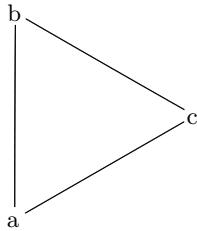


S-graphs

An S-graph is a simple graph with possible multiple loops. The number of loops at a given vertex is called the loop number or path number of the vertex. The degree of a vertex in an S-graph is the number of edges attached to the vertex plus twice the number of loops (according to Diestel's book on Graph Theory). The signless laplacian of an S-graph G is $Q(G) = A(G) + D(G)$ where $D(G)$ denotes the diagonal matrix of vertex degrees.

The following list is a list of compliant S-graphs. The number of loops if positive is indicated as well occasionally attached paths of finite length attached to vertices. The list is not intended to be complete. Listed eigenvalues are for the corresponding effective matrices in case of attached paths.

SG1



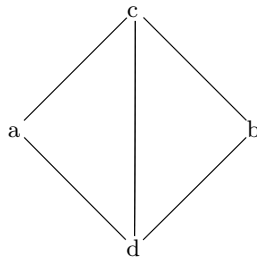
3 vertices

vertex b: 3 loops

vertex c: 1 loop

$\kappa_1 = 8.464102$, $\kappa_2 = 4.000000$,

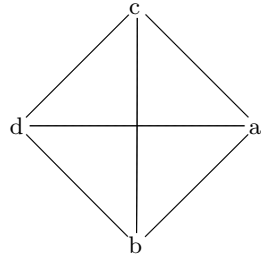
SG2



4 vertices

vertex a: 1 loop
vertex b: 1 loop
vertex c: 2 loops
 $\kappa_1 = 8.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

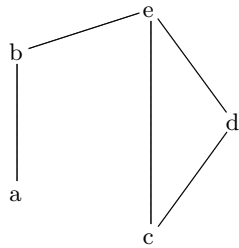
SG3



4 vertices

vertex a: 1 loop
vertex b: 1 loop
vertex c: 1 loop
vertex d: 1 loop
 $\kappa_1 = 8.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

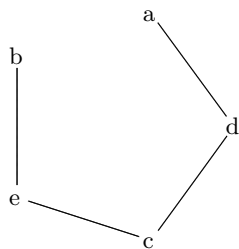
SG4



5 vertices

vertex d: 12 loops
 $\kappa_1 = 26.088665$, $\kappa_2 = 4.000000$,

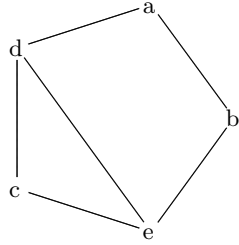
SG5



5 vertices

vertex a: 1 loop
vertex b: 1 loop
vertex d: 12 loops
 $\kappa_1 = 26.084910$, $\kappa_2 = 3.797450$,

