In[1]:=
```
1
```
Out[1]=
```
1
```

In[55]:=
```
Array[1 &, 64]
```
Out[55]=
```
{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1}
```

In[66]:=
```
nzeros[n_] := Array[0 &, n] ~Join~ Array[1 &, 8 - n]
```

In[74]:=
```
Directory[]
```
Out[74]=
```
/Users/mepistol/People/Mats-Erik/IsospectralGraphs/Mathematica programs/Graphs
```

In[73]:=
```
Module[{directory = SystemDialogInput["Directory"]},
 If[directory =!= $Canceled, SetDirectory[directory]]]
```
Out[73]=
```
/Users/mepistol/People/Mats-Erik/IsospectralGraphs/Mathematica programs/Graphs
```

In[78]:=
```
Run[ls]
```
Out[78]=
```
0
```

In[115]:=
```
str = OpenRead ["s8graphs"]
```
Out[115]=
```
RefLink[OpenRead, paclet : ref/OpenRead][s8graphs]
```

In[83]:=
```
str
```
Out[83]=
```
RefLink[OpenRead, paclet : ref/OpenRead][8graphs]
```

In[129]:=
```
ReadLine["s8graphs"]
```
Out[129]=
```
11001111
```

In[128]:=
```
Read["s8graphs", {Word, Number}]
```
Out[128]=
```
{00111111, 111 111}
```

In[295]:=
```
Close["8graphs"]
```
Out[295]=
```
8graphs
```

In[290]:=
```
ReadMatrix[n_] := Do[ReadLine["8graphs"];
    mm[j] = {IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number],
      IntegerDigits[#, 10, 8] &@Read["8graphs", Number]}, {j, 1, n}];
```

In[296]:=
```
ReadMatrix[11 117]
```

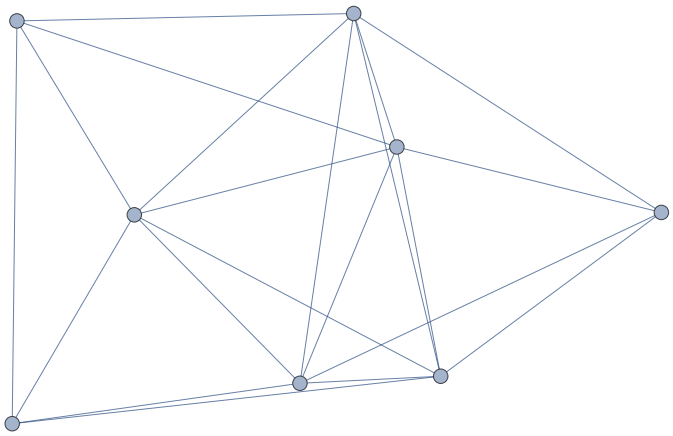
```
11 117
```

In[424]:=
```
graphtable = Table[AdjacencyGraph@mm[i], {i, 1, 11 117}];
```

In[431]:=
```
graphtables = Table[AdjacencyGraph@mm[i], {i, 1, 200}];
```

In[439]:=
```
graphtable[[11 000]]
```

Out[439]=

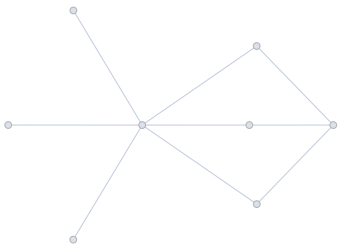
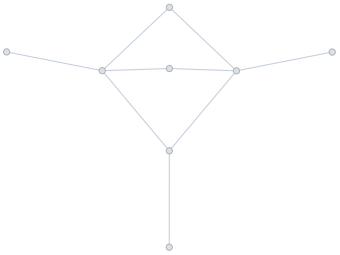
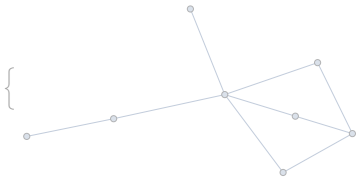
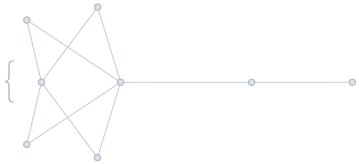
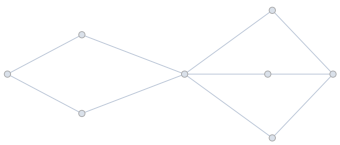
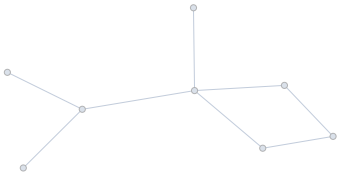


