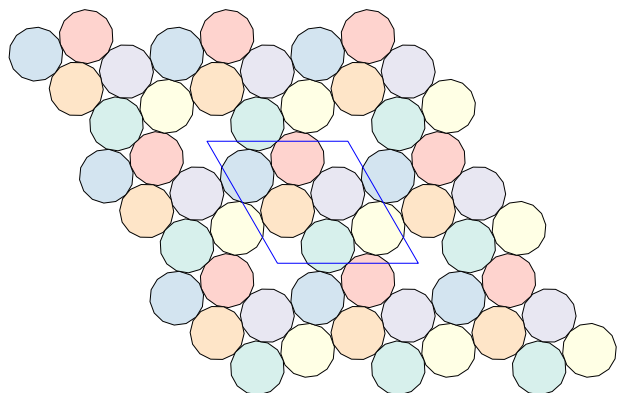
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.216526157353528	0
\mathbf{b}_2	-2.608263078676762	4.517644171774175

Centroid in Cartesian coordinates:

	x	y
	1.864815906006971	0.643223957241115

Angle of rotation: 0.728659877703904



14. *Plane group: p31m*

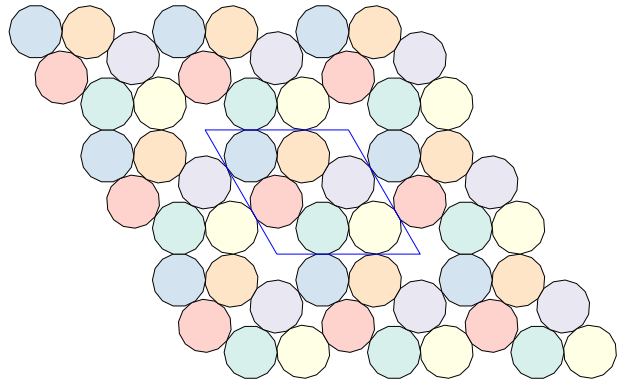
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.391824662465178	0
\mathbf{b}_2	-2.695912331232587	4.669457130446300

Centroid in Cartesian coordinates:

	x	y
	1.714346664141339	0.974927924084486

Angle of rotation: 0.897597945869252



15. *Plane group: p3m1*

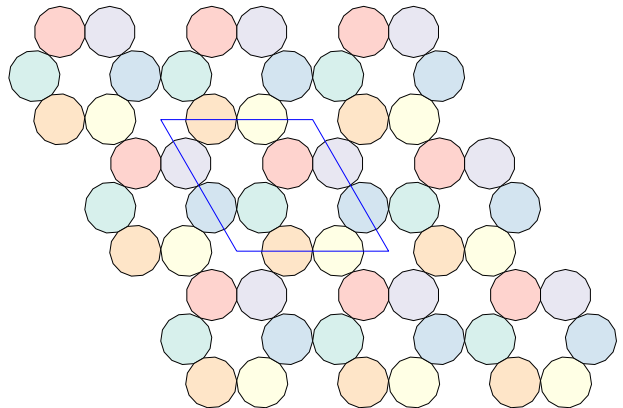
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.938671058209311	0
\mathbf{b}_2	-2.969335529104654	5.143040001128678

Centroid in Cartesian coordinates:

	x	y
	0.997203799392672	1.701485675390119

Angle of rotation: 0.972397730221499



16. *Plane group: p4mm*

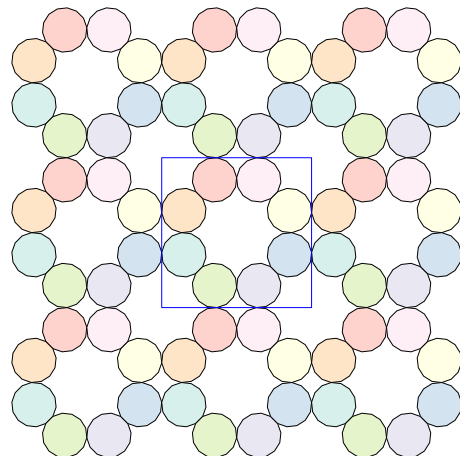
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.732361466314693	0
\mathbf{b}_2	0	6.732361466314693

Centroid in Cartesian coordinates:

	x	y
	0.993712228125639	2.372468519568682

Angle of rotation: 3.926990857371965



17. *Plane group: p6mm*

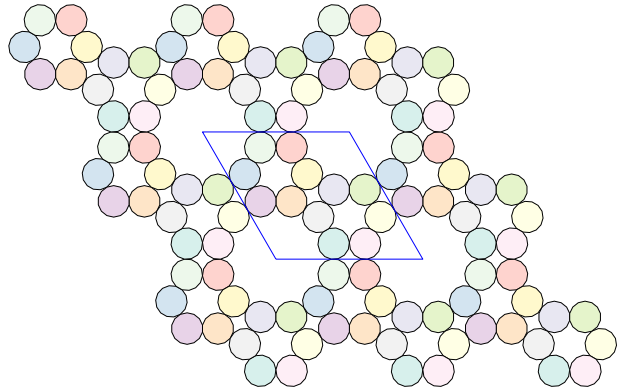
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.319529817640259	0
\mathbf{b}_2	-4.659764908820128	8.070949573403022

Centroid in Cartesian coordinates:

	x	y
	0.993712228125639	2.372468519568682

Angle of rotation: 1.421196612887537



M. 15-gon

1. *Plane group: p2*

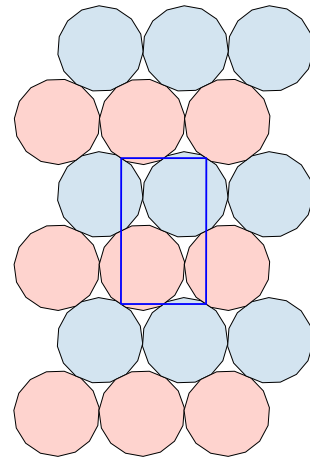
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.983507807530312	0.006011737319164
\mathbf{b}_2	0	3.399842630626983

Centroid in Cartesian coordinates:

	x	y
	0.489175214829520	0.850689834143244

Angle of rotation: 3.486938128202419



2. *Plane group: p2gg*

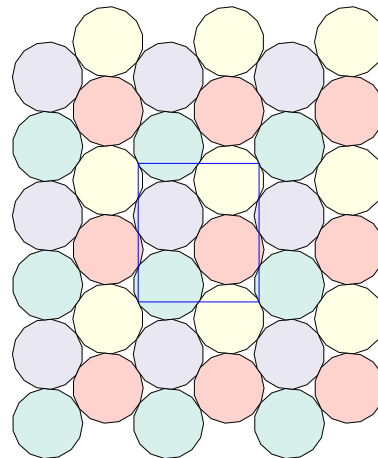
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.431382149637687	0
\mathbf{b}_2	0	3.933528594973862

Centroid in Cartesian coordinates:

	x	y
	0.856386158138308	0.481392376620551

Angle of rotation: 1.675516073462406



3. Plane group: pg

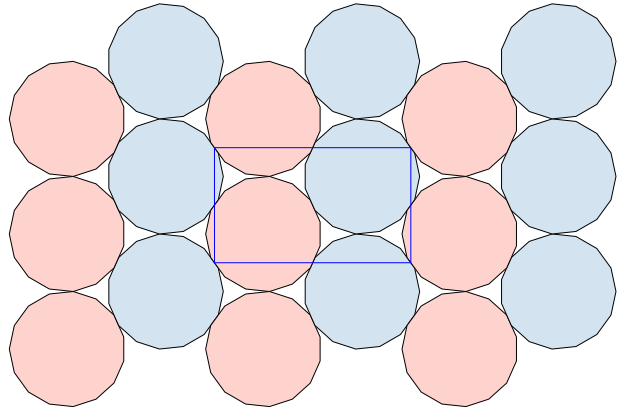
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.394193425542462	0
\mathbf{b}_2	0	1.989043790954008

Centroid in Cartesian coordinates:

	x	y
	0.847775701020911	0.497260947738502

Angle of rotation: 4.817108735184074



4. Plane group: $p3$

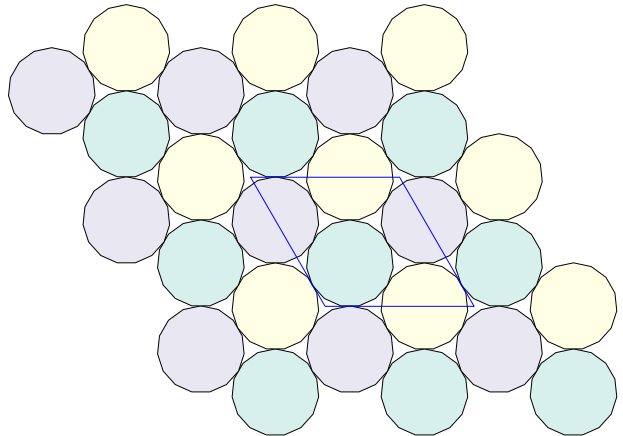
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.426252205112743	0
\mathbf{b}_2	-1.713126102556371	2.967221449400087

Centroid in Cartesian coordinates:

	x	y
	0.571042034283830	0.989073816735992

Angle of rotation: 1.151747505271304



5. Plane group: $p1$

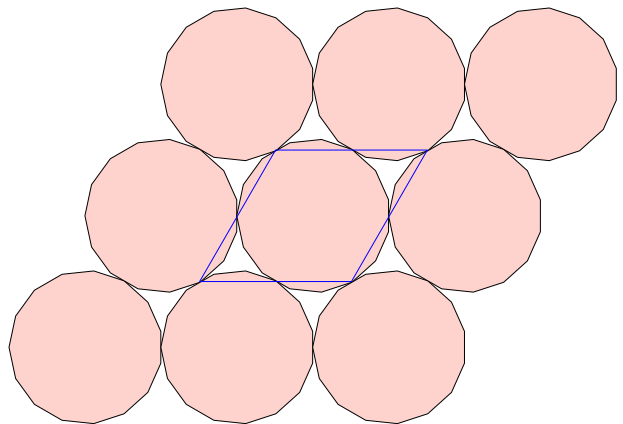
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.978147601725756	0
\mathbf{b}_2	0.989073800872326	1.713126074549311

Centroid in Cartesian coordinates:

	x	y
	1.483610701299041	0.856563037274656

Angle of rotation: 1.884953315560896



6. Plane group: $p2mg$

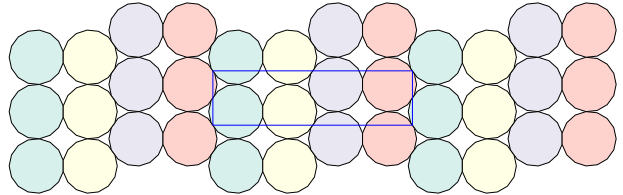
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.303693535343694	0
\mathbf{b}_2	0	1.989043774082973

Centroid in Cartesian coordinates:

	x	y
	0.847775745785277	0.497260879149065

Angle of rotation: 0.628318438995054



7. Plane group: cm

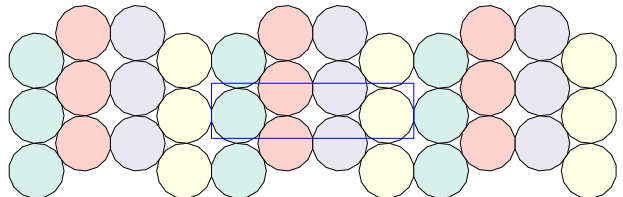
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.303693318800172	0
\mathbf{b}_2	0	1.989043794199379

Centroid in Cartesian coordinates:

	x	y
	0.978147619139763	0.815746299990914

Angle of rotation: 5.026548249045566



8. Plane group: $p4$

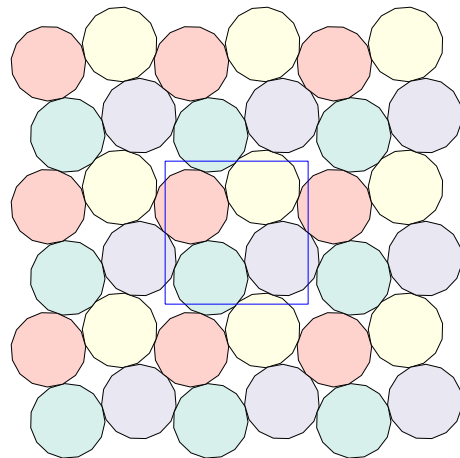
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.816662370673160	0
\mathbf{b}_2	0	3.816662370673160

Centroid in Cartesian coordinates:

	x	y
	1.211940078418387	0.699210532163653

Angle of rotation: 5.419163283346836



9. Plane group: $p4gm$

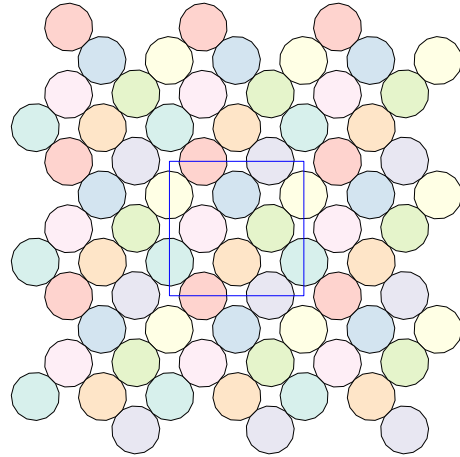
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.592484951664423	0
\mathbf{b}_2	0	5.592484951664423

Centroid in Cartesian coordinates:

	x	y
	0.011578380047357	1.401354463047907

Angle of rotation: 3.089232875521735



10. Plane group: $c2mm$

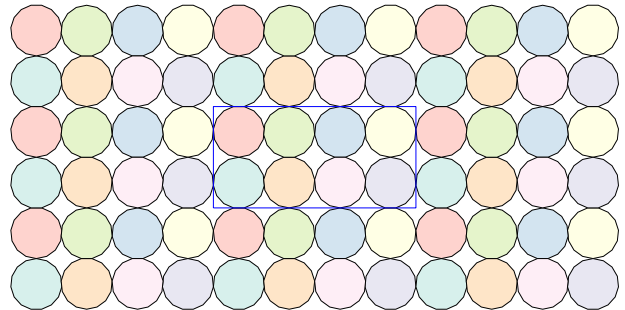
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.907636159099503	0
\mathbf{b}_2	0	3.956295333881844

Centroid in Cartesian coordinates:

	x	y
	0.994521907364205	0.978147634350781

Angle of rotation: 2.827433416844432



11. Plane group: pm

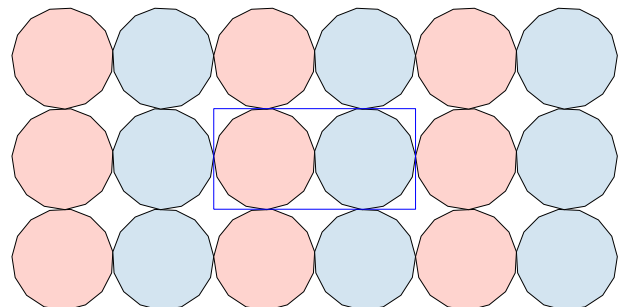
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.973569047883662	0
\mathbf{b}_2	0	1.980397046173232

Centroid in Cartesian coordinates:

	x	y
	0.998372932377347	0.990198523086616

Angle of rotation: 2.665660866039743



12. *Plane group: p2mm*

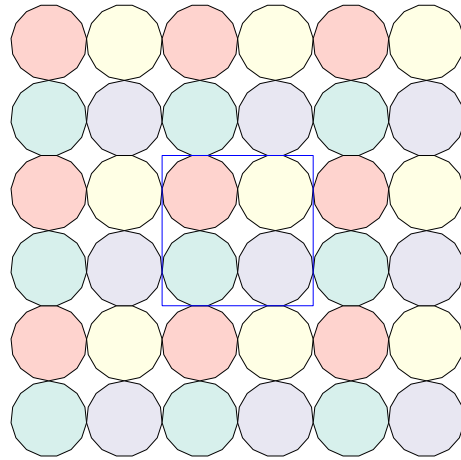
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.978087622378342	0
\mathbf{b}_2	0	3.956295265621000

Centroid in Cartesian coordinates:

	x	y
	0.994521912223210	0.978147631203867

Angle of rotation: 2.827433382245693



13. *Plane group: p6*

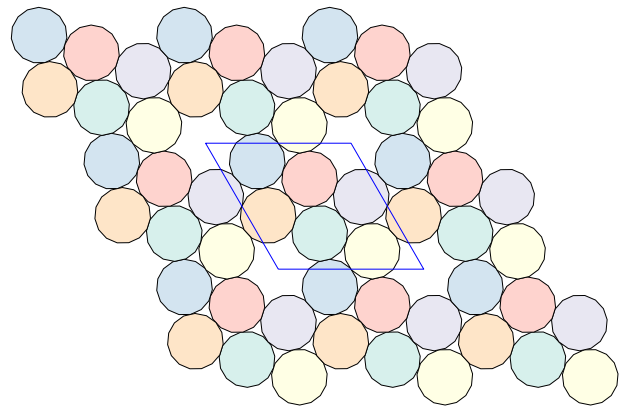
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.205431219575353	0
\mathbf{b}_2	-2.602715609787675	4.508035673804868

Centroid in Cartesian coordinates:

	x	y
	1.482629888828038	1.277986530800724

Angle of rotation: 0.535665775544816



14. *Plane group: p31m*

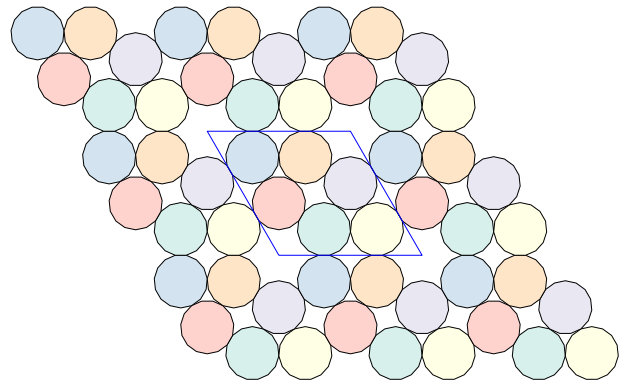
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.377446555506944	0
\mathbf{b}_2	-2.688723277753471	4.657005324562141

Centroid in Cartesian coordinates:

	x	y
	1.694201379994358	0.978147612120569

Angle of rotation: 4.084070414093085



15. Plane group: $p3m1$

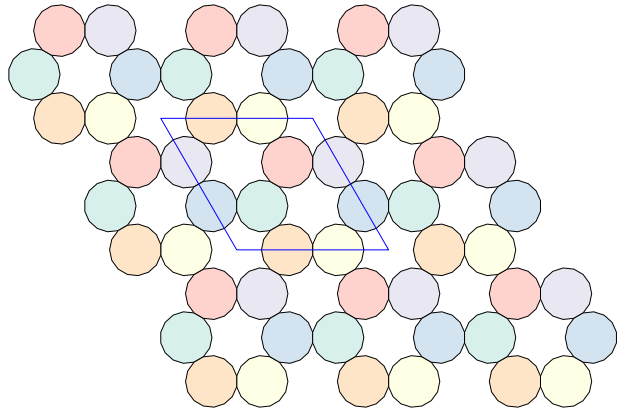
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.868885711574716	0
\mathbf{b}_2	-2.934442855787357	5.082604118131217

Centroid in Cartesian coordinates:

	x	y
	0.978147639083584	1.694201373096996

Angle of rotation: 2.513274117323104



16. Plane group: $p4mm$

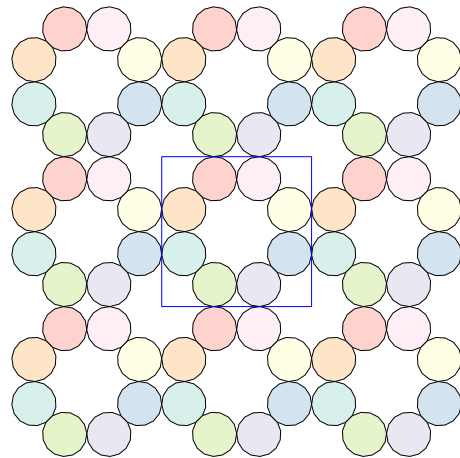
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.761137430631615	0
\mathbf{b}_2	0	6.761137430631615

Centroid in Cartesian coordinates:

	x	y
	0.998629549163315	2.381939171869865

Angle of rotation: 3.612831612447885



17. Plane group: $p6mm$

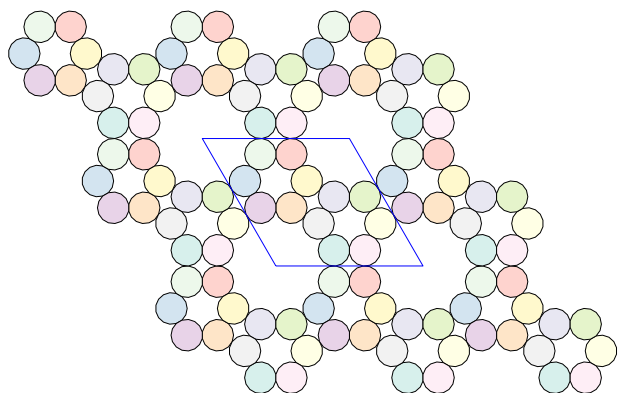
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.314010677705783	0
\mathbf{b}_2	-4.657005338852890	8.066169858012724

Centroid in Cartesian coordinates:

	x	y
	0.998629549163315	2.381939171869865

Angle of rotation: 1.884955616226309



N. 16-gon

1. *Plane group: p2*

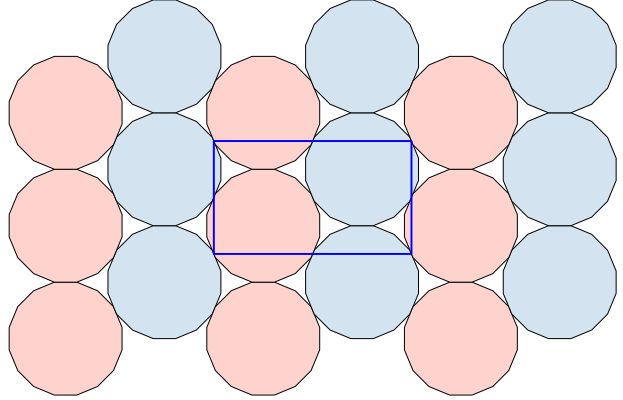
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.433868231007525	0.000013861104135
\mathbf{b}_2	0	1.961570561204713

Centroid in Cartesian coordinates:

	x	y
	0.858467058054727	0.490396101714215

Angle of rotation: 2.159819244953635



2. *Plane group: p2gg*

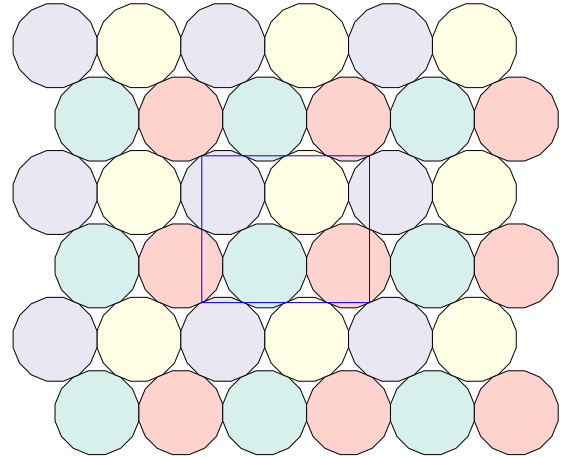
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.923141130054776	0
\mathbf{b}_2	0	3.433868223365515

Centroid in Cartesian coordinates:

	x	y
	1.471177925086202	0.858467056656503

Angle of rotation: 2.945243109070841



3. *Plane group: pg*

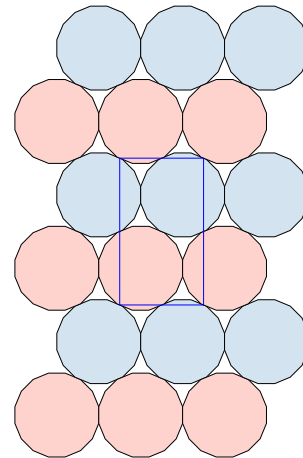
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.961570560888544	0
\mathbf{b}_2	0	3.433868222306588

Centroid in Cartesian coordinates:

	x	y
	0.490392639991042	0.858467055576647

Angle of rotation: 4.908738522223250



4. *Plane group: p3*

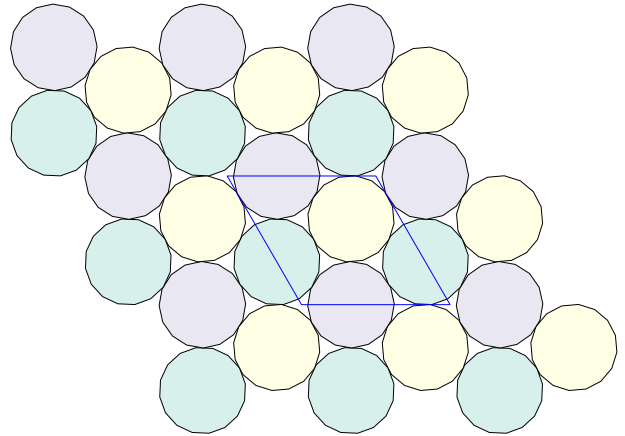
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.433665046857233	0
\mathbf{b}_2	-1.716832523428616	2.973641158665048

Centroid in Cartesian coordinates:

	x	y
	-0.570116005279450	0.991118779999761

Angle of rotation: 4.864843765747168



5. *Plane group: p1*

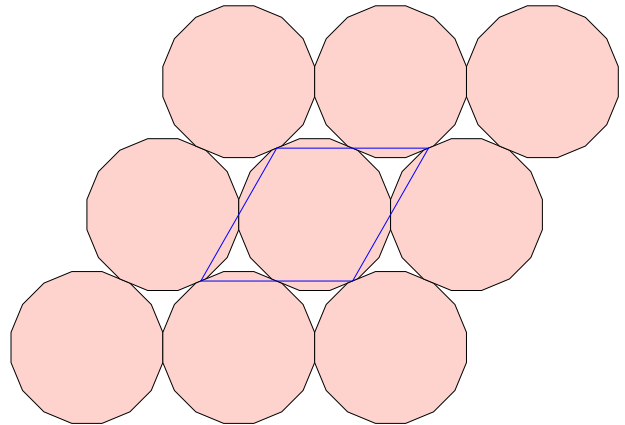
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.961570561761615	0
\mathbf{b}_2	0.980804747769149	1.716934111986614

Centroid in Cartesian coordinates:

	x	y
	1.471187654765382	0.858467055993307

Angle of rotation: 3.337972102880709



6. *Plane group: p2mg*

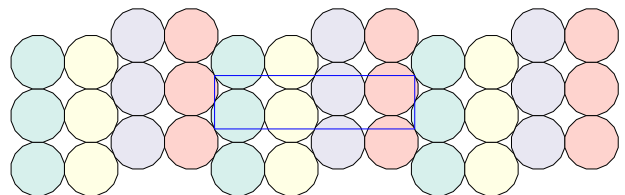
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.357009356270651	0
\mathbf{b}_2	0	1.961570564506162

Centroid in Cartesian coordinates:

	x	y
	0.858467055887057	0.490392641243610

Angle of rotation: 0.589048621189840



7. Plane group: cm

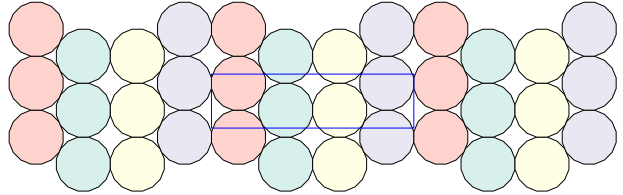
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.357009346092875	0
\mathbf{b}_2	0	1.961570562487539

Centroid in Cartesian coordinates:

	x	y
	2.697719392021637	0.650875393158989

Angle of rotation: 5.301437601736782



8. Plane group: $p4$

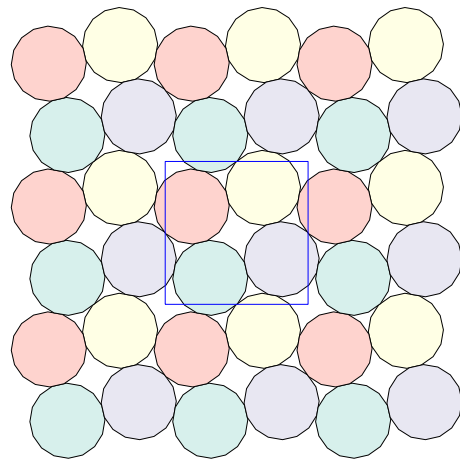
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.804294316328450	0
\mathbf{b}_2	0	3.804294316328450

Centroid in Cartesian coordinates:

	x	y
	1.200309446411498	0.704933562407602

Angle of rotation: 2.775344205803233



9. Plane group: $p4gm$

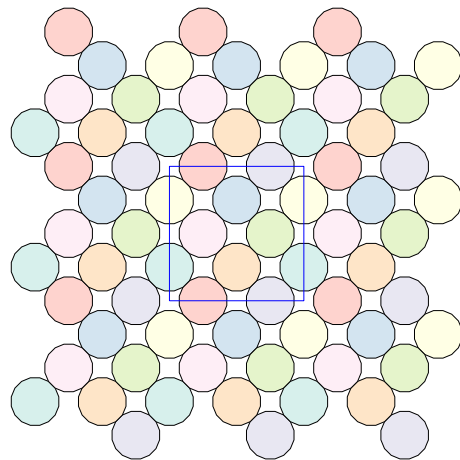
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.548159391423525	0
\mathbf{b}_2	0	5.548159391423525

Centroid in Cartesian coordinates:

	x	y
	0.000000000981668	1.387039846580615

Angle of rotation: 3.337942197348635



10. *Plane group: c2mm*

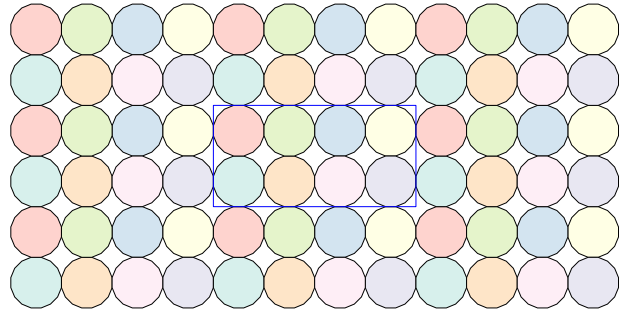
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.846282267553612	0
\mathbf{b}_2	0	3.923141149510091

Centroid in Cartesian coordinates:

	x	y
	0.980785283289234	0.980785285655043

Angle of rotation: 6.086835767309010



11. *Plane group: pm*

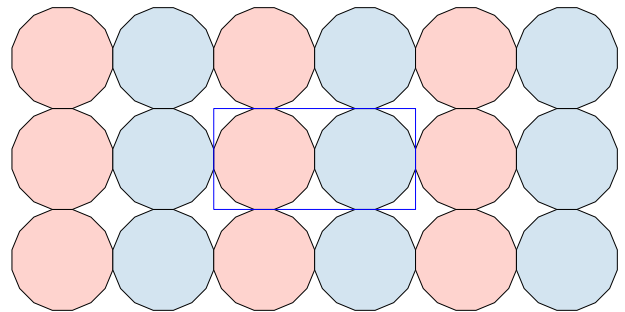
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.923141127231236	0
\mathbf{b}_2	0	1.961570560824599

Centroid in Cartesian coordinates:

	x	y
	0.980785282371171	0.980785280412299

Angle of rotation: 0.589048620430058



12. *Plane group: p2mm*

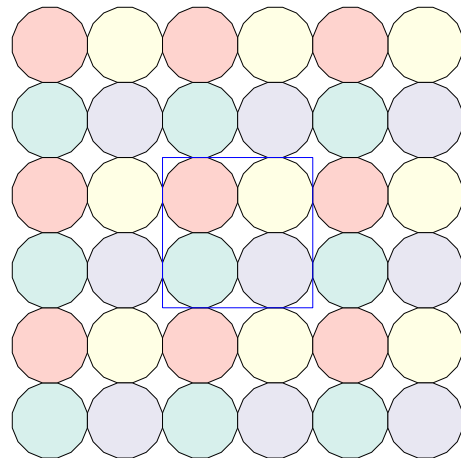
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.923141134133309	0
\mathbf{b}_2	0	3.923141126955887

Centroid in Cartesian coordinates:

	x	y
	0.980785282608067	0.980785281039409

Angle of rotation: 5.694136686240057



13. Plane group: $p6$

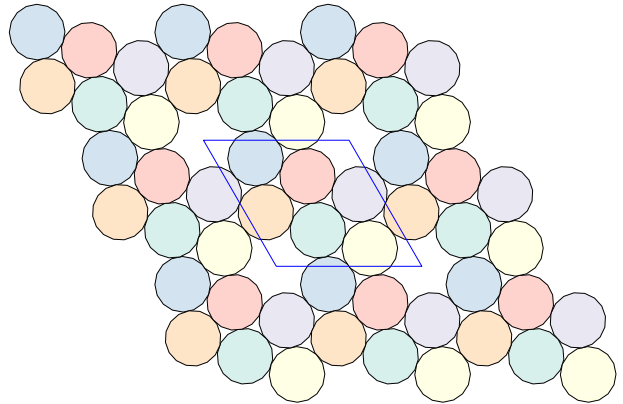
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.233976558853219	0
\mathbf{b}_2	-2.616988279426608	4.532756662779146

Centroid in Cartesian coordinates:

	x	y
	1.494538419368013	1.297167293834096

Angle of rotation: 3.023464738225176



14. Plane group: $p31m$

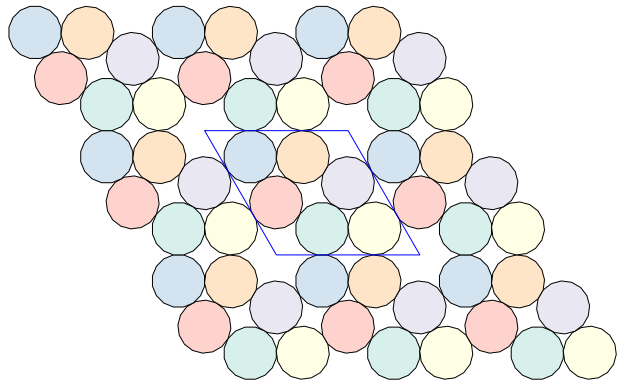
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.405756497681363	0
\mathbf{b}_2	-2.702878248840680	4.681522453664855

Centroid in Cartesian coordinates:

	x	y
	1.718484882774129	0.980785281178779

Angle of rotation: 1.767145871157192



15. Plane group: $p3m1$

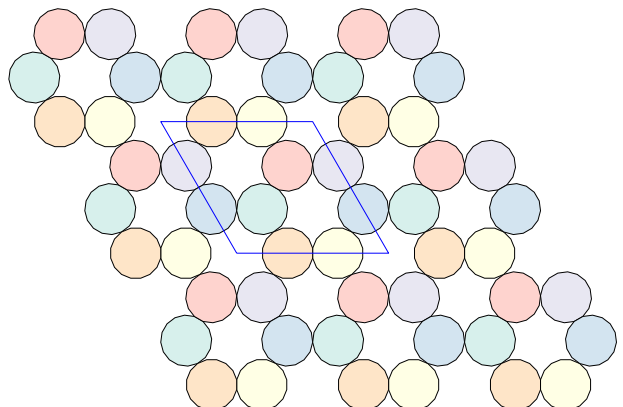
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.953006258496401	0
\mathbf{b}_2	-2.976503129248199	5.155454648745636

Centroid in Cartesian coordinates:

	x	y
	0.997858924140176	1.728342354503207

Angle of rotation: 2.421644335245576



16. Plane group: $p4mm$

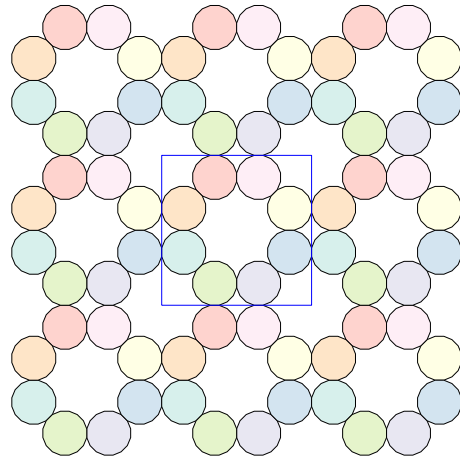
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.697220828944176	0
\mathbf{b}_2	0	6.697220828944176

Centroid in Cartesian coordinates:

	x	y
	0.980785284839477	2.367825132437746

Angle of rotation: 0.196349542914181



17. Plane group: $p6mm$

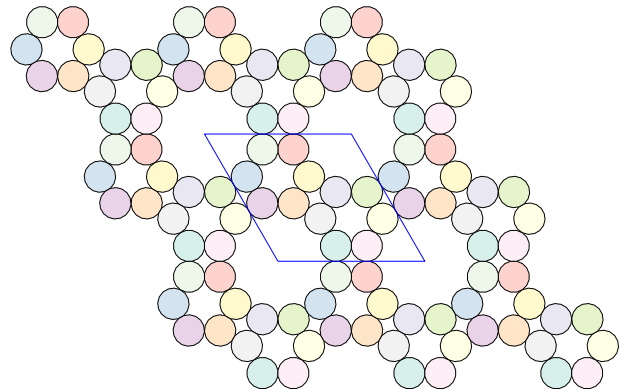
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.350546138535449	0
\mathbf{b}_2	-4.675273069267723	8.097810495230187

Centroid in Cartesian coordinates:

	x	y
	0.980785284839477	2.367825132437746

Angle of rotation: 2.552544031288920



O. 17-gon

1. Plane group: $p2$

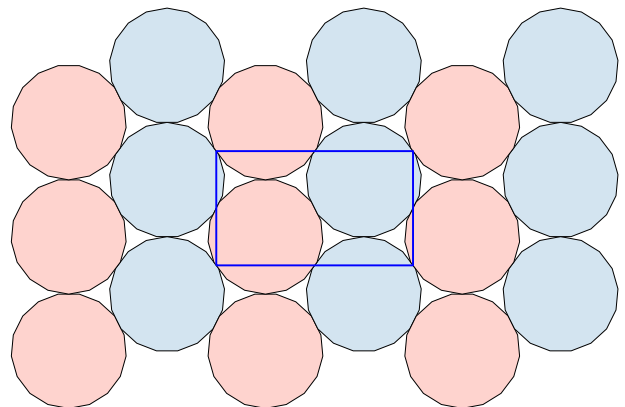
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.414759959681168	0.000006444850888
\mathbf{b}_2	0	1.982973103063111

Centroid in Cartesian coordinates:

	x	y
	0.853694296406919	0.500659497662325

Angle of rotation: 2.125236229049476



2. **Plane group: $p2gg$**

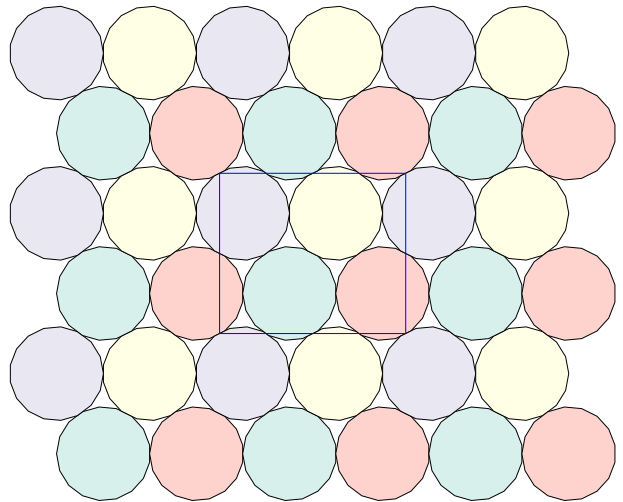
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.965946222813549	0
\mathbf{b}_2	0	3.414759945228728

Centroid in Cartesian coordinates:

	x	y
	1.492144444050188	0.853689985967119

Angle of rotation: 4.619989189082164



3. **Plane group: pg**

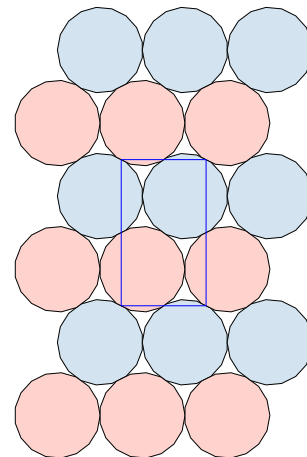
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.982973099819712	0
\mathbf{b}_2	0	3.414759948725055

Centroid in Cartesian coordinates:

	x	y
	0.490828663271016	0.853689987181264

Angle of rotation: 1.478396542399064



4. **Plane group: $p3$**

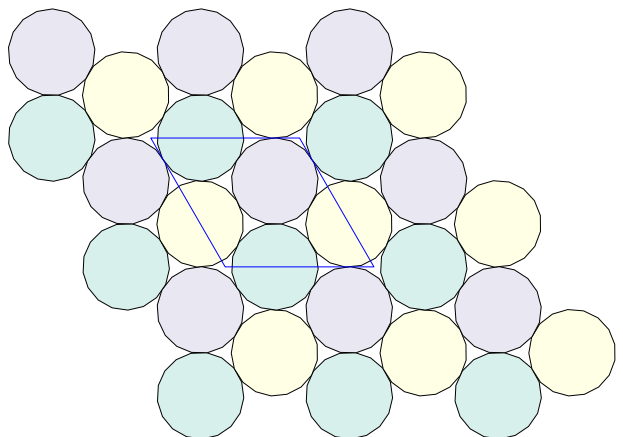
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.431181239263068	0
\mathbf{b}_2	-1.715590619631533	2.971490118190389