SG6

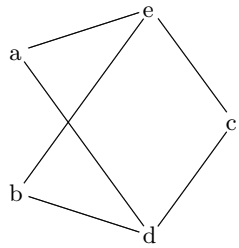


5 vertices

vertex d: 10 loops

$\kappa_1 = 23.149594$, $\kappa_2 = 4.000000$,

SG7

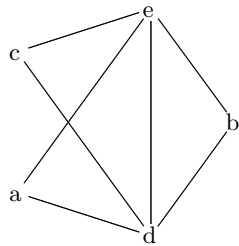


5 vertices

vertex e: 2 loops

$\kappa_1 = 7.605551$, $\kappa_2 = 4.000000$,

SG8



5 vertices

vertex a: 1 loop

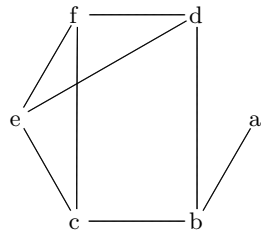
vertex b: 1 loop

vertex c: 1 loop

vertex e: 1 loop

$\kappa_1 = 7.828427$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

SG9



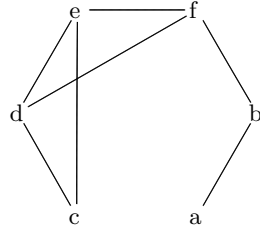
6 vertices

vertex e: 1 loop

vertex f: 1 loop

$\kappa_1 = 7.110092$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

SG10

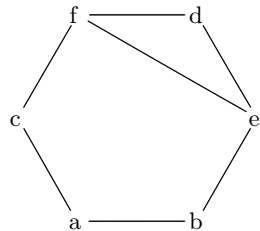


6 vertices

vertex e: 3 loops

$\kappa_1 = 9.553074$, $\kappa_2 = 4.000000$,

SG11

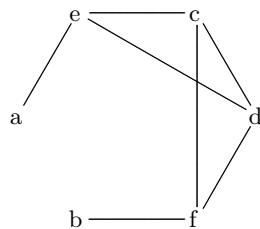


6 vertices

vertex e: 6 loops

$\kappa_1 = 15.247116$, $\kappa_2 = 4.000000$,

SG12

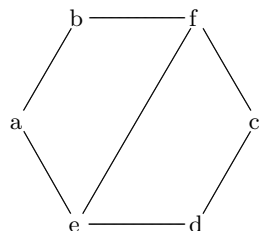


6 vertices

vertex d: 3 loops

$\kappa_1 = 9.582576$, $\kappa_2 = 4.000000$,

SG13

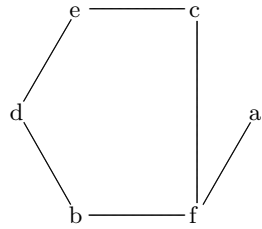


6 vertices

vertex e: 4 loops

$\kappa_1 = 11.345276$, $\kappa_2 = 4.000000$,

SG14

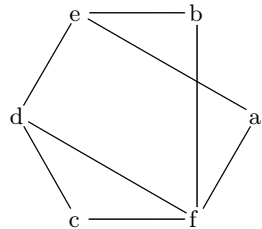


6 vertices

vertex c: 10 loops

$\kappa_1 = 22.102499$, $\kappa_2 = 4.000000$,

SG15



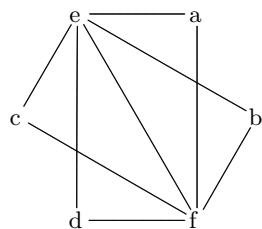
6 vertices

vertex c: 1 loop

vertex f: 1 loop

$\kappa_1 = 7.258786$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

SG16



6 vertices

vertex a: 1 loop

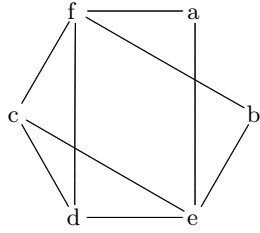
vertex b: 1 loop

vertex c: 1 loop

vertex d: 1 loop

$\kappa_1 = 8.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,

SG17



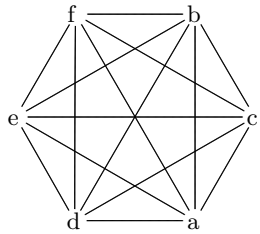
6 vertices

vertex c: 1 loop

vertex d: 1 loop

$\kappa_1 = 7.464102$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

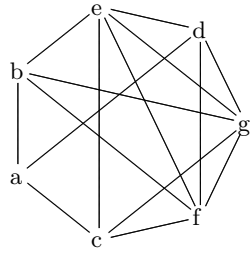
SG18



6 vertices

$\kappa_1 = 10.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

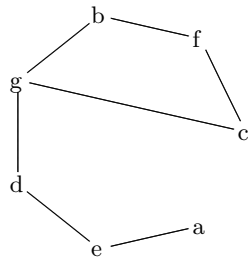
SG19



7 vertices

$\kappa_1 = 9.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

SG20

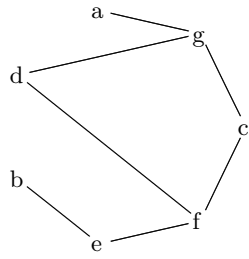


7 vertices

vertex c: 3 loops

$\kappa_1 = 8.369243$, $\kappa_2 = 4.000000$,

SG21

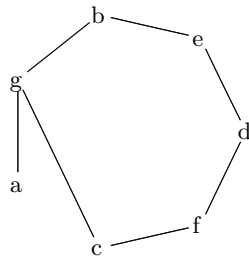


7 vertices

vertex d: 3 loops

$\kappa_1 = 8.404460$, $\kappa_2 = 4.000000$,

SG22

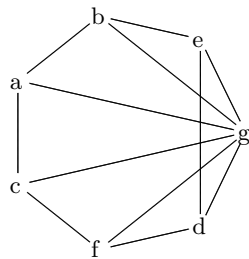


7 vertices

vertex c: 6 loops

$\kappa_1 = 14.173502$, $\kappa_2 = 4.000000$,

SG23

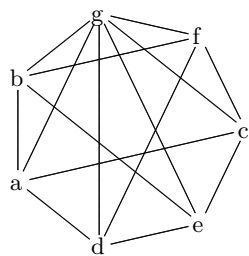


7 vertices

vertex g: 2 loops

$\kappa_1 = 11.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

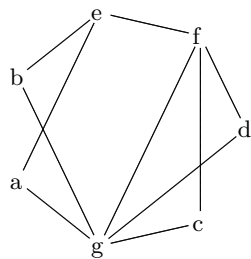
SG24



7 vertices

$\kappa_1 = 9.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

SG25



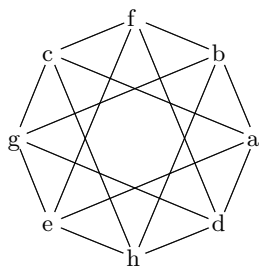
7 vertices

vertex c: 1 loop

vertex d: 1 loop

$\kappa_1 = 7.258786$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

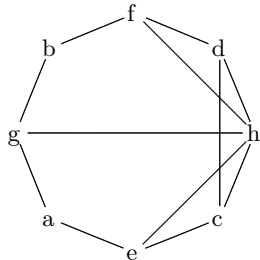
SG26



8 vertices

$\kappa_1 = 8.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$, $\kappa_7 = 4.000000$,