In[425]:=
```
NGraphRoots[graphtables[[3]] /. 0 → ∞]
```

Out[425]=

$$\left\{\left\{k \to 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\},\right.$$
$$\left\{k \to -12.5664 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\}, \left\{k \to 12.5664 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\},$$
$$\left\{k \to -16.7552 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\}, \left\{k \to 16.7552 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\},$$
$$\left\{k \to -21.4843 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\}, \left\{k \to 21.4843 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\},$$
$$\left.\left\{k \to -9.29344 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\}, \left\{k \to 9.29344 + 50.2655\, c_1 \text{ if } c_1 \in \mathbb{Z}\right\}\right\}$$

```
IsospectralPairs[graphtable] // Timing
```

Out[432]= {38.139, {{  ,  }, {{  ,  }, {{  ,  }, {{  ,  }}}}}

```
IsospectralPairs[graphtable]
```

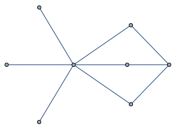
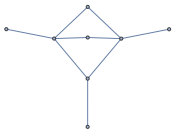
Out[443]= $Aborted

```
38 * 55 / 60.
```

Out[442]= 34.8333

```
11 000 / 200.
```

Out[437]= 55.

```
DeterminantD /@ {  ,  }
```

Out[436]= $\left\{144\, e^{-i k}\left(-1+e^{\frac{2ik}{9}}\right)^3\left(1+e^{\frac{2ik}{9}}\right)^4\left(1+e^{\frac{2ik}{9}}+e^{\frac{4ik}{9}}\right),\right.$
$\left.-192\, e^{-i k}\left(-1+e^{\frac{2ik}{9}}\right)^3\left(1+2\,e^{\frac{2ik}{9}}+2\,e^{\frac{4ik}{9}}+e^{\frac{2ik}{3}}\right)^2\right\}$

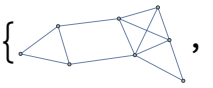
```
isop = IsoCharacteristicPolynomialPairs[graphtable];
```

```
isop // Length
```

Out[447]= 91

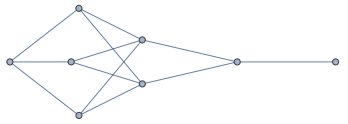
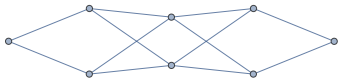
In[454]:= DeterminantD /@ {  } // Simplify

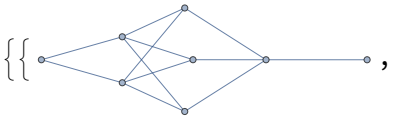
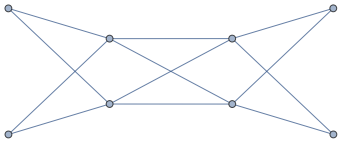
Out[454]=
$$\left\{-320\, e^{-i k}\left(-1+e^{\frac{i k}{21}}\right)^{15}\left(1+e^{\frac{i k}{21}}\right)^{13}\left(3+e^{\frac{i k}{21}}+3\, e^{\frac{2 i k}{21}}\right)^{5}\left(3+e^{\frac{i k}{21}}+4\, e^{\frac{2 i k}{21}}+e^{\frac{i k}{7}}+3\, e^{\frac{4 i k}{21}}\right),\right.$$
$$512\, e^{-i k}\left(-1+e^{\frac{i k}{21}}\right)^{15}\left(1+e^{\frac{i k}{21}}\right)^{13}\left(3+e^{\frac{i k}{21}}+3\, e^{\frac{2 i k}{21}}\right)^{5}\left(3+e^{\frac{i k}{21}}+4\, e^{\frac{2 i k}{21}}+e^{\frac{i k}{7}}+3\, e^{\frac{4 i k}{21}}\right),$$
$$\left.-576\, e^{-i k}\left(-1+e^{\frac{i k}{21}}\right)^{15}\left(1+e^{\frac{i k}{21}}\right)^{13}\left(3+e^{\frac{i k}{21}}+3\, e^{\frac{2 i k}{21}}\right)^{5}\left(3+e^{\frac{i k}{21}}+4\, e^{\frac{2 i k}{21}}+e^{\frac{i k}{7}}+3\, e^{\frac{4 i k}{21}}\right)\right\}$$

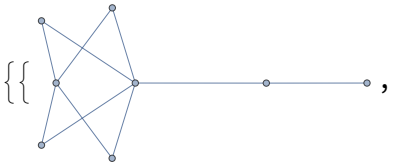
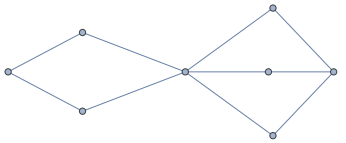
In[457]:= DeterminantD /@ {  } // Simplify