Centroid in Cartesian coordinates:

	x	y
	1.146308261396559	0.001929191220268

Angle of rotation: 0.318057838936087



5. Plane group: $p1$

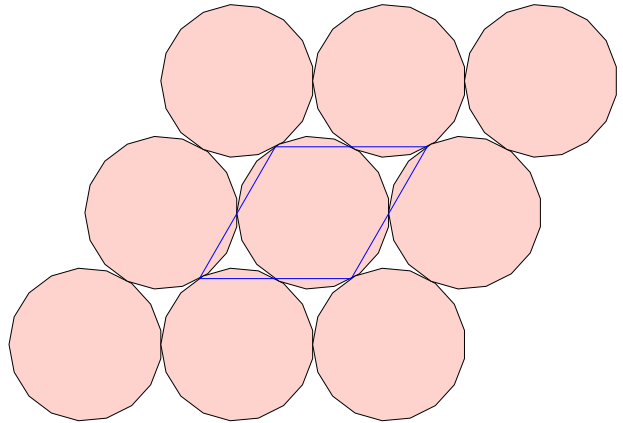
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.982973099972388	0
\mathbf{b}_2	0.991489379740397	1.721506601452255

Centroid in Cartesian coordinates:

	x	y
	1.487231239856393	0.860753300726128

Angle of rotation: 2.402404874391615



6. Plane group: $p2mg$

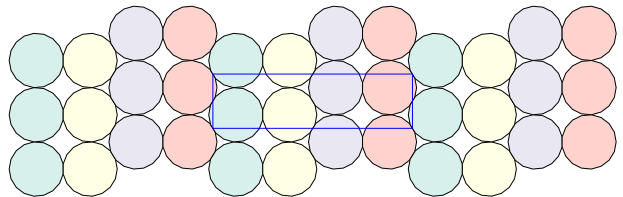
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.323401811090805	0
\mathbf{b}_2	0	1.991468352970819

Centroid in Cartesian coordinates:

	x	y
	0.847877351878827	0.497867086636988

Angle of rotation: 1.663196109529122



7. Plane group: cm

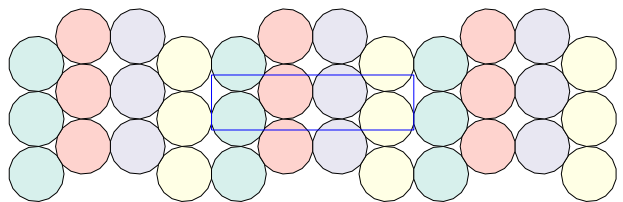
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.323401819968695	0
\mathbf{b}_2	0	1.991468350421141

Centroid in Cartesian coordinates:

	x	y
	0.982973102280361	0.399911817554473

Angle of rotation: 4.435189615601320



8. *Plane group: p4*

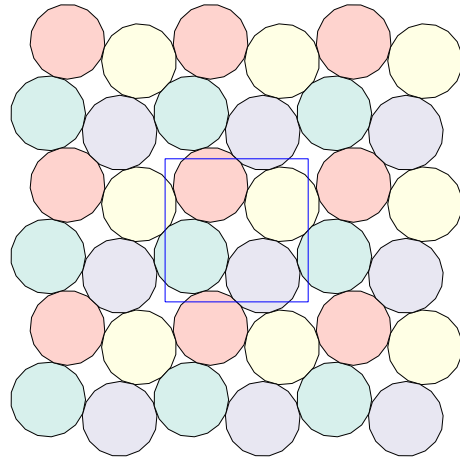
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.819506614145764	0
\mathbf{b}_2	0	3.819506614145764

Centroid in Cartesian coordinates:

	x	y
	0.695506885318540	1.214065770257533

Angle of rotation: 1.471116090237837



9. *Plane group: p4gm*

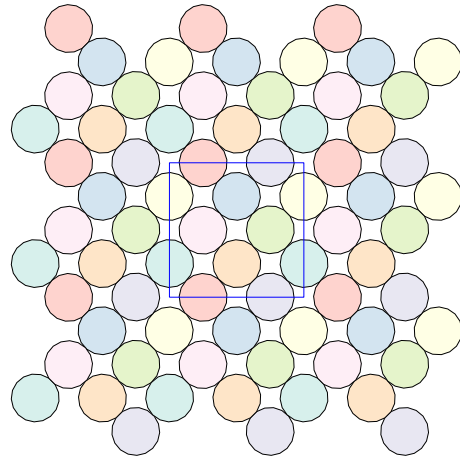
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.610289887962079	0
\mathbf{b}_2	0	5.610289887962079

Centroid in Cartesian coordinates:

	x	y
	0.009023445066275	1.405987607042521

Angle of rotation: 2.448594268661468



10. *Plane group: c2mm*

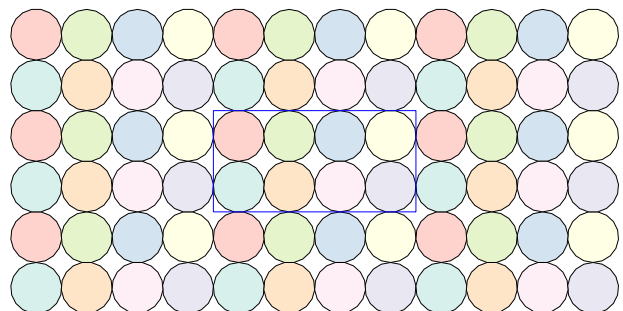
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.934829297612539	0
\mathbf{b}_2	0	3.965946205381170

Centroid in Cartesian coordinates:

	x	y
	0.995734177098972	0.982973100350608

Angle of rotation: 3.049192867672045



11. Plane group: pm

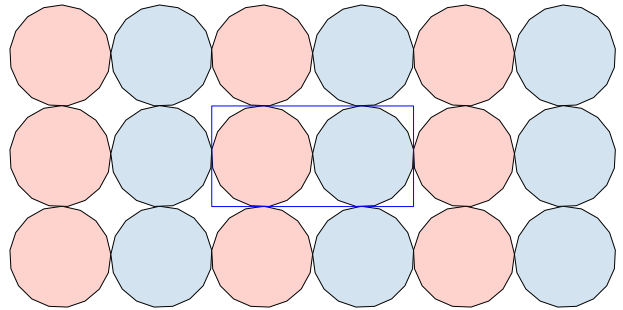
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.979748548164964	0
\mathbf{b}_2	0	1.984561658203941

Centroid in Cartesian coordinates:

	x	y
	0.991246089814579	0.992280829101971

Angle of rotation: 4.117976206687109



12. Plane group: $p2mm$

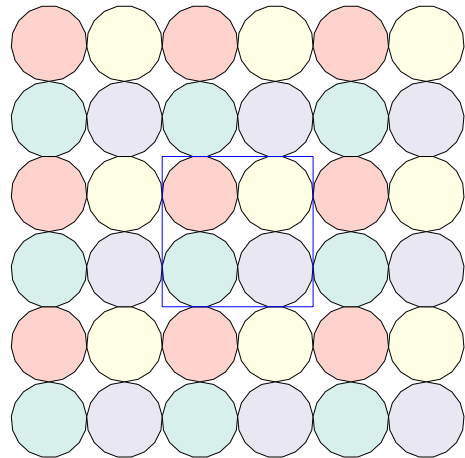
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.982936709304561	0
\mathbf{b}_2	0	3.965946206604882

Centroid in Cartesian coordinates:

	x	y
	0.995734176040360	0.982973103240789

Angle of rotation: 0.092399780518688



13. Plane group: $p6$

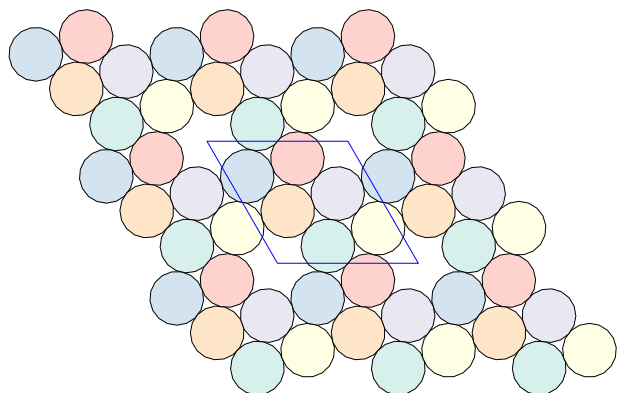
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.238014519853876	0
\mathbf{b}_2	-2.619007259926937	4.536253639585206

Centroid in Cartesian coordinates:

	x	y
	1.875482485875182	0.643194228355709

Angle of rotation: 2.076196439250571



14. *Plane group: p31m*

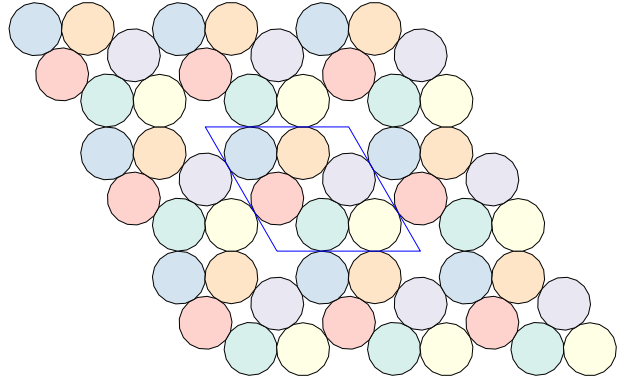
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.408122132539223	0
\mathbf{b}_2	-2.704061066269610	4.683571153547840

Centroid in Cartesian coordinates:

	x	y
	1.711294795554375	0.998103328761141

Angle of rotation: 2.433194299023375



15. *Plane group: p3m1*

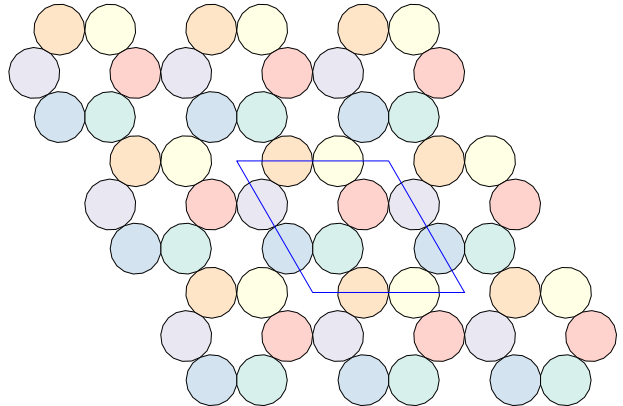
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.958359520001631	0
\mathbf{b}_2	-2.979179760000814	5.160090709202267

Centroid in Cartesian coordinates:

	x	y
	0.982973101820925	1.720030236526822

Angle of rotation: 2.217594820067971



16. *Plane group: p4mm*

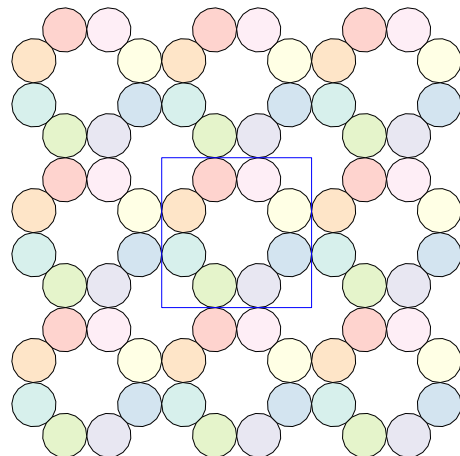
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.775999686976565	0
\mathbf{b}_2	0	6.775999686976565

Centroid in Cartesian coordinates:

	x	y
	0.998932975854681	2.389066868431371

Angle of rotation: 1.247397081205273



17. *Plane group: p6mm*

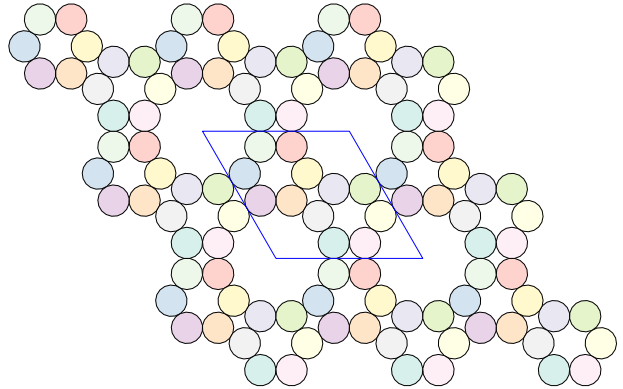
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.349248960020470	0
\mathbf{b}_2	-4.674624480010233	8.096687105682971

Centroid in Cartesian coordinates:

	x	y
	0.998932975854681	2.389066868431371

Angle of rotation: 4.157990253987249



P. 18-gon

1. *Plane group: p2*

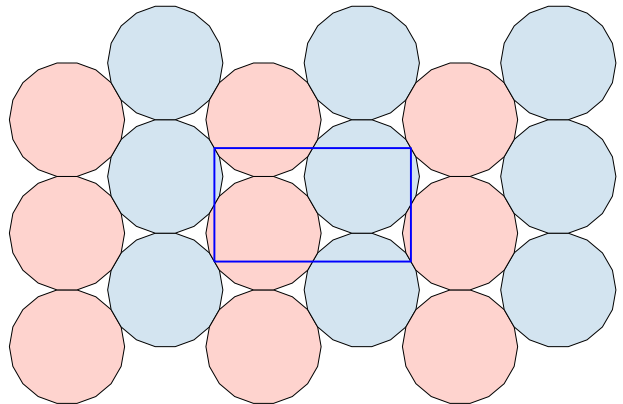
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.411475054981430	0.000000002860150
\mathbf{b}_2	0	1.969616043231910

Centroid in Cartesian coordinates:

	x	y
	0.852868764950180	0.492404013170291

Angle of rotation: 3.838988641223017



2. *Plane group: p2gg*

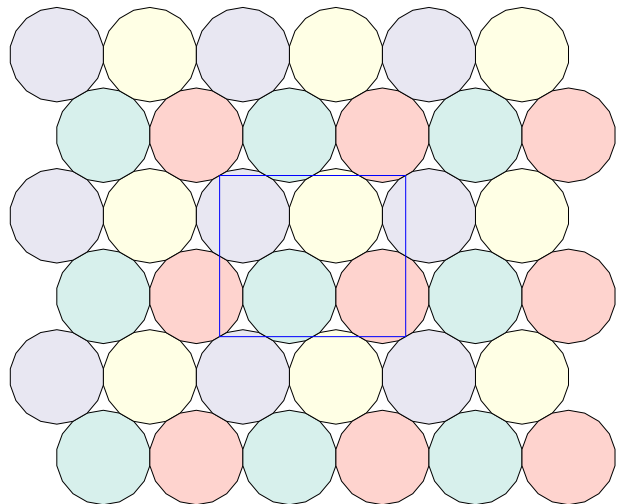
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.939231016159738	0
\mathbf{b}_2	0	3.411474137748684

Centroid in Cartesian coordinates:

	x	y
	1.477211630981855	0.852868531643201

Angle of rotation: 4.712388979766280



3. *Plane group: pg*

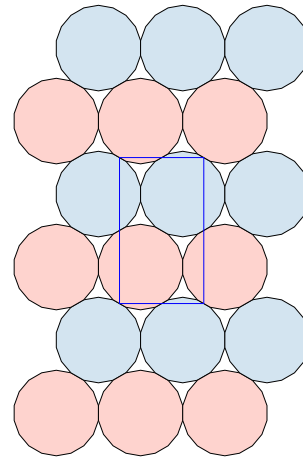
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.969615507240693	0
\mathbf{b}_2	0	3.411474128792847

Centroid in Cartesian coordinates:

	x	y
	0.492403876452178	0.852868532198212

Angle of rotation: 1.221730475456247



4. *Plane group: p3*

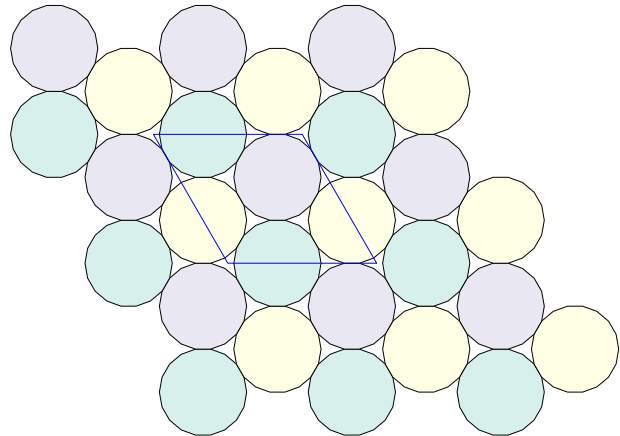
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.411474146167155	0
\mathbf{b}_2	-1.705737073083577	2.954423274934584

Centroid in Cartesian coordinates:

	x	y
	1.137158048658151	0.0000000000004903

Angle of rotation: 2.094497494060657



5. *Plane group: p1*

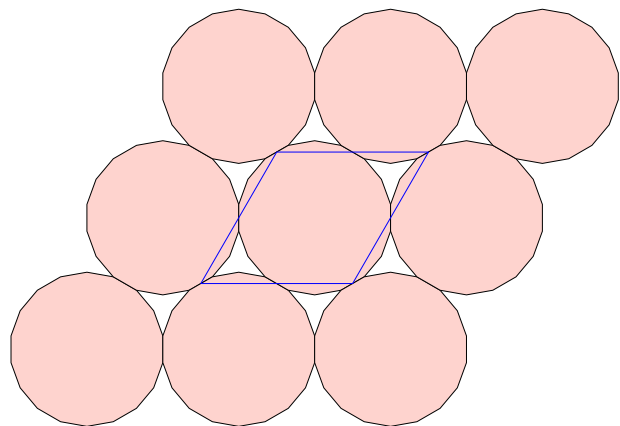
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.969615506524071	0
\mathbf{b}_2	0.984807753269881	1.705737064499580

Centroid in Cartesian coordinates:

	x	y
	1.477211629896976	0.852868532249790

Angle of rotation: 2.617971638963629



6. Plane group: $p2mg$

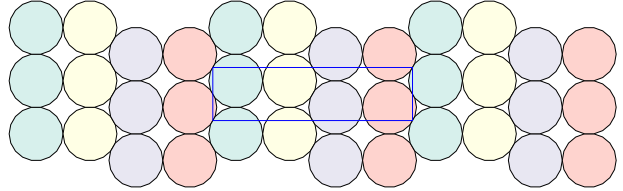
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.411473842168280	0
\mathbf{b}_2	0	1.969616481192813

Centroid in Cartesian coordinates:

	x	y
	0.852868954505957	1.477212360774765

Angle of rotation: 2.793521794571929



7. Plane group: cm

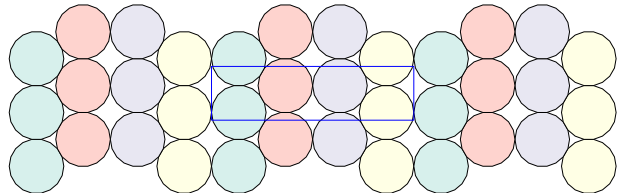
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.411474137423220	0
\mathbf{b}_2	0	1.969615506652126

Centroid in Cartesian coordinates:

	x	y
	1.000000000307338	0.282267774205625

Angle of rotation: 4.188790205762287



8. Plane group: $p4$

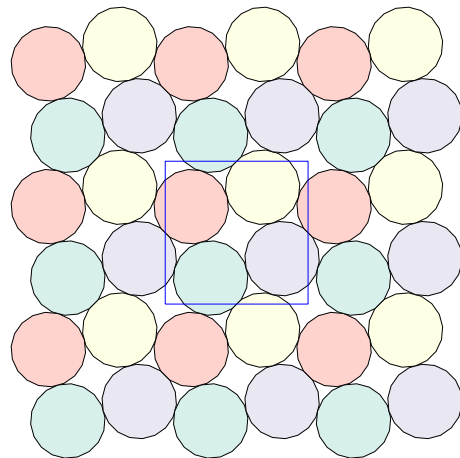
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.829813863649829	0
\mathbf{b}_2	0	3.829813863649829

Centroid in Cartesian coordinates:

	x	y
	1.218541895188659	0.696363465211074

Angle of rotation: 0.785225137201118



9. Plane group: $p4gm$

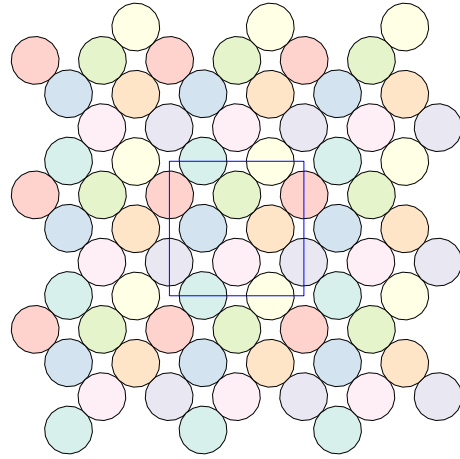
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.613884090540695	0
\mathbf{b}_2	0	5.613884090540695

Centroid in Cartesian coordinates:

	x	y
	1.403471021657219	0.010742538801155

Angle of rotation: 3.403392052410610



10. Plane group: $c2mm$

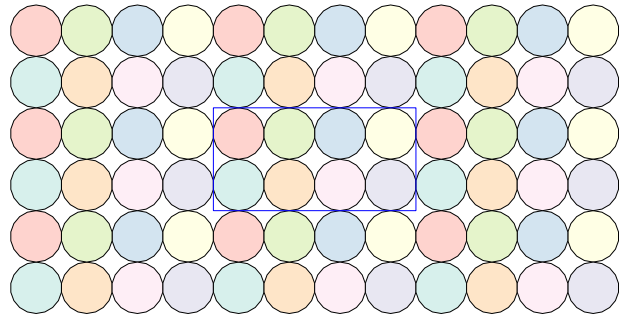
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.878462085167465	0
\mathbf{b}_2	0	4.000000008318000

Centroid in Cartesian coordinates:

	x	y
	0.984807761133783	1.000000003870545

Angle of rotation: 5.061454837980497



11. Plane group: pm

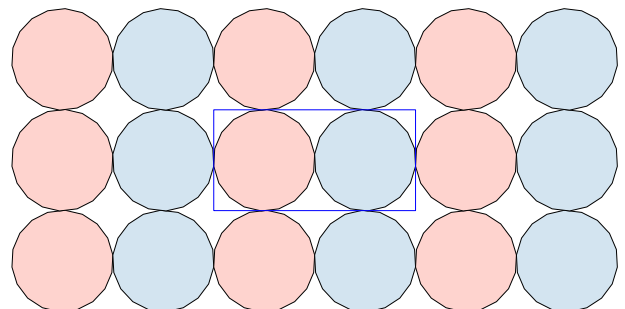
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.971243293795200	0
\mathbf{b}_2	0	1.983877955779303

Centroid in Cartesian coordinates:

	x	y
	0.992810823367692	0.991938977889651

Angle of rotation: 6.054101184636894



12. *Plane group: p2mm*

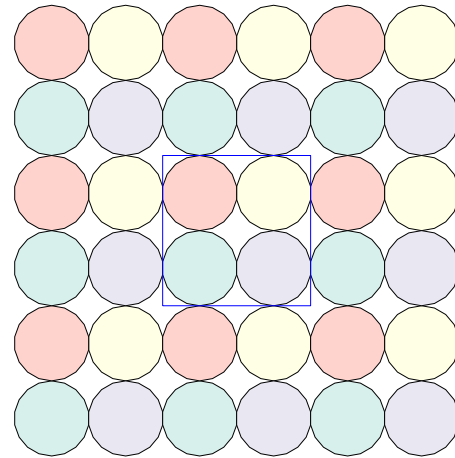
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.939231016112268	0
\mathbf{b}_2	0	4.000000006322078

Centroid in Cartesian coordinates:

	x	y
	0.984807754162198	1.000000001382006

Angle of rotation: 4.014257274798688



13. *Plane group: p6*

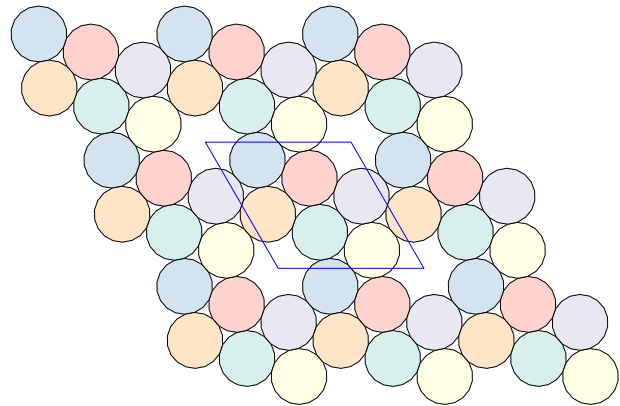
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.211112826352722	0
\mathbf{b}_2	-2.605556413176360	4.512956089608384

Centroid in Cartesian coordinates:

	x	y
	1.488889378968269	1.289416025234219

Angle of rotation: 1.586305607956202



14. *Plane group: p31m*

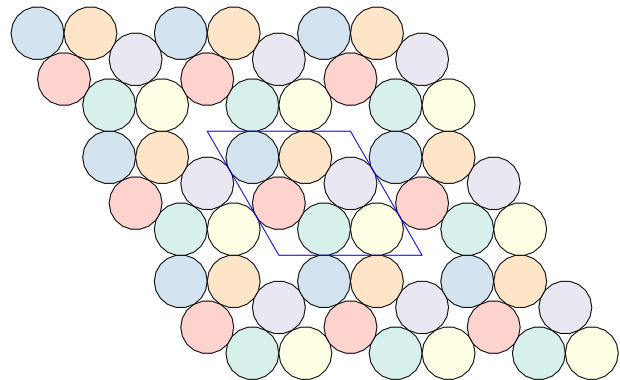
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.411474141881948	0
\mathbf{b}_2	-2.705737070940973	4.686474078792363

Centroid in Cartesian coordinates:

	x	y
	1.705737080091764	0.984807762584195

Angle of rotation: 1.047197604003589



15. Plane group: $p3m1$

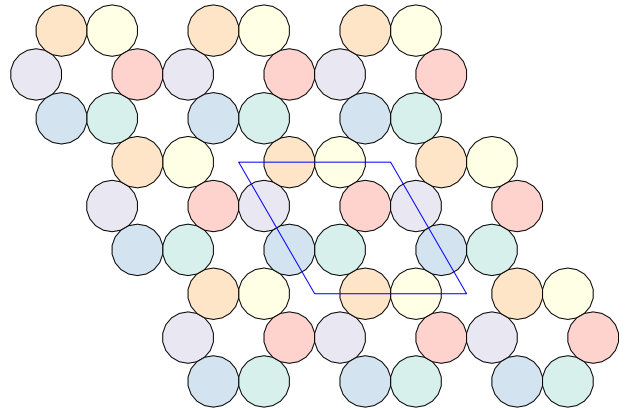
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.908846526821118	0
\mathbf{b}_2	-2.954423263410558	5.117211199290537

Centroid in Cartesian coordinates:

	x	y
	0.984807753658432	1.705737065982853

Angle of rotation: 5.759586533621018



16. Plane group: $p4mm$

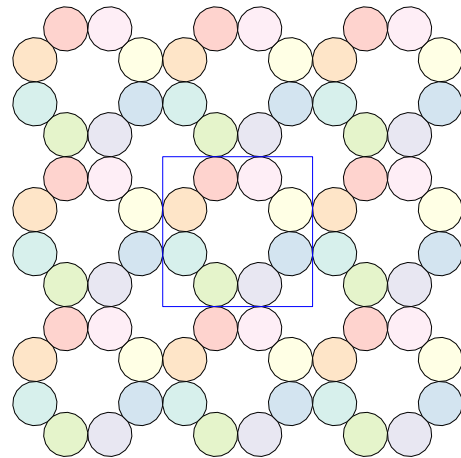
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.770235761715726	0
\mathbf{b}_2	0	6.770235761715726

Centroid in Cartesian coordinates:

	x	y
	0.996194700910761	2.388923181991723

Angle of rotation: 4.625122516290166



17. Plane group: $p6mm$

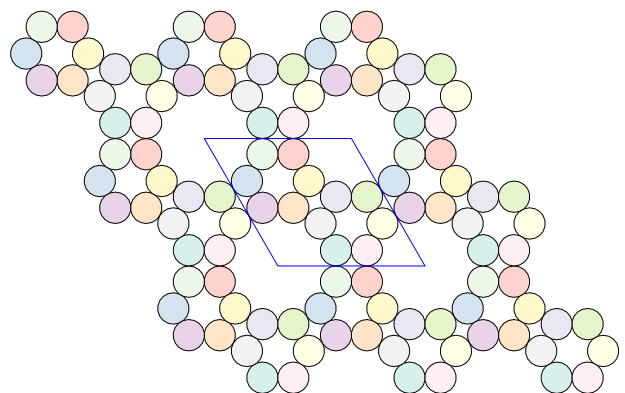
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.372948141474527	0
\mathbf{b}_2	-4.686474070737262	8.117211198871082

Centroid in Cartesian coordinates:

	x	y
	0.996194700910761	2.388923181991723

Angle of rotation: 1.570796326566053



Q. 19-gon

1. Plane group: $p2$

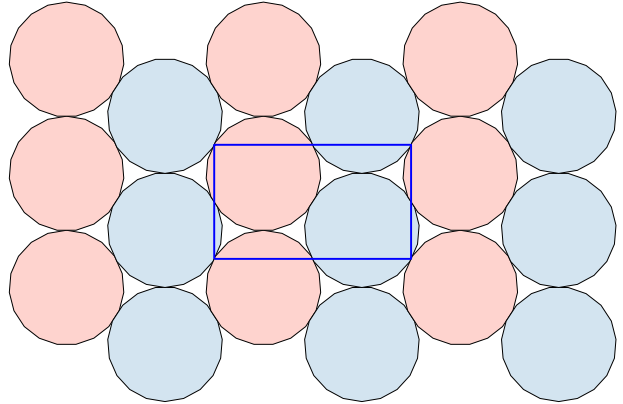
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.428216601224324	0.000004453582823
\mathbf{b}_2	0	1.986361307012748

Centroid positions in Cartesian coordinates:

	x	y
	0.857050389659155	1.484753583857777

Angle of rotation θ 5.869778971667534



2. Plane group: $p2gg$

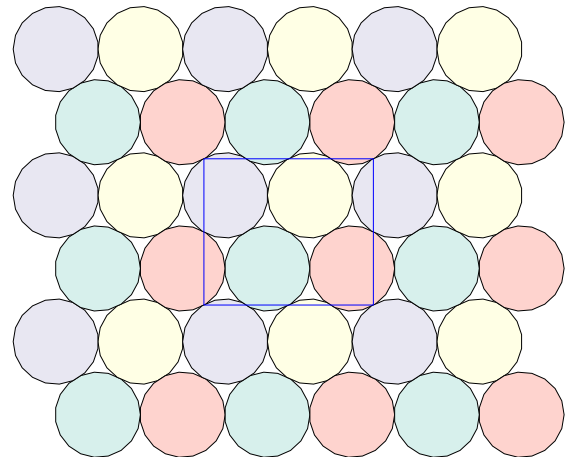
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.972722611537695	0
\mathbf{b}_2	0	3.428216599360923

Centroid positions in Cartesian coordinates:

	x	y
	1.484752471588656	0.857054149727538

Angle of rotation θ 3.306939636675712



3. Plane group: pg

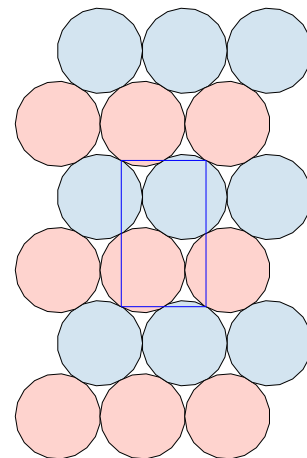
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.986361303827848	0
\mathbf{b}_2	0	3.428216598790784

Centroid positions in Cartesian coordinates:

	x	y
	0.501608834552714	0.857054149697696

Angle of rotation θ 4.464368507849222



4. **Plane group: $p3$**

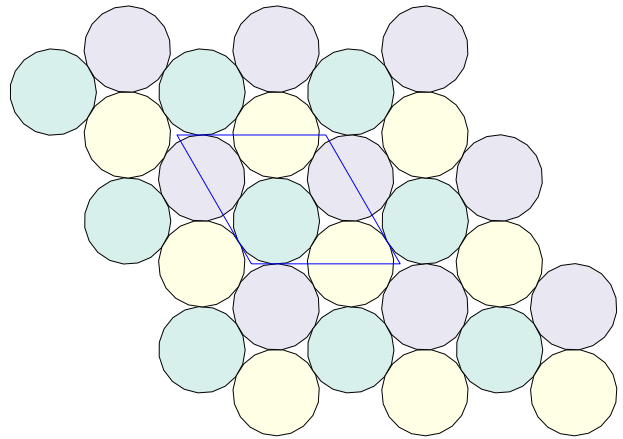
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.438447731188578	0
\mathbf{b}_2	-1.719223865594288	2.977783084794276

Centroid positions in Cartesian coordinates:

	x	y
	0.575727382333212	0.991606189871727

Angle of rotation θ 3.628425356888191



5. **Plane group: $p1$**

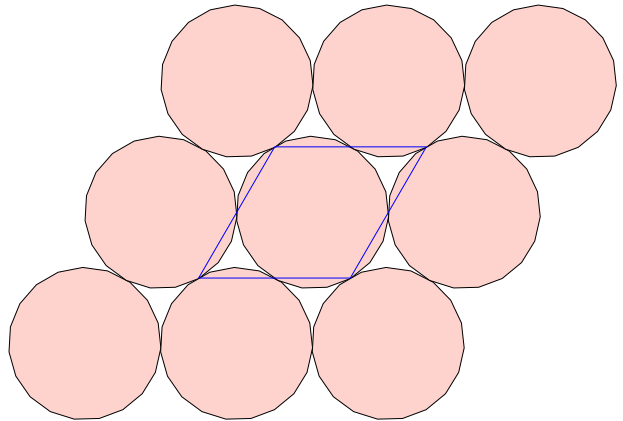
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.989481017350726	0
\mathbf{b}_2	0.997860447701726	1.721139121373047

Centroid positions in Cartesian coordinates:

	x	y
	1.493670732526226	0.860569560686524

Angle of rotation θ 2.920236487393687



6. **Plane group: $p2mg$**

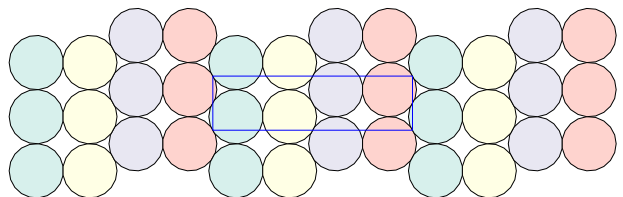
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.352939379958592	0
\mathbf{b}_2	0	1.993168979483882

Centroid positions in Cartesian coordinates:

	x	y
	0.851873531249054	0.498292241816323

Angle of rotation θ 0.496040998683869



7. Plane group: cm

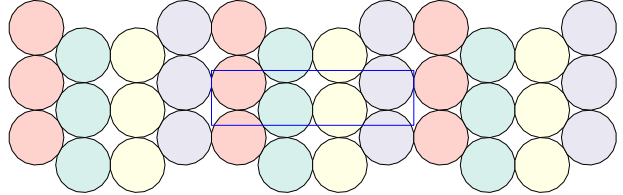
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.352939335596655	0
\mathbf{b}_2	0	1.993168985643044

Centroid positions in Cartesian coordinates:

	x	y
	2.690108362969687	0.551617680596380

Angle of rotation θ 5.787144359442146



8. Plane group: $p4$

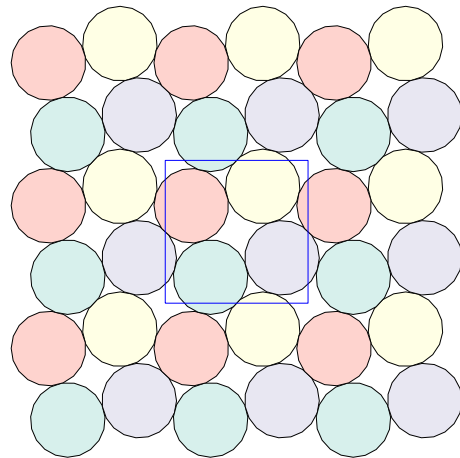
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.828553017984795	0
\mathbf{b}_2	0	3.828553017984795

Centroid positions in Cartesian coordinates:

	x	y
	1.216283061818992	0.697780045950852

Angle of rotation θ 6.028840503477753



9. Plane group: $p4gm$

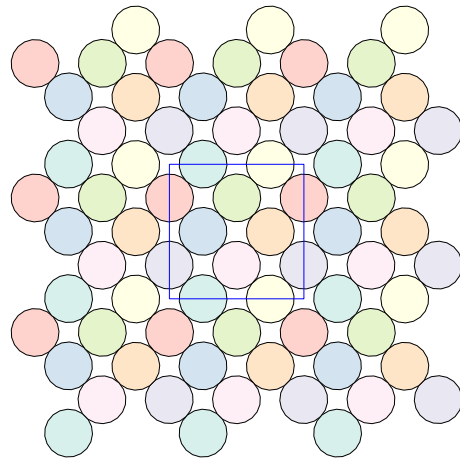
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.617030638319870	0
\mathbf{b}_2	0	5.617030638319870

Centroid positions in Cartesian coordinates:

	x	y
	1.406360897365965	0.007228885396431

Angle of rotation θ 3.596296844993085



10. *Plane group: c2mm*

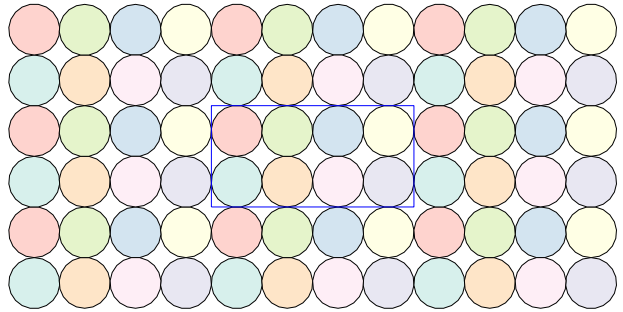
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.943044817283595	0
\mathbf{b}_2	0	3.972722613211209

Centroid positions in Cartesian coordinates:

	x	y
	0.996584493410250	0.986361305654233

Angle of rotation θ 4.877735957453354



11. *Plane group: pm*

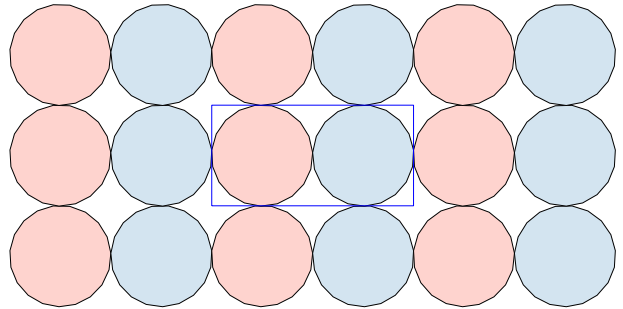
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.985042569587749	0
\mathbf{b}_2	0	1.987007002976249

Centroid positions in Cartesian coordinates:

	x	y
	0.994155572020330	0.993503501488125

Angle of rotation θ 5.017588691589981



12. *Plane group: p2mm*

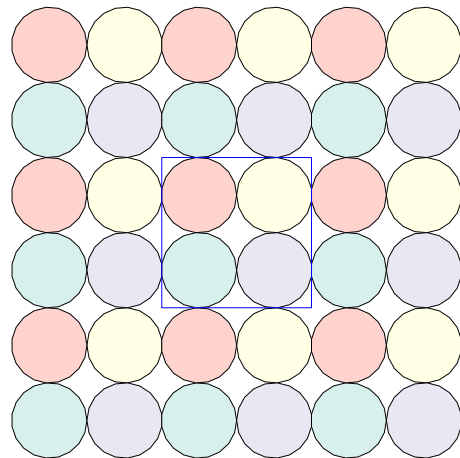
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.972722622279620	0
\mathbf{b}_2	0	3.986337976259335

Centroid positions in Cartesian coordinates:

	x	y
	0.986361309659657	0.996584494428041

Angle of rotation θ 4.960409449921785



13. Plane group: $p6$

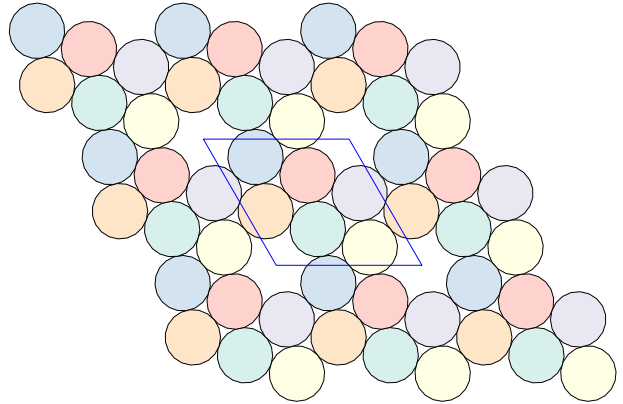
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.250430870499923	0
\mathbf{b}_2	-2.625215435249960	4.547006514666978