SG27

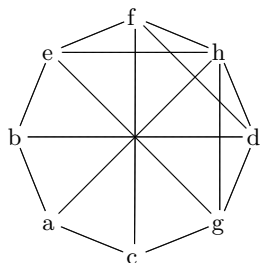


8 vertices

vertex h: 2 loops

$\kappa_1 = 9.914968$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

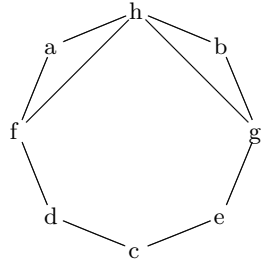
SG28



8 vertices

$\kappa_1 = 8.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

SG29

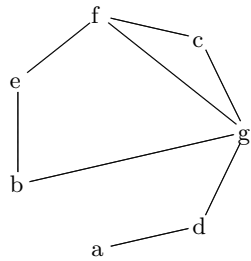


8 vertices

vertex h: 4 loops

$\kappa_1 = 12.450736$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

SG30



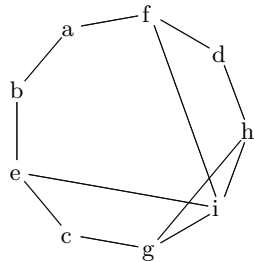
7 vertices

vertex c: 1 loop

vertex g: 0 loops, P3 added

$\kappa_1 = 7.006426$, $\kappa_2 = 3.996463$,

SG31

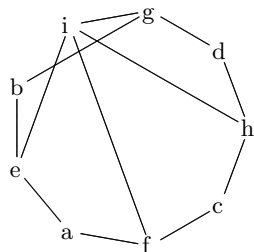


9 vertices

vertex i: 2 loops

$\kappa_1 = 8.815736$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

SG32

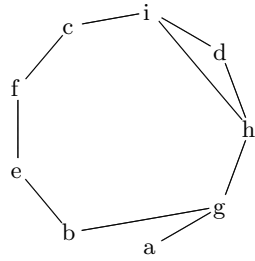


9 vertices

vertex i: 2 loops

$\kappa_1 = 8.772002$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

SG33

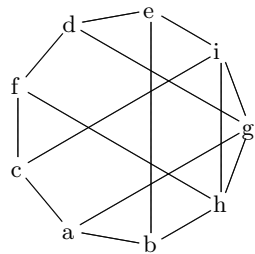


9 vertices

vertex h: 4 loops

$\kappa_1 = 11.378947$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

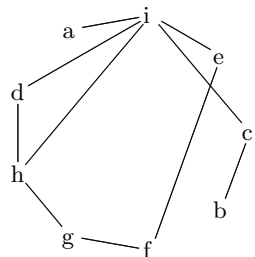
SG34



9 vertices

$\kappa_1 = 7.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

SG35

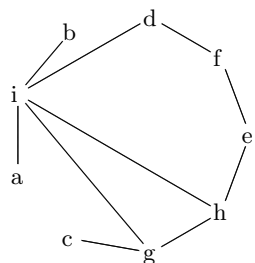


9 vertices

vertex d: 1 loop

$\kappa_1 = 6.641941$, $\kappa_2 = 3.987215$,

SG36

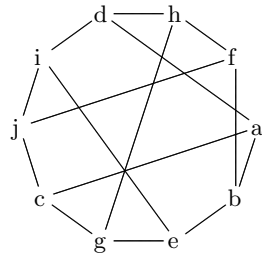


9 vertices

vertex i: 1 loop

$\kappa_1 = 7.983762$, $\kappa_2 = 3.988647$,

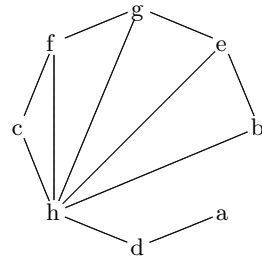
SG37



10 vertices

$\kappa_1 = 6.000000$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$, $\kappa_5 = 4.000000$,
 $\kappa_6 = 4.000000$,

SG38

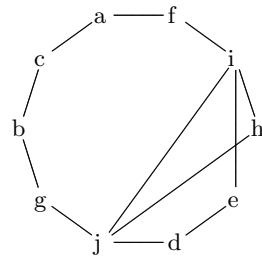


8 vertices

vertex h: 1 loop, P3 added

$\kappa_1 = 10.624031$, $\kappa_2 = 3.998488$,

SG39

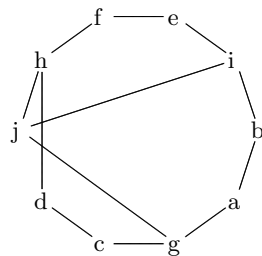


10 vertices

vertex h: 1 loop

$\kappa_1 = 6.379077$, $\kappa_2 = 4.000000$,

SG40

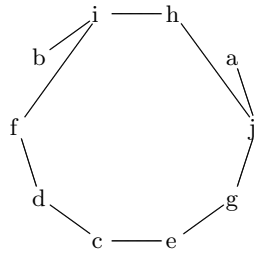


10 vertices

vertex j: 2 loops

$\kappa_1 = 7.701562$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$, $\kappa_4 = 4.000000$,