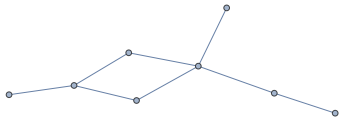
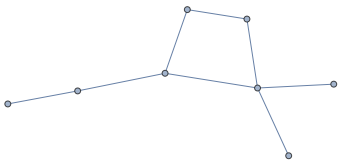
Out[457]=
$$\left\{-16\, e^{-i k}\left(-1+e^{\frac{i k}{13}}\right)^{7}\left(1+e^{\frac{i k}{13}}\right)^{5}\right.$$
$$\left(540+1080\, e^{\frac{i k}{13}}+3315\, e^{\frac{2 i k}{13}}+4278\, e^{\frac{3 i k}{13}}+7727\, e^{\frac{4 i k}{13}}+7448\, e^{\frac{5 i k}{13}}+10\,558\, e^{\frac{6 i k}{13}}+8524\, e^{\frac{7 i k}{13}}+\right.$$
$$\left.10\,558\, e^{\frac{8 i k}{13}}+7448\, e^{\frac{9 i k}{13}}+7727\, e^{\frac{10 i k}{13}}+4278\, e^{\frac{11 i k}{13}}+3315\, e^{\frac{12 i k}{13}}+1080\, e^{i k}+540\, e^{\frac{14 i k}{13}}\right),$$
$$16\, e^{-i k}\left(-1+e^{\frac{i k}{13}}\right)^{7}\left(1+e^{\frac{i k}{13}}\right)^{5}\left(540+1080\, e^{\frac{i k}{13}}+3315\, e^{\frac{2 i k}{13}}+4278\, e^{\frac{3 i k}{13}}+\right.$$
$$7727\, e^{\frac{4 i k}{13}}+7448\, e^{\frac{5 i k}{13}}+10\,558\, e^{\frac{6 i k}{13}}+8524\, e^{\frac{7 i k}{13}}+10\,558\, e^{\frac{8 i k}{13}}+$$
$$\left.\left.7448\, e^{\frac{9 i k}{13}}+7727\, e^{\frac{10 i k}{13}}+4278\, e^{\frac{11 i k}{13}}+3315\, e^{\frac{12 i k}{13}}+1080\, e^{i k}+540\, e^{\frac{14 i k}{13}}\right)\right\}$$

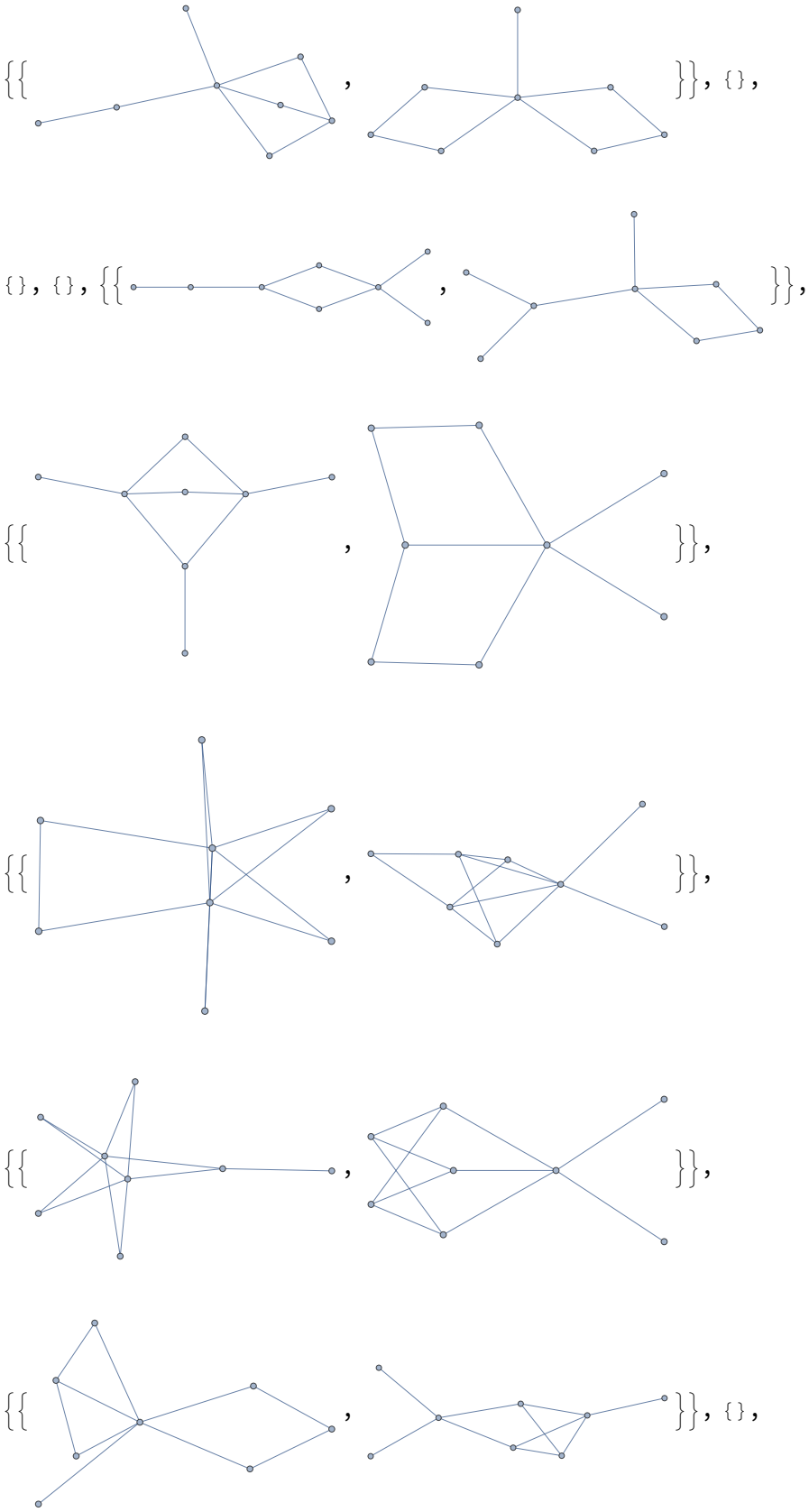
In[450]:= Table[IsospectralPairs[isop[[i]]], {i, 1, 91}]