Centroid positions in Cartesian coordinates:

	x	y
	1.498201841660511	1.304624821287270

Angle of rotation θ 5.248754068254952



14. Plane group: $p31m$

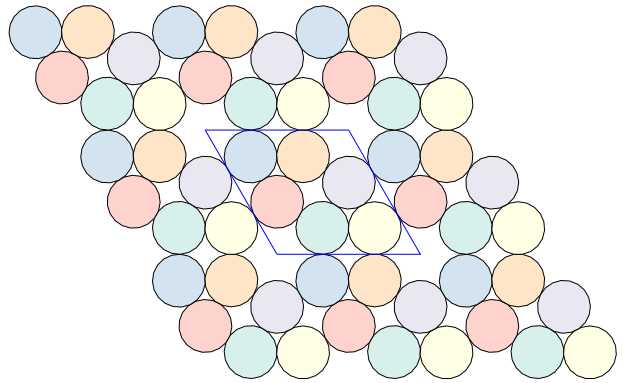
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.418558695893275	0
\mathbf{b}_2	-2.709279347946636	4.692609482540655

Centroid positions in Cartesian coordinates:

	x	y
	1.715425505833958	0.998481515567285

Angle of rotation θ 2.783340884369531



15. Plane group: $p3m1$

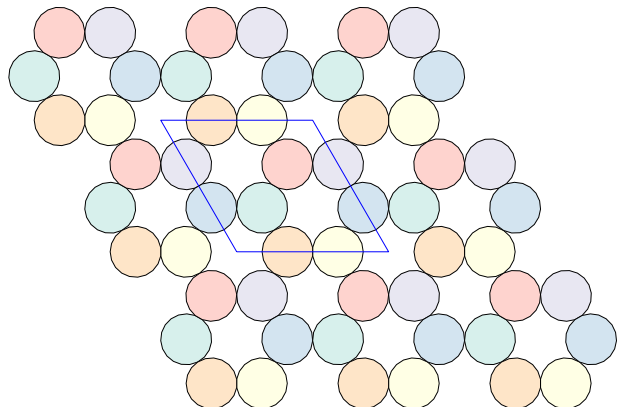
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.966648687927647	0
\mathbf{b}_2	-2.983324343963822	5.167269339202432

Centroid positions in Cartesian coordinates:

	x	y
	0.998481518576484	1.729420717156086

Angle of rotation θ 3.527402257843132



16. Plane group: $p4mm$

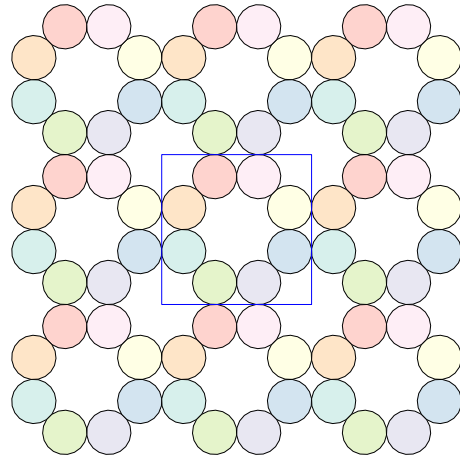
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.759133398534956	0
\mathbf{b}_2	0	6.759133398534956

Centroid positions in Cartesian coordinates:

x	y
0.992320583178303	2.387246119683750

Angle of rotation θ 0.372030717662711



17. Plane group: $p6mm$

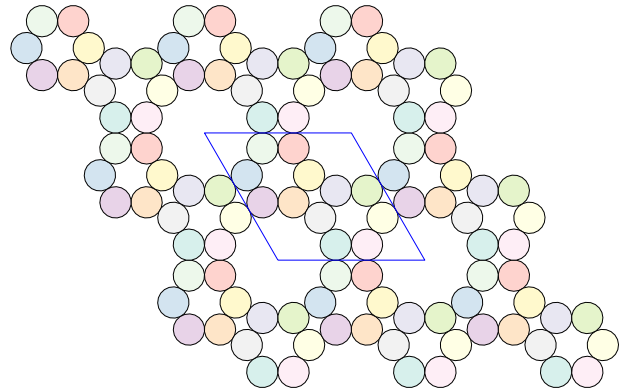
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.372113125892595	0
\mathbf{b}_2	-4.686056562946296	8.116488054164572

Centroid positions in Cartesian coordinates:

x	y
0.992320583178303	2.387246119683750

Angle of rotation θ 5.539123950425365



R. 20-gon

1. Plane group: $p2$

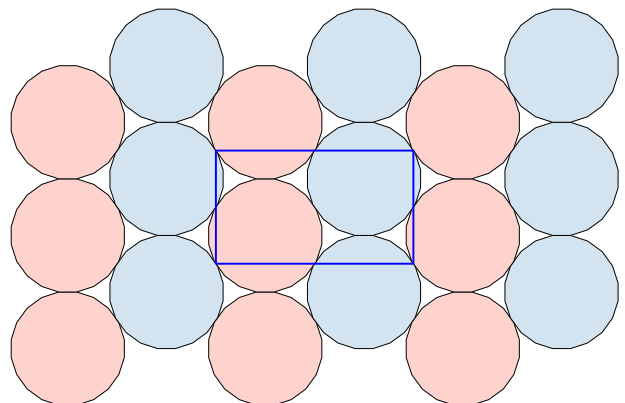
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.448204631182465	0.000109382608880
\mathbf{b}_2	0	1.975376748454318

Centroid positions in Cartesian coordinates:

x	y
0.862051157863653	0.493871535150466

Angle of rotation θ 3.927197242118893



2. **Plane group: $p2gg$**

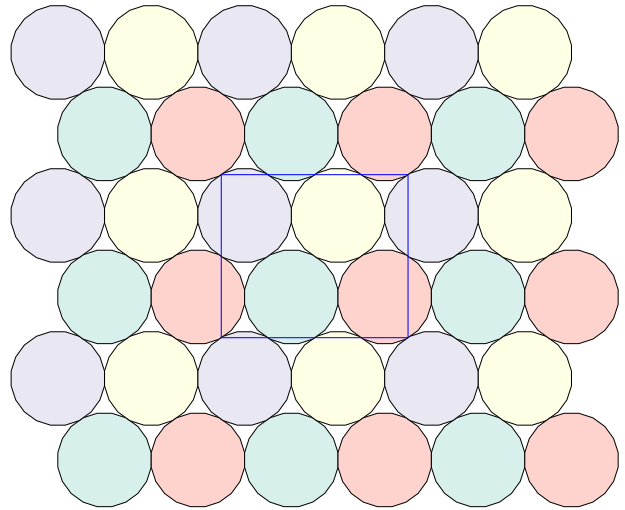
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.950753367211139	0
\mathbf{b}_2	0	3.448204556171995

Centroid positions in Cartesian coordinates:

	x	y
	1.481532511593589	0.862051136259416

Angle of rotation θ 3.926990810143598



3. **Plane group: pg**

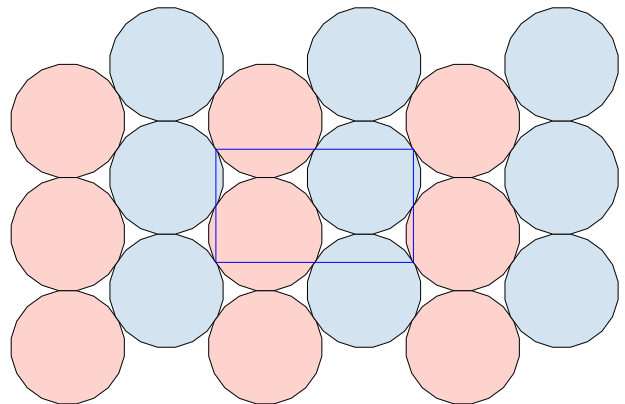
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.448204550857219	0
\mathbf{b}_2	0	1.975376682920507

Centroid positions in Cartesian coordinates:

	x	y
	0.862051137681548	0.493844170730127

Angle of rotation θ 5.497787143212132



4. **Plane group: $p3$**

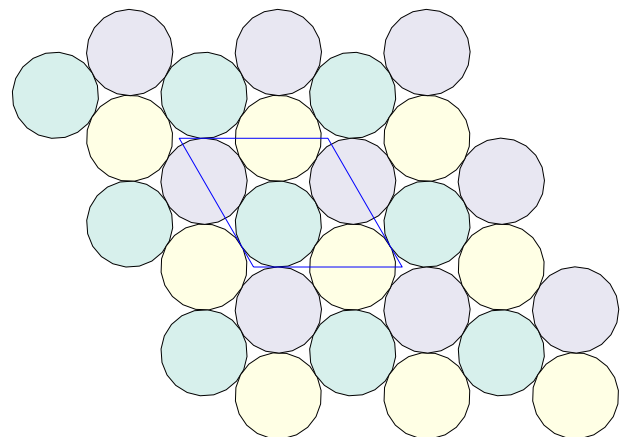
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.444607017959910	0
\mathbf{b}_2	-1.722303508979955	2.983117183607443

Centroid positions in Cartesian coordinates:

	x	y
	0.574840158751431	0.995554724050444

Angle of rotation θ 5.253326773156031



5. **Plane group: $p1$**

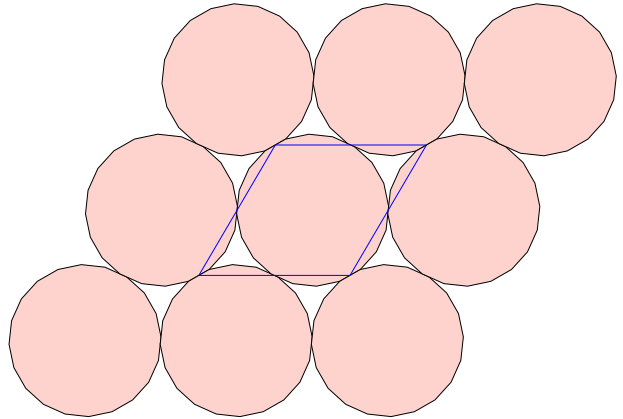
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.986963015140936	0
\mathbf{b}_2	1.005051621044508	1.714048732263369

Centroid positions in Cartesian coordinates:

	x	y
	1.496007318092722	0.857024366131684

Angle of rotation θ 0.677353233943120



6. **Plane group: $p2mg$**

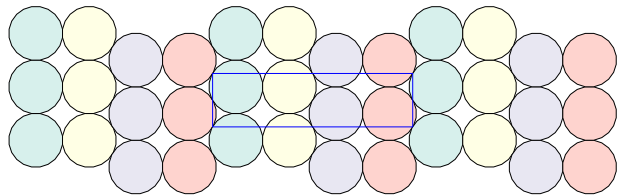
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.398957933076877	0
\mathbf{b}_2	0	1.975376682869780

Centroid positions in Cartesian coordinates:

	x	y
	0.862051140371353	1.481532516479363

Angle of rotation θ 5.183627890361063



7. **Plane group: cm**

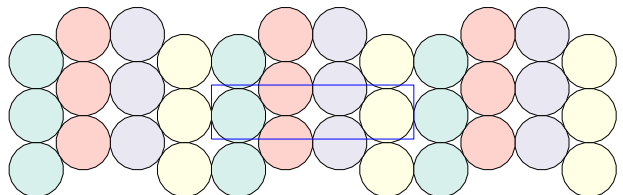
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.398957929305650	0
\mathbf{b}_2	0	1.975376682495950

Centroid positions in Cartesian coordinates:

	x	y
	0.987688343823430	0.857754021575672

Angle of rotation θ 3.298672290062576



8. Plane group: $p4$

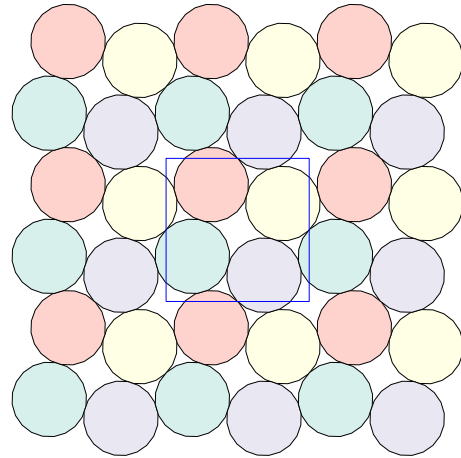
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.827655751554670	0
\mathbf{b}_2	0	3.827655751554670

Centroid positions in Cartesian coordinates:

	x	y
	0.703099286386544	1.207661635480638

Angle of rotation θ 4.843323432274627



9. Plane group: $p4gm$

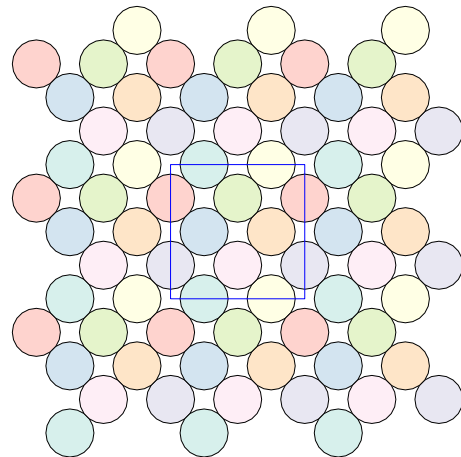
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.587208995676106	0
\mathbf{b}_2	0	5.587208995676106

Centroid positions in Cartesian coordinates:

	x	y
	1.396802247205361	0.000000001124250

Angle of rotation θ 2.199114861297295



10. Plane group: $c2mm$

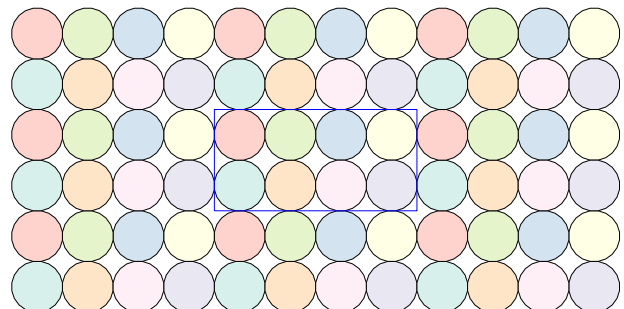
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.901506741587010	0
\mathbf{b}_2	0	3.950753375700511

Centroid positions in Cartesian coordinates:

	x	y
	0.987688343723944	0.987688343912422

Angle of rotation θ 1.727875944409275



11. Plane group: pm

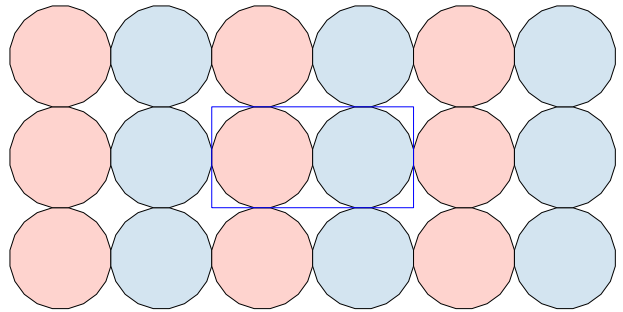
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.950753367302288	0
\mathbf{b}_2	0	1.975376681401403

Centroid positions in Cartesian coordinates:

	x	y
	0.987688342177347	0.987688340700701

Angle of rotation θ 4.869468608105037



12. Plane group: $p2mm$

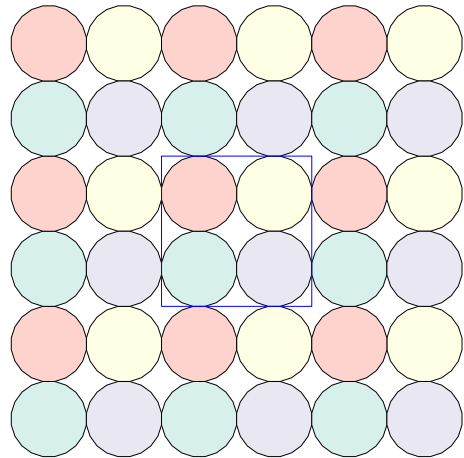
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.950753371328763	0
\mathbf{b}_2	0	3.950753370623756

Centroid positions in Cartesian coordinates:

	x	y
	0.987688343543842	0.987688342718362

Angle of rotation θ 4.555309339046991



13. Plane group: $p6$

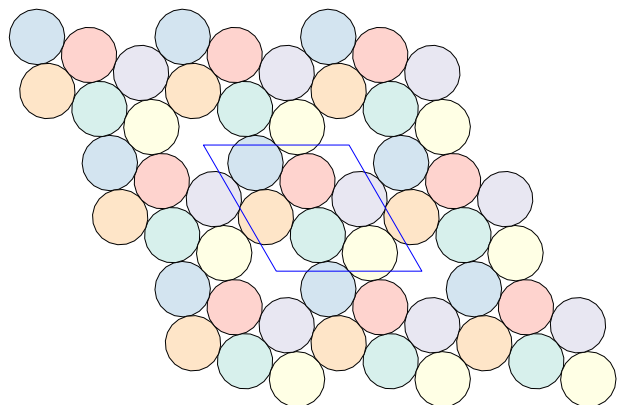
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.254708462602293	0
\mathbf{b}_2	-2.627354231301145	4.550711018094658

Centroid positions in Cartesian coordinates:

	x	y
	1.500865546852387	1.301456497692875

Angle of rotation θ 5.149616182555314



14. *Plane group: p31m*

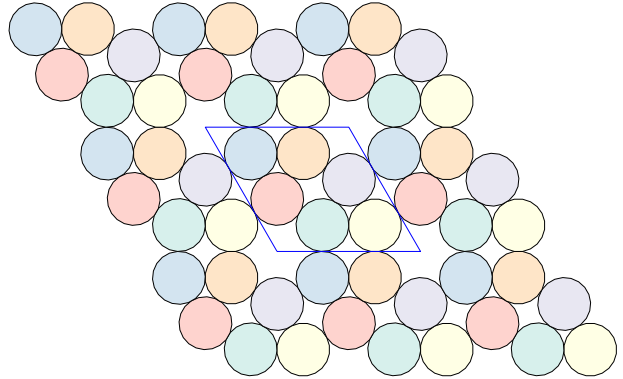
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.426721362524576	0
\mathbf{b}_2	-2.713360681262287	4.699678559205986

Centroid positions in Cartesian coordinates:

	x	y
	1.717043290941606	0.998629534488190

Angle of rotation θ 4.974188361360222



15. *Plane group: p3m1*

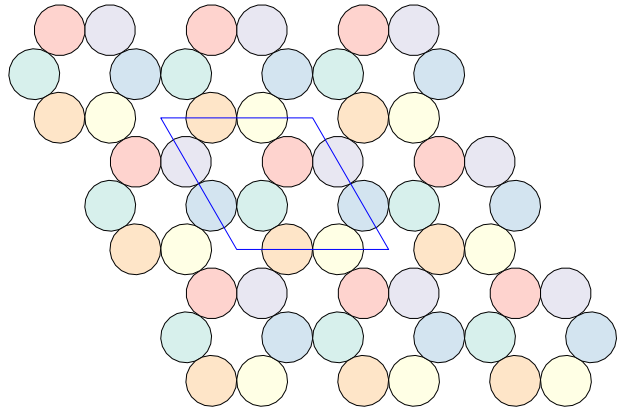
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.969894829151134	0
\mathbf{b}_2	-2.984947414575565	5.170080579966243

Centroid positions in Cartesian coordinates:

	x	y
	0.998629536849956	1.717043291905352

Angle of rotation θ 5.707226659259009



16. *Plane group: p4mm*

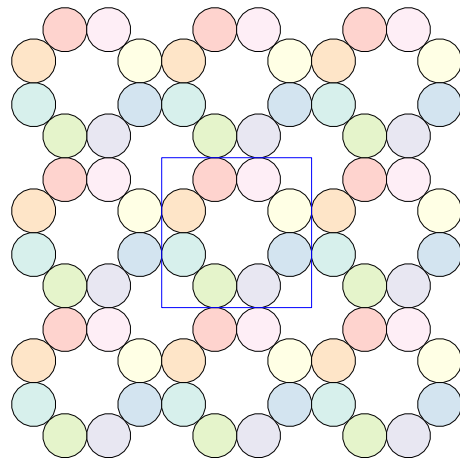
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.779180505550302	0
\mathbf{b}_2	0	6.779180505550302

Centroid positions in Cartesian coordinates:

	x	y
	0.987688342234535	2.401901904617628

Angle of rotation θ 5.497787142299319



17. Plane group: $p6mm$

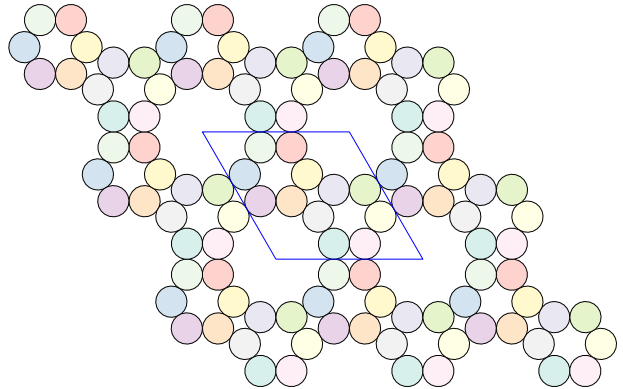
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.391347603446139	0
\mathbf{b}_2	-4.695673801723068	8.133145600354464

Centroid positions in Cartesian coordinates:

	x	y
	0.987688342234535	2.401901904617628

Angle of rotation θ 1.727875951869562



S. 21-gon

1. Plane group: $p2$

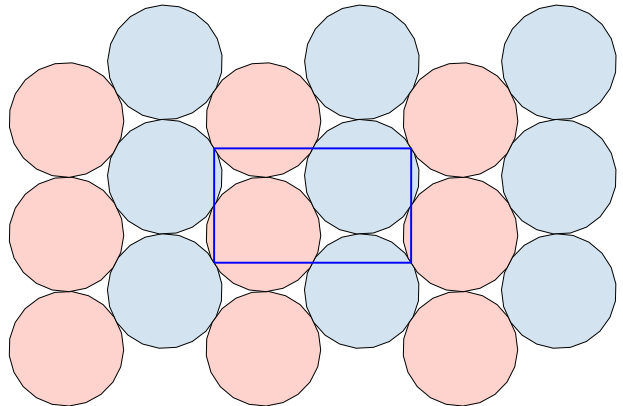
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.431577877849961	0.001327903616776
\mathbf{b}_2	0	1.991428827845249

Centroid in Cartesian coordinates:

	x	y
	0.857617442622562	0.494596148214214

Angle of rotation: 1.172420617742542



2. Plane group: $p2gg$

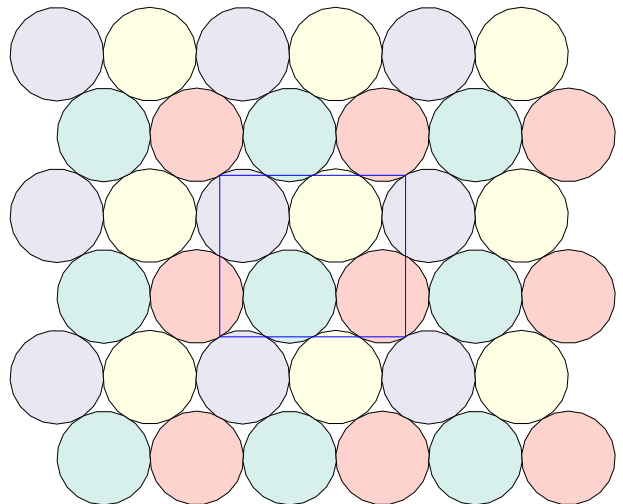
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.966253203731436	0
\mathbf{b}_2	0	3.447513150188256

Centroid in Cartesian coordinates:

	x	y
	1.492696133964182	0.861340573730578

Angle of rotation: 0.523598685756612



3. Plane group: pg

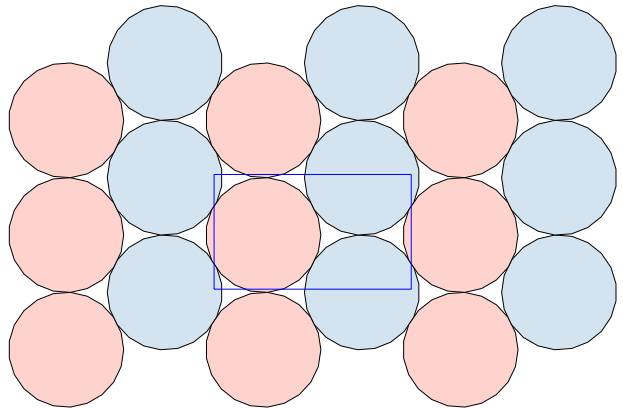
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.428500376037322	0
\mathbf{b}_2	0	1.994407595256777

Centroid in Cartesian coordinates:

	x	y
	0.856844785537921	0.498601898814194

Angle of rotation: 3.889590968678992



4. Plane group: $p3$

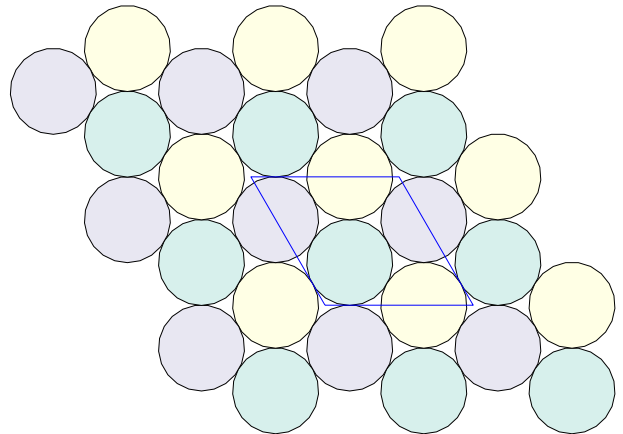
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.444756047150194	0
\mathbf{b}_2	-1.722378023575097	2.983246246672134

Centroid in Cartesian coordinates:

	x	y
	0.574126007778702	0.994415415901906

Angle of rotation: 2.617928774531444



5. Plane group: $p1$

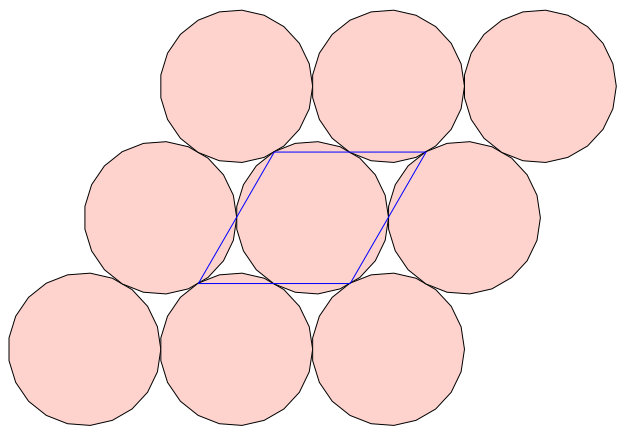
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.988830828638841	0
\mathbf{b}_2	0.994415415546544	1.722378021126824

Centroid in Cartesian coordinates:

	x	y
	1.491623122092692	0.861189010563412

Angle of rotation: 1.795229706562983



6. Plane group: $p2mg$

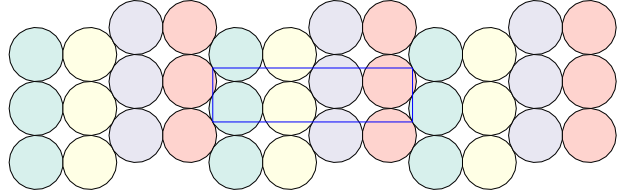
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.384944977394941	0
\mathbf{b}_2	0	1.994407594678960

Centroid in Cartesian coordinates:

	x	y
	0.857405403134847	0.498601908902564

Angle of rotation: 2.543194053093009



7. Plane group: cm

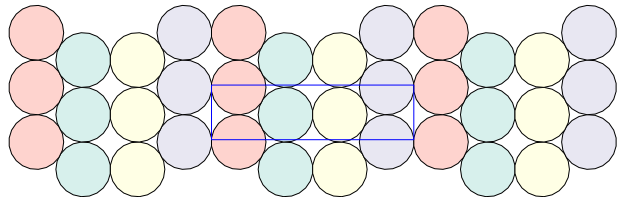
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.384945035382238	0
\mathbf{b}_2	0	1.994407587378087

Centroid in Cartesian coordinates:

	x	y
	2.703641670540141	0.912811444306873

Angle of rotation: 0.448798864043998



8. Plane group: $p4$

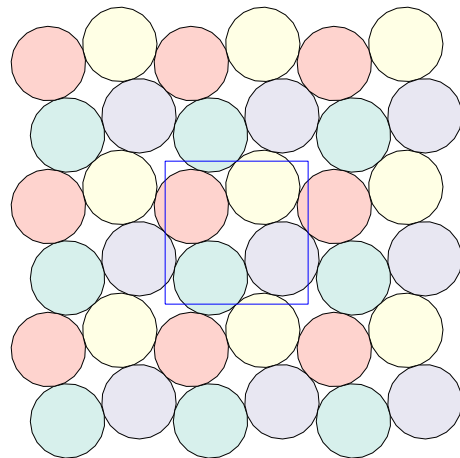
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.839630883648216	0
\mathbf{b}_2	0	3.839630883648216

Centroid in Cartesian coordinates:

	x	y
	1.218057635338226	0.703005200501357

Angle of rotation: 0.764224760212261



9. Plane group: $p4gm$

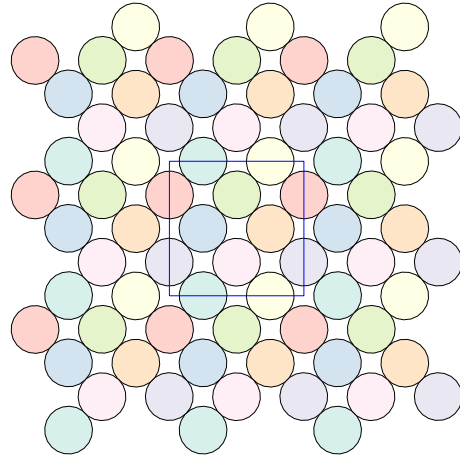
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.626117256008507	0
\mathbf{b}_2	0	5.626117256008507

Centroid in Cartesian coordinates:

	x	y
	1.408720071959165	0.005920578299670

Angle of rotation: 5.722186612996884



10. Plane group: $c2mm$

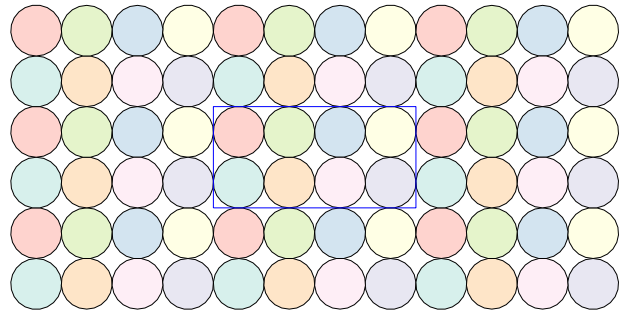
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.956903479104977	0
\mathbf{b}_2	0	3.977661697485265

Centroid in Cartesian coordinates:

	x	y
	0.997203797332712	0.988830832248046

Angle of rotation: 4.861988603117839



11. Plane group: pm

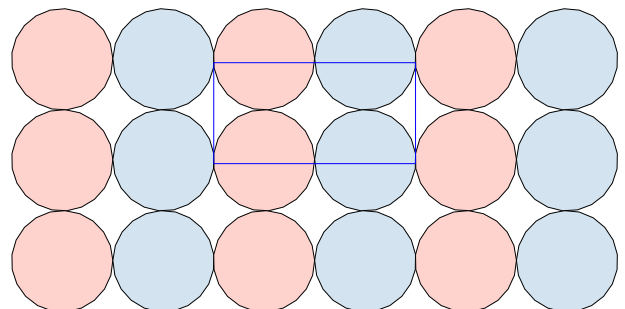
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.982301642192861	0
\mathbf{b}_2	0	1.992083807901100

Centroid in Cartesian coordinates:

	x	y
	0.991306469260330	0.996041903950550

Angle of rotation: 1.214441128194272



12. *Plane group: p2mm*

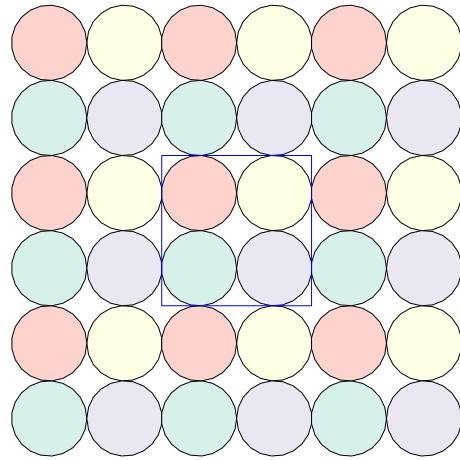
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.977661653261001	0
\mathbf{b}_2	0	3.988815189145627

Centroid in Cartesian coordinates:

	x	y
	0.988830826344191	0.997203797313952

Angle of rotation: 3.590391604795701



13. *Plane group: p6*

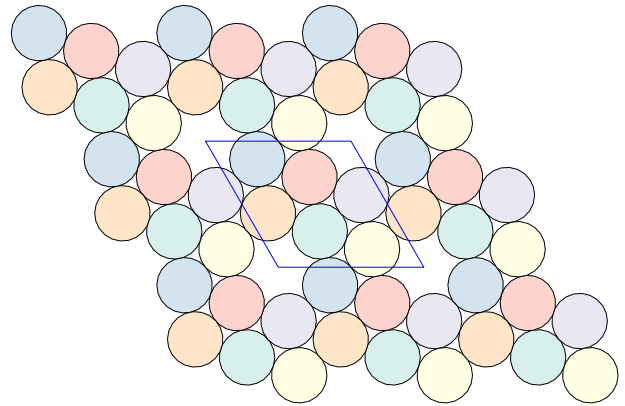
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.247685024780995	0
\mathbf{b}_2	-2.623842512390496	4.544628542519513

Centroid in Cartesian coordinates:

	x	y
	1.497013742346939	1.293147429155505

Angle of rotation: 1.783017849365434



14. *Plane group: p31m*

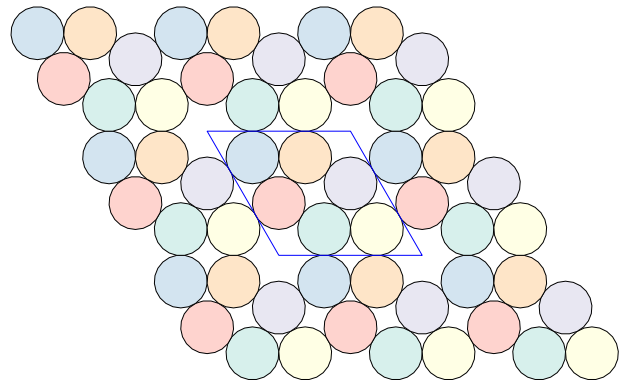
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.419818085971551	0
\mathbf{b}_2	-2.709909042985774	4.693700146341716

Centroid in Cartesian coordinates:

	x	y
	1.712705239939217	0.988830835416343

Angle of rotation: 0.373999113516880



15. *Plane group: p3m1*

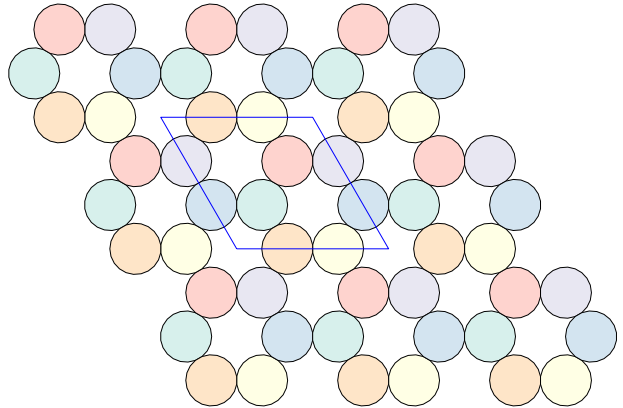
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.932985010117738	0
\mathbf{b}_2	-2.966492505058868	5.138115739034236

Centroid in Cartesian coordinates:

	x	y
	0.988830832675249	1.712705236652020

Angle of rotation: 0.299199298501025



16. *Plane group: p4mm*

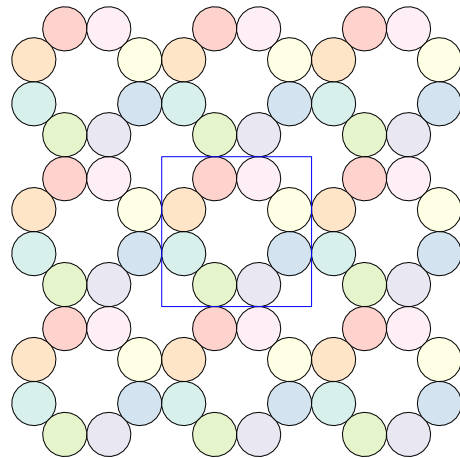
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.771684854045848	0
\mathbf{b}_2	0	6.771684854045848

Centroid in Cartesian coordinates:

	x	y
	0.993712207953818	2.392130193328435

Angle of rotation: 5.647386881600147



17. *Plane group: p6mm*

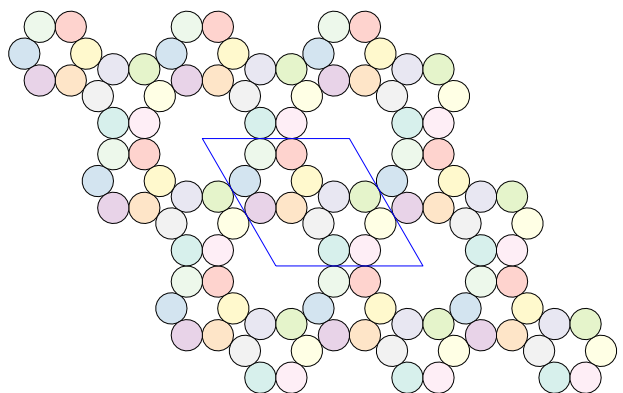
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.387400329845454	0
\mathbf{b}_2	-4.693700164922725	8.129727161140583

Centroid in Cartesian coordinates:

	x	y
	0.993712207953818	2.392130193328435

Angle of rotation: 3.739991306974691



T. 22-gon

1. Plane group: $p2$

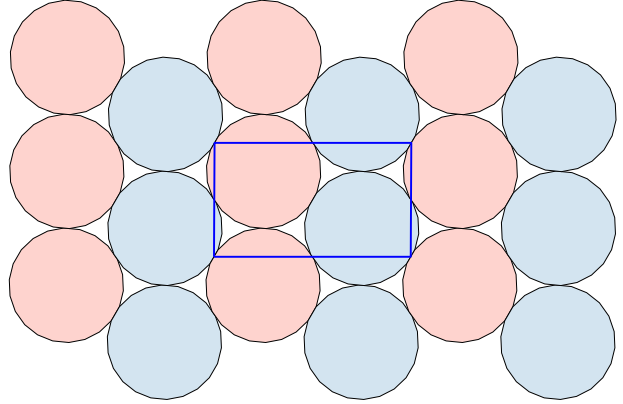
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.433796898736772	0.009879891027017
\mathbf{b}_2	0	1.988148927397768

Centroid positions in Cartesian coordinates:

	x	y
	0.858449225859669	1.493581669767563

Angle of rotation θ 1.044759333565818



2. Plane group: $p2gg$

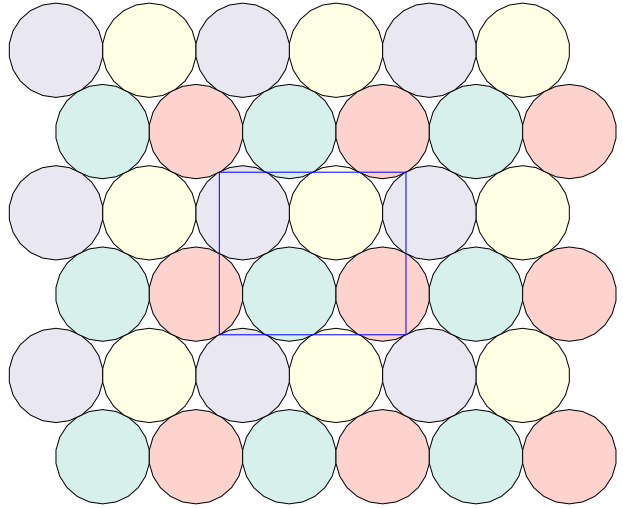
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.959285774603539	0
\mathbf{b}_2	0	3.448551072591987

Centroid positions in Cartesian coordinates:

	x	y
	1.484732165538660	0.862137768203405

Angle of rotation θ 0.428398996974178



3. Plane group: pg

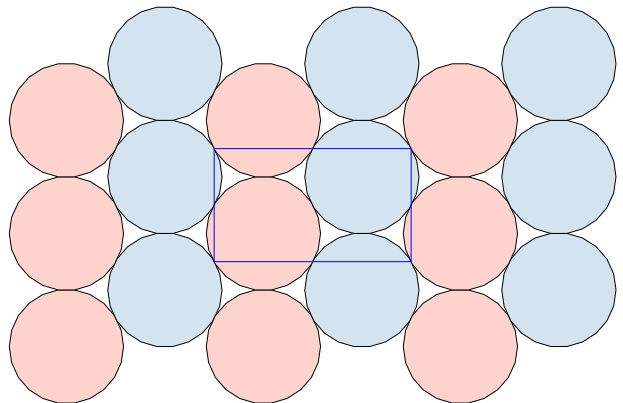
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.448551073898422	0
\mathbf{b}_2	0	1.979642883950932