SG41

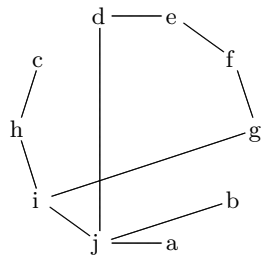


10 vertices

vertex h: 4 loops

$\kappa_1 = 10.283556$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

SG42

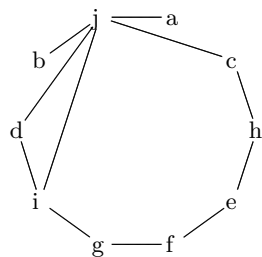


10 vertices

vertex j: 1 loop

$\kappa_1 = 6.851024$, $\kappa_2 = 3.993445$,

SG43

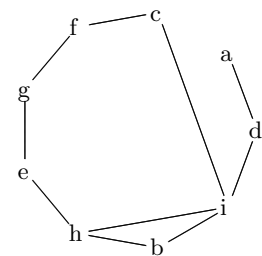


10 vertices

vertex d: 1 loop

$\kappa_1 = 6.607823$, $\kappa_2 = 4.000000$,

SG44

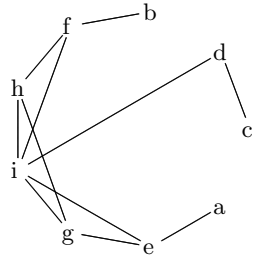


9 vertices

vertex i: 3 loops, P3 added

$\kappa_1 = 12.146689$, $\kappa_2 = 3.999726$,

SG45

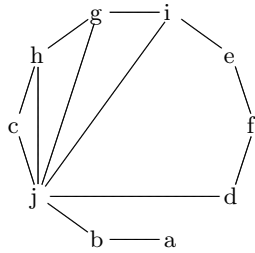


9 vertices

vertex i: 1 loop, P3 added

$\kappa_1 = 9.638775$, $\kappa_2 = 3.997920$,

SG46

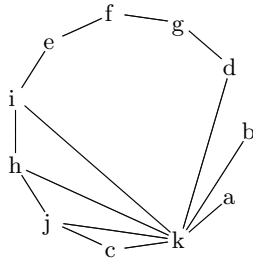


10 vertices

vertex j: 0 loops, P2 added

$\kappa_1 = 8.806527$, $\kappa_2 = 4.000000$,

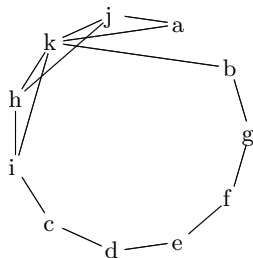
SG47



11 vertices

$\kappa_1 = 8.422646$, $\kappa_2 = 4.000000$,

SG48

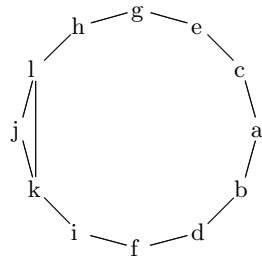


11 vertices

vertex k: 1 loop

$\kappa_1 = 8.214142$, $\kappa_2 = 4.000000$,

SG49

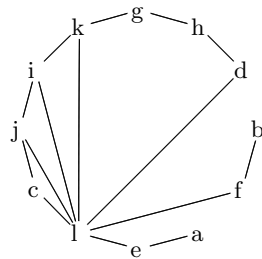


12 vertices

vertex k: 3 loops

$\kappa_1 = 9.477049$, $\kappa_2 = 4.000000$,

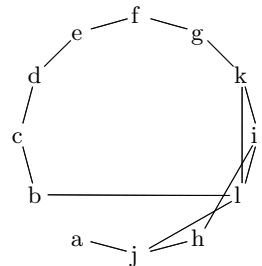
SG50



12 vertices

$\kappa_1 = 8.460470$, $\kappa_2 = 4.000000$,

SG51

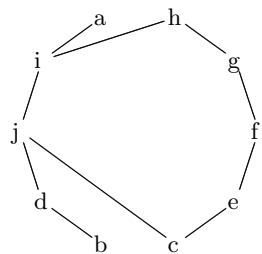


12 vertices

vertex l: 1 loop

$\kappa_1 = 7.171622$, $\kappa_2 = 4.000000$,

SG52

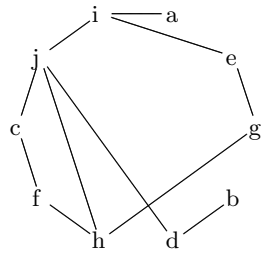


10 vertices

vertex j: 3 loops, P3 added

$\kappa_1 = 11.064848$, $\kappa_2 = 3.999839$,

SG53

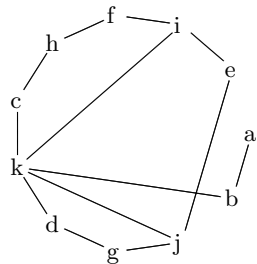