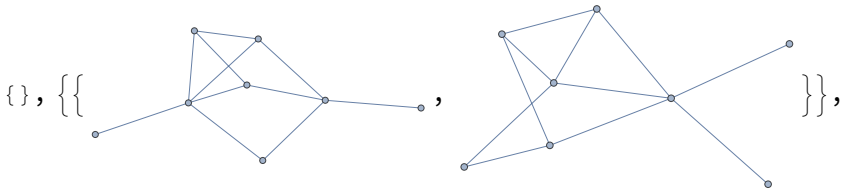
Out[450]= { {}, {}, {}, {  },  },

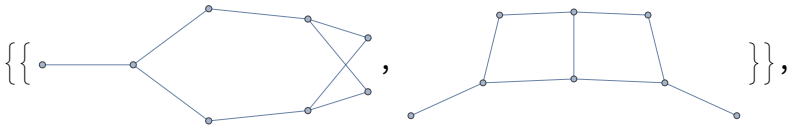
 ,  },

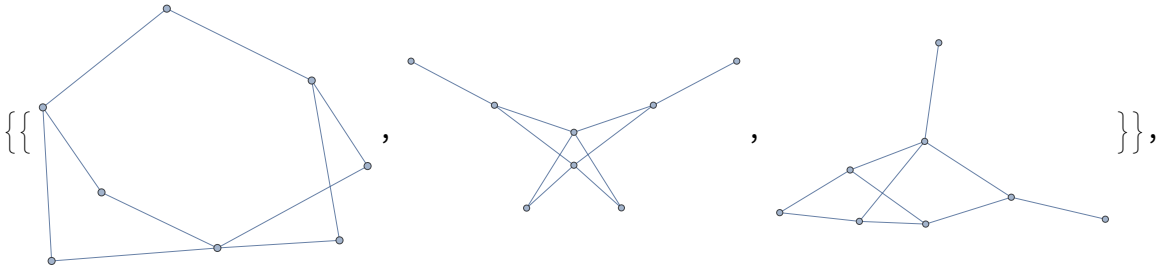
 ,  }, {},

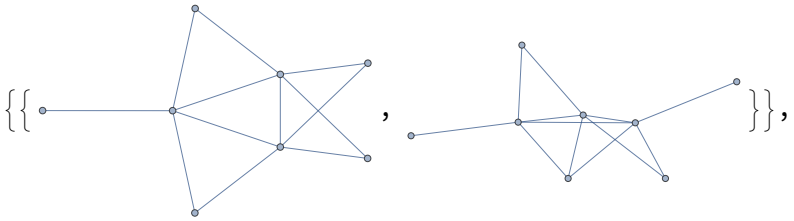
{}, {}, {  ,  },

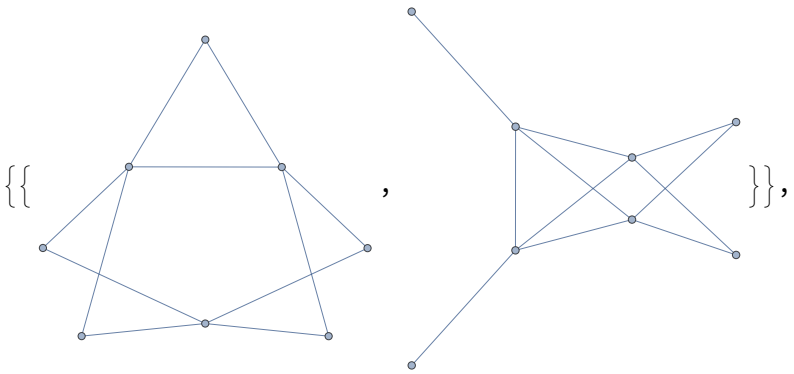