Centroid positions in Cartesian coordinates:

	x	y
	0.862137768314418	0.494910720987733

Angle of rotation θ 0.285599332606343



4. *Plane group: p3*

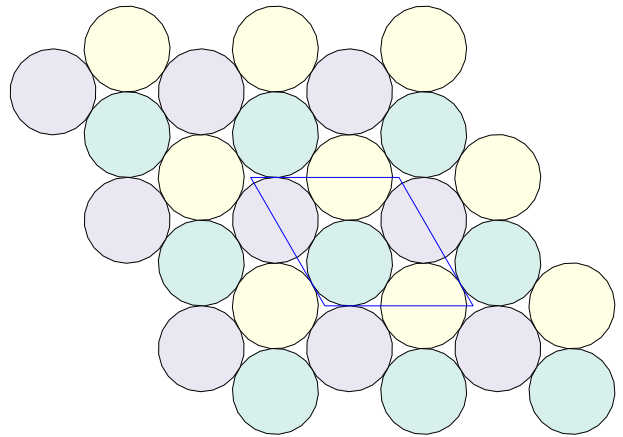
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.447986500755633	0
\mathbf{b}_2	-1.723993250377816	2.986043901560191

Centroid positions in Cartesian coordinates:

	x	y
	0.575208313658124	0.996363386555697

Angle of rotation θ 6.219834743118072



5. *Plane group: p1*

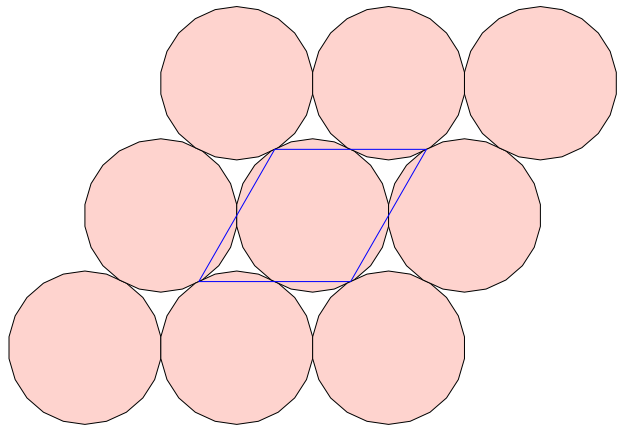
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.979642883809972	0
\mathbf{b}_2	0.989818796388777	1.724275536492500

Centroid positions in Cartesian coordinates:

	x	y
	1.484730840099374	0.862137768246250

Angle of rotation θ 5.283581674891280



6. *Plane group: p2mg*

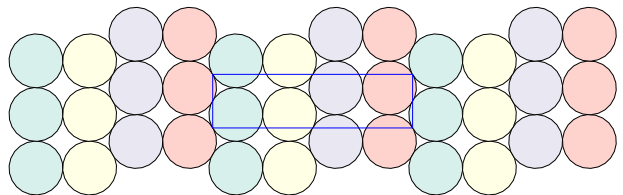
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.416700169766972	0
\mathbf{b}_2	0	1.988144466874580

Centroid positions in Cartesian coordinates:

	x	y
	0.858451180822482	0.501316626338020

Angle of rotation θ 5.905074461495831



7. Plane group: cm

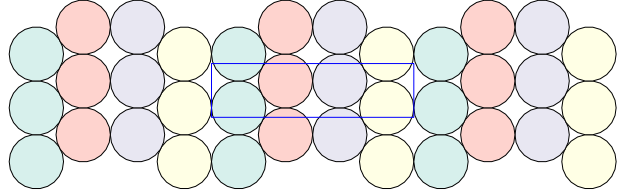
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.448551073712421	0
\mathbf{b}_2	0	1.979642885893707

Centroid positions in Cartesian coordinates:

x	y
1.000000000247153	0.348147045093203

Angle of rotation θ 3.712791318656784



8. Plane group: $p4$

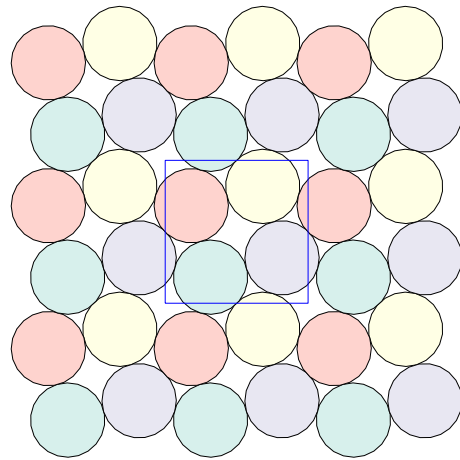
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.843051134508150	0
\mathbf{b}_2	0	3.843051134508150

Centroid positions in Cartesian coordinates:

x	y
1.220084994020459	0.700920186552010

Angle of rotation θ 2.153546821729920



9. Plane group: $p4gm$

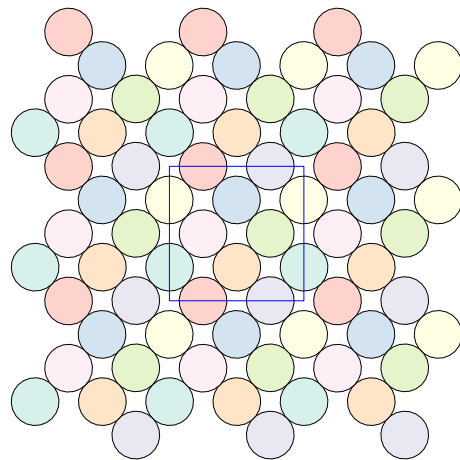
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.628064943736098	0
\mathbf{b}_2	0	5.628064943736098

Centroid positions in Cartesian coordinates:

x	y
0.007197326930496	1.407016235421652

Angle of rotation θ 3.212992479068550



10. *Plane group: c2mm*

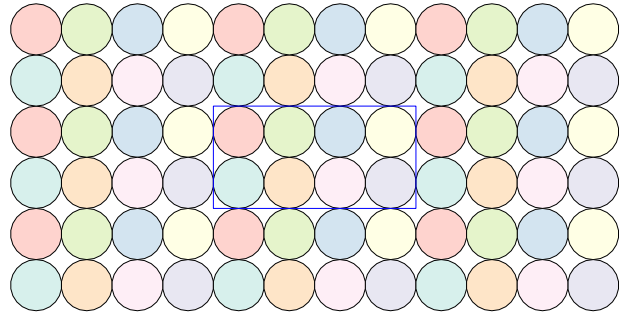
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.918571549828517	0
\mathbf{b}_2	0	4.000000001980312

Centroid positions in Cartesian coordinates:

	x	y
	0.989821444320200	1.000000000324219

Angle of rotation θ 0.142799667165404



11. *Plane group: pm*

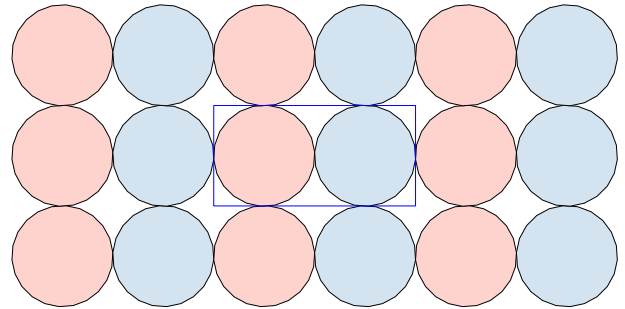
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.988979313901569	0
\mathbf{b}_2	0	1.985112209229572

Centroid positions in Cartesian coordinates:

	x	y
	0.997244828295398	0.992556104614786

Angle of rotation θ 2.930242063915669



12. *Plane group: p2mm*

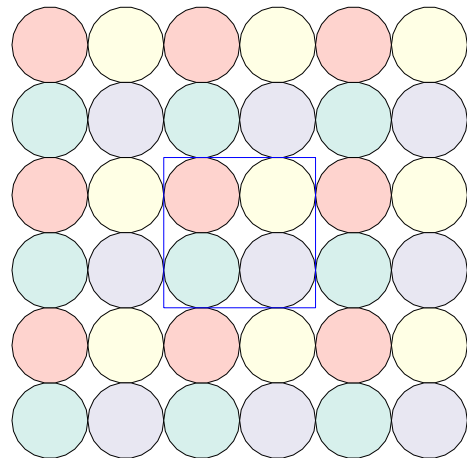
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.0000000008227976	0
\mathbf{b}_2	0	3.959285788278296

Centroid positions in Cartesian coordinates:

	x	y
	1.000000000402877	0.989821447522220

Angle of rotation θ 4.283990013910072



13. Plane group: $p6$

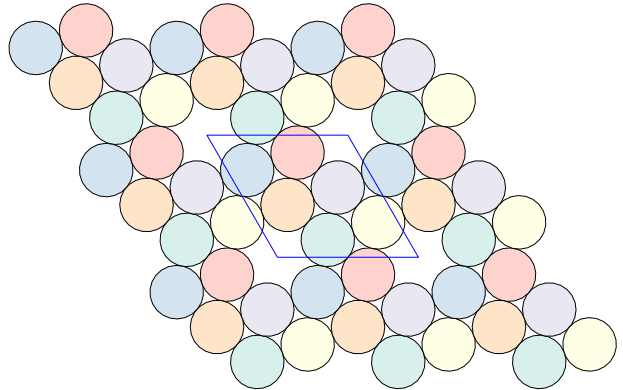
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.261054933131036	0
\mathbf{b}_2	-2.630527466565517	4.556207222796918

Centroid positions in Cartesian coordinates:

	x	y
	1.879661624053264	0.649954516331139

Angle of rotation θ 3.794538803475388



14. Plane group: $p31m$

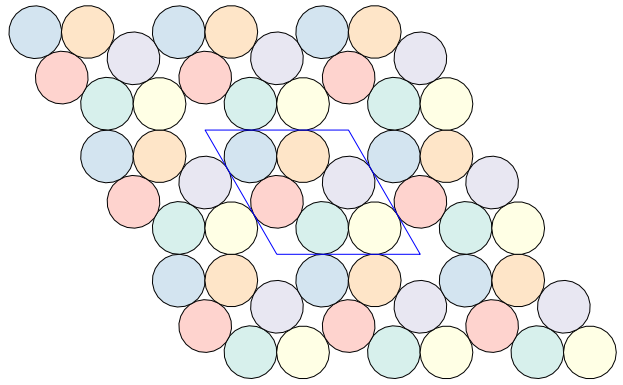
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.435884765295300	0
\mathbf{b}_2	-2.717942382647649	4.707614298790541

Centroid positions in Cartesian coordinates:

	x	y
	1.719643679608597	0.998867339185674

Angle of rotation θ 1.903995548703770



15. Plane group: $p3m1$

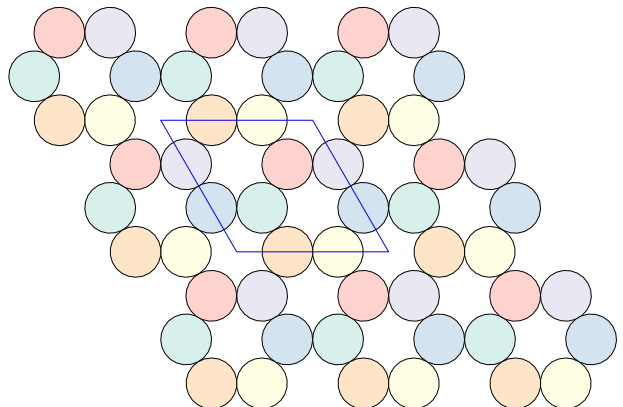
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.975112246790101	0
\mathbf{b}_2	-2.987556123395049	5.174598996183742

Centroid positions in Cartesian coordinates:

	x	y
	0.998867339937181	1.730088981857661

Angle of rotation θ 5.473987189179825



16. Plane group: $p4mm$

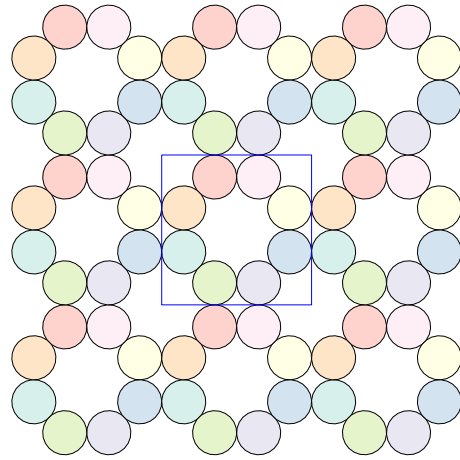
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.789446278691769	0
\mathbf{b}_2	0	6.789446278691769

Centroid positions in Cartesian coordinates:

x	y
0.997452114591986	2.397271023356677

Angle of rotation θ 3.070192814942263



17. Plane group: $p6mm$

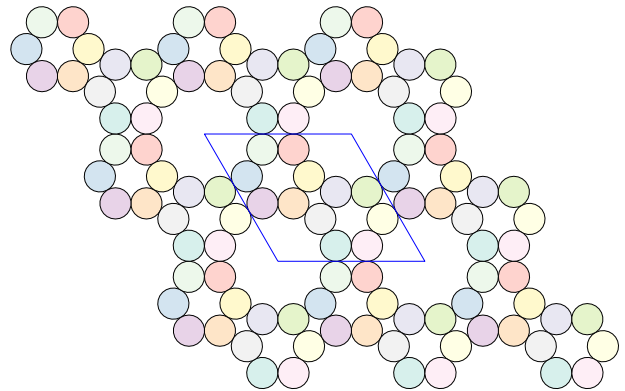
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.405436345838480	0
\mathbf{b}_2	-4.702718172919238	8.145346809173605

Centroid positions in Cartesian coordinates:

x	y
0.997452114591986	2.397271023356677

Angle of rotation θ 2.237194766124186



U. 23-gon

1. Plane group: $p2$

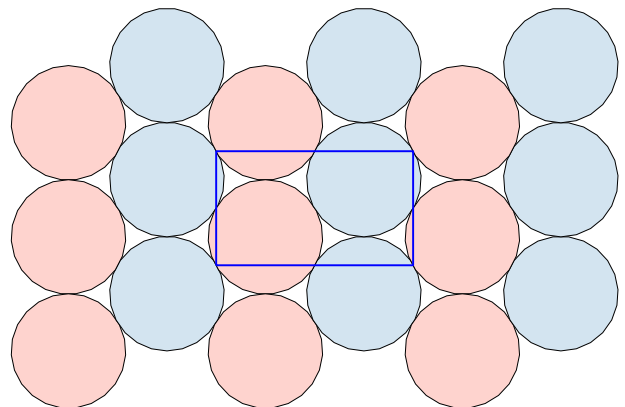
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.437445386197280	0.000047504907897
\mathbf{b}_2	0	1.990686159497826

Centroid in Cartesian coordinates:

x	y
0.859328696729872	0.494880618393993

Angle of rotation: 4.029854283096109



2. **Plane group: $p2gg$**

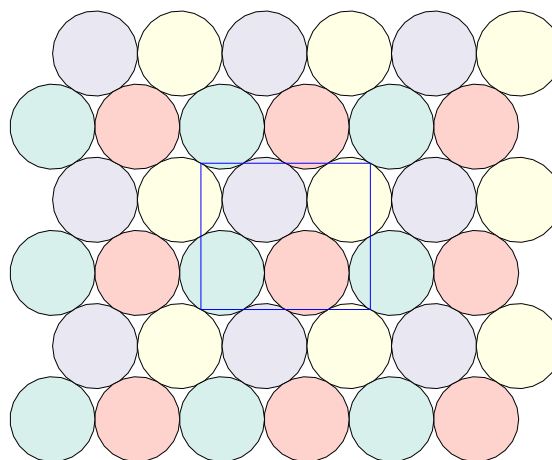
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.981371922537035	0
\mathbf{b}_2	0	3.437445081241103

Centroid in Cartesian coordinates:

	x	y
	0.494868699856519	0.859361272546863

Angle of rotation: 2.731819603203230



3. **Plane group: pg**

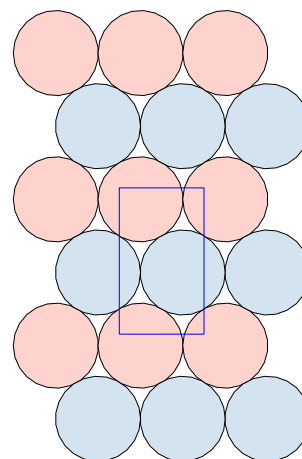
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.990685946913483	0
\mathbf{b}_2	0	3.437445055169406

Centroid in Cartesian coordinates:

	x	y
	0.500474277677935	0.859361263792351

Angle of rotation: 3.687956612080007



4. **Plane group: $p3$**

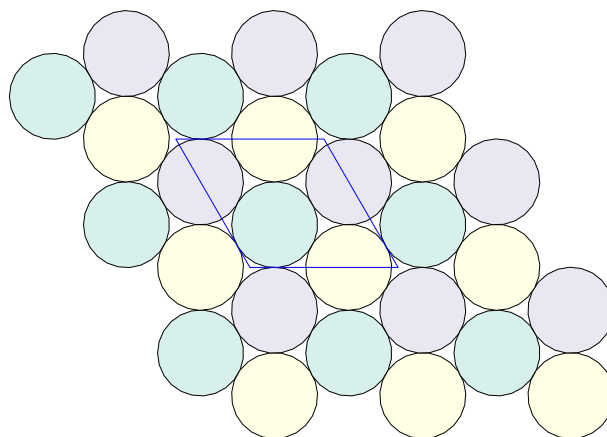
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.446172507779627	0
\mathbf{b}_2	-1.723086253889813	2.984472937560683

Centroid in Cartesian coordinates:

	x	y
	0.576009332563426	0.994137182801678

Angle of rotation: 3.968541755910394



5. **Plane group: $p1$**

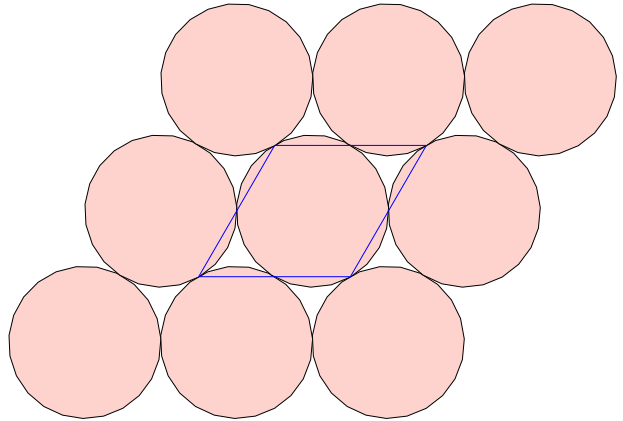
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.992694949203085	0
\mathbf{b}_2	0.998362556400994	1.724567666788867

Centroid in Cartesian coordinates:

	x	y
	1.495528752802040	0.862283833394433

Angle of rotation: 3.596273357417858



6. **Plane group: $p2mg$**

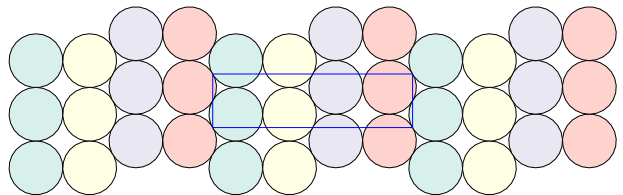
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.428056475905710	0
\mathbf{b}_2	0	1.990693977470282

Centroid in Cartesian coordinates:

	x	y
	0.859155558900224	0.495001302642252

Angle of rotation: 2.393182272868370



7. **Plane group: cm**

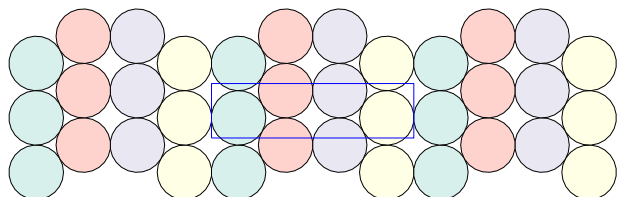
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.416472705898241	0
\mathbf{b}_2	0	1.995337538208722

Centroid in Cartesian coordinates:

	x	y
	0.990685957500963	0.737520280950026

Angle of rotation: 0.000000015614818



8. *Plane group: p4*

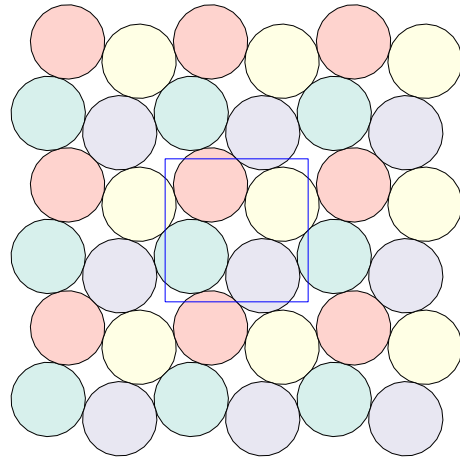
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.842109279151372	0
\mathbf{b}_2	0	3.842109279151372

Centroid in Cartesian coordinates:

	x	y
	0.700520865247782	1.220534002610827

Angle of rotation: 0.034150271300680



9. *Plane group: p4gm*

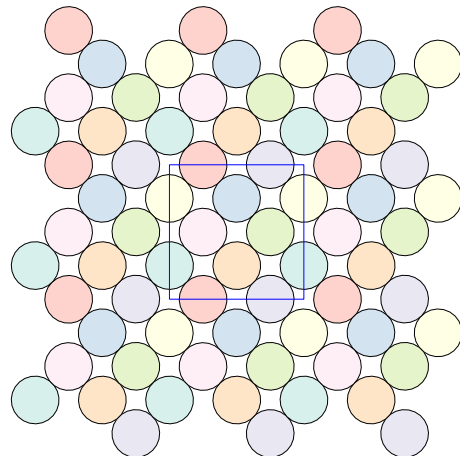
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.629811587115589	0
\mathbf{b}_2	0	5.629811587115589

Centroid in Cartesian coordinates:

	x	y
	0.004937602065948	1.408926680190539

Angle of rotation: 3.107444955438529



10. *Plane group: c2mm*

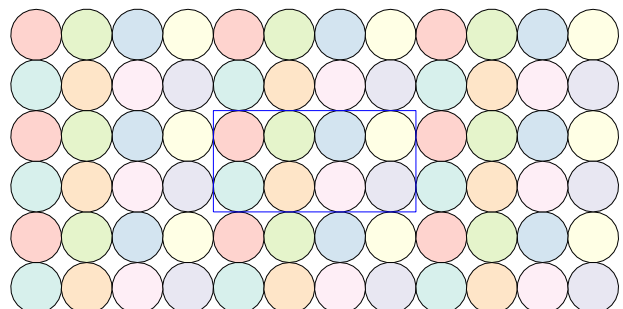
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.961404360393657	0
\mathbf{b}_2	0	3.981371929004001

Centroid in Cartesian coordinates:

	x	y
	0.997668778797107	1.000000008962609

Angle of rotation: 4.439207008475456



11. Plane group: pm

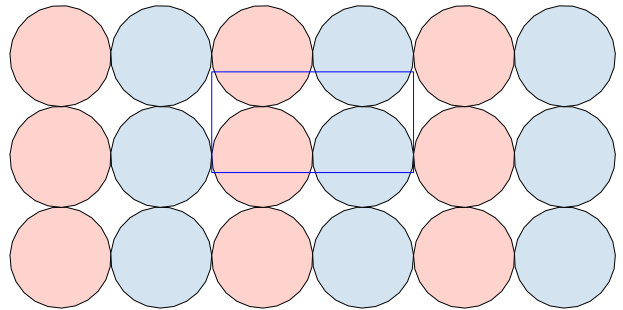
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.989798115200453	0
\mathbf{b}_2	0	1.991123505594715

Centroid in Cartesian coordinates:

	x	y
	0.998880114075698	0.995561752797358

Angle of rotation: 1.455170183693407



12. Plane group: $p2mm$

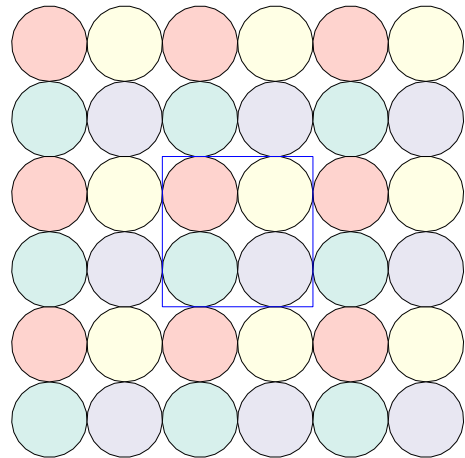
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.990675080745417	0
\mathbf{b}_2	0	3.981371898684468

Centroid in Cartesian coordinates:

	x	y
	0.997668769902702	0.990685948798250

Angle of rotation: 0.751250413324313



13. Plane group: $p6$

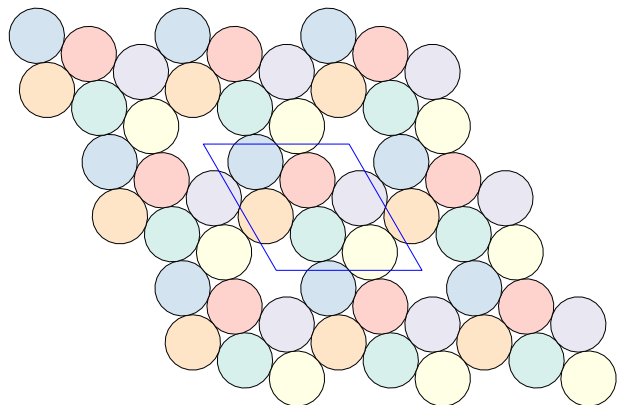
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.262415291054515	0
\mathbf{b}_2	-2.631207645527256	4.557385327316891

Centroid in Cartesian coordinates:

	x	y
	1.502528346795550	1.305721706731346

Angle of rotation: 1.611459287508470



14. Plane group: $p31m$

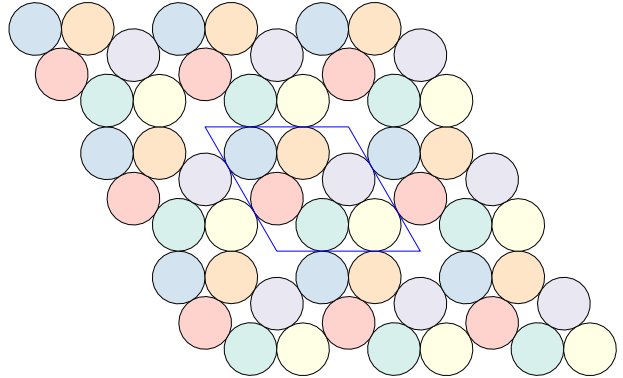
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.436792734721725	0
\mathbf{b}_2	-2.718396367360861	4.708400623379685

Centroid in Cartesian coordinates:

	x	y
	1.720697544120506	0.998963674970577

Angle of rotation: 4.393676670241651



15. Plane group: $p3m1$

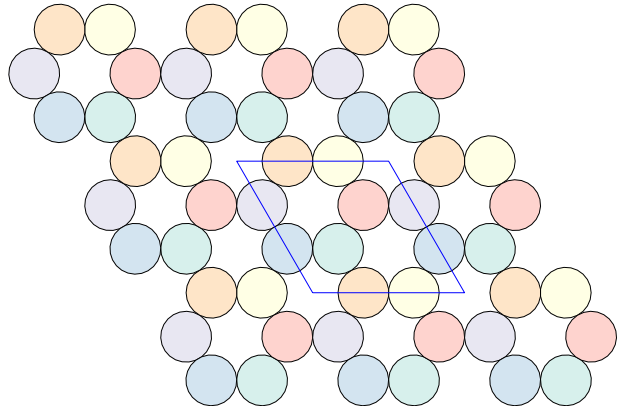
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.977226632634076	0
\mathbf{b}_2	-2.988613316317037	5.176430108038026

Centroid in Cartesian coordinates:

	x	y
	0.998963679210810	1.730255851671519

Angle of rotation: 4.735154185009667



16. Plane group: $p4mm$

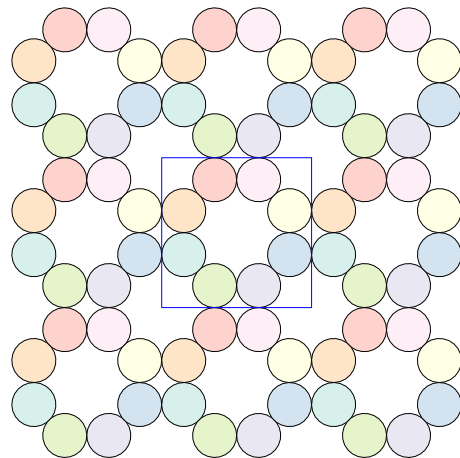
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.799751122009788	0
\mathbf{b}_2	0	6.799751122009788

Centroid in Cartesian coordinates:

	x	y
	0.999417028195080	2.400458538669942

Angle of rotation: 0.443920662573517



17. *Plane group: p6mm*

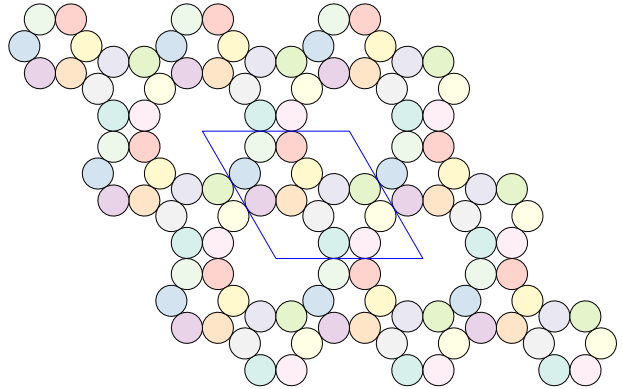
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.423875194355983	0
\mathbf{b}_2	-4.711937597177990	8.161315320406295

Centroid in Cartesian coordinates:

	x	y
	0.999417028195080	2.400458538669942

Angle of rotation: 3.596895945904461



V. 24-gon

1. *Plane group: p2*

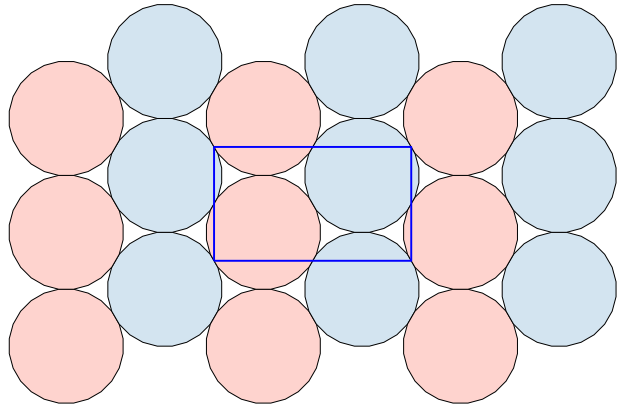
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.434465876952083	0.000000006065445
\mathbf{b}_2	0	1.982889728367183

Centroid in Cartesian coordinates:

	x	y
	0.858616461048913	0.495722391613873

Angle of rotation: 3.272430457172647



2. *Plane group: p2gg*

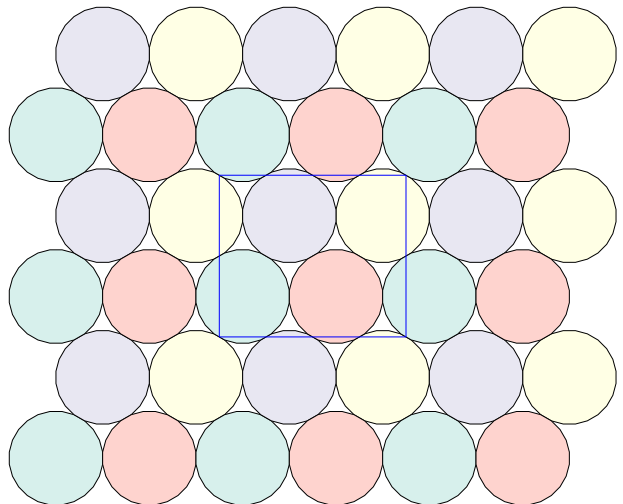
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.965779468300888	0
\mathbf{b}_2	0	3.434465769114201

Centroid in Cartesian coordinates:

	x	y
	0.495722426870067	0.858616445622223

Angle of rotation: 3.272492359310792



3. Plane group: pg

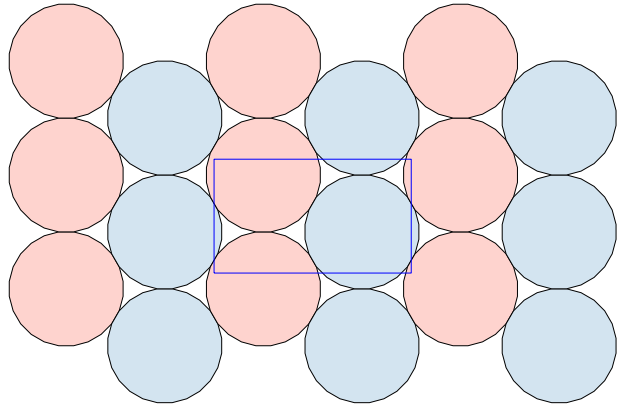
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.434465771865005	0
\mathbf{b}_2	0	1.982889723964695

Centroid in Cartesian coordinates:

	x	y
	0.858616446582721	0.495722430991174

Angle of rotation: 5.105088053967114



4. Plane group: $p3$

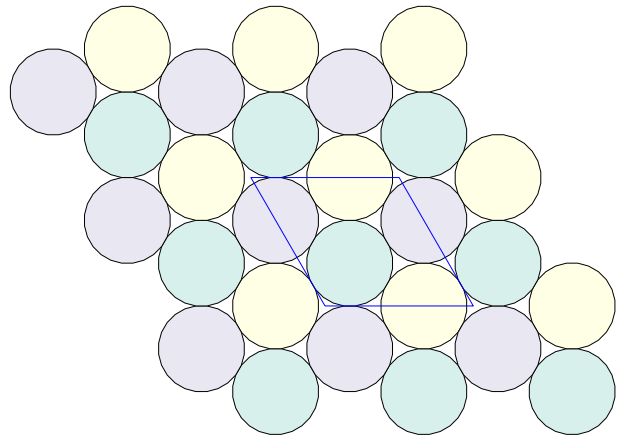
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.434465787292161	0
\mathbf{b}_2	-1.717232893646080	2.974334620223534

Centroid in Cartesian coordinates:

	x	y
	0.572410962632809	0.991444873324438

Angle of rotation: 5.105236480807640



5. Plane group: $p1$

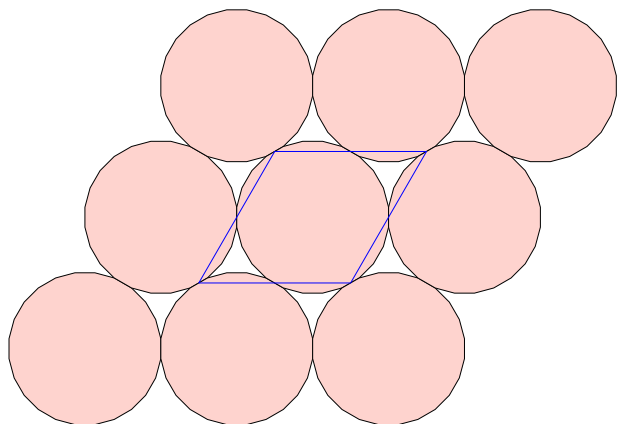
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.982889723297542	0
\mathbf{b}_2	0.991444863614162	1.717232874426591

Centroid in Cartesian coordinates:

	x	y
	1.487167293455852	0.858616437213295

Angle of rotation: 3.010710039048464



6. Plane group: $p2mg$

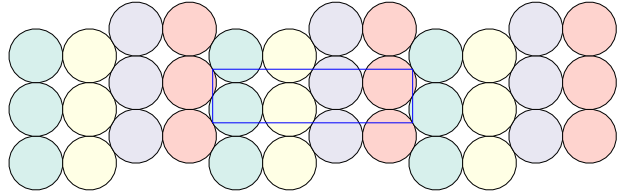
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.400245393612868	0
\mathbf{b}_2	0	1.982889730544343

Centroid in Cartesian coordinates:

	x	y
	0.858616479972287	0.495722456455778

Angle of rotation: 1.178097251558217



7. Plane group: cm

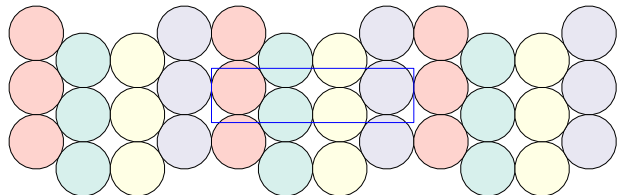
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.400245217338989	0
\mathbf{b}_2	0	1.982889723389237

Centroid in Cartesian coordinates:

	x	y
	2.708677744152539	0.291560720199876

Angle of rotation: 5.890486218452836



8. Plane group: $p4$

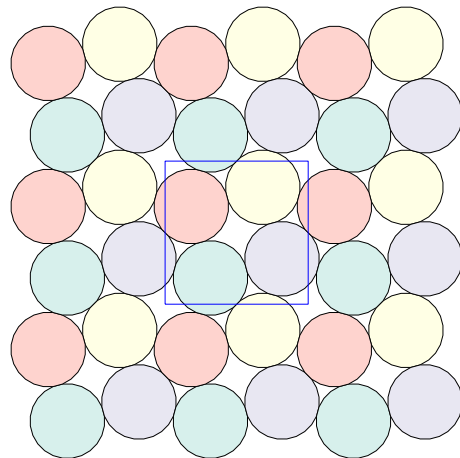
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.830648792770817	0
\mathbf{b}_2	0	3.830648792770817

Centroid in Cartesian coordinates:

	x	y
	1.214267011976761	0.701057386618571

Angle of rotation: 3.010679318482744



9. Plane group: $p4gm$

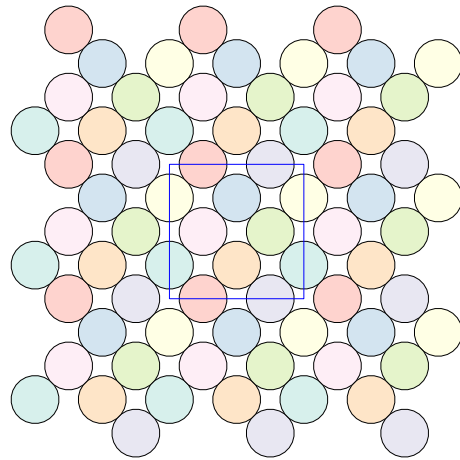
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.608459344862746	0
\mathbf{b}_2	0	5.608459344862746

Centroid in Cartesian coordinates:

	x	y
	0.000000103161252	1.402114786485277

Angle of rotation: 0.392699058765402



10. Plane group: $c2mm$

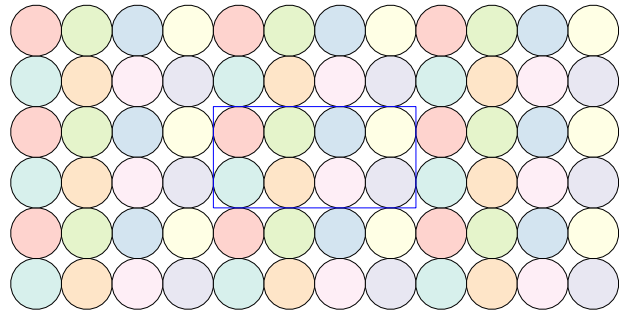
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.931559087833474	0
\mathbf{b}_2	0	3.965779537386936

Centroid in Cartesian coordinates:

	x	y
	0.991444909565806	0.991444889307363

Angle of rotation: 5.366887326050905



11. Plane group: pm

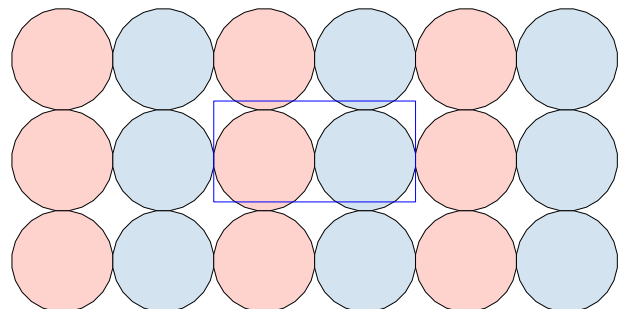
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.965779497586287	0
\mathbf{b}_2	0	1.982889725330825

Centroid in Cartesian coordinates:

	x	y
	0.991444864159889	0.991444862665413

Angle of rotation: 5.628686845360816



12. *Plane group: p2mm*

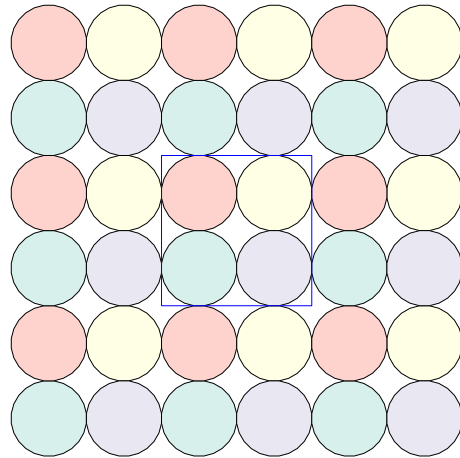
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.965779458387100	0
\mathbf{b}_2	0	3.965779476623216

Centroid in Cartesian coordinates:

	x	y
	0.991444864957152	0.991444871662669

Angle of rotation: 5.105088044237128



13. *Plane group: p6*

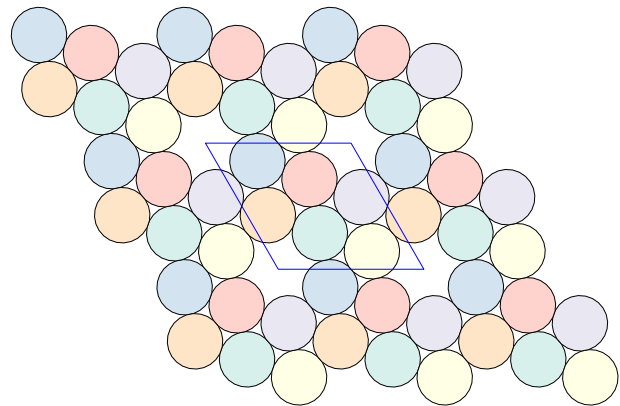
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.246233117062964	0
\mathbf{b}_2	-2.623116558531481	4.543371153551748