10 vertices

vertex j: 1 loop, P3 added

$\kappa_1 = 8.434060$, $\kappa_2 = 3.999156$,

SG54

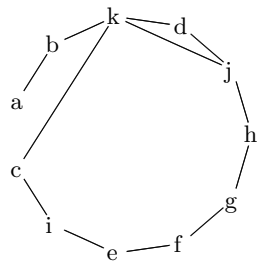


11 vertices

vertex k: 0 loops, P2 added

$\kappa_1 = 7.652045$, $\kappa_2 = 4.000000$,

SG55

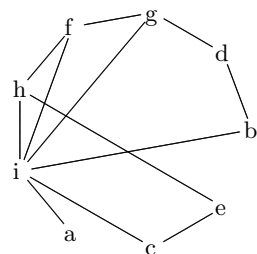


11 vertices

vertex k: 2 loops, P2 added

$\kappa_1 = 10.153964$, $\kappa_2 = 4.000000$,

SG56

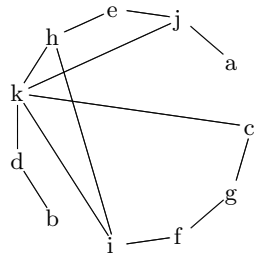


9 vertices

vertex i: 0 loops, P7 added

$\kappa_1 = 8.967832$, $\kappa_2 = 4.000000$,

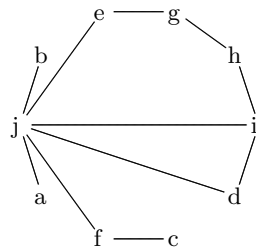
SG57



11 vertices

vertex k: 0 loops, P2 added
 $\kappa_1 = 7.765115$, $\kappa_2 = 4.000000$,

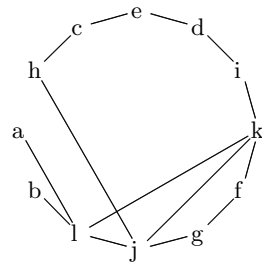
SG58



10 vertices

vertex j: 3 loops, P3 added
 $\kappa_1 = 14.218182$, $\kappa_2 = 3.999798$,

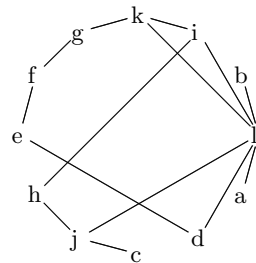
SG59



12 vertices

$\kappa_1 = 6.473372$, $\kappa_2 = 4.000000$, $\kappa_3 = 4.000000$,

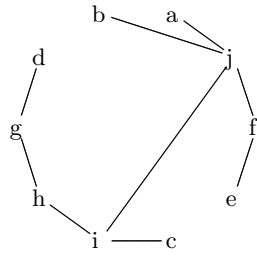
SG60



12 vertices

$\kappa_1 = 7.403133$, $\kappa_2 = 4.000000$,

SG61

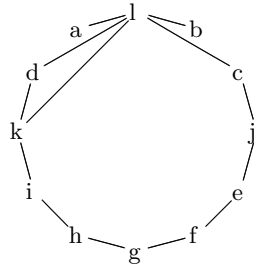


10 vertices

vertex j: 9 loops, P3 added

$\kappa_1 = 23.895465$, $\kappa_2 = 3.999976$,

SG62

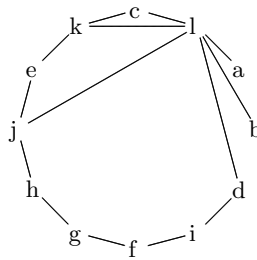


12 vertices

vertex l: 2 loops

$\kappa_1 = 9.691070$, $\kappa_2 = 4.000000$,

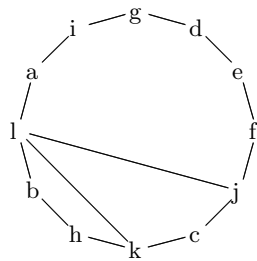
SG63



12 vertices

$\kappa_1 = 7.336291$, $\kappa_2 = 4.000000$,

SG64

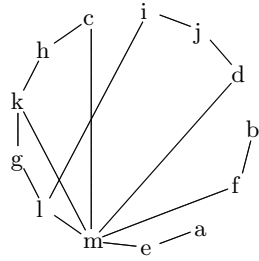


12 vertices

vertex l: 1 loop

$\kappa_1 = 7.024453$, $\kappa_2 = 4.000000$,

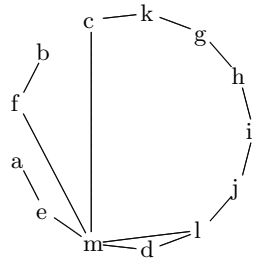
SG65



13 vertices

$$\kappa_1 = 7.330987, \kappa_2 = 4.000000,$$