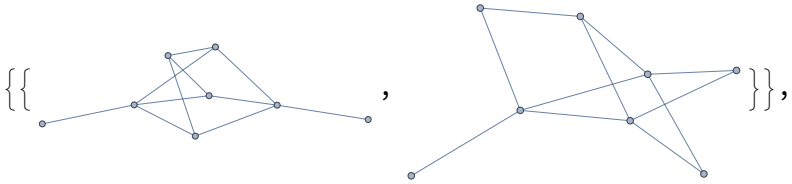


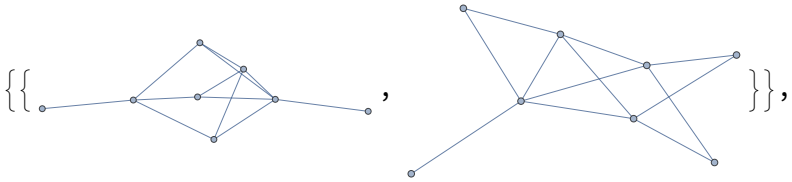


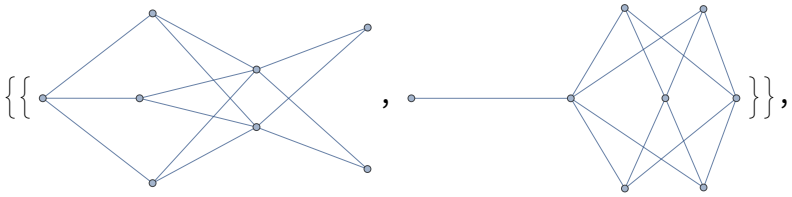


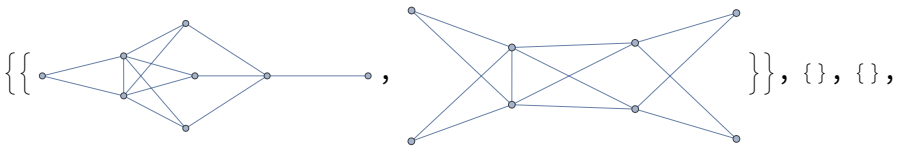


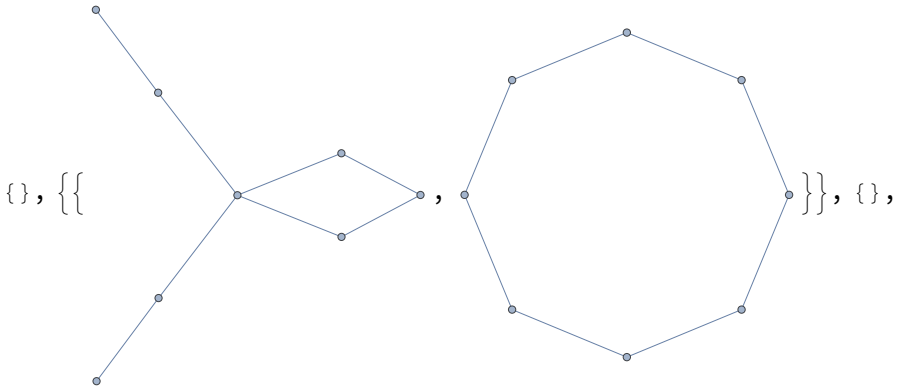


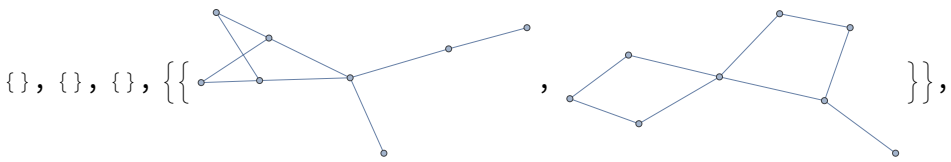