Centroid in Cartesian coordinates:

	x	y
	1.498923749318855	1.298106040689091

Angle of rotation: 1.891721425872742



14. *Plane group: p31m*

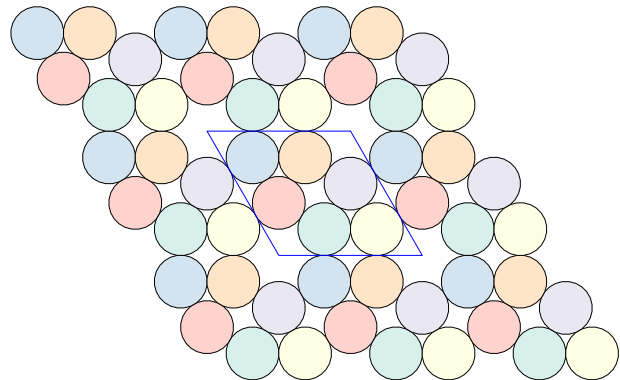
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.417355522865952	0
\mathbf{b}_2	-2.708677761432975	4.691567504133845

Centroid in Cartesian coordinates:

	x	y
	1.717232895337383	0.991444868249444

Angle of rotation: 4.581489239733405



15. *Plane group: p3m1*

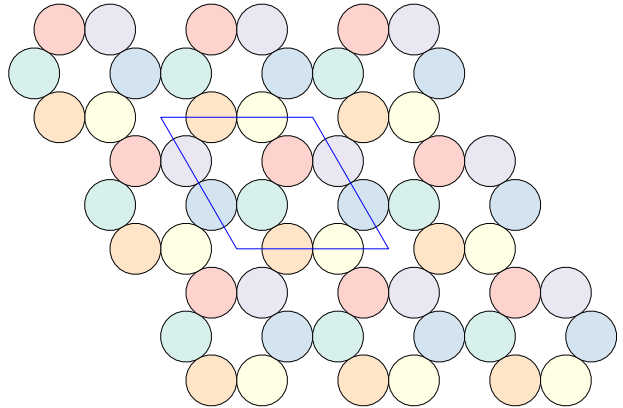
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.948669223280108	0
\mathbf{b}_2	-2.974334611640053	5.151698666071219

Centroid in Cartesian coordinates:

	x	y
	0.991444878404200	1.717232892623217

Angle of rotation: 3.534291728344308



16. *Plane group: p4mm*

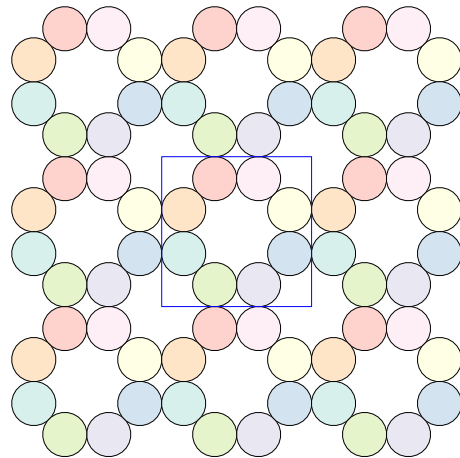
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.770009114405342	0
\mathbf{b}_2	0	6.770009114405342

Centroid in Cartesian coordinates:

	x	y
	0.991444896085352	2.393559688045997

Angle of rotation: 2.748893571934560



17. *Plane group: p6mm*

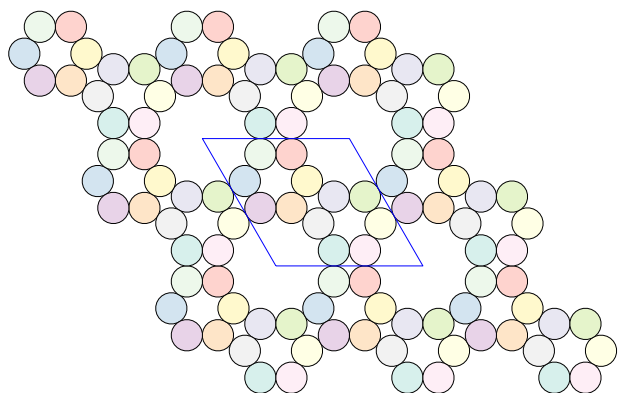
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.383135033186990	0
\mathbf{b}_2	-4.691567516593493	8.126033305879677

Centroid in Cartesian coordinates:

	x	y
	0.991444896085352	2.393559688045997

Angle of rotation: 3.010692931813773



W. 25-gon

1. *Plane group: p2*

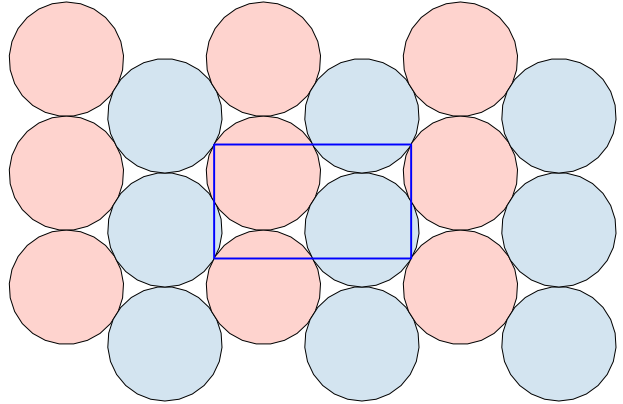
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.443112888370742	0.000010141283199
\mathbf{b}_2	0	1.992114715466018

Centroid in Cartesian coordinates:

	x	y
	0.860769890071730	1.491249064688617

Angle of rotation: 5.340593872031045



2. *Plane group: p2gg*

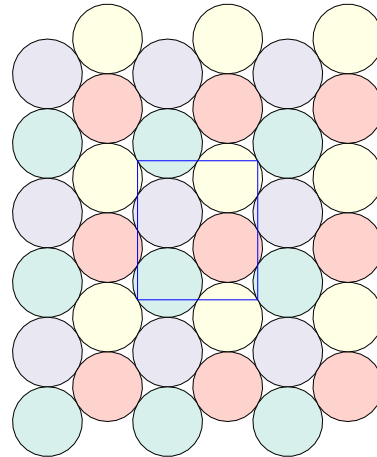
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.443112864423396	0
\mathbf{b}_2	0	3.984229560538473

Centroid in Cartesian coordinates:

	x	y
	0.860778215943286	0.495189210225607

Angle of rotation: 4.838052928794920



3. *Plane group: pg*

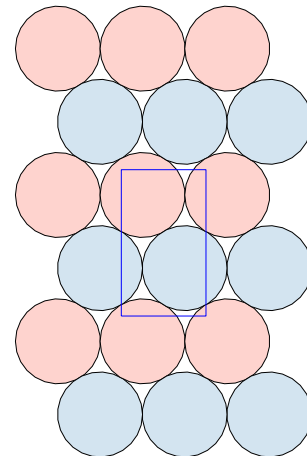
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.992114705429351	0
\mathbf{b}_2	0	3.443112809201558

Centroid in Cartesian coordinates:

	x	y
	0.500868178954657	0.860778202300390

Angle of rotation: 5.152211950536723



4. **Plane group: $p3$**

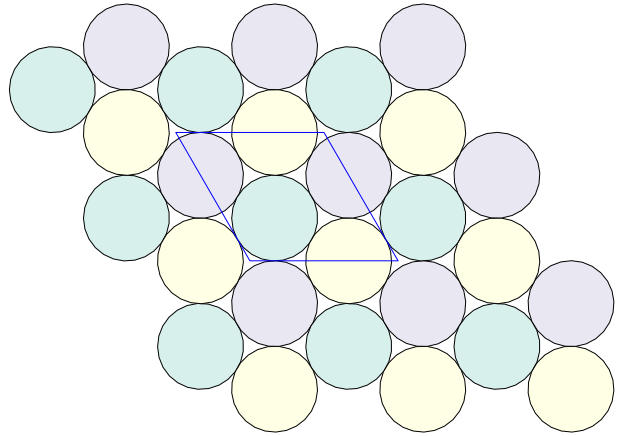
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.449231103322722	0
\mathbf{b}_2	-1.724615551661360	2.987121759000905

Centroid in Cartesian coordinates:

	x	y
	0.576386643450307	0.996271279889811

Angle of rotation: 0.635187316551167



5. **Plane group: $p1$**

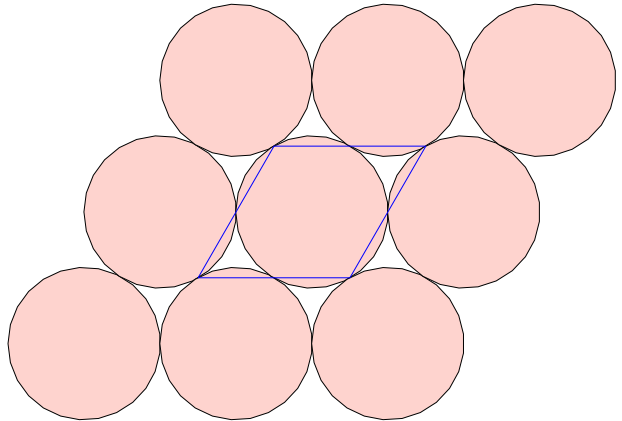
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.992114705505917	0
\mathbf{b}_2	0.996065985613309	1.727291543748089

Centroid in Cartesian coordinates:

	x	y
	1.494090345559613	0.863645771874045

Angle of rotation: 1.382246040763279



6. **Plane group: $p2mg$**

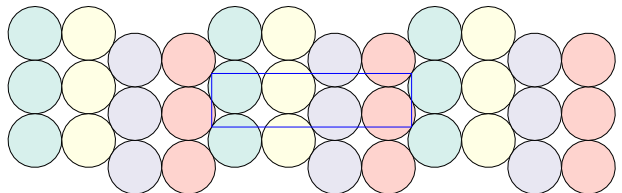
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.434795804954907	0
\mathbf{b}_2	0	1.992170295871057

Centroid in Cartesian coordinates:

	x	y
	0.860230978836133	1.491594845845280

Angle of rotation: 6.087218931318878



7. Plane group: cm

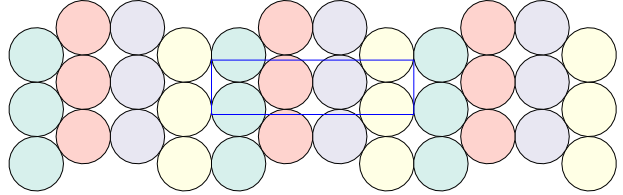
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.423525948521906	0
\mathbf{b}_2	0	1.996053457202426

Centroid in Cartesian coordinates:

	x	y
	0.992114705207375	0.189777913397164

Angle of rotation: 6.031857908819410



8. Plane group: $p4$

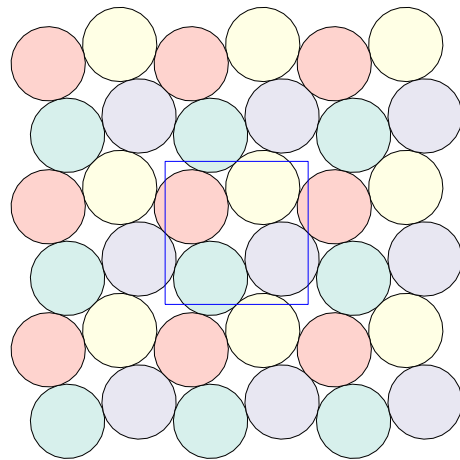
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.846054522657336	0
\mathbf{b}_2	0	3.846054522657336

Centroid in Cartesian coordinates:

	x	y
	1.221496152555740	0.701530958149050

Angle of rotation: 4.366812128766690



9. Plane group: $p4gm$

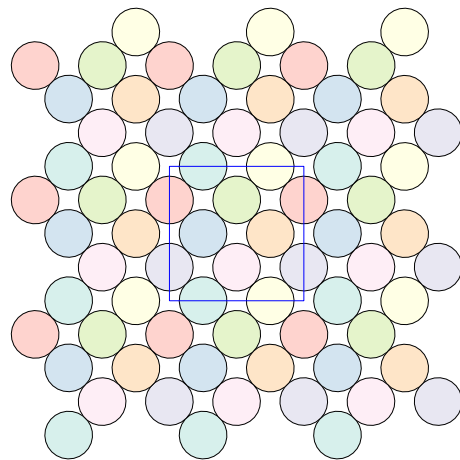
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.635060776695999	0
\mathbf{b}_2	0	5.635060776695999

Centroid in Cartesian coordinates:

	x	y
	1.410287846428322	0.004180424276065

Angle of rotation: 5.937610398553821



10. *Plane group: c2mm*

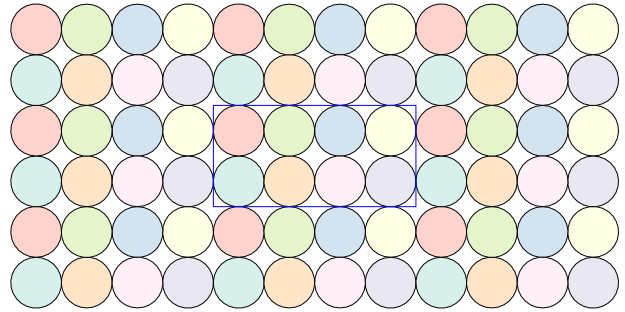
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.969404328617754	0
\mathbf{b}_2	0	3.984229424785328

Centroid in Cartesian coordinates:

	x	y
	0.998026731434132	0.992114709350493

Angle of rotation: 5.843362276666665



11. *Plane group: pm*

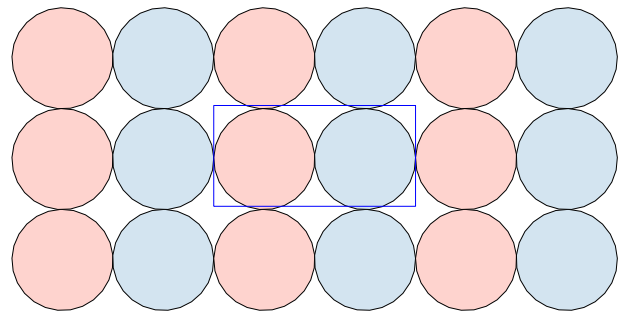
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.990142475483307	0
\mathbf{b}_2	0	1.993095468545361

Centroid in Cartesian coordinates:

	x	y
	0.999505200984179	0.996547734272681

Angle of rotation: 5.623407600367494



12. *Plane group: p2mm*

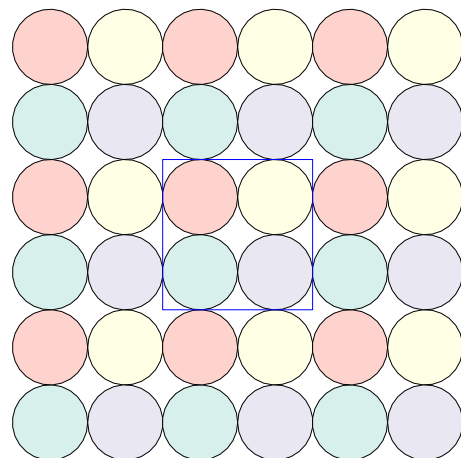
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.984229445116847	0
\mathbf{b}_2	0	3.992106969230051

Centroid in Cartesian coordinates:

	x	y
	0.992114704353824	0.998026748446447

Angle of rotation: 4.523893423390547



13. Plane group: $p6$

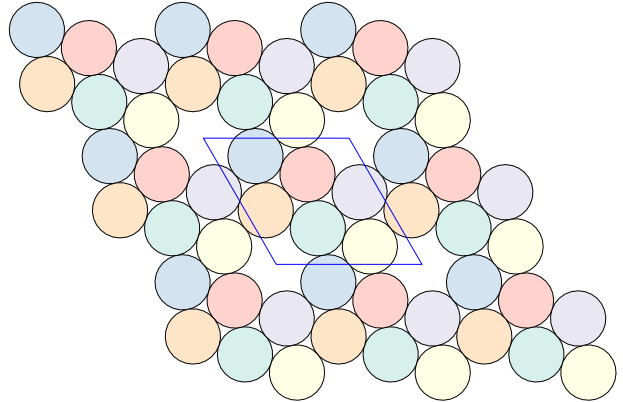
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.267643999611670	0
\mathbf{b}_2	-2.633821999805833	4.561913521756372

Centroid in Cartesian coordinates:

	x	y
	1.503955799715155	1.306556041042749

Angle of rotation: 2.652476812215194



14. Plane group: $p31m$

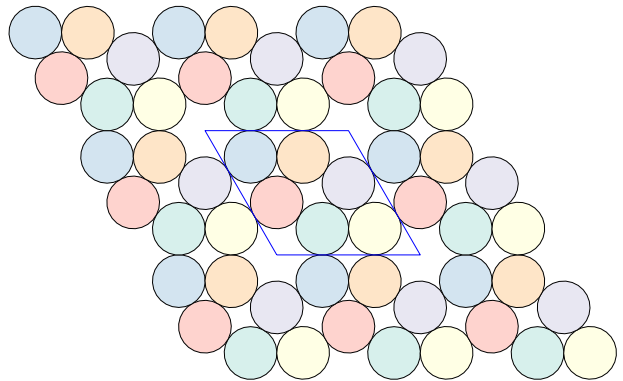
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.441904896657444	0
\mathbf{b}_2	-2.720952448328721	4.712827885484278

Centroid in Cartesian coordinates:

	x	y
	1.726485365136749	0.992114707895996

Angle of rotation: 3.330088168950055



15. Plane group: $p3m1$

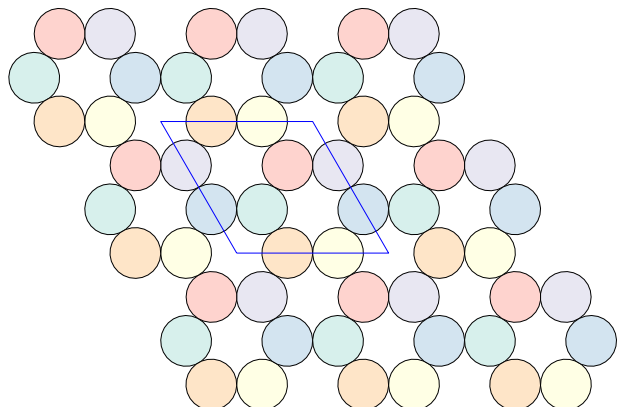
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.980720767199397	0
\mathbf{b}_2	-2.990360383599697	5.179456117335836

Centroid in Cartesian coordinates:

	x	y
	0.999122832230431	1.722439229376579

Angle of rotation: 4.105014308700309



16. Plane group: $p4mm$

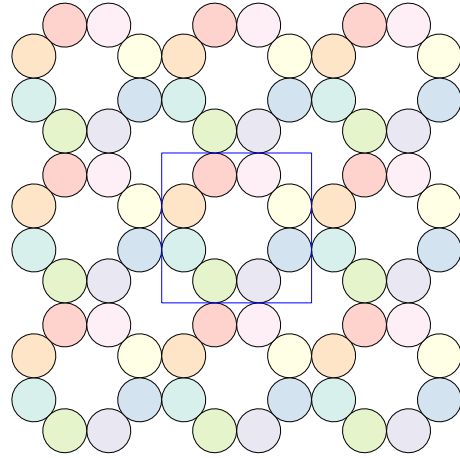
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.804150404859768	0
\mathbf{b}_2	0	6.804150404859768

Centroid in Cartesian coordinates:

	x	y
	0.999506564802522	2.402568635684562

Angle of rotation: 4.366813790357742



17. Plane group: $p6mm$

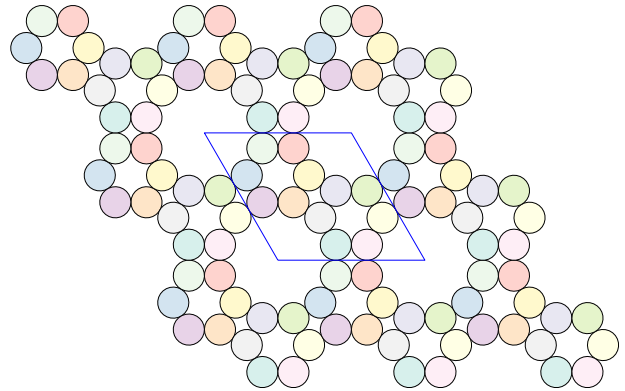
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.431962375142211	0
\mathbf{b}_2	-4.715981187571104	8.168319024412167

Centroid in Cartesian coordinates:

	x	y
	0.999506564802522	2.402568635684562

Angle of rotation: 0.565486632122320



X. 30-gon

1. Plane group: $p2$

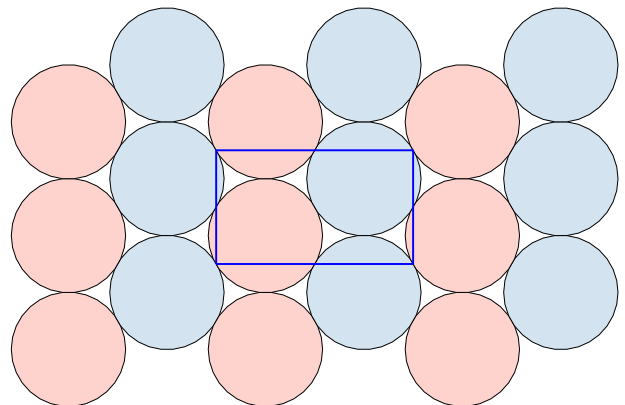
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.445125090323160	0.000000000228513
\mathbf{b}_2	0	1.989043894341109

Centroid positions in Cartesian coordinates:

	x	y
	0.861281272141736	0.497260972240086

Angle of rotation θ 3.979671929271436



2. **Plane group: $p2gg$**

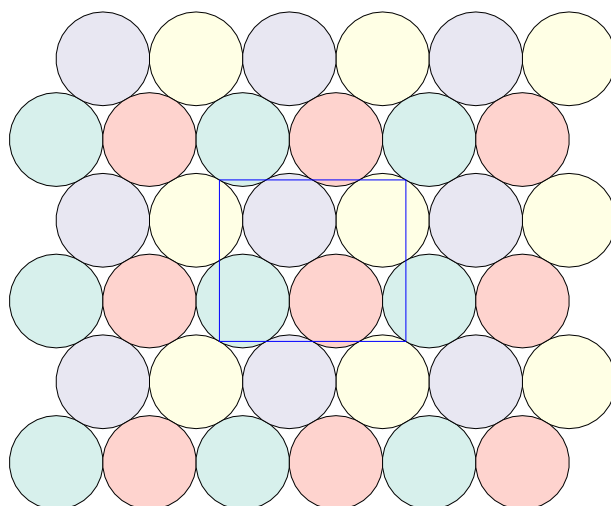
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.978087587131846	0
\mathbf{b}_2	0	3.445124910699947

Centroid positions in Cartesian coordinates:

	x	y
	0.497260947851034	0.861281226512354

Angle of rotation θ 2.199114852801825



3. **Plane group: pg**

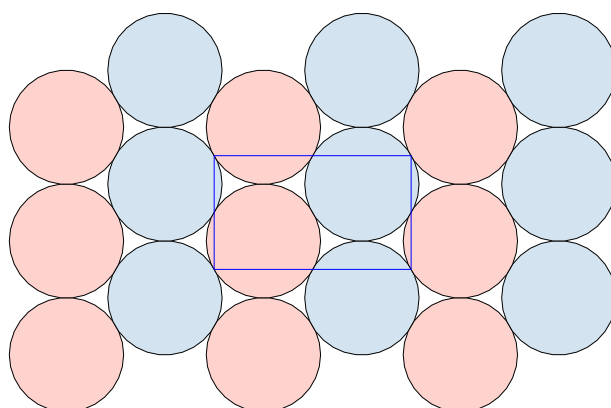
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.445124907408318	0
\mathbf{b}_2	0	1.989043790994450

Centroid positions in Cartesian coordinates:

	x	y
	0.861281227052736	0.497260947748613

Angle of rotation θ 5.445427264622526



4. **Plane group: $p3$**

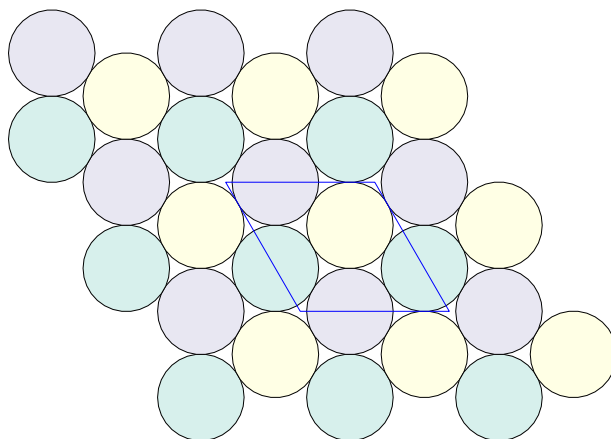
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.445125058963942	0
\mathbf{b}_2	-1.722562529481970	2.983565820277136

Centroid positions in Cartesian coordinates:

	x	y
	-0.574187509819288	0.994521940086018

Angle of rotation θ 2.303535282188903



5. Plane group: $p1$

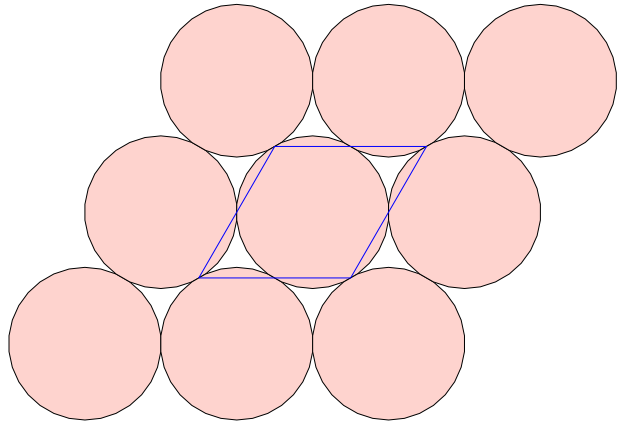
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.989043791588809	0
\mathbf{b}_2	0.994521895834154	1.722562452727110

Centroid positions in Cartesian coordinates:

	x	y
	1.491782843711481	0.861281226363555

Angle of rotation θ 3.665218088234845



6. Plane group: $p2mg$

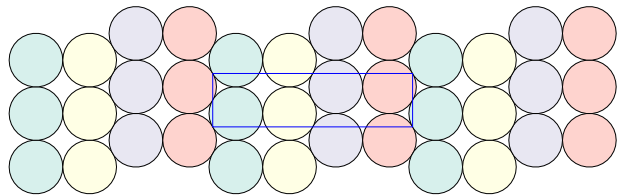
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.445124903145595	0
\mathbf{b}_2	0	1.989043814253335

Centroid positions in Cartesian coordinates:

	x	y
	0.861281237097747	0.497260953067252

Angle of rotation θ 1.466229737782592



7. Plane group: cm

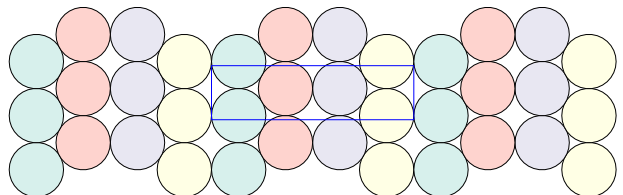
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.445124916440620	0
\mathbf{b}_2	0	1.989043790826922

Centroid positions in Cartesian coordinates:

	x	y
	1.000000001214548	0.151493569638773

Angle of rotation θ 1.466076571416059



8. Plane group: $p4$

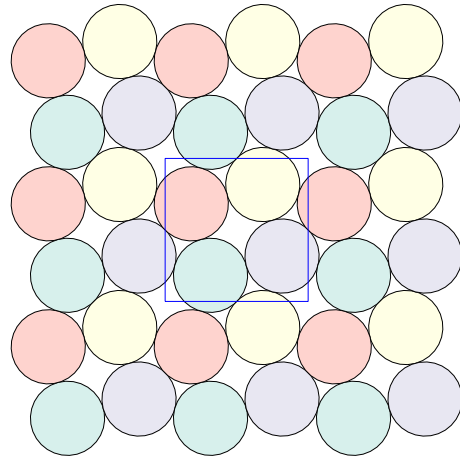
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.851483243127511	0
\mathbf{b}_2	0	3.851483243127511

Centroid positions in Cartesian coordinates:

x	y
1.222508410535965	0.703233141991088

Angle of rotation θ 2.251453753767779



9. Plane group: $p4gm$

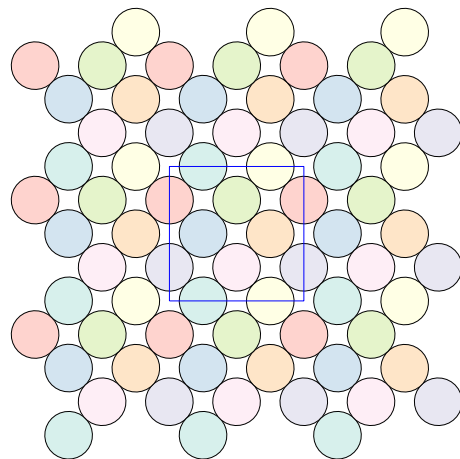
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.641359832703334	0
\mathbf{b}_2	0	5.641359832703334

Centroid positions in Cartesian coordinates:

x	y
1.410339957652675	0.003873605773052

Angle of rotation θ 2.146754977359226



10. Plane group: $c2mm$

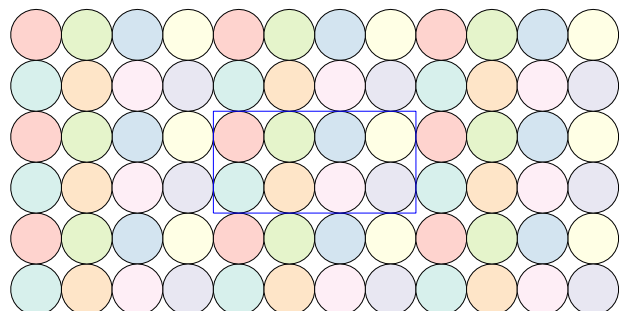
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.956175187605791	0
\mathbf{b}_2	0	4.000000011306363

Centroid positions in Cartesian coordinates:

x	y
0.994521899967448	1.000000004156030

Angle of rotation θ 4.502949442527293



11. Plane group: pm

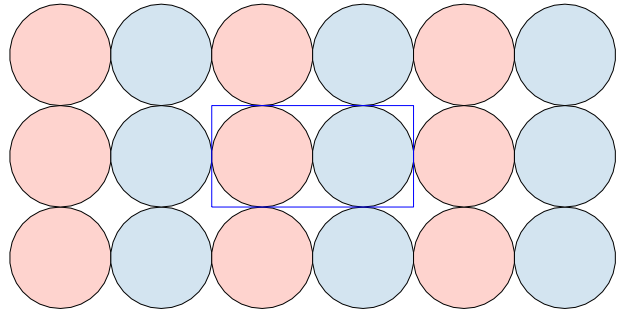
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.978295544279030	0
\mathbf{b}_2	0	1.999895451774931

Centroid positions in Cartesian coordinates:

	x	y
	0.994573886175284	0.999947725887465

Angle of rotation θ 5.969524606094043



12. Plane group: $p2mm$

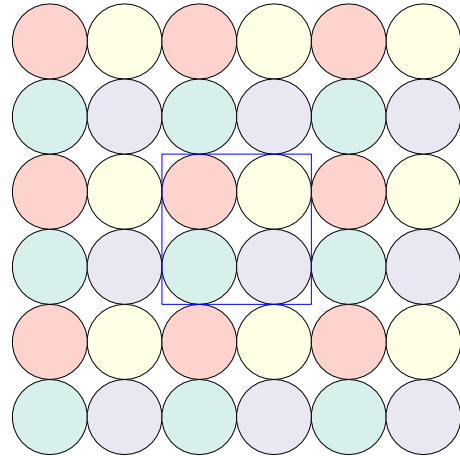
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.978087599765411	0
\mathbf{b}_2	0	4.000000008048103

Centroid positions in Cartesian coordinates:

	x	y
	0.994521900452633	1.000000003618748

Angle of rotation θ 6.178465584874671



13. Plane group: $p6$

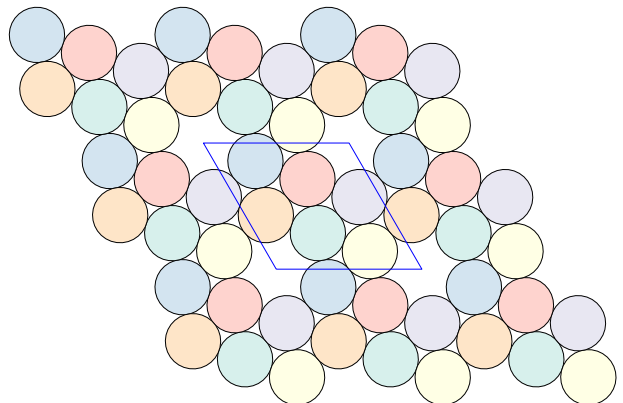
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.262515224988263	0
\mathbf{b}_2	-2.631257612494130	4.557471872642217

Centroid positions in Cartesian coordinates:

	x	y
	1.503575778047915	1.302134820652734

Angle of rotation θ 2.912889477423029



14. *Plane group: p31m*

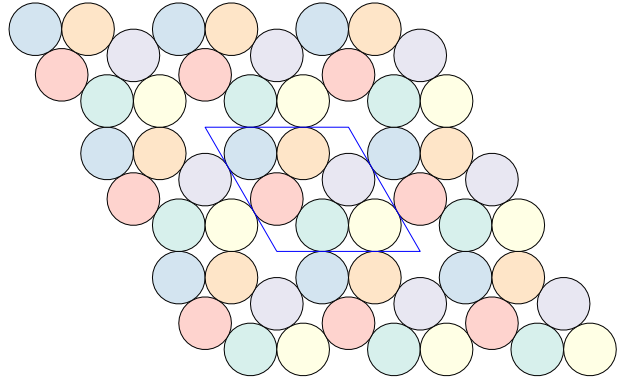
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.445124908457089	0
\mathbf{b}_2	-2.722562454228543	4.715616497503255

Centroid positions in Cartesian coordinates:

	x	y
	1.722562456377930	0.994521897636141

Angle of rotation θ 2.303834592660324



15. *Plane group: p3m1*

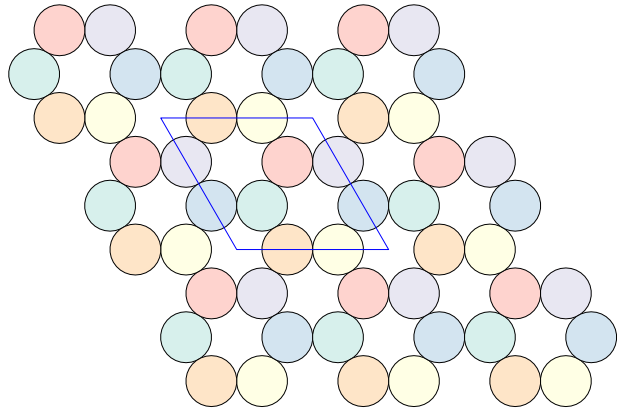
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.967131379415902	0
\mathbf{b}_2	-2.983565689707950	5.167687362293452

Centroid positions in Cartesian coordinates:

	x	y
	0.994521896446032	1.722562453045122

Angle of rotation θ 1.151917309437141



16. *Plane group: p4mm*

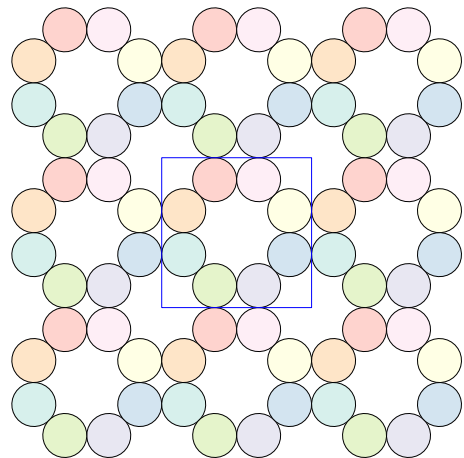
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.807450851960866	0
\mathbf{b}_2	0	6.807450851960866

Centroid positions in Cartesian coordinates:

	x	y
	0.998629534488567	2.405095890560691

Angle of rotation θ 3.089232763789347



17. *Plane group: p6mm*

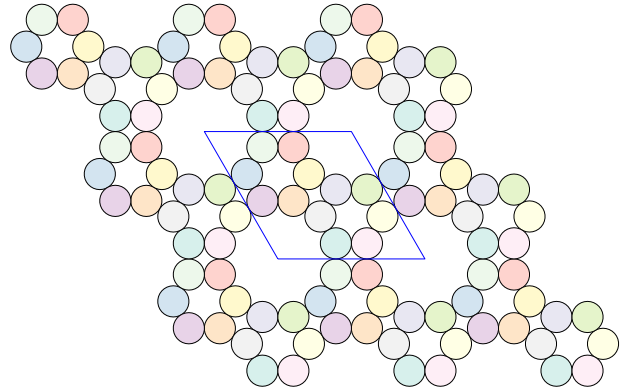
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.431233018105180	0
\mathbf{b}_2	-4.715616509052588	8.167687382689669

Centroid positions in Cartesian coordinates:

	x	y
	0.998629534488567	2.405095890560691

Angle of rotation θ 3.246312382838873



Y. 35-gon

1. *Plane group: p2*

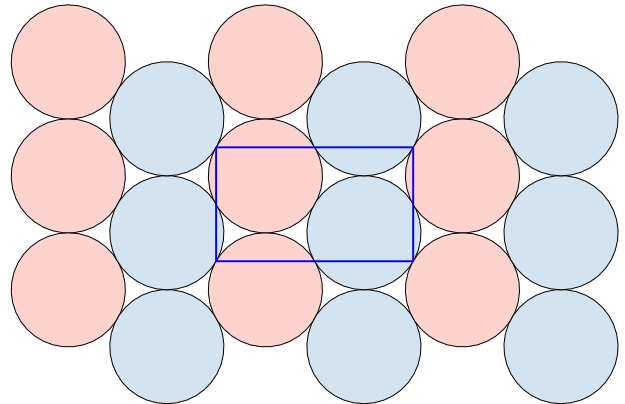
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.452721977603784	0.000005526720656
\mathbf{b}_2	0	1.995974302122693

Centroid positions in Cartesian coordinates:

	x	y
	0.863176586955469	1.495724359771762

Angle of rotation θ 4.263666135241825



2. *Plane group: p2gg*

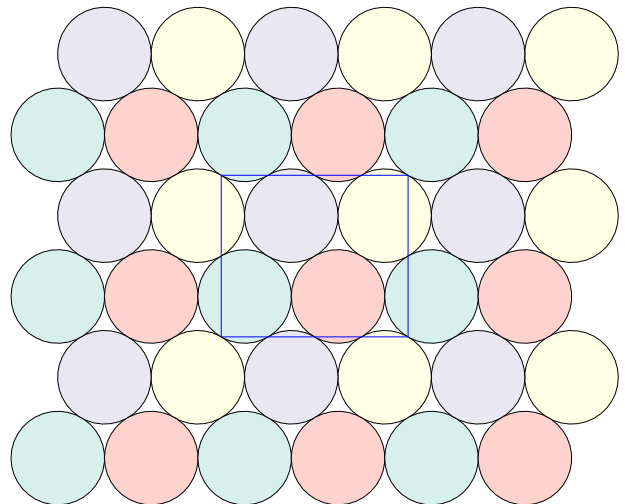
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.991948589931517	0
\mathbf{b}_2	0	3.452721968048101

Centroid positions in Cartesian coordinates:

	x	y
	0.500251321204895	0.863180492299354

Angle of rotation θ 5.295827617727955



3. Plane group: pg

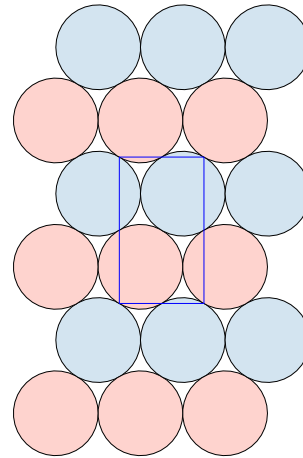
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.995974294209266	0
\mathbf{b}_2	0	3.452721966646063

Centroid positions in Cartesian coordinates:

x	y
0.497735826262977	0.863180491661516

Angle of rotation θ 1.795195800711735



4. Plane group: $p3$

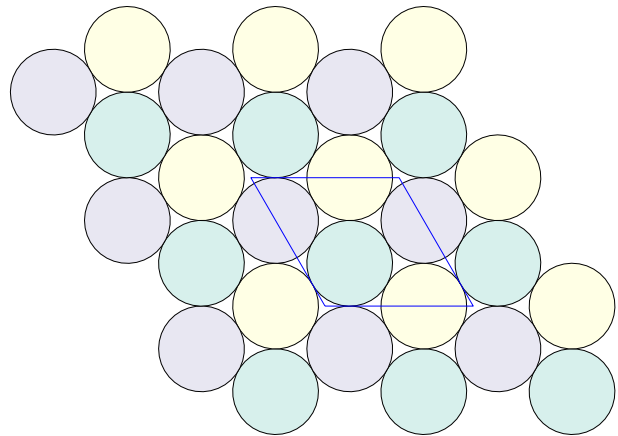
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.456383943292435	0
\mathbf{b}_2	-1.728191971646217	2.993316300123881