SG66

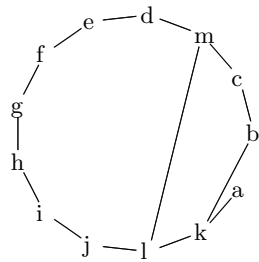


13 vertices

vertex m: 2 loops

$$\kappa_1 = 9.721655, \kappa_2 = 4.000000,$$

SG67

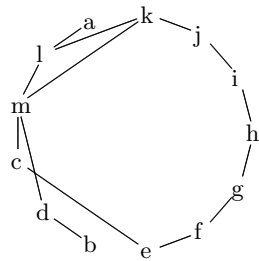


13 vertices

vertex l: 1 loop

$$\kappa_1 = 6.061888, \kappa_2 = 4.000000,$$

SG68

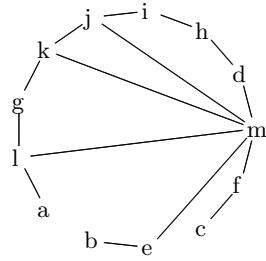


13 vertices

vertex m: 1 loop

$$\kappa_1 = 7.094565, \kappa_2 = 3.997021,$$

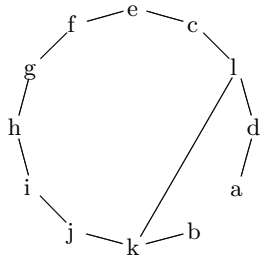
SG69



13 vertices

$$\kappa_1 = 7.454816, \kappa_2 = 4.000000,$$

SG70

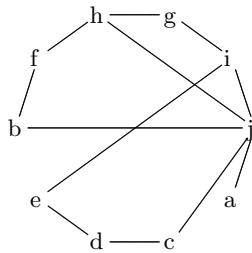


12 vertices

vertex l: 2 loops, P2 added

$$\kappa_1 = 9.061355, \kappa_2 = 4.000000,$$

SG71

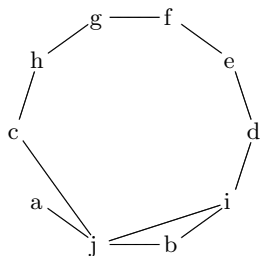


10 vertices

vertex j: 0 loops, P7 added

$$\kappa_1 = 7.844411, \kappa_2 = 4.000000,$$

SG72

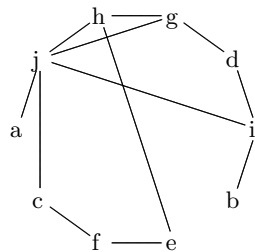


10 vertices

vertex j: 2 loops, P7 added

$$\kappa_1 = 10.388576, \kappa_2 = 4.000000,$$

SG73

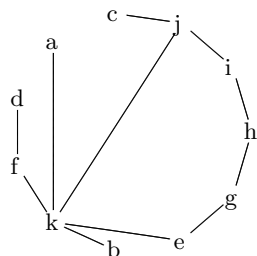


10 vertices

vertex j: 0 loops, P7 added

$\kappa_1 = 7.950821$, $\kappa_2 = 4.000000$,

SG74

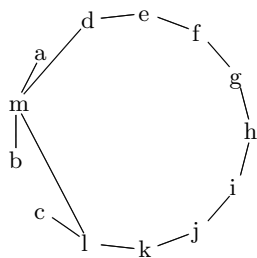


11 vertices

vertex k: 3 loops, P3 added

$\kappa_1 = 13.159525$, $\kappa_2 = 3.999891$,

SG75

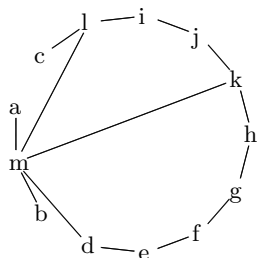


13 vertices

vertex m: 2 loops

$\kappa_1 = 8.605957$, $\kappa_2 = 4.000000$,

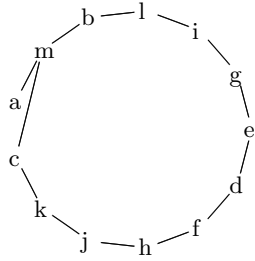
SG76



13 vertices

$\kappa_1 = 6.331084$, $\kappa_2 = 4.000000$,

SG77

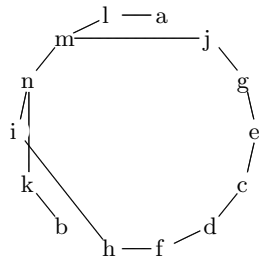


13 vertices

vertex c: 3 loops

$\kappa_1 = 8.358917$, $\kappa_2 = 4.000000$,

SG78

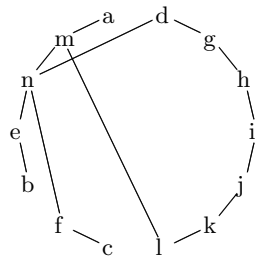


14 vertices