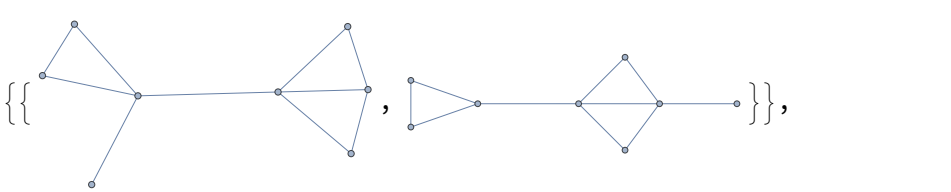


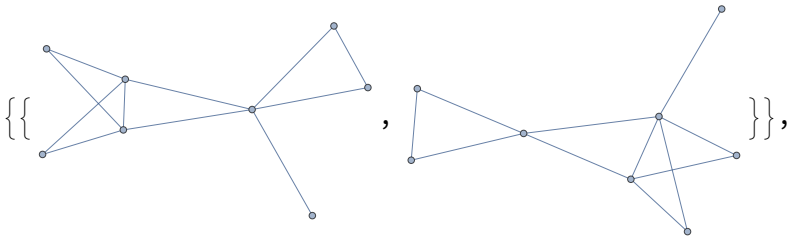


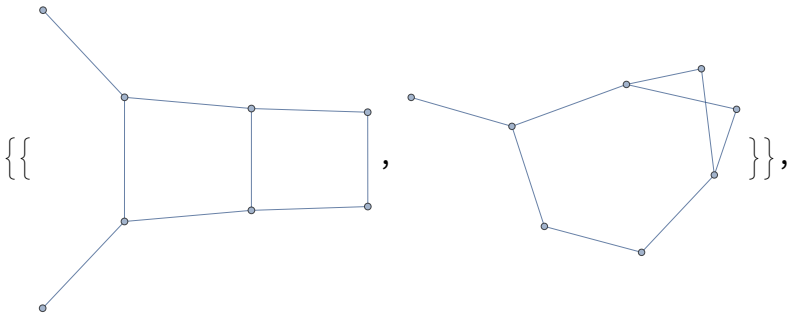


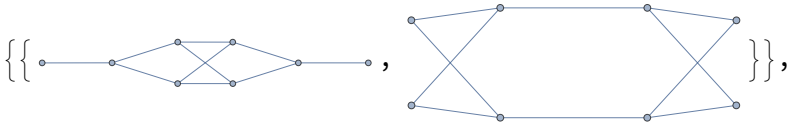


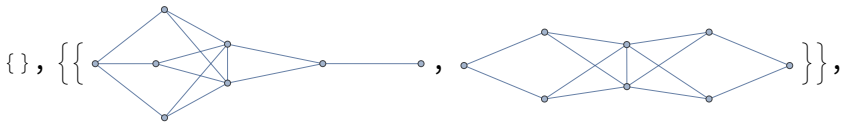


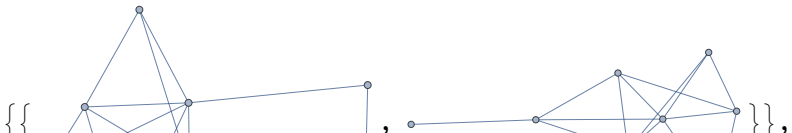