Centroid positions in Cartesian coordinates:

x	y
0.575449103592590	0.998251934466181

Angle of rotation θ 3.256445312445816



5. Plane group: $p1$

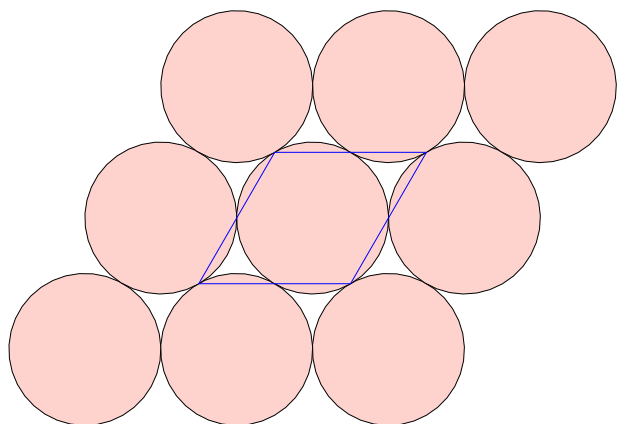
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.996850507047020	0
\mathbf{b}_2	0.999306084456864	1.728819977109280

Centroid positions in Cartesian coordinates:

x	y
1.498078295751942	0.864409988554640

Angle of rotation θ 0.927223214459197



6. Plane group: $p2mg$

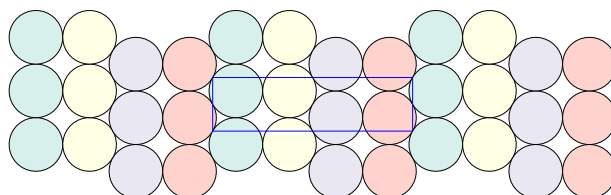
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.448627704669533	0
\mathbf{b}_2	0	1.995985346034776

Centroid positions in Cartesian coordinates:

	x	y
	0.863020095715772	1.498146528902631

Angle of rotation θ 1.298189329044400



7. Plane group: cm

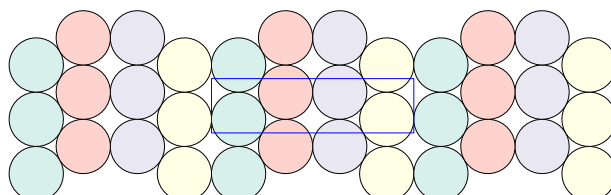
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.443761050398537	0
\mathbf{b}_2	0	1.997962166192877

Centroid positions in Cartesian coordinates:

	x	y
	0.996008319441936	0.500704608598365

Angle of rotation θ 0.359342557210859



8. Plane group: $p4$

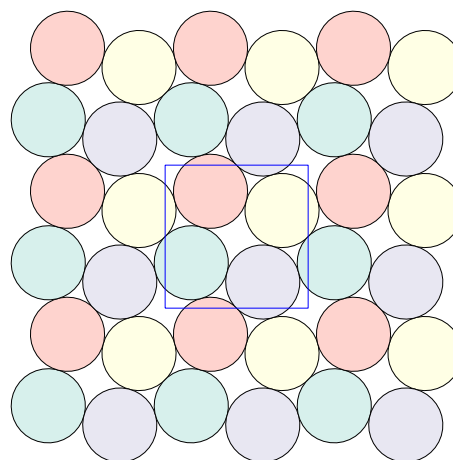
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.854429020077627	0
\mathbf{b}_2	0	3.854429020077627

Centroid positions in Cartesian coordinates:

	x	y
	0.704259683742444	1.222953838957722

Angle of rotation θ 2.266418249452431



9. Plane group: $p4gm$

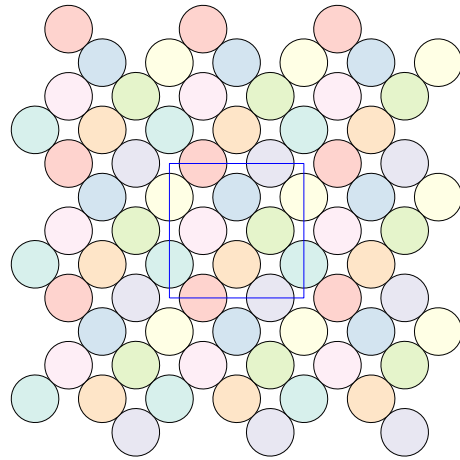
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.645271804461911	0
\mathbf{b}_2	0	5.645271804461911

Centroid positions in Cartesian coordinates:

x	y
0.002134595012839	1.411980951744475

Angle of rotation θ 1.952275433608951



10. Plane group: $c2mm$

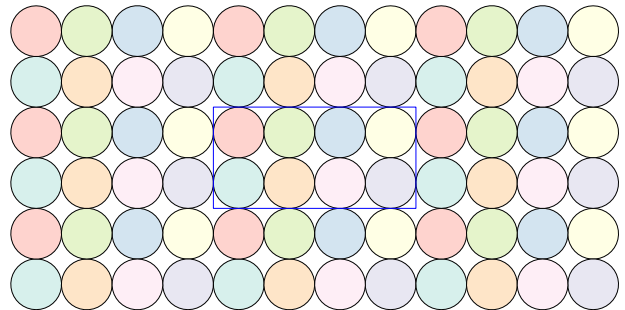
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.983523462422658	0
\mathbf{b}_2	0	3.991948601907867

Centroid positions in Cartesian coordinates:

x	y
0.998993068387903	1.000000002498748

Angle of rotation θ 5.969026042748426



11. Plane group: pm

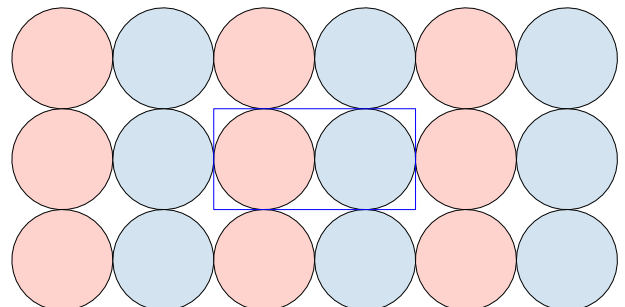
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.995034274032029	0
\mathbf{b}_2	0	1.996442928692219

Centroid positions in Cartesian coordinates:

x	y
0.997786528003999	0.998221464346110

Angle of rotation θ 3.746698958401691



12. *Plane group: p2mm*

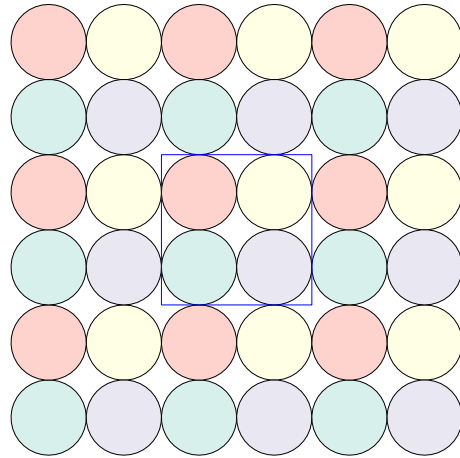
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.995972266718406	0
\mathbf{b}_2	0	3.991948598104190

Centroid positions in Cartesian coordinates:

x	y
0.998993068007467	1.000000001702633

Angle of rotation θ 4.353349848646193



13. *Plane group: p6*

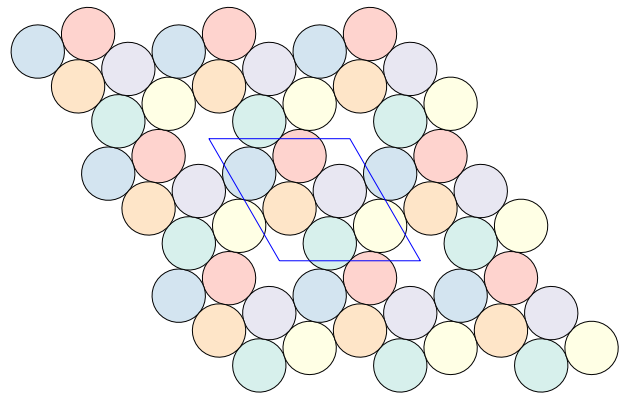
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.279002045521913	0
\mathbf{b}_2	-2.639501022760955	4.571749878051993

Centroid positions in Cartesian coordinates:

x	y
1.886471296576202	0.651910132830610

Angle of rotation θ 1.180148830868763



14. *Plane group: p31m*

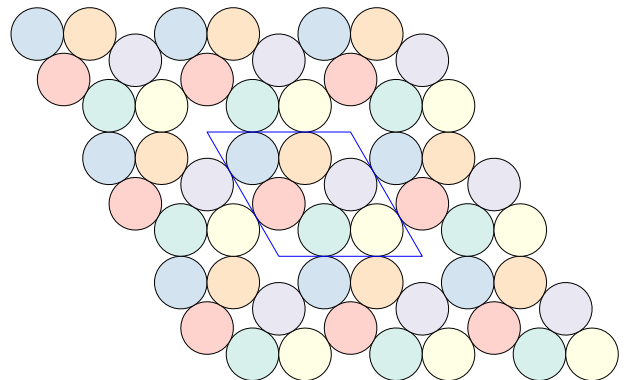
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.452387444102406	0
\mathbf{b}_2	-2.726193722051202	4.721906037867990

Centroid positions in Cartesian coordinates:

x	y
1.727143920158768	0.999552432976590

Angle of rotation θ 1.989675350735179



15. *Plane group: p3m1*

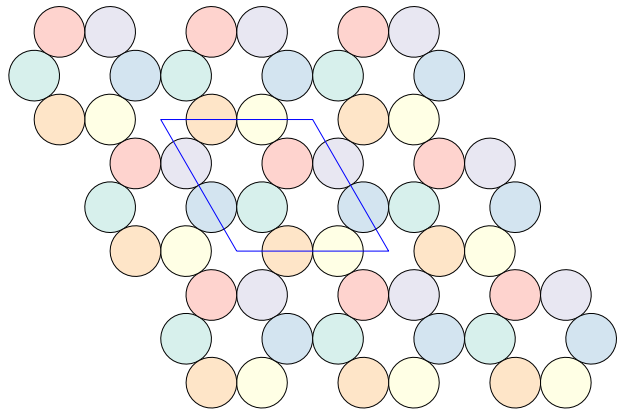
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.990158325203156	0
\mathbf{b}_2	-2.995079162601577	5.187629282316780

Centroid positions in Cartesian coordinates:

	x	y
	0.999552432719194	1.731275598086586

Angle of rotation θ 1.855035672058887



16. *Plane group: p4mm*

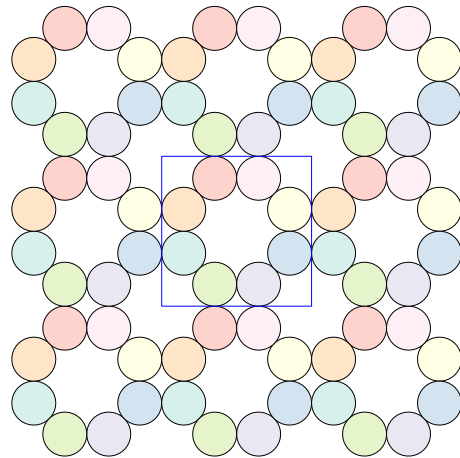
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.807980219982179	0
\mathbf{b}_2	0	6.807980219982179

Centroid positions in Cartesian coordinates:

	x	y
	0.997734875548785	2.406255232171230

Angle of rotation θ 3.792351126073282



17. *Plane group: p6mm*

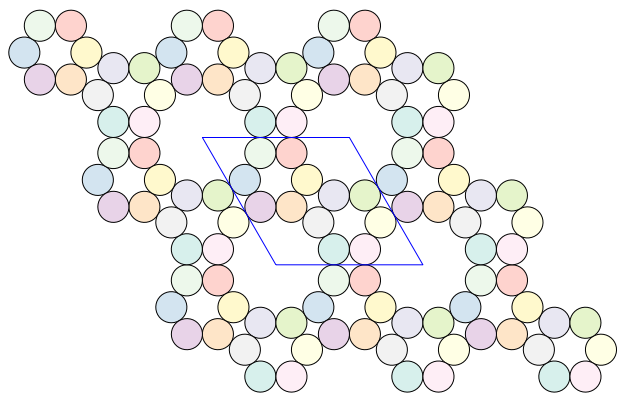
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.446716039432527	0
\mathbf{b}_2	-4.723358019716262	8.181096072486488

Centroid positions in Cartesian coordinates:

	x	y
	0.997734875548785	2.406255232171230

Angle of rotation θ 0.209439525762658



Z. 36-gon

1. *Plane group: p2*

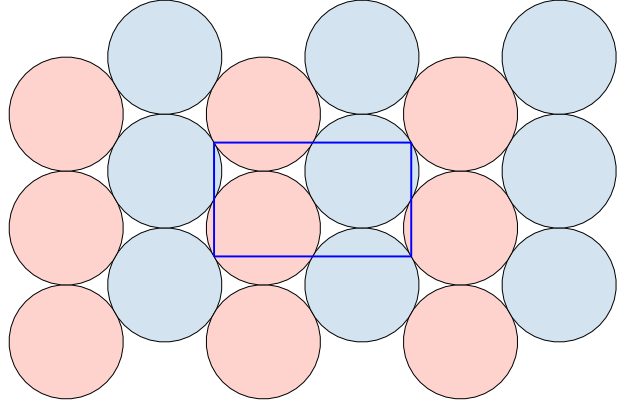
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.450919710044475	0.000000004639291
\mathbf{b}_2	0	1.992389405555464

Centroid in Cartesian coordinates:

	x	y
	0.862729921629063	0.498097357850543

Angle of rotation: 0.610909949513108



2. *Plane group: p2gg*

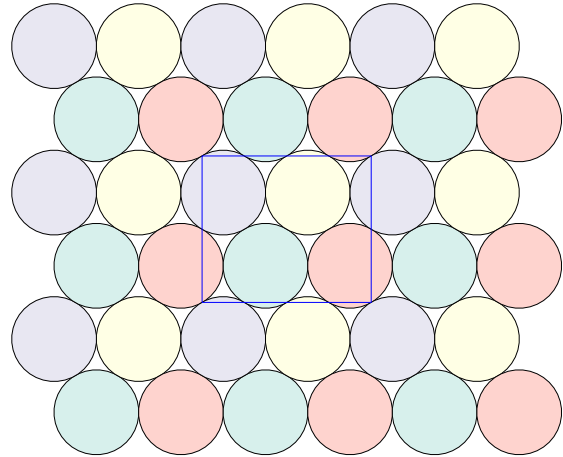
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.984778824933875	0
\mathbf{b}_2	0	3.450919682717857

Centroid in Cartesian coordinates:

	x	y
	1.494292054458829	0.862729922005968

Angle of rotation: 6.021385886631171



3. *Plane group: pg*

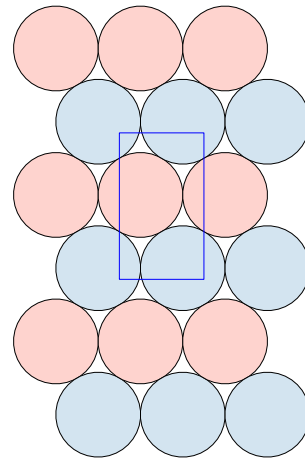
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.992389398618552	0
\mathbf{b}_2	0	3.450919668535081

Centroid in Cartesian coordinates:

	x	y
	0.498097348821184	0.862729917133770

Angle of rotation: 4.974188361283939



4. *Plane group: p3*

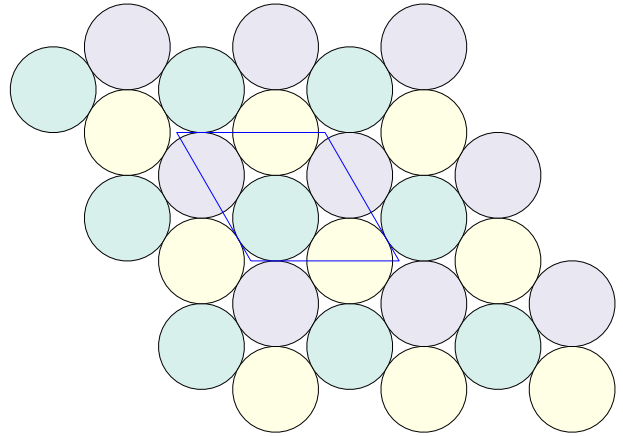
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.450919674317214	0
\mathbf{b}_2	-1.725459837158606	2.988584104378229

Centroid in Cartesian coordinates:

	x	y
	0.575153281555435	0.996194700616884

Angle of rotation: 0.959887207037205



5. *Plane group: p1*

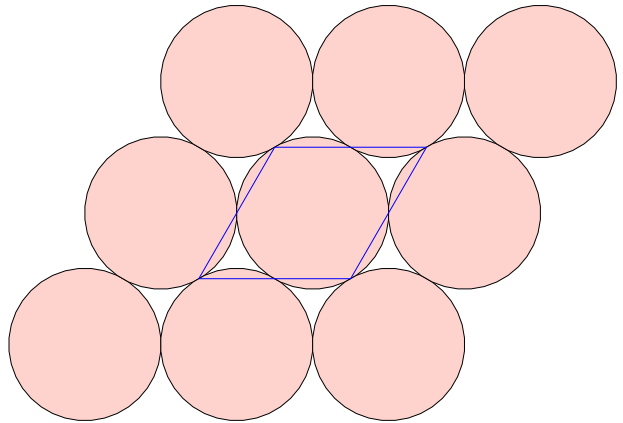
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.992389396350816	0
\mathbf{b}_2	0.996194699466387	1.725459832082928

Centroid in Cartesian coordinates:

	x	y
	1.494292047908602	0.862729916041464

Angle of rotation: 3.054319304627193



6. *Plane group: p2mg*

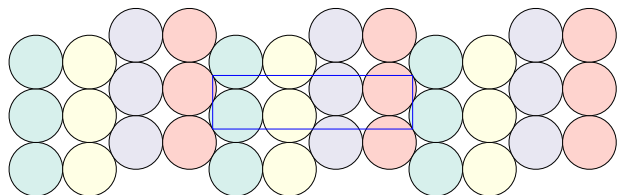
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.435698504861311	0
\mathbf{b}_2	0	1.992389400990571

Centroid in Cartesian coordinates:

	x	y
	0.862729922853917	0.498097353830462

Angle of rotation: 4.101523733279007



7. Plane group: cm

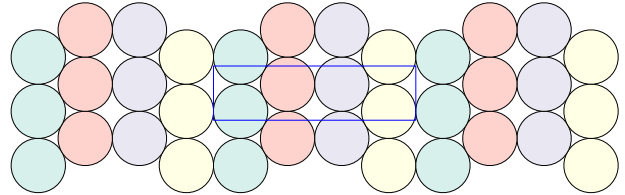
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.435698507535244	0
\mathbf{b}_2	0	1.992389398851769

Centroid in Cartesian coordinates:

	x	y
	0.996194703380659	0.328724163122431

Angle of rotation: 5.148721292713041



8. Plane group: $p4$

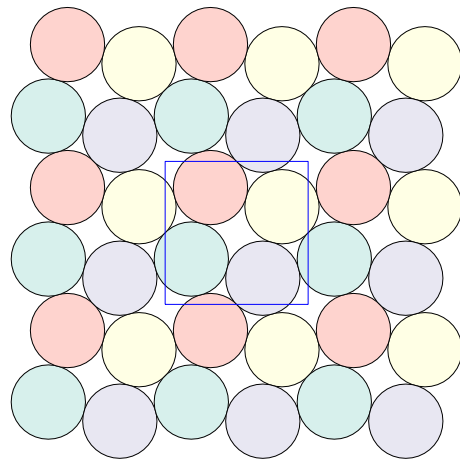
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.849000749997781	0
\mathbf{b}_2	0	3.849000749997781

Centroid in Cartesian coordinates:

	x	y
	0.704416028127645	1.220084347141755

Angle of rotation: 5.061451617298746



9. Plane group: $p4gm$

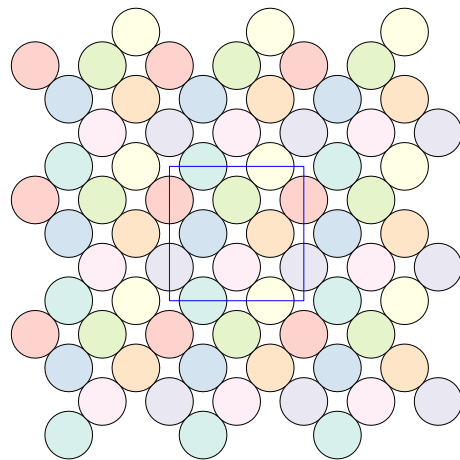
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.635328242978019	0
\mathbf{b}_2	0	5.635328242978019

Centroid in Cartesian coordinates:

	x	y
	1.408832053585225	0.000000000392080

Angle of rotation: 2.967059670723942



10. Plane group: $c2mm$

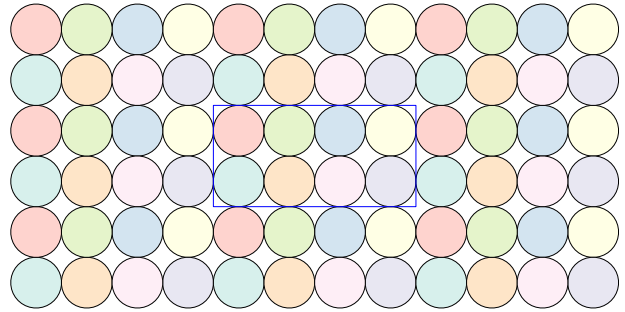
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.969557639550808	0
\mathbf{b}_2	0	3.984778865297762

Centroid in Cartesian coordinates:

	x	y
	0.996194705170722	0.996194705399315

Angle of rotation: 2.530727410073979



11. Plane group: pm

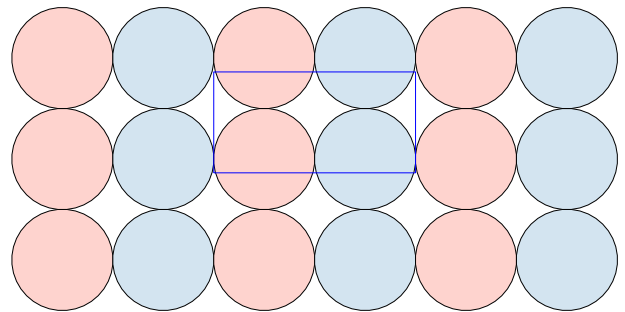
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.984778894195994	0
\mathbf{b}_2	0	1.992389415414842

Centroid in Cartesian coordinates:

	x	y
	0.996194724797841	0.996194707707421

Angle of rotation: 3.577925073416544



12. Plane group: $p2mm$

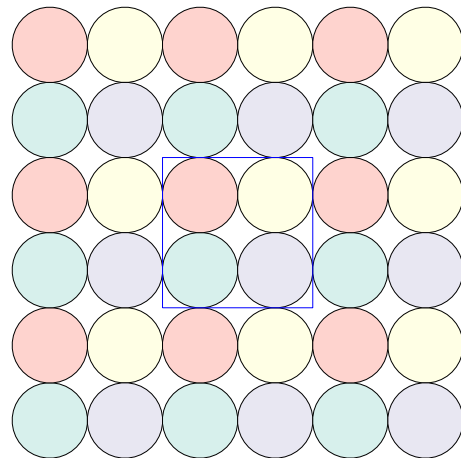
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.984778852114794	0
\mathbf{b}_2	0	3.984778852919894

Centroid in Cartesian coordinates:

	x	y
	0.996194718306409	0.996194713888769

Angle of rotation: 3.752458002469069



13. Plane group: $p6$

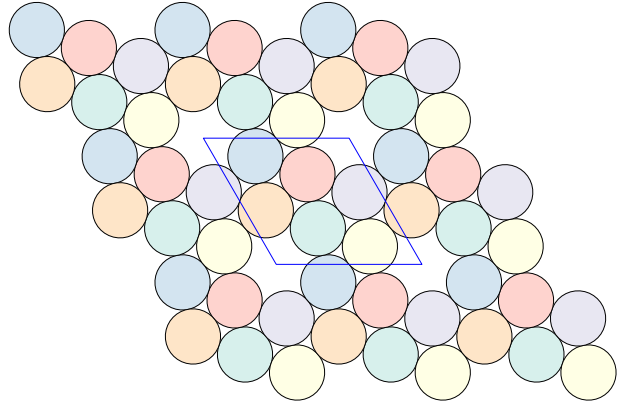
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.271366866303502	0
\mathbf{b}_2	-2.635683433151750	4.565137618886402

Centroid in Cartesian coordinates:

	x	y
	1.506104819845909	1.304325031838740

Angle of rotation: 5.687863047701113



14. Plane group: $p31m$

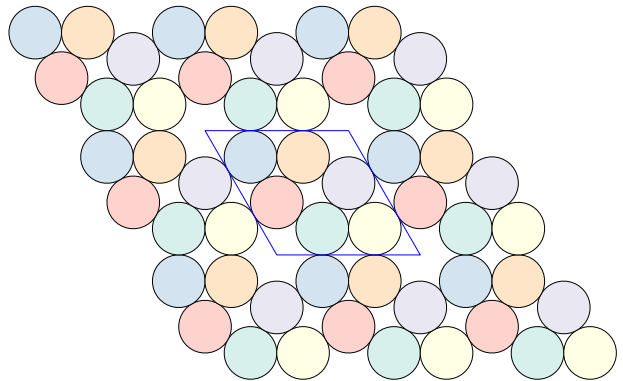
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.443309099885620	0
\mathbf{b}_2	-2.721654549942809	4.714043961151954

Centroid in Cartesian coordinates:

	x	y
	1.725459847250673	0.996194714977130

Angle of rotation: 4.450589600485202



15. Plane group: $p3m1$

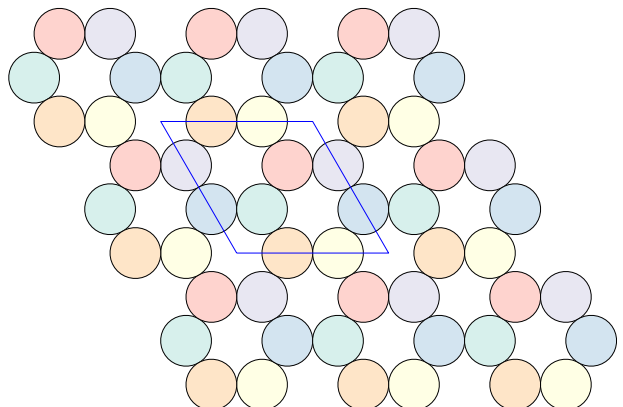
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.977168292581471	0
\mathbf{b}_2	-2.988584146290734	5.176379584070412

Centroid in Cartesian coordinates:

	x	y
	0.996194732407898	1.725459860667507

Angle of rotation: 2.879793311287412



16. Plane group: $p4mm$

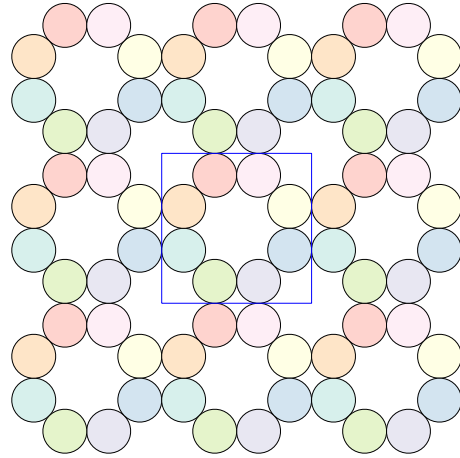
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.813205974819326	0
\mathbf{b}_2	0	6.813205974819326

Centroid in Cartesian coordinates:

	x	y
	0.996194709011111	2.410408273558815

Angle of rotation: 5.497787022900029



17. Plane group: $p6mm$

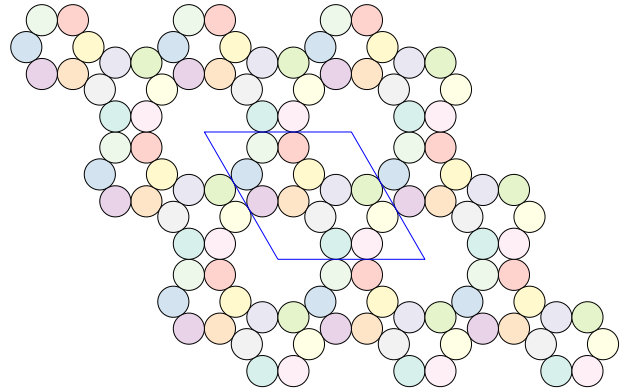
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.428087977559015	0
\mathbf{b}_2	-4.714043988779506	8.164963697680758

Centroid in Cartesian coordinates:

	x	y
	0.996194709011111	2.410408273558815

Angle of rotation: 3.577925055452041



AA. 37-gon

1. Plane group: $p2$

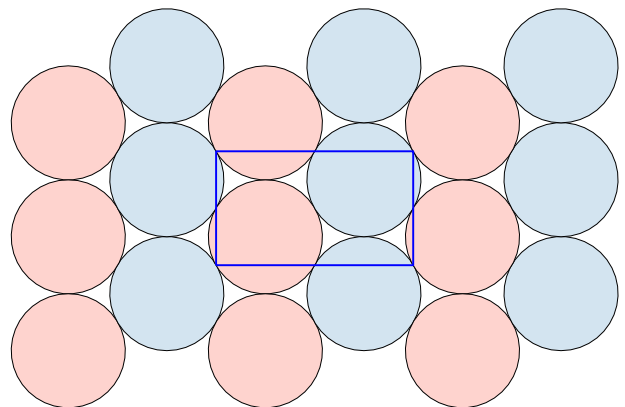
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.454399339064570	0.000005369859139
\mathbf{b}_2	0	1.996397496624759

Centroid in Cartesian coordinates:

	x	y
	0.863595562310731	0.497833586367493

Angle of rotation: 5.646289463583110



2. *Plane group: p2gg*

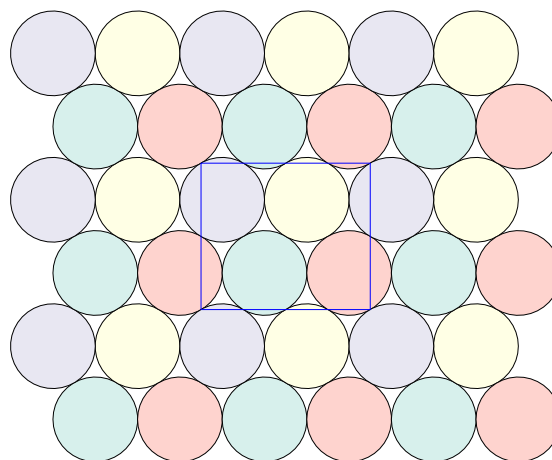
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.992794982508518	0
\mathbf{b}_2	0	3.454399374520027

Centroid in Cartesian coordinates:

	x	y
	1.498565247309666	0.863599830793655

Angle of rotation: 3.141592317522648



3. *Plane group: pg*

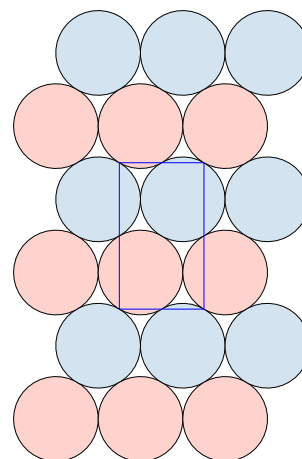
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.996397489670687	0
\mathbf{b}_2	0	3.454399328768862

Centroid in Cartesian coordinates:

	x	y
	0.500366499637542	0.863599832192216

Angle of rotation: 2.462329310625222



4. *Plane group: p3*

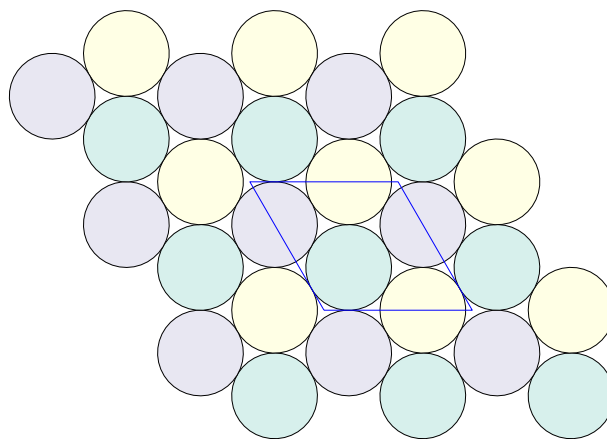
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.457288721717725	0
\mathbf{b}_2	-1.728644360858862	2.994099861224979

Centroid in Cartesian coordinates:

	x	y
	0.575641229490953	0.997572896670897

Angle of rotation: 1.551873811741266



5. **Plane group: $p1$**

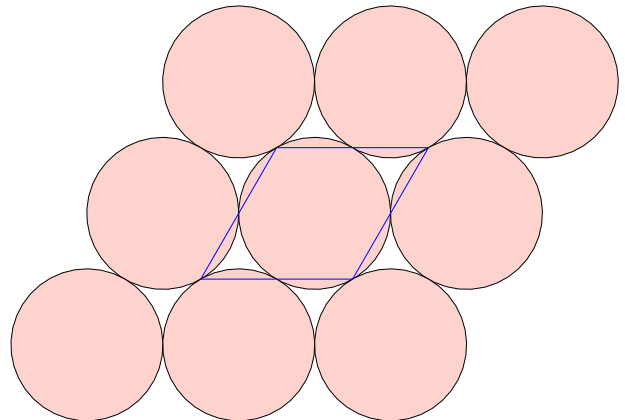
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.997211277920808	0
\mathbf{b}_2	0.997793177672481	1.729165035557815

Centroid in Cartesian coordinates:

	x	y
	1.497502227796645	0.864582517778907

Angle of rotation: 4.613574984994425



6. **Plane group: $p2mg$**

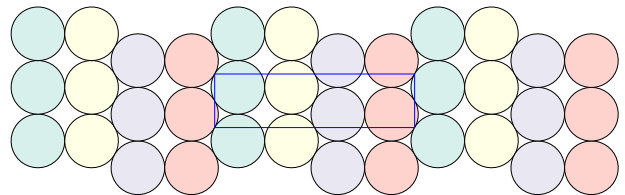
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.450618461390107	0
\mathbf{b}_2	0	1.996423064884535

Centroid in Cartesian coordinates:

	x	y
	0.863353627579670	1.498442798169214

Angle of rotation: 3.698555585940980



7. **Plane group: cm**

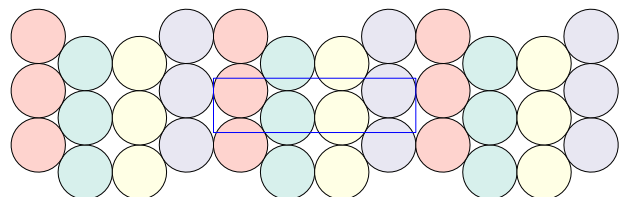
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.445597348099761	0
\mathbf{b}_2	0	1.998197937229748

Centroid in Cartesian coordinates:

	x	y
	2.726401183730027	0.540799299962930

Angle of rotation: 2.632145192199059



8. *Plane group: p4*

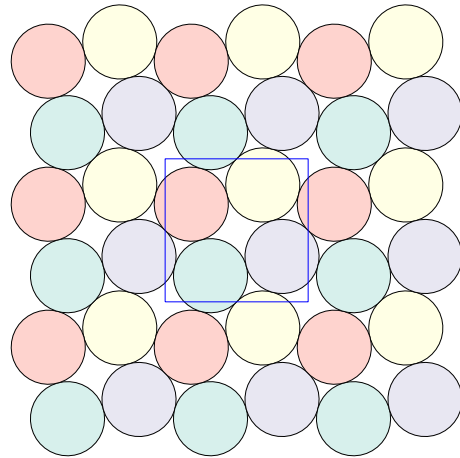
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.855596368755854	0
\mathbf{b}_2	0	3.855596368755854

Centroid in Cartesian coordinates:

	x	y
	1.223235484507991	0.704556156219749

Angle of rotation: 1.337190844195511



9. *Plane group: p4gm*

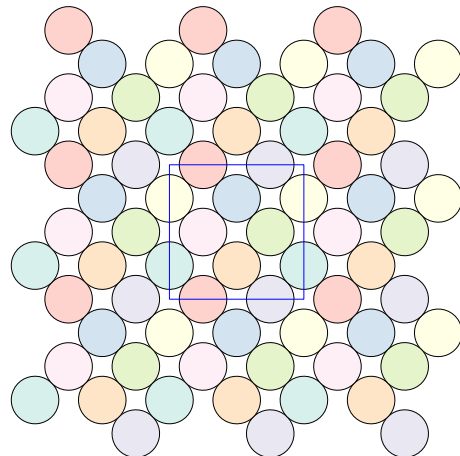
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.646823708965770	0
\mathbf{b}_2	0	5.646823708965770

Centroid in Cartesian coordinates:

	x	y
	0.001910238809036	1.412382760508600

Angle of rotation: 3.077911706273854



10. *Plane group: c2mm*

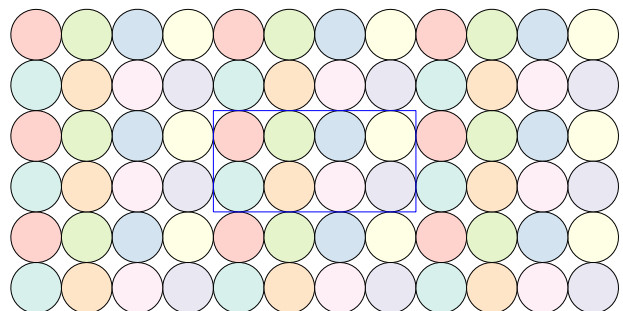
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.985886459138740	0
\mathbf{b}_2	0	3.992795060757206

Centroid in Cartesian coordinates:

	x	y
	0.999098977343963	1.000000001101614

Angle of rotation: 4.033126076524662



11. Plane group: pm

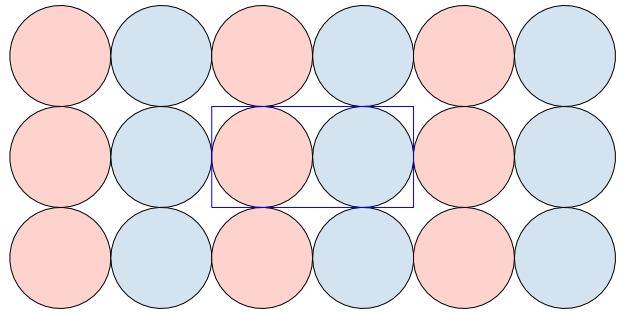
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.992965558590964	0
\mathbf{b}_2	0	1.998112576805535

Centroid in Cartesian coordinates:

	x	y
	0.996483295776667	0.999056288402768

Angle of rotation: 2.885851087641187



12. Plane group: $p2mm$

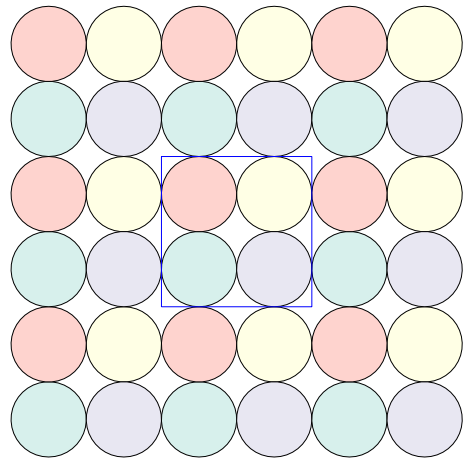
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.996395915881981	0
\mathbf{b}_2	0	3.992795117115862

Centroid in Cartesian coordinates:

	x	y
	0.999098990821358	1.000000044333797

Angle of rotation: 1.485888242644838



13. Plane group: $p6$

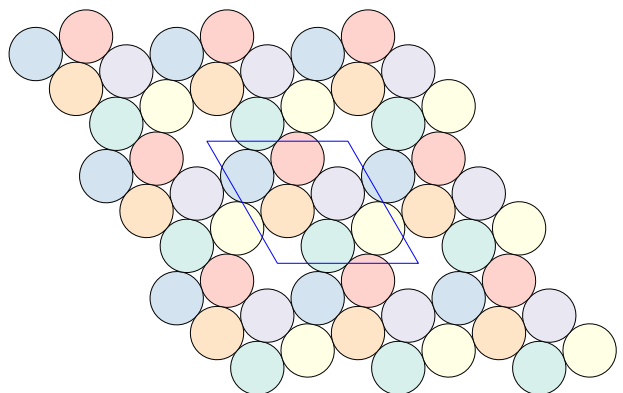
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.280549177930693	0
\mathbf{b}_2	-2.640274588965345	4.573089734021014

Centroid in Cartesian coordinates:

	x	y
	1.886914823772745	0.652167862241208

Angle of rotation: 4.118077668060721



14. *Plane group: p31m*

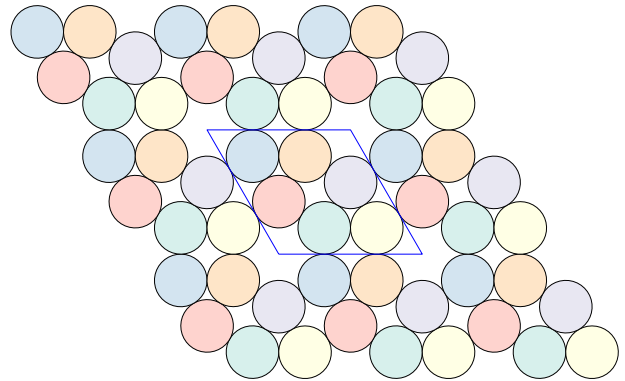
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.453899094006937	0
\mathbf{b}_2	-2.726949547003467	4.723215165086942