vertex m: 1 loop

$\kappa_1 = 5.952532$, $\kappa_2 = 3.997894$,

SG79

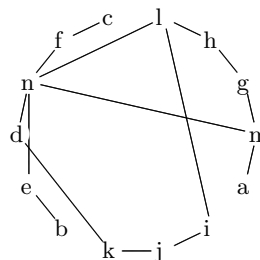


14 vertices

vertex n: 2 loops

$\kappa_1 = 8.647387$, $\kappa_2 = 4.000000$,

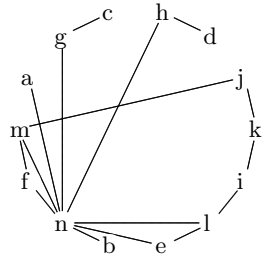
SG80



14 vertices

$\kappa_1 = 6.405848$, $\kappa_2 = 4.000000$,

SG81

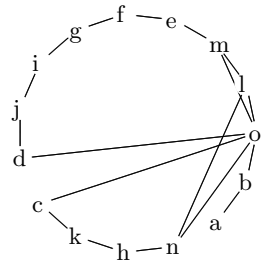


14 vertices

vertex n: 1 loop

$\kappa_1 = 10.968308$, $\kappa_2 = 4.000000$,

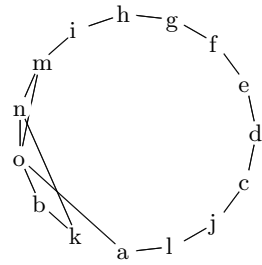
SG82



15 vertices

$\kappa_1 = 7.543189$, $\kappa_2 = 4.000000$,

SG83

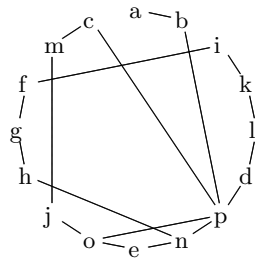


15 vertices

vertex o: 1 loop

$\kappa_1 = 7.119825$, $\kappa_2 = 4.000000$,

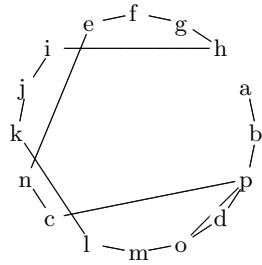
SG84



16 vertices

$\kappa_1 = 6.444721$, $\kappa_2 = 4.000000$,

SG85

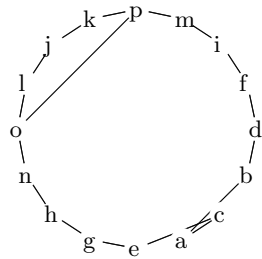


16 vertices

vertex p: 2 loops

$\kappa_1 = 8.699000$, $\kappa_2 = 4.000000$,

SG86

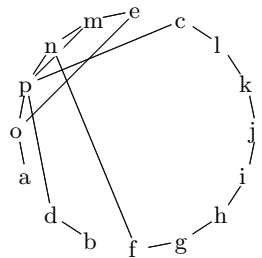


16 vertices

vertex o: 1 loop

$\kappa_1 = 5.968033$, $\kappa_2 = 4.000000$,

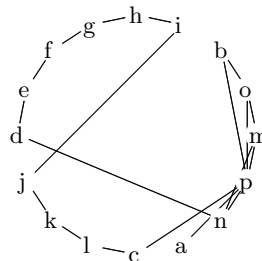
SG87



16 vertices

$\kappa_1 = 6.642677$, $\kappa_2 = 4.000000$,

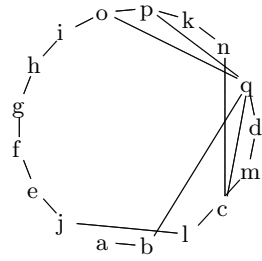
SG88



16 vertices

$\kappa_1 = 7.595145$, $\kappa_2 = 4.000000$,

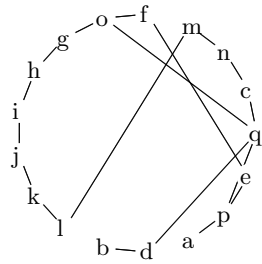
SG89



17 vertices

$$\kappa_1 = 6.559406, \kappa_2 = 3.996185,$$

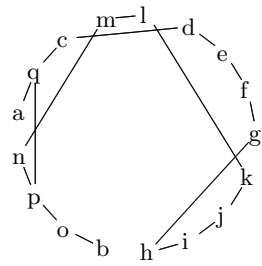
SG90



17 vertices

$$\kappa_1 = 5.612284, \kappa_2 = 4.000000,$$

SG91

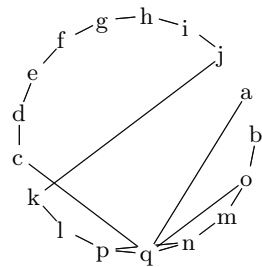


17 vertices

vertex p: 2 loops

$$\kappa_1 = 7.602420, \kappa_2 = 4.000000,$$

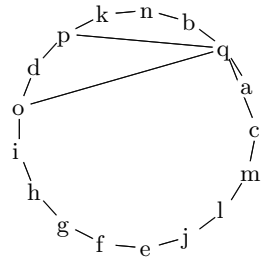