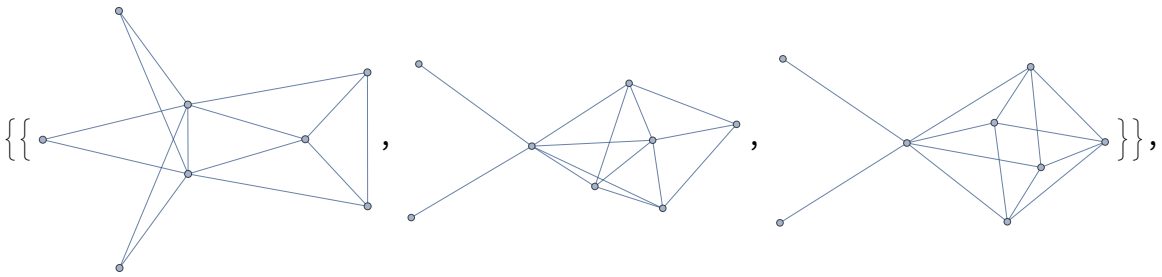


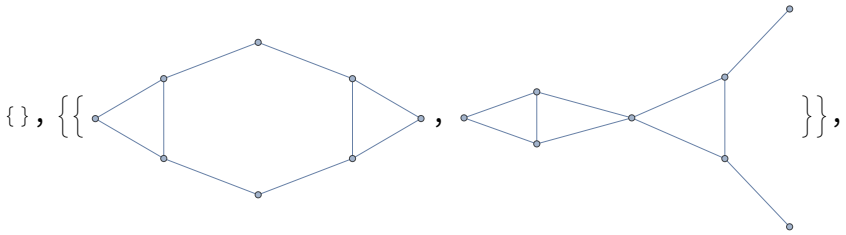


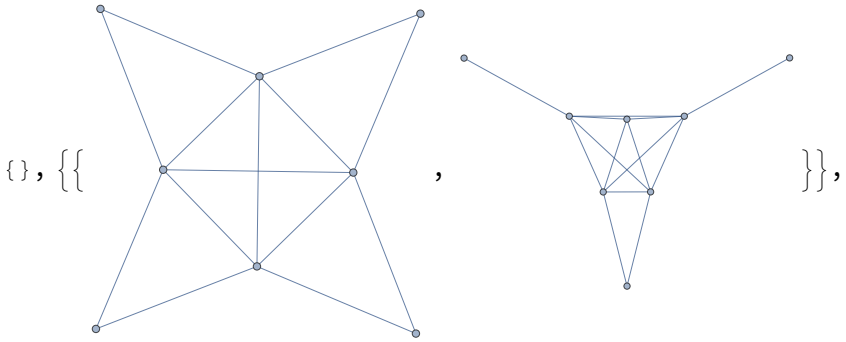


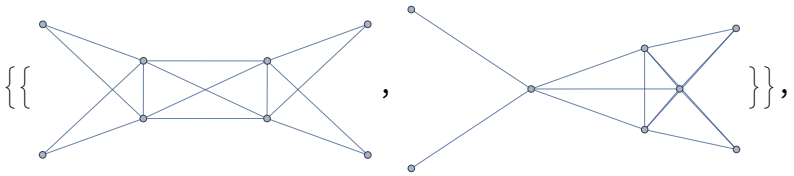


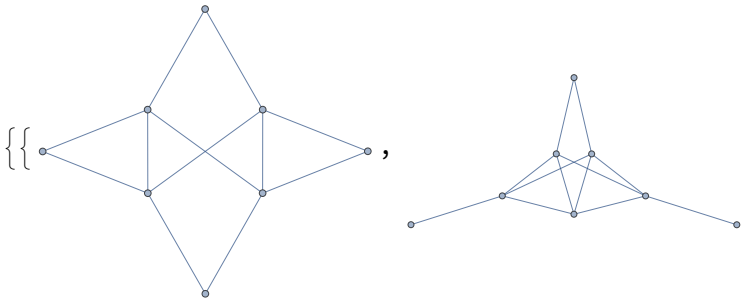


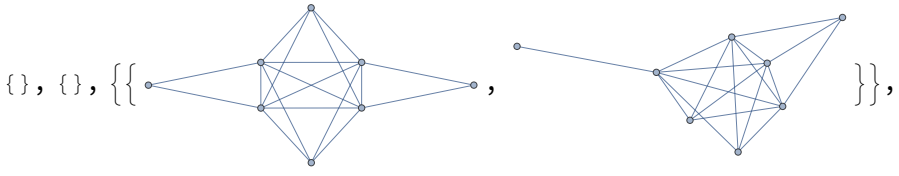


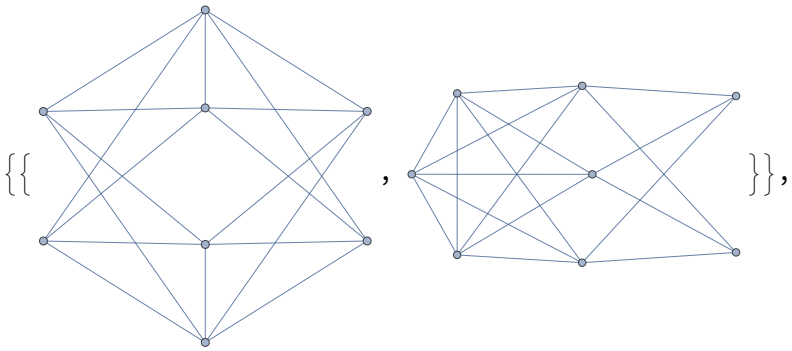