Centroid in Cartesian coordinates:

	x	y
	1.727659769330847	0.999599506524885

Angle of rotation: 0.495296195630556



15. *Plane group: p3m1*

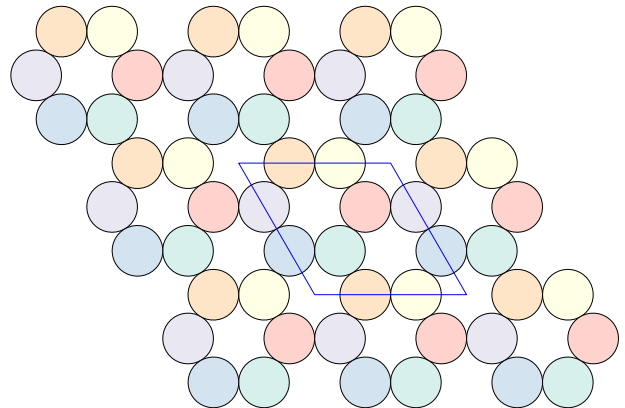
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.991193036696805	0
\mathbf{b}_2	-2.995596518348401	5.188525368755868

Centroid in Cartesian coordinates:

	x	y
	0.996397492484673	1.729508451326776

Angle of rotation: 2.717053141653393



16. *Plane group: p4mm*

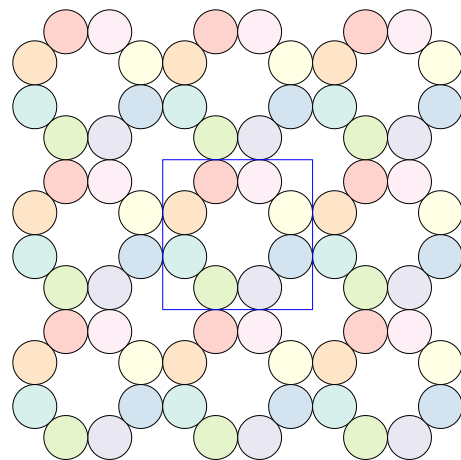
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.810129965285889	0
\mathbf{b}_2	0	6.810129965285889

Centroid in Cartesian coordinates:

	x	y
	0.997973051931693	2.407091915806792

Angle of rotation: 1.507115446455818



17. *Plane group: p6mm*

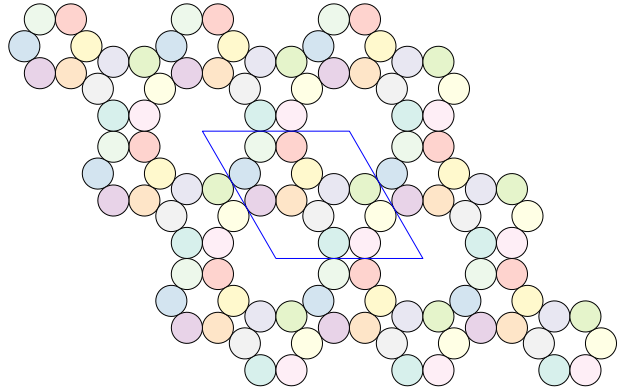
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.448543899636922	0
\mathbf{b}_2	-4.724271949818459	8.182679045858061

Centroid in Cartesian coordinates:

	x	y
	0.997973051931693	2.407091915806792

Angle of rotation: 1.839671542053431



AB. 39-gon

1. *Plane group: p2*

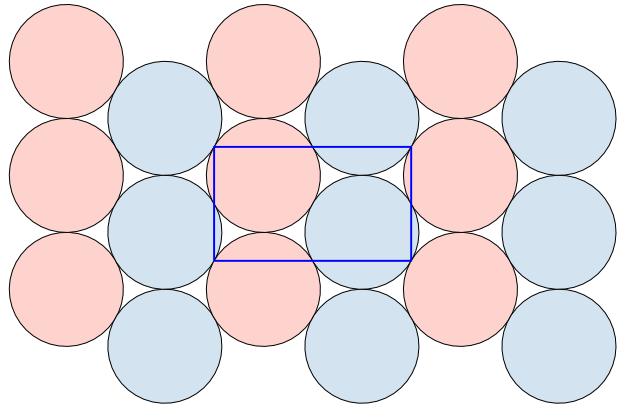
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.454744418688189	0.000215567225373
\mathbf{b}_2	0	1.997471985176867

Centroid in Cartesian coordinates:

	x	y
	0.863642326464438	1.497064337155682

Angle of rotation: 1.516886007737218



2. *Plane group: p2gg*

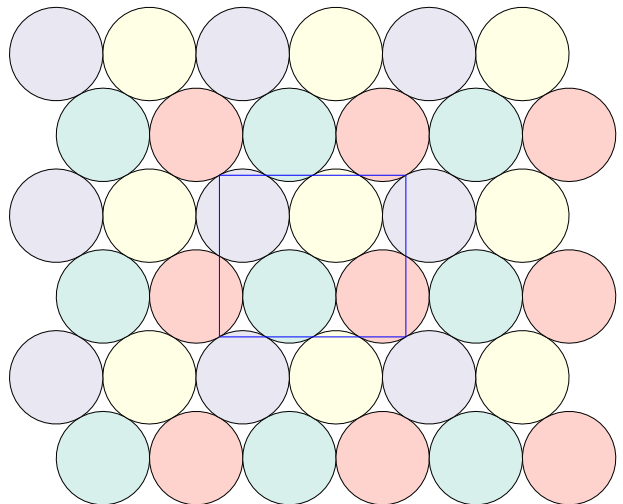
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.990251631071255	0
\mathbf{b}_2	0	3.459341635734331

Centroid in Cartesian coordinates:

	x	y
	1.497928566473785	0.864750145442865

Angle of rotation: 3.826298801138662



3. *Plane group: pg*

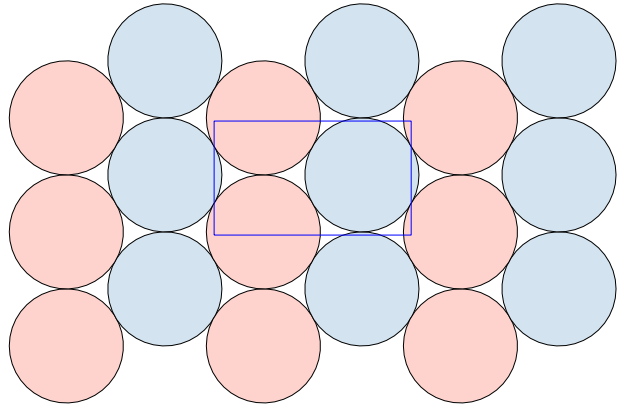
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.453793412011396	0
\mathbf{b}_2	0	1.998377996655937

Centroid in Cartesian coordinates:

	x	y
	0.863404735145501	0.499594499163984

Angle of rotation: 5.880417023459918



4. *Plane group: p3*

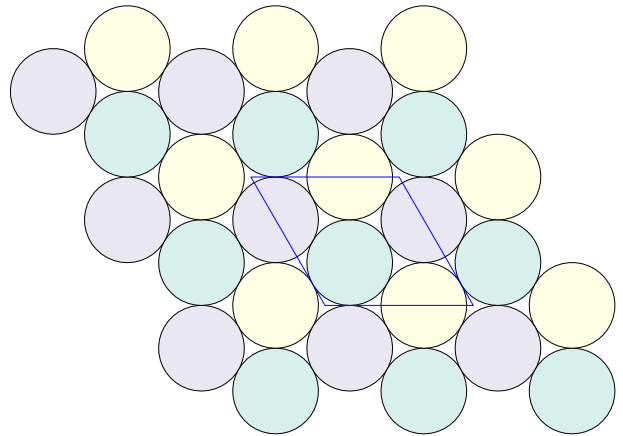
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.458485111155028	0
\mathbf{b}_2	-1.729242555577513	2.995135964870503

Centroid in Cartesian coordinates:

	x	y
	0.576414184425552	0.998378654918379

Angle of rotation: 2.456881571797685



5. *Plane group: p1*

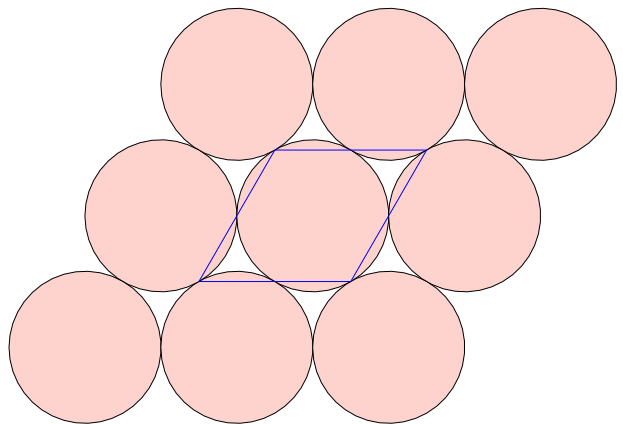
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.996757308398275	0
\mathbf{b}_2	0.998378653996500	1.729242554372010

Centroid in Cartesian coordinates:

	x	y
	1.497567981197387	0.864621277186005

Angle of rotation: 4.913781761943312



6. Plane group: $p2mg$

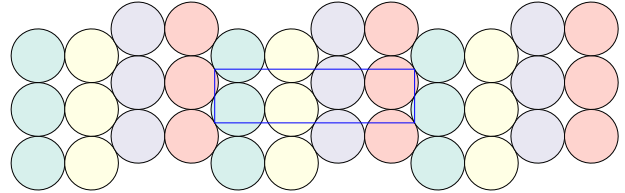
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.440648233145313	0
\mathbf{b}_2	0	1.998377994537206

Centroid in Cartesian coordinates:

	x	y
	0.863404746186269	0.499594505089224

Angle of rotation: 2.174948737549661



7. Plane group: cm

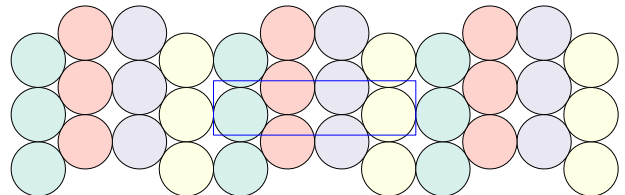
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.440648205984277	0
\mathbf{b}_2	0	1.998378009587667

Centroid in Cartesian coordinates:

	x	y
	0.996757315351586	0.753610420065340

Angle of rotation: 3.222146382074924



8. Plane group: $p4$

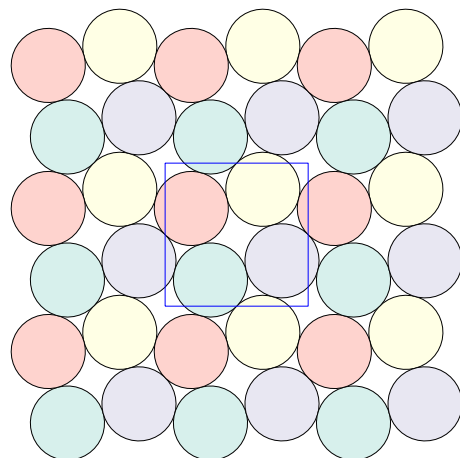
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.856730998250519	0
\mathbf{b}_2	0	3.856730998250519

Centroid in Cartesian coordinates:

	x	y
	1.222430544044447	0.705534942721735

Angle of rotation: 1.338736363837322



9. Plane group: $p4gm$

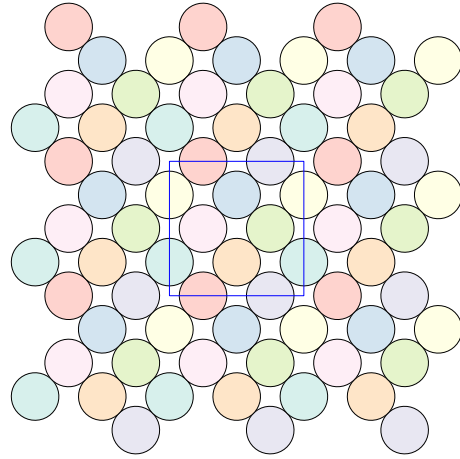
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.647541173478928	0
\mathbf{b}_2	0	5.647541173478928

Centroid in Cartesian coordinates:

	x	y
	0.001719462049389	1.412423410704310

Angle of rotation: 1.510381109410936



10. Plane group: $c2mm$

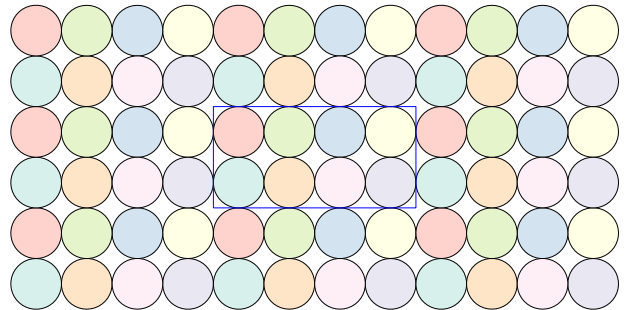
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.986760014335335	0
\mathbf{b}_2	0	3.993514701623270

Centroid in Cartesian coordinates:

	x	y
	0.999189012563514	0.996757325411771

Angle of rotation: 3.826298552973928



11. Plane group: pm

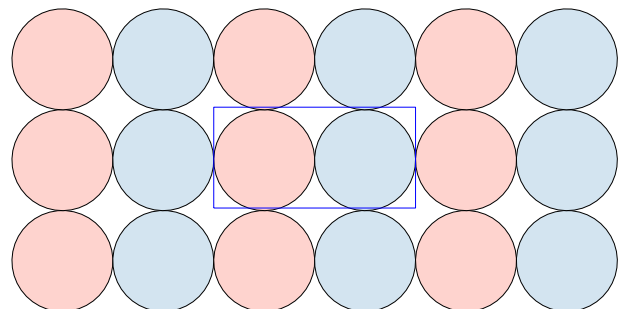
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.996437920500335	0
\mathbf{b}_2	0	1.996916233018779

Centroid in Cartesian coordinates:

	x	y
	0.999617471031594	0.998458116509390

Angle of rotation: 2.791717438044693



12. Plane group: $p2mm$

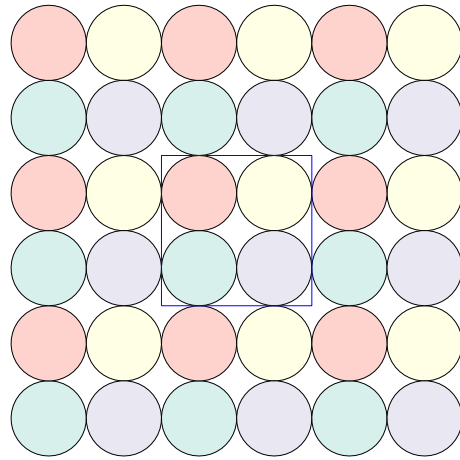
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.996755999674273	0
\mathbf{b}_2	0	3.993514633976380

Centroid in Cartesian coordinates:

	x	y
	0.999188996831612	1.000000000109689

Angle of rotation: 0.684706033480314



13. Plane group: $p6$

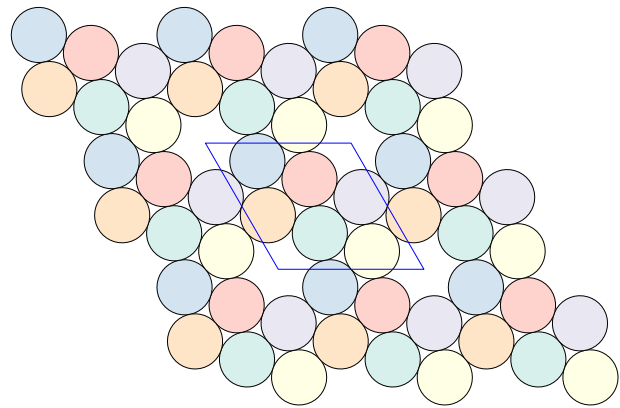
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.278836202455938	0
\mathbf{b}_2	-2.639418101227968	4.571606253743817

Centroid in Cartesian coordinates:

	x	y
	1.507577354903250	1.304565184259094

Angle of rotation: 3.383675222821557



14. Plane group: $p31m$

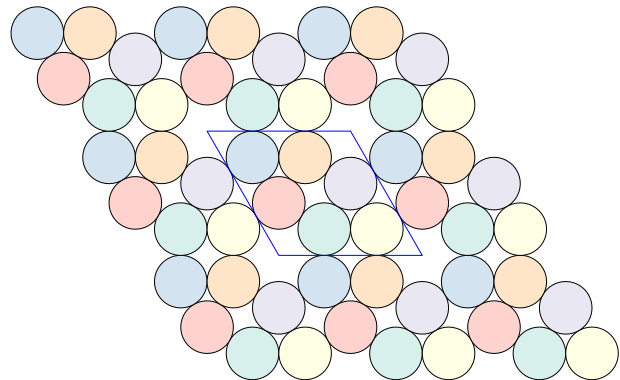
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.451246630319070	0
\mathbf{b}_2	-2.725623315159534	4.720918064150633

Centroid in Cartesian coordinates:

	x	y
	1.726434307416459	0.996757311307976

Angle of rotation: 3.020762153511605



15. Plane group: $p3m1$

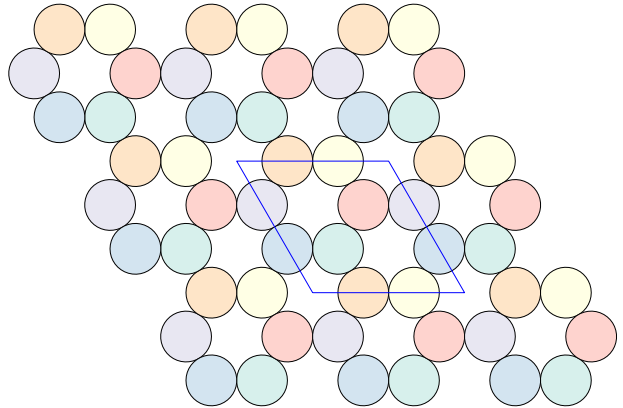
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.980543914661346	0
\mathbf{b}_2	-2.990271957330672	5.179302958545160

Centroid in Cartesian coordinates:

	x	y
	0.996757316639993	1.726434322935148

Angle of rotation: 3.383253544208066



16. Plane group: $p4mm$

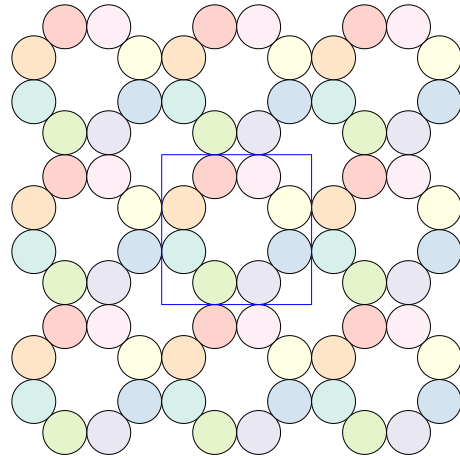
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.818444351702001	0
\mathbf{b}_2	0	6.818444351702001

Centroid in Cartesian coordinates:

	x	y
	0.999797232049985	2.409424941271743

Angle of rotation: 4.772804212665835



17. Plane group: $p6mm$

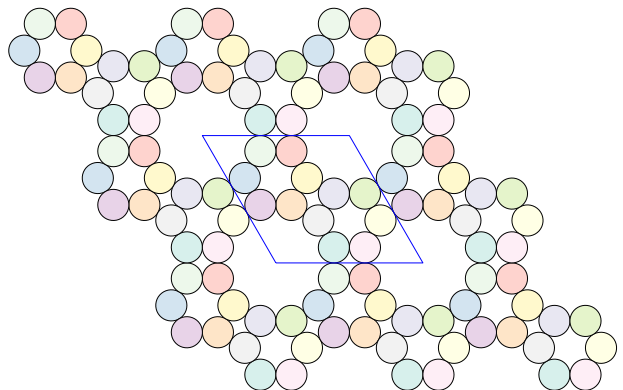
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.441836165100787	0
\mathbf{b}_2	-4.720918082550392	8.176869977347925

Centroid in Cartesian coordinates:

	x	y
	0.999797232049985	2.409424941271743

Angle of rotation: 3.947129289321320



AC. 42-gon

1. Plane group: $p2$

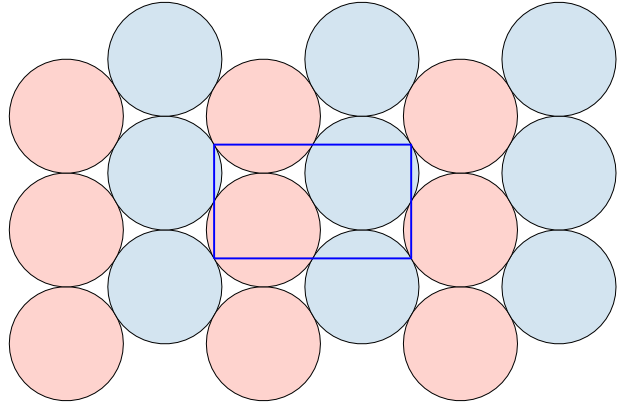
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.454415310727778	0.000000010578505
\mathbf{b}_2	0	1.994407627529681

Centroid in Cartesian coordinates:

	x	y
	0.863603826403979	0.498601910582771

Angle of rotation: 1.795102813068991



2. Plane group: $p2gg$

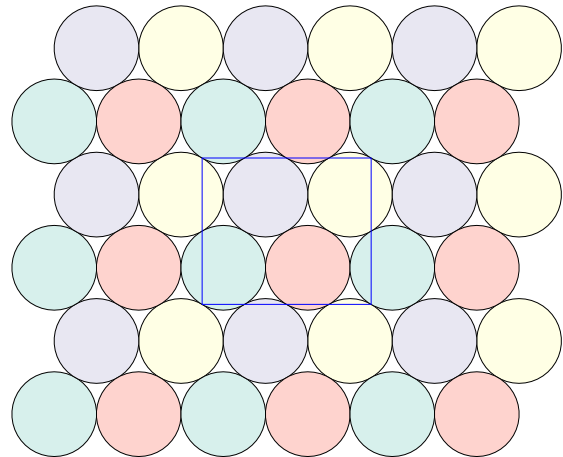
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.988815222273144	0
\mathbf{b}_2	0	3.454415318761713

Centroid in Cartesian coordinates:

	x	y
	0.498601896209626	0.863603833487963

Angle of rotation: 2.617993972065892



3. Plane group: pg

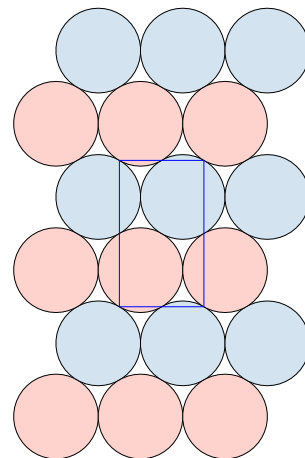
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.994407596508720	0
\mathbf{b}_2	0	3.454415299862601

Centroid in Cartesian coordinates:

	x	y
	0.498601905080574	0.863603824965650

Angle of rotation: 5.909186178157045



4. **Plane group: $p3$**

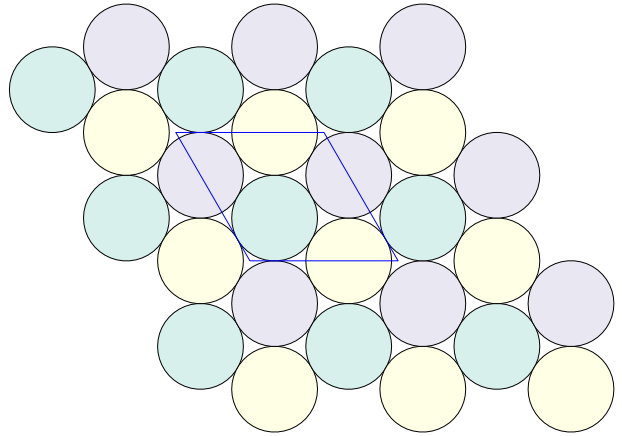
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.454415428313397	0
\mathbf{b}_2	-1.727207714156698	2.991611516144304

Centroid in Cartesian coordinates:

	x	y
	0.575735904382531	0.997203837960803

Angle of rotation: 3.889876326065659



5. **Plane group: $p1$**

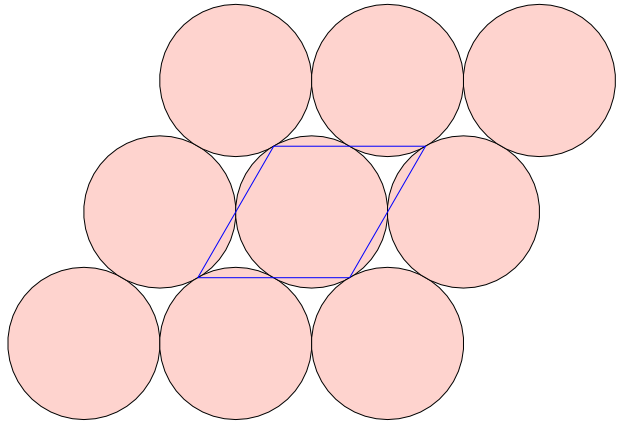
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.994407595643148	0
\mathbf{b}_2	0.997203797743469	1.727207643265702

Centroid in Cartesian coordinates:

	x	y
	1.495805696693309	0.863603821632851

Angle of rotation: 5.011559229496076



6. **Plane group: $p2mg$**

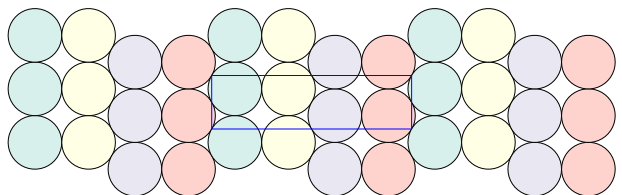
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.454415102174824	0
\mathbf{b}_2	0	1.994408425884010

Centroid in Cartesian coordinates:

	x	y
	0.863604187657214	1.495806319433549

Angle of rotation: 1.197706994440179



7. Plane group: cm

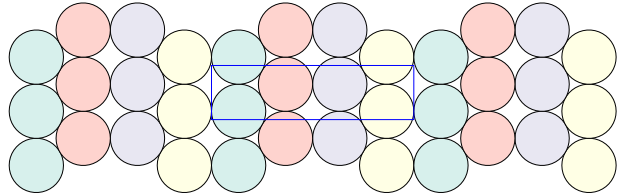
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.454415337495703	0
\mathbf{b}_2	0	1.994407610264823

Centroid in Cartesian coordinates:

	x	y
	1.000000007259300	0.307727031994233

Angle of rotation: 3.291192238505809



8. Plane group: $p4$

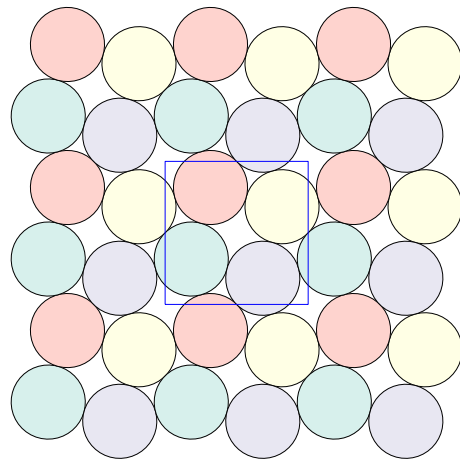
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.857465799955948	0
\mathbf{b}_2	0	3.857465799955948

Centroid in Cartesian coordinates:

	x	y
	0.705129618865633	1.223603379613641

Angle of rotation: 2.131734387809202



9. Plane group: $p4gm$

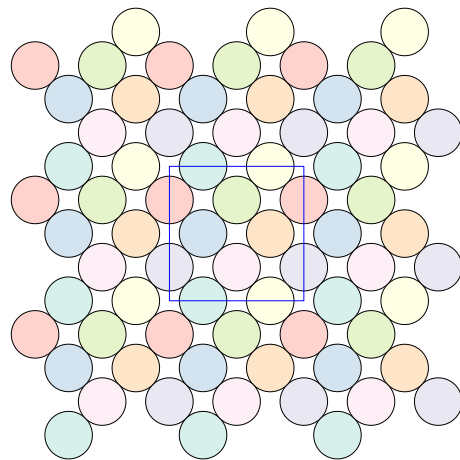
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.648945443793968	0
\mathbf{b}_2	0	5.648945443793968

Centroid in Cartesian coordinates:

	x	y
	1.412236358987903	0.001977207079322

Angle of rotation: 2.505794223488575



10. Plane group: $c2mm$

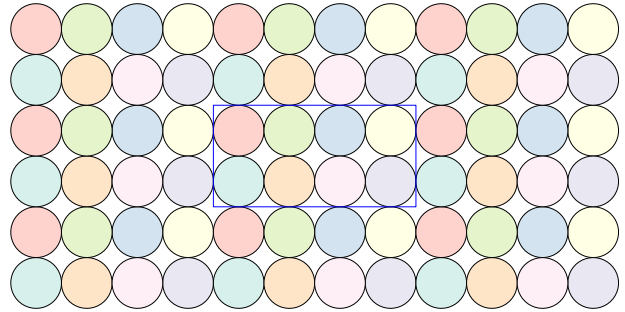
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.977630494447605	0
\mathbf{b}_2	0	4.000000114869466

Centroid in Cartesian coordinates:

	x	y
	0.997203823291217	1.000000054098080

Angle of rotation: 0.673198688295592



11. Plane group: pm

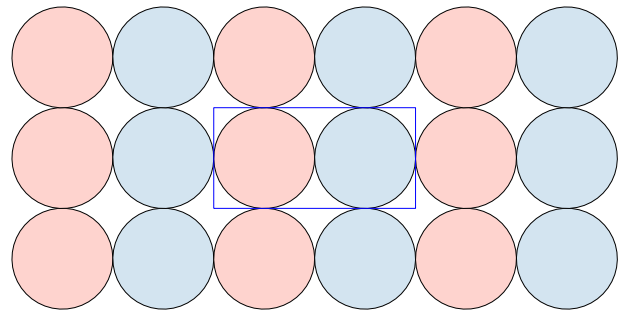
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.999027371055530	0
\mathbf{b}_2	0	1.994892677966106

Centroid in Cartesian coordinates:

	x	y
	0.999756842300105	0.997446338983053

Angle of rotation: 3.313245503277334



12. Plane group: $p2mm$

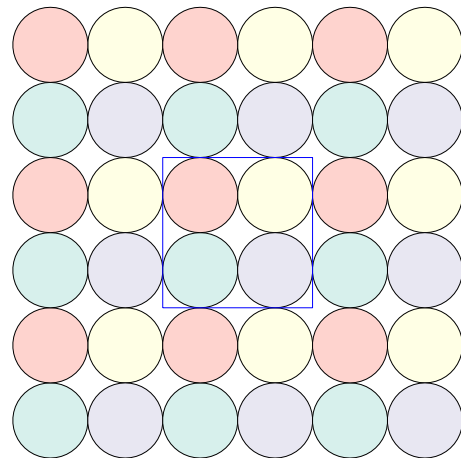
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.988815209485558	0
\mathbf{b}_2	0	4.000000046108940

Centroid in Cartesian coordinates:

	x	y
	0.997203804349170	1.000000015656590

Angle of rotation: 4.861988625308485



13. Plane group: $p6$

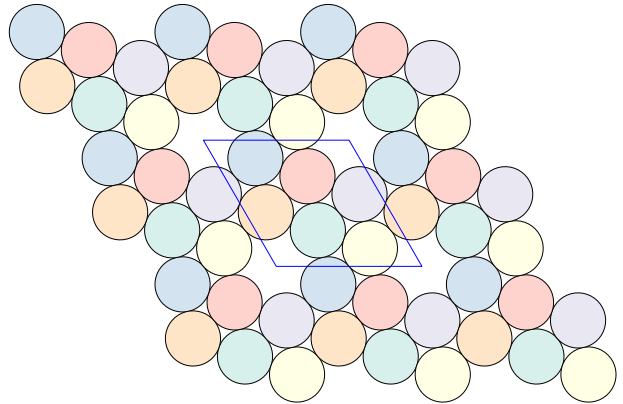
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.276706570588197	0
\mathbf{b}_2	-2.638353285294097	4.569761938445644

Centroid in Cartesian coordinates:

	x	y
	1.507630447303917	1.305646268876180

Angle of rotation: 1.835578173711883



14. Plane group: $p31m$

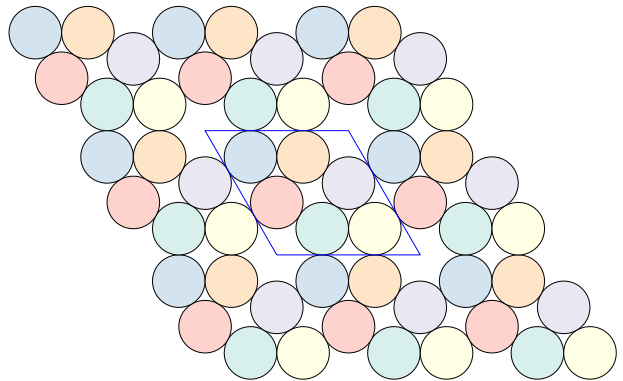
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.454415295885490	0
\mathbf{b}_2	-2.727207647942744	4.723662209027251

Centroid in Cartesian coordinates:

	x	y
	1.727207647379214	0.997203801665879

Angle of rotation: 0.448798940734553



15. Plane group: $p3m1$

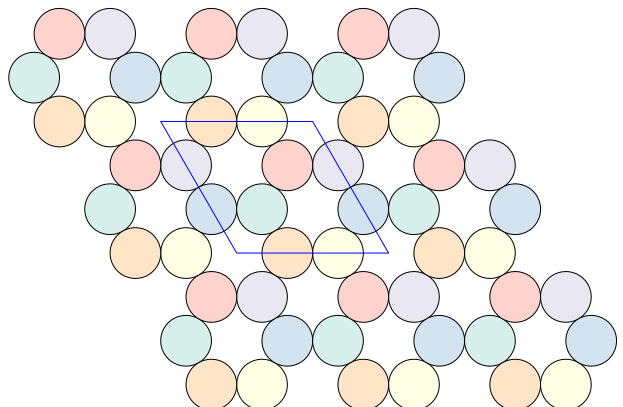
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.983222824797265	0
\mathbf{b}_2	-2.991611412398631	5.181622962777321

Centroid in Cartesian coordinates:

	x	y
	0.997203802475040	1.727207649657773

Angle of rotation: 3.515591785832502



16. Plane group: $p4mm$

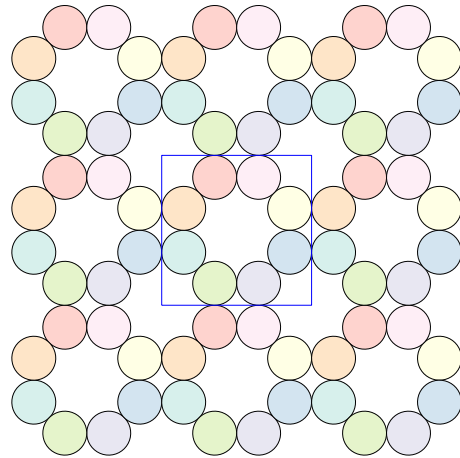
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.817721131161487	0
\mathbf{b}_2	0	6.817721131161487

Centroid in Cartesian coordinates:

	x	y
	0.999300706392262	2.409559856432768

Angle of rotation: 0.486198964384268



17. Plane group: $p6mm$

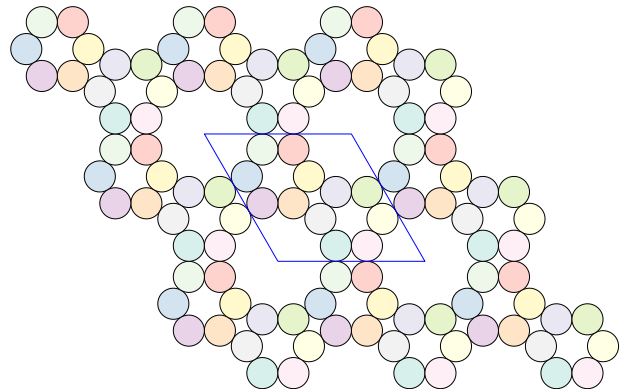
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.447324485103294	0
\mathbf{b}_2	-4.723662242551645	8.181623001894195

Centroid in Cartesian coordinates:

	x	y
	0.999300706392262	2.409559856432768

Angle of rotation: 5.310787587064184



AD. 55-gon

1. Plane group: $p2$

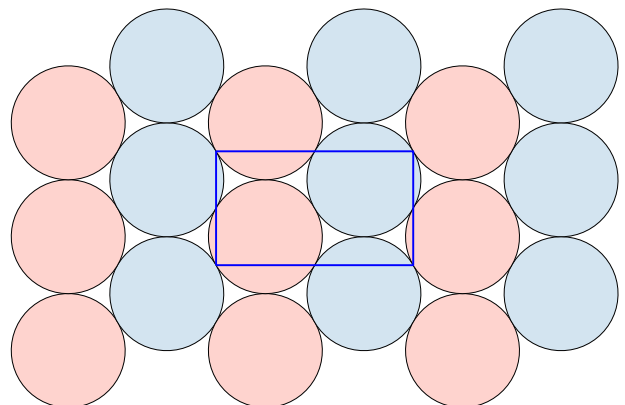
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.459674455464102	0.000002307757275
\mathbf{b}_2	0	1.998369119752982

Centroid in Cartesian coordinates:

	x	y
	0.864920426353086	0.500156904971098

Angle of rotation: 2.656019045776258



2. **Plane group: $p2gg$**

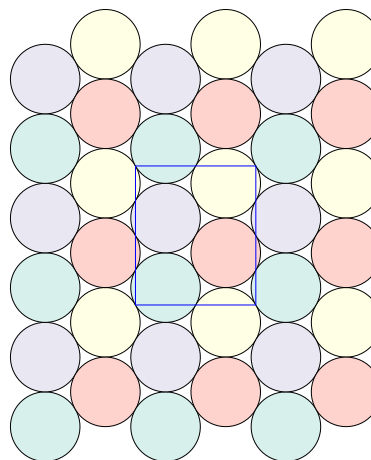
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.459674361364169	0
\mathbf{b}_2	0	3.996738347503810

Centroid in Cartesian coordinates:

	x	y
	0.864918597316282	0.499028234737280

Angle of rotation: 5.683426783367110



3. **Plane group: pg**

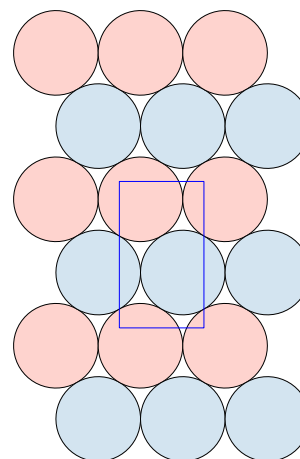
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.998369104865988	0
\mathbf{b}_2	0	3.459674375411484

Centroid in Cartesian coordinates:

	x	y
	0.499028218275274	0.864918593852871

Angle of rotation: 0.114239724449386



4. **Plane group: $p3$**

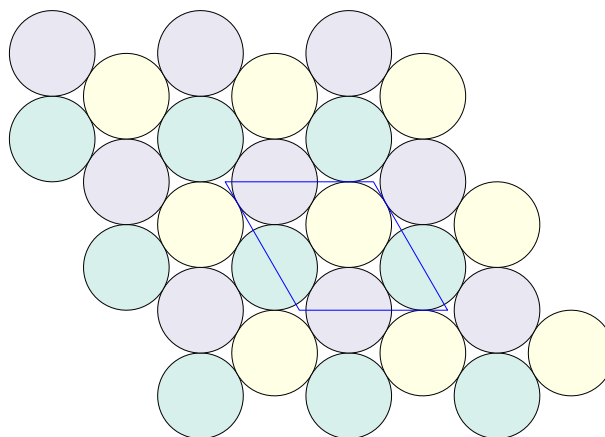
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.461011178144114	0
\mathbf{b}_2	-1.730505589072056	2.997323603054712

Centroid in Cartesian coordinates:

	x	y
	-0.576783866499893	0.999432957654690

Angle of rotation: 4.591757869313739



5. *Plane group: p1*

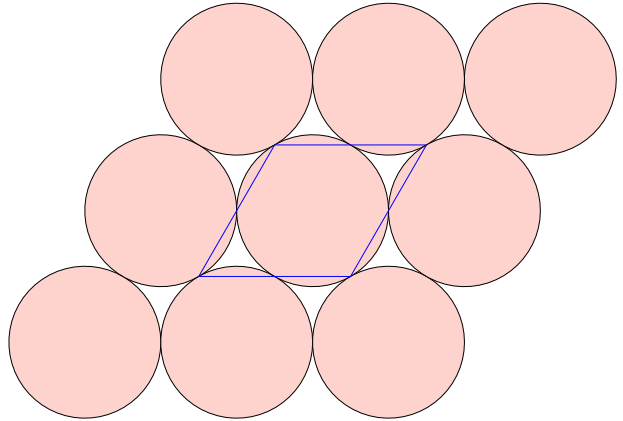
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.998369108263520	0
\mathbf{b}_2	0.999186779554816	1.731061385308996

Centroid in Cartesian coordinates:

	x	y
	1.498777943909168	0.865530692654498

Angle of rotation: 5.369237381196190



6. *Plane group: p2mg*

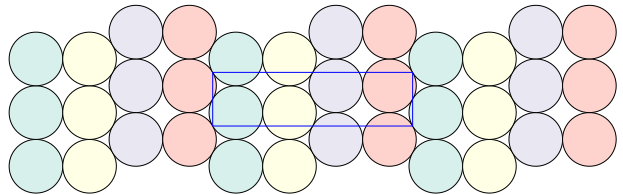
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.450754974356664	0
\mathbf{b}_2	0	1.999184371304362