SG92



17 vertices

$$\kappa_1 = 6.613714, \kappa_2 = 4.000000,$$

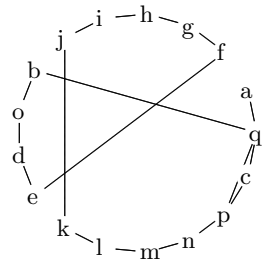
SG93



17 vertices

$$\kappa_1 = 6.410138, \kappa_2 = 4.000000,$$

SG94

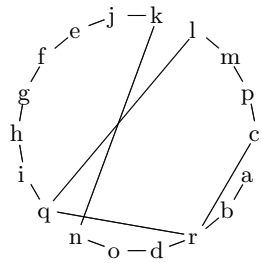


17 vertices

vertex q: 2 loops

$$\kappa_1 = 8.679060, \kappa_2 = 4.000000,$$

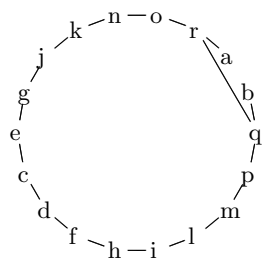
SG95



18 vertices

$$\kappa_1 = 5.485941, \kappa_2 = 3.997065,$$

SG96

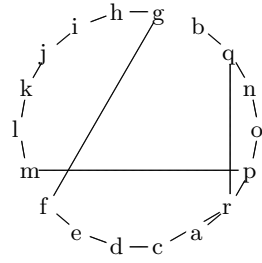


18 vertices

vertex r: 2 loops

$$\kappa_1 = 7.573779, \kappa_2 = 4.000000,$$

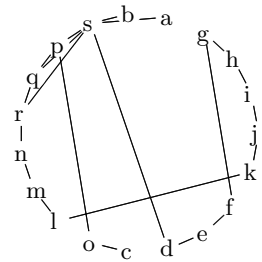
SG97



18 vertices

$$\kappa_1 = 5.569084, \kappa_2 = 4.000000,$$

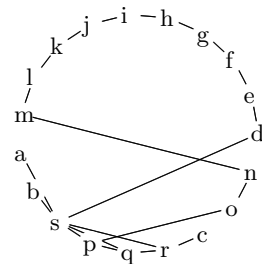
SG98



19 vertices

$$\kappa_1 = 7.493396, \kappa_2 = 4.000000,$$

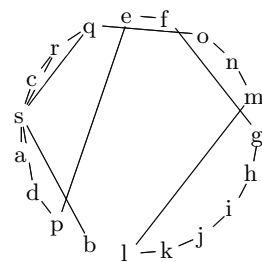
SG99



19 vertices

$$\kappa_1 = 7.491067, \kappa_2 = 4.000000,$$

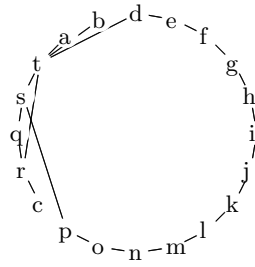
SG100



19 vertices

$$\kappa_1 = 7.426280, \kappa_2 = 4.000000,$$

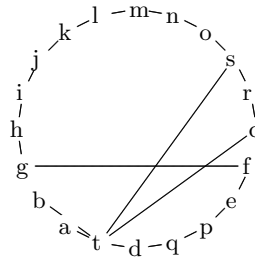
SG101



20 vertices

$$\kappa_1 = 6.360372, \kappa_2 = 4.000000,$$

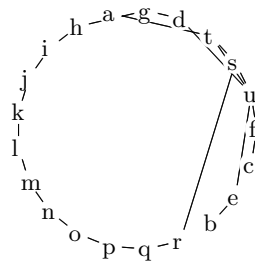
SG102



20 vertices

$$\kappa_1 = 6.276894, \kappa_2 = 4.000000,$$

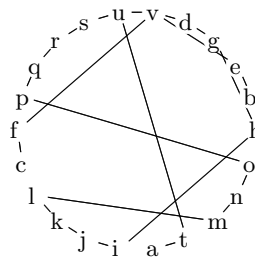
SG103



21 vertices

$$\kappa_1 = 6.545150, \kappa_2 = 4.000000,$$

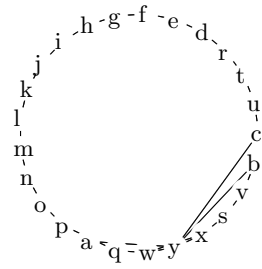
SG104



22 vertices

$$\kappa_1 = 5.473202, \kappa_2 = 4.000000,$$

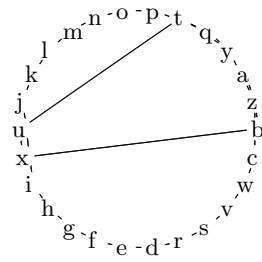
SG105



25 vertices

$$\kappa_1 = 6.528213, \kappa_2 = 4.000000,$$

SG106



26 vertices

$$\kappa_1 = 5.435733, \kappa_2 = 4.000000,$$