Centroid in Cartesian coordinates:

	x	y
	0.864319618614224	0.499796100090245

Angle of rotation: 0.514079117528682



7. *Plane group: cm*

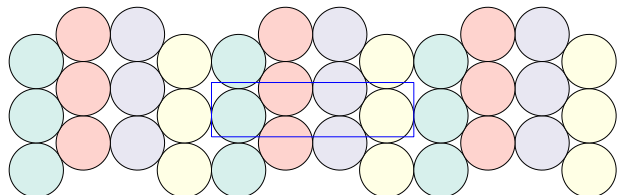
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.450754866394912	0
\mathbf{b}_2	0	1.999184390181773

Centroid in Cartesian coordinates:

	x	y
	0.998369107905203	0.772391233373526

Angle of rotation: 5.255027684433105



8. *Plane group: p4*

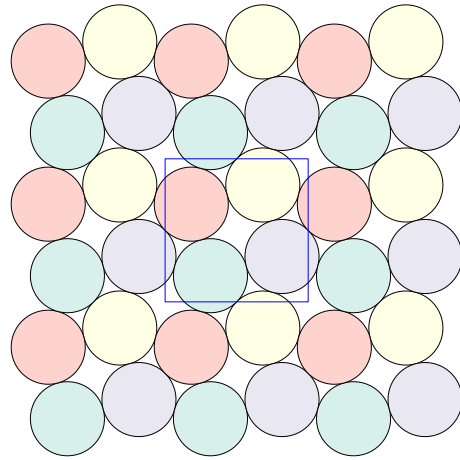
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.859492539414685	0
\mathbf{b}_2	0	3.859492539414685

Centroid in Cartesian coordinates:

	x	y
	1.223752718086912	0.706016518941738

Angle of rotation: 2.686822194622029



9. *Plane group: p4gm*

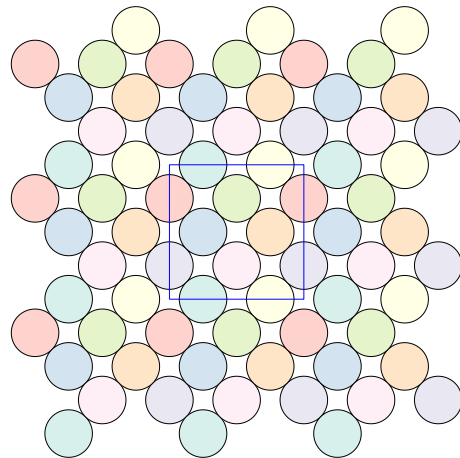
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.652191287897335	0
\mathbf{b}_2	0	5.652191287897335

Centroid in Cartesian coordinates:

	x	y
	1.413323654364533	0.000864848207581

Angle of rotation: 4.155470414502147



10. *Plane group: c2mm*

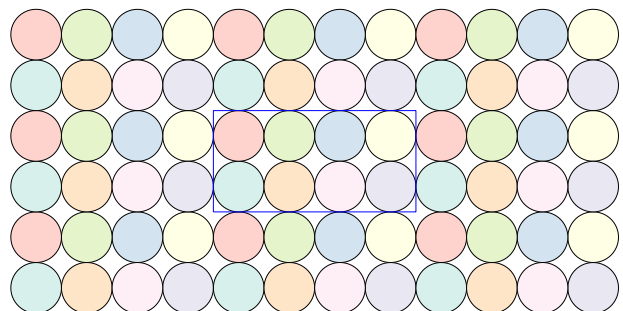
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.993381316364568	0
\mathbf{b}_2	0	3.996738239085899

Centroid in Cartesian coordinates:

	x	y
	0.999592201377395	0.998369112258767

Angle of rotation: 0.885357823760336



11. Plane group: pm

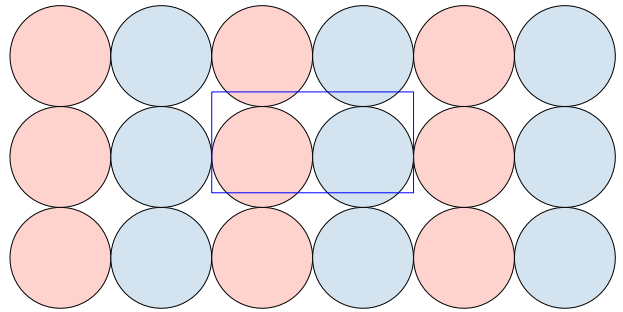
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.998058396686582	0
\mathbf{b}_2	0	1.998524249152140

Centroid in Cartesian coordinates:

	x	y
	0.999870406734935	0.999262124576070

Angle of rotation: 2.440054653028596



12. Plane group: $p2mm$

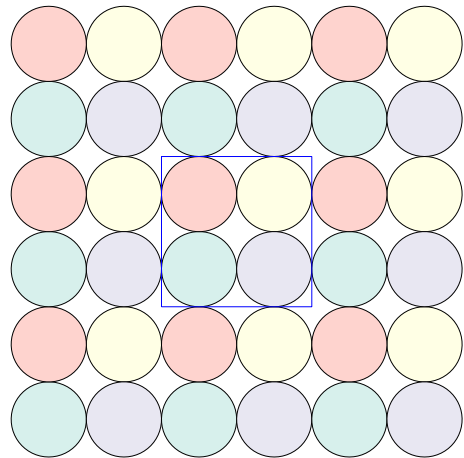
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.998368772095697	0
\mathbf{b}_2	0	3.996738208888592

Centroid in Cartesian coordinates:

	x	y
	0.999592192952115	1.000000000335080

Angle of rotation: 2.998792987859904



13. Plane group: $p6$

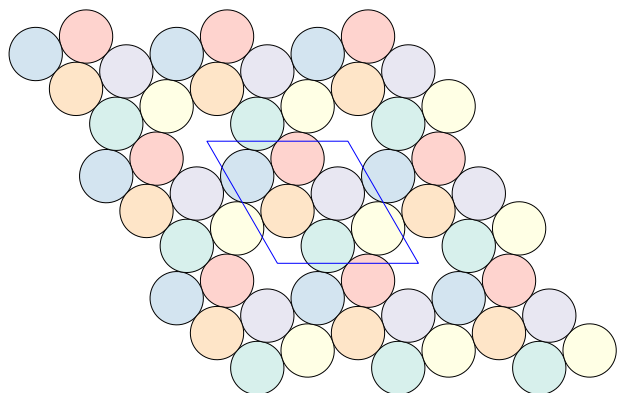
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.286527316053768	0
\mathbf{b}_2	-2.643263658026883	4.578266953502930

Centroid in Cartesian coordinates:

	x	y
	1.888499489754848	0.653530366106891

Angle of rotation: 0.823111840615294



14. *Plane group: p31m*

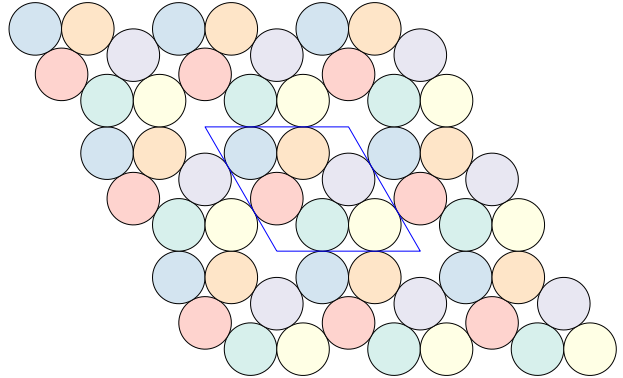
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.458683767270303	0
\mathbf{b}_2	-2.729341883635150	4.727358813681826

Centroid in Cartesian coordinates:

	x	y
	1.730062971967926	0.999818744997500

Angle of rotation: 0.847278088547772



15. *Plane group: p3m1*

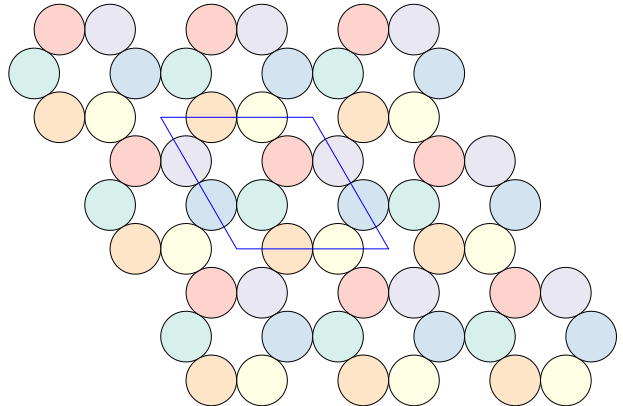
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.996013228521975	0
\mathbf{b}_2	-2.998006614260986	5.192699777327579

Centroid in Cartesian coordinates:

	x	y
	0.999818744398046	1.730062980740739

Angle of rotation: 1.294716787132568



16. *Plane group: p4mm*

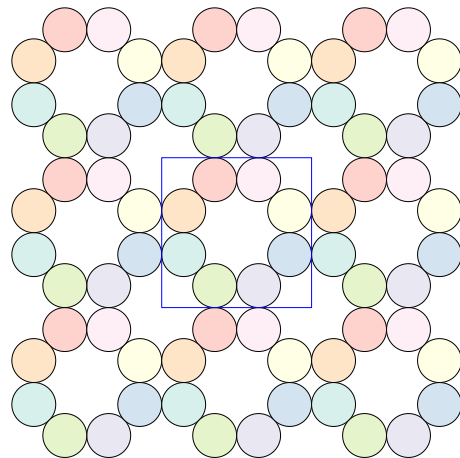
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.823406517973060	0
\mathbf{b}_2	0	6.823406517973060

Centroid in Cartesian coordinates:

	x	y
	0.999898065611068	2.411805199779709

Angle of rotation: 3.270112432151243



17. Plane group: $p6mm$

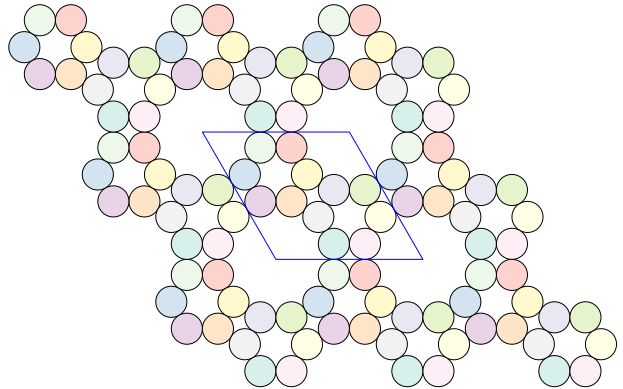
Primitive cell basic vectors:

x	y
\mathbf{b}_1 9.453105802626036	0
\mathbf{b}_2 -4.726552901313016	8.186629769736234

Centroid in Cartesian coordinates:

x	y
0.999898065611068	2.411805199779709

Angle of rotation: 2.141995105741121



AE. 89-gon

1. Plane group: $p2$

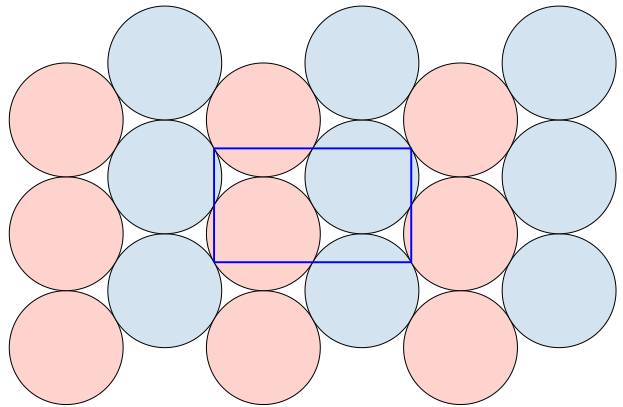
Primitive cell basic vectors:

x	y
\mathbf{b}_1 3.462366498915140	0.000000523110681
\mathbf{b}_2 0	1.999377063512676

Centroid in Cartesian coordinates:

x	y
0.865592002698640	0.500047038331839

Angle of rotation: 1.394320730396376



2. Plane group: $p2gg$

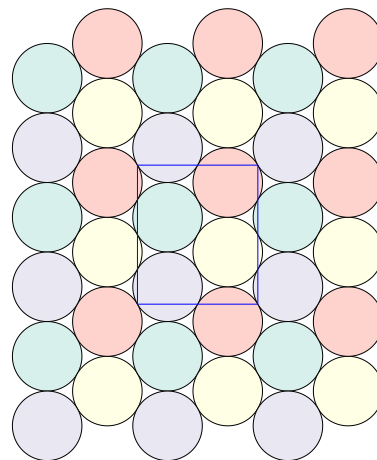
Primitive cell basic vectors:

x	y
\mathbf{b}_1 3.462366494906159	0
\mathbf{b}_2 0	3.998754141397348

Centroid in Cartesian coordinates:

x	y
0.865591623314583	2.499423981787553

Angle of rotation: 4.712388904690959



3. **Plane group: pg**

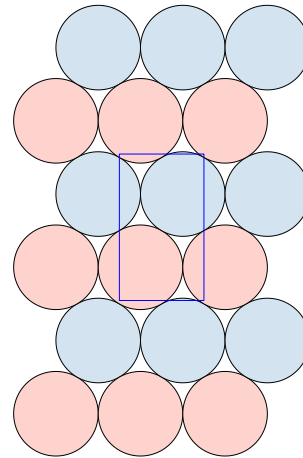
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.999377064486347	0
\mathbf{b}_2	0	3.462366478258379

Centroid in Cartesian coordinates:

	x	y
	0.500046903492380	0.865591619564595

Angle of rotation: 3.494580596475612



4. **Plane group: $p3$**

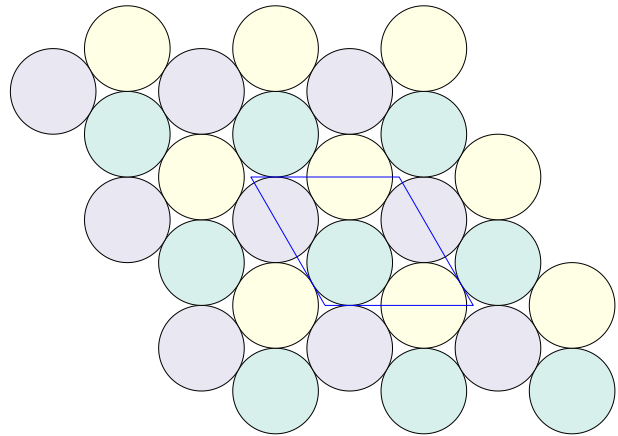
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.462912834387225	0
\mathbf{b}_2	-1.731456417193612	2.998970485670512

Centroid in Cartesian coordinates:

	x	y
	0.577138630222058	0.999781823987791

Angle of rotation: 3.367299169077332



5. **Plane group: $p1$**

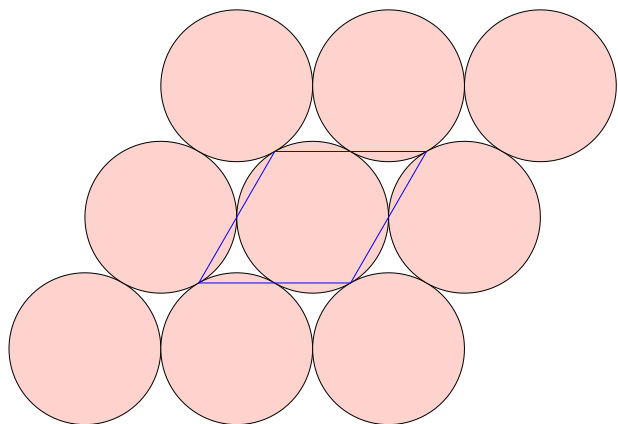
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	1.999514742919882	0
\mathbf{b}_2	0.999894640198261	1.731550837009712

Centroid in Cartesian coordinates:

	x	y
	1.499704691559072	0.865775418504856

Angle of rotation: 5.518347020754919



6. Plane group: $p2mg$

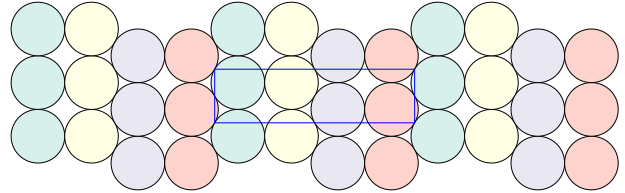
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.458985460319108	0
\mathbf{b}_2	0	1.999688482015938

Centroid in Cartesian coordinates:

	x	y
	0.865369272045409	1.499766382411460

Angle of rotation: 0.670677805726147



7. Plane group: cm

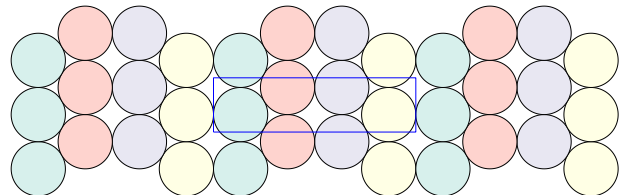
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.458985422500577	0
\mathbf{b}_2	0	1.999688533134994

Centroid in Cartesian coordinates:

	x	y
	0.999377088790376	0.643487007558268

Angle of rotation: 2.117927660294210



8. Plane group: $p4$

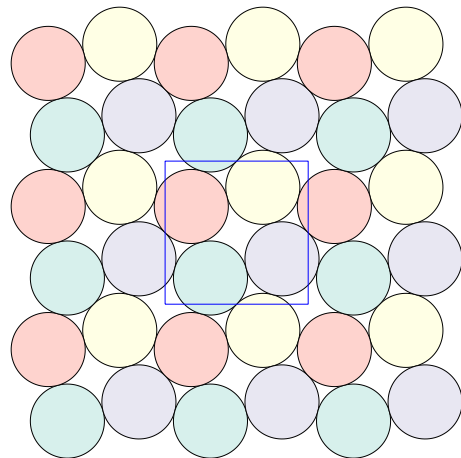
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.862092119315094	0
\mathbf{b}_2	0	3.862092119315094

Centroid in Cartesian coordinates:

	x	y
	1.224356585752544	0.706680212084132

Angle of rotation: 4.466884016046113



9. Plane group: $p4gm$

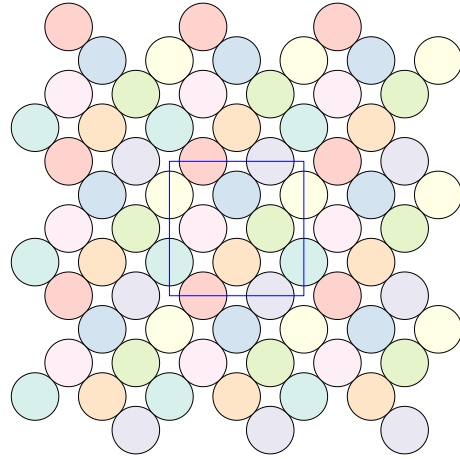
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.655103917509999	0
\mathbf{b}_2	0	5.655103917509999

Centroid in Cartesian coordinates:

	x	y
	0.000330367874704	1.413888990881784

Angle of rotation: 3.221014884030033



10. Plane group: $c2mm$

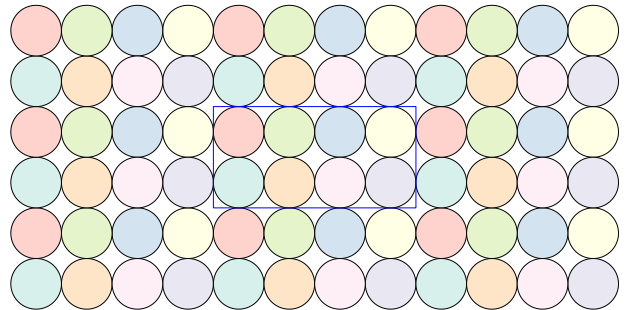
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.997530159747128	0
\mathbf{b}_2	0	3.998754158152758

Centroid in Cartesian coordinates:

	x	y
	0.999844306718663	1.000000004759780

Angle of rotation: 4.218205676152095



11. Plane group: pm

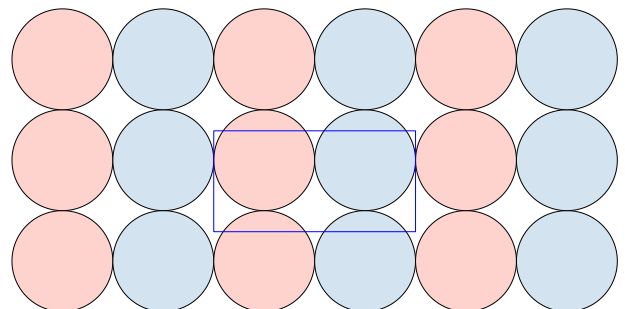
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.999335346074308	0
\mathbf{b}_2	0	1.999397894557362

Centroid in Cartesian coordinates:

	x	y
	0.999914399519733	0.999698947278681

Angle of rotation: 0.471968841149441



12. *Plane group: p2mm*

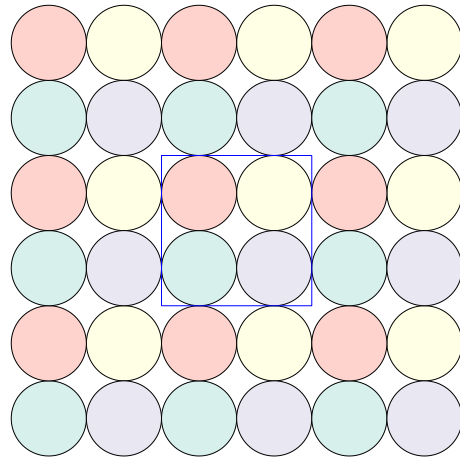
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.999377079105258	0
\mathbf{b}_2	0	3.998754415028372

Centroid in Cartesian coordinates:

	x	y
	0.999844285623364	1.000000077125655

Angle of rotation: 1.253106934069687



13. *Plane group: p6*

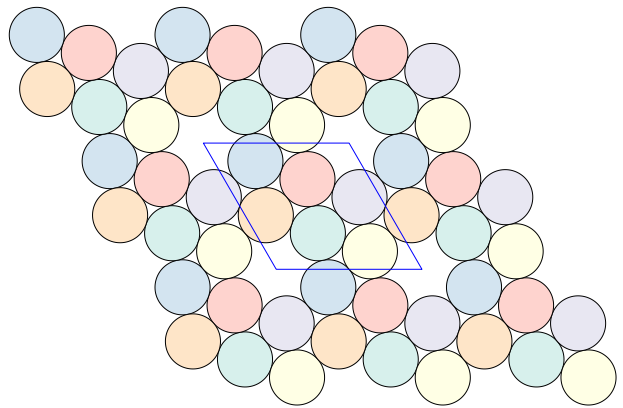
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.289580996762976	0
\mathbf{b}_2	-2.644790498381487	4.580911518572150

Centroid in Cartesian coordinates:

	x	y
	1.511231582044015	1.309075542218165

Angle of rotation: 1.651562048176791



14. *Plane group: p31m*

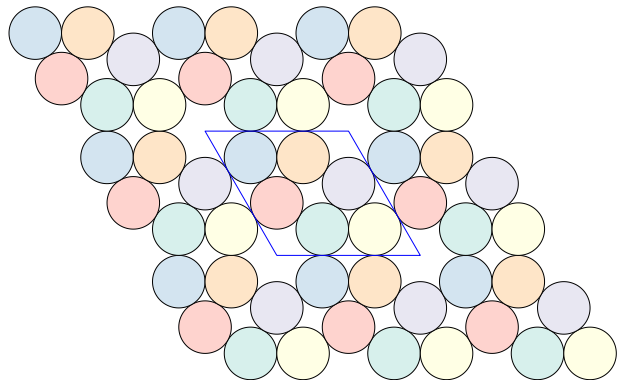
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.462040812236135	0
\mathbf{b}_2	-2.731020406118066	4.730266099903883

Centroid in Cartesian coordinates:

	x	y
	1.731291541163525	0.999930779393627

Angle of rotation: 3.076878170005434



15. *Plane group: p3m1*

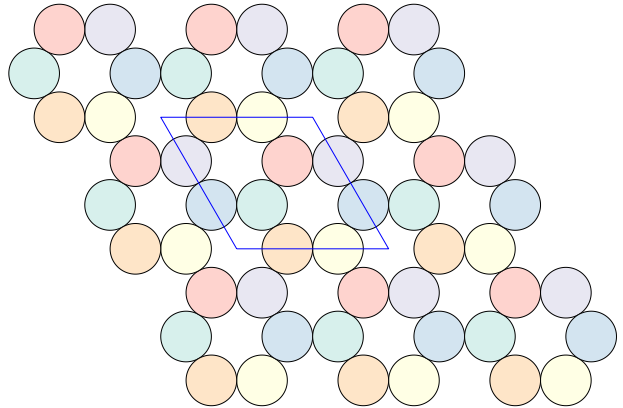
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.998477282170934	0
\mathbf{b}_2	-2.999238641085466	5.194833710383866

Centroid in Cartesian coordinates:

	x	y
	0.999930785355448	1.731930920987744

Angle of rotation: 2.494448398065868



16. *Plane group: p4mm*

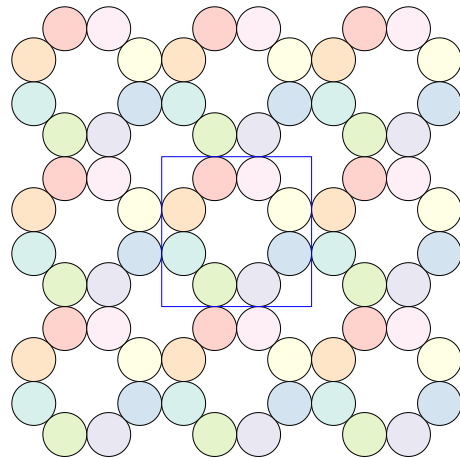
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.826759649134300	0
\mathbf{b}_2	0	6.826759649134300

Centroid in Cartesian coordinates:

	x	y
	0.999377067970785	2.413535565263114

Angle of rotation: 1.694342219404441



17. *Plane group: p6mm*

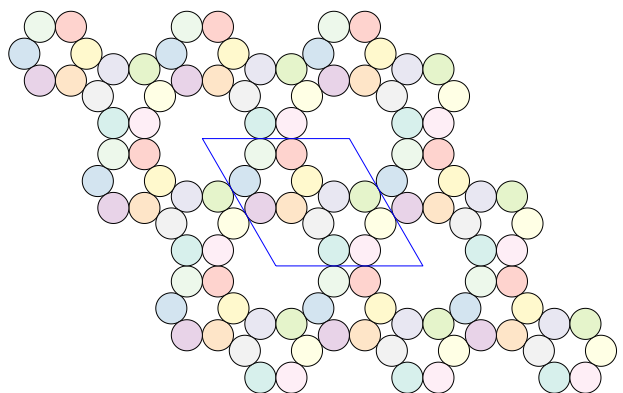
Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.459901810679691	0
\mathbf{b}_2	-4.729950905339844	8.192515285355022

Centroid in Cartesian coordinates:

	x	y
	0.999377067970785	2.413535565263114

Angle of rotation: 2.982747974265308



AF. Disc

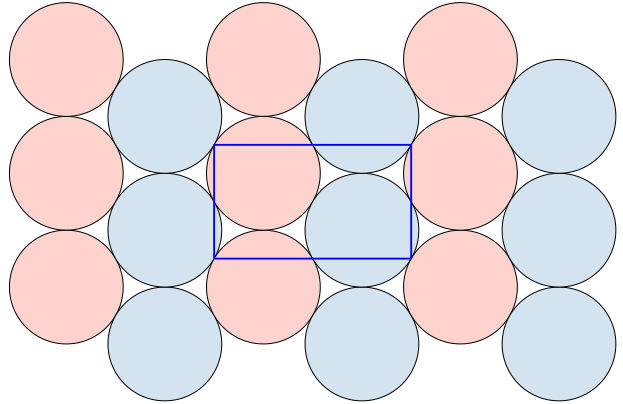
1. *Plane group: p2*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464101856112119	0
\mathbf{b}_2	0.000000100479871	2.000000002836626

Centroid in Cartesian coordinates:

	x	y
	0.866025538231085	1.500000037216006



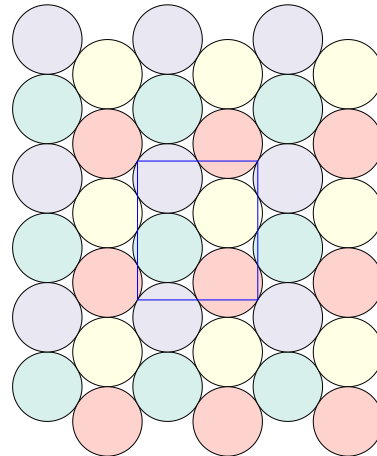
2. *Plane group: p2gg*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.464101674591188	0
\mathbf{b}_2	0	4.000000084886905

Centroid in Cartesian coordinates:

	x	y
	0.866025423954704	1.500000036329977



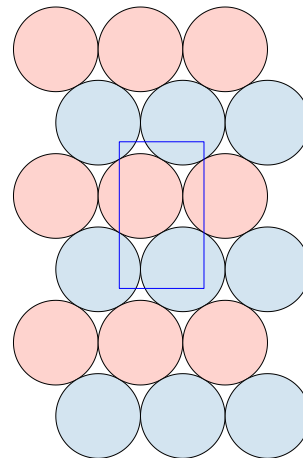
3. *Plane group: pg*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	2.0000000044341767	0
\mathbf{b}_2	0	3.464101700157892

Centroid in Cartesian coordinates:

	x	y
	0.499999983738604	2.183462208905175



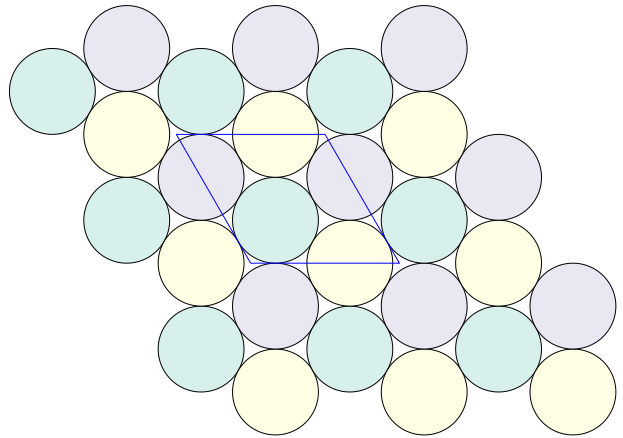
4. *Plane group: p3*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 3.464101650498534	0
\mathbf{b}_2 -1.732050825249267	3.000000030623334

Centroid in Cartesian coordinates:

x	y
0.577350281600167	0.999999997978270



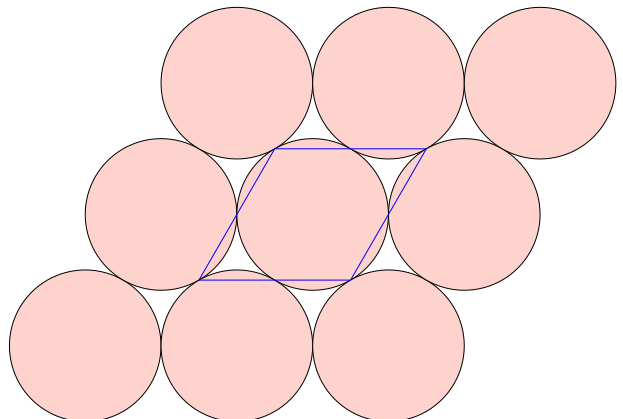
5. *Plane group: p1*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 2.000000001598095	0
\mathbf{b}_2 0.999999970190531	1.732050847848287

Centroid in Cartesian coordinates:

x	y
1.499999985894313	0.866025423924143



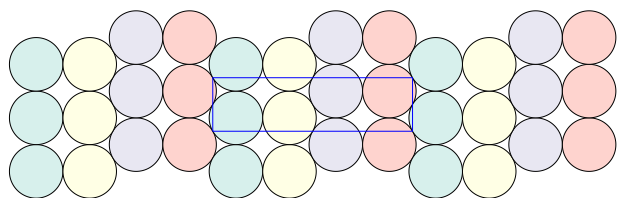
6. *Plane group: p2mg*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 7.464101681114728	0
\mathbf{b}_2 0	2.000000003184337

Centroid in Cartesian coordinates:

x	y
0.866025416648361	0.500000010757428



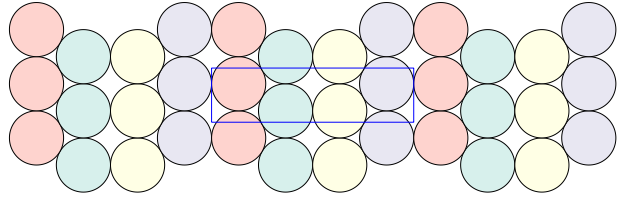
7. Plane group: cm

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	7.464101658563498	0
\mathbf{b}_2	0	2.000000007265415

Centroid in Cartesian coordinates:

	x	y
	2.732050818414129	0.419562510705568



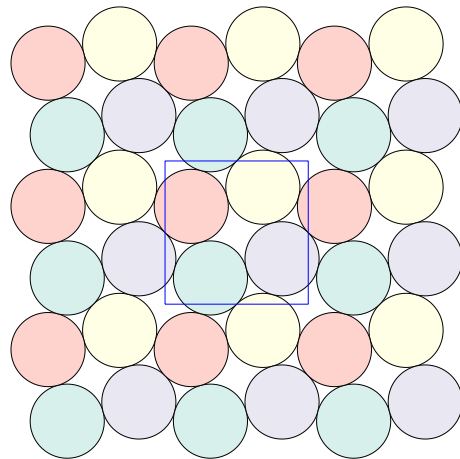
8. Plane group: $p4$

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	3.863703305186667	0
\mathbf{b}_2	0	3.863703305186667

Centroid in Cartesian coordinates:

	x	y
	1.224744871409612	0.707106781198198



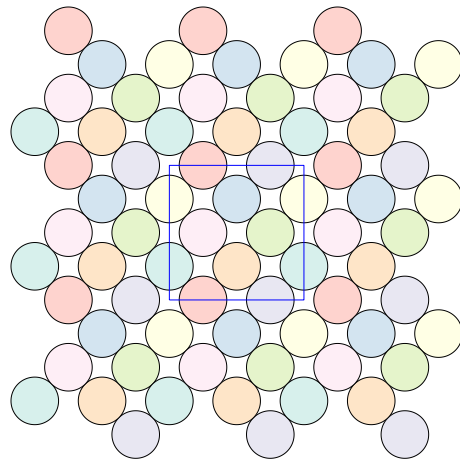
9. Plane group: $p4gm$

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	5.656854317984162	0
\mathbf{b}_2	0	5.656854317984162

Centroid in Cartesian coordinates:

	x	y
	0.000000016510117	1.414213565117921



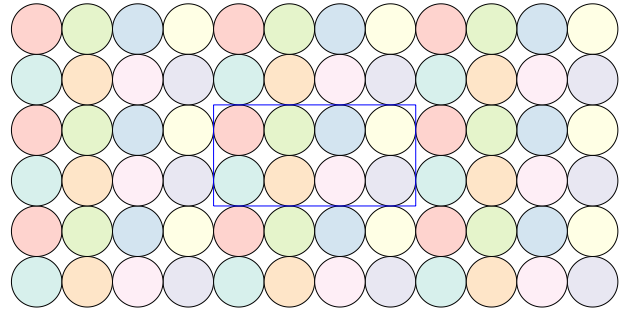
10. *Plane group: c2mm*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	8.000000011103326	0
\mathbf{b}_2	0	4.000000016081907

Centroid in Cartesian coordinates:

	x	y
	1.000000002676427	1.000000004734098



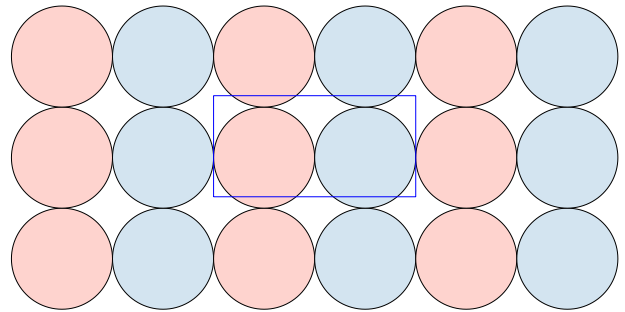
11. *Plane group: pm*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000019701399	0
\mathbf{b}_2	0	2.000000012309221

Centroid in Cartesian coordinates:

	x	y
	1.000000009036836	0.774469996797881



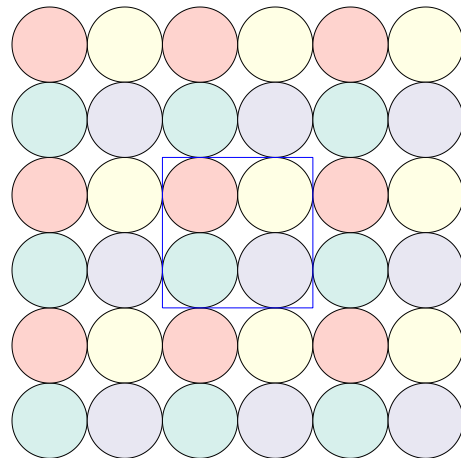
12. *Plane group: p2mm*

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	4.000000006940648	0
\mathbf{b}_2	0	4.000000010094652

Centroid in Cartesian coordinates:

	x	y
	1.000000002442195	1.000000004424181



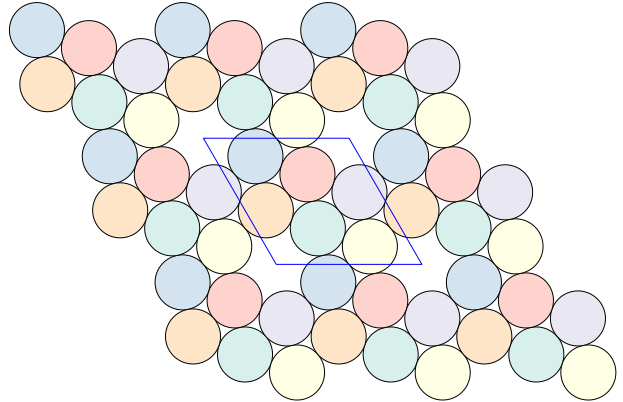
13. *Plane group: p6*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 5.291502629109987	0
\mathbf{b}_2 -2.645751314554992	4.582575701001395

Centroid in Cartesian coordinates:

x	y
1.511857896824970	1.309307336089649



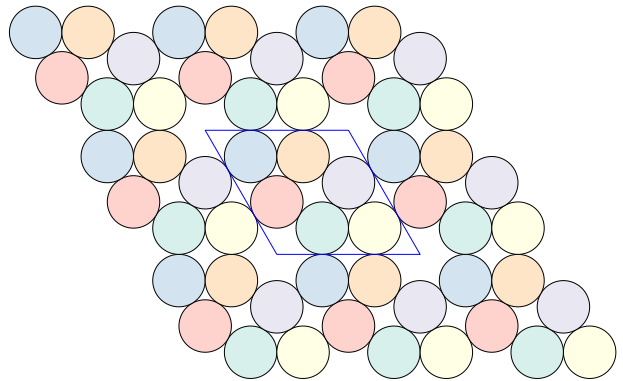
14. *Plane group: p31m*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 5.464101626278719	0
\mathbf{b}_2 -2.732050813139358	4.732050817217236

Centroid in Cartesian coordinates:

x	y
1.732050811579991	1.000000005905124



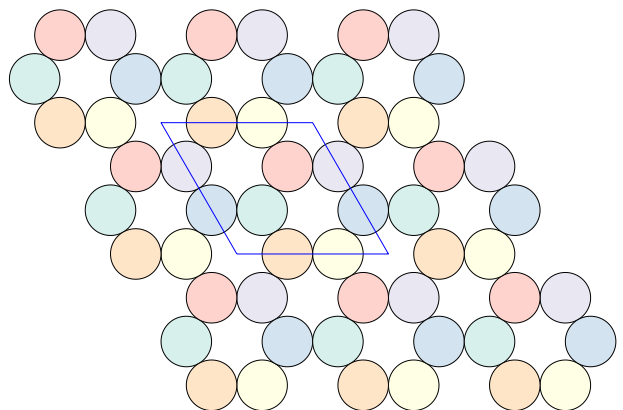
15. *Plane group: p3m1*

Primitive cell basic vectors:

x	y
\mathbf{b}_1 6.000000010596380	0
\mathbf{b}_2 -3.000000005298189	5.196152431883366

Centroid in Cartesian coordinates:

x	y
1.000000002900298	1.732050811434018



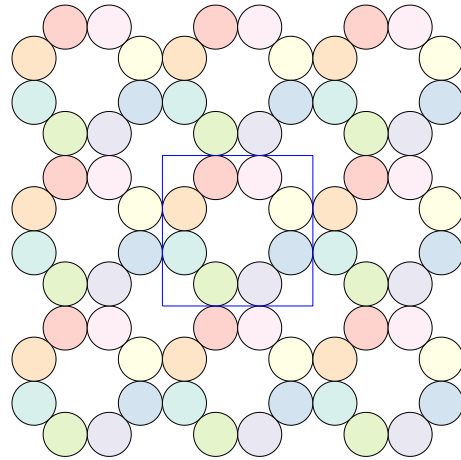
16. Plane group: $p4mm$

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	6.828427139502553	0
\mathbf{b}_2	0	6.828427139502553

Centroid in Cartesian coordinates:

	x	y
	1.000000001109510	2.414213567216762



17. Plane group: $p6mm$

Primitive cell basic vectors:

	x	y
\mathbf{b}_1	9.464101629281808	0
\mathbf{b}_2	-4.732050814640902	8.196152434955742

Centroid in Cartesian coordinates:

	x	y
	3.732050810556720	1.0000000000004544