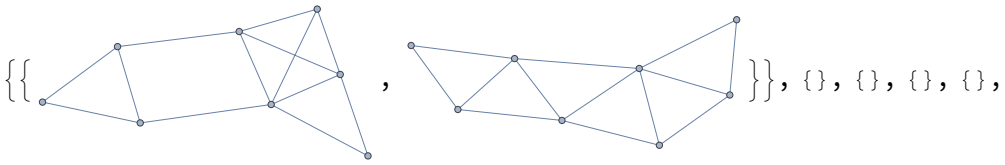


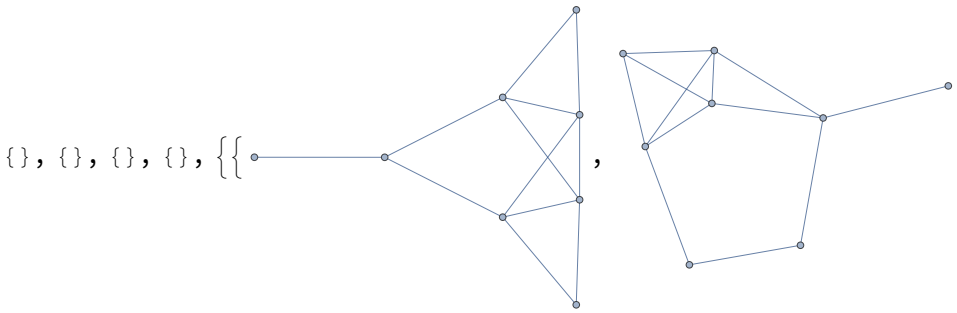


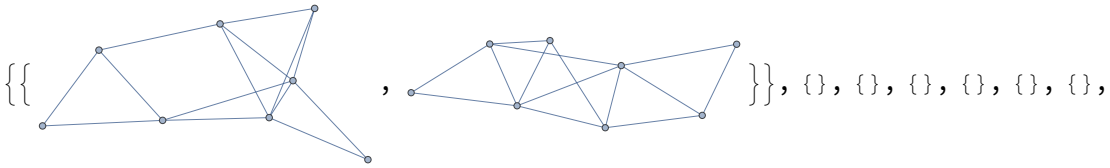


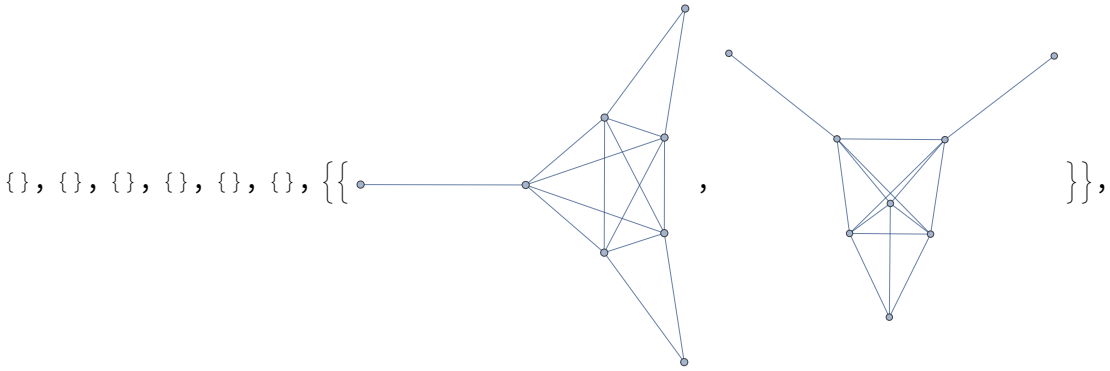


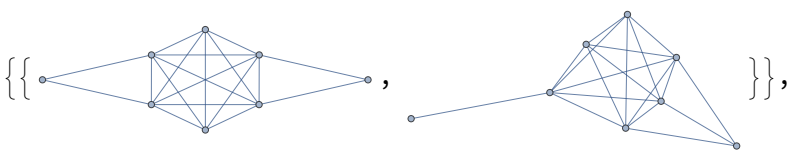


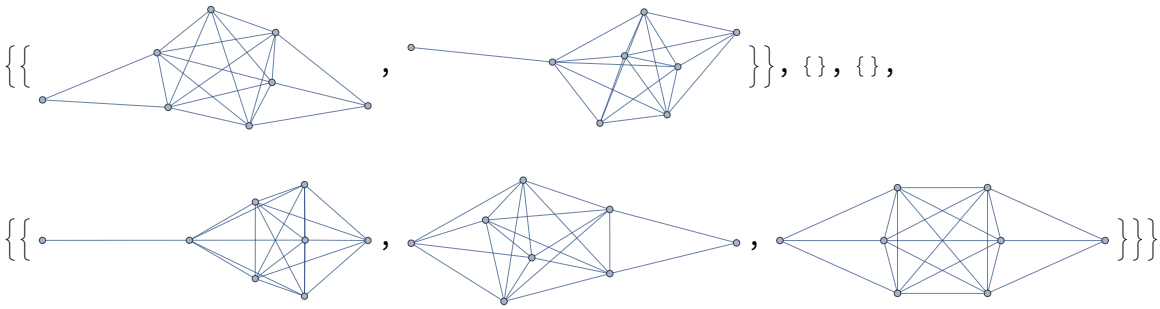




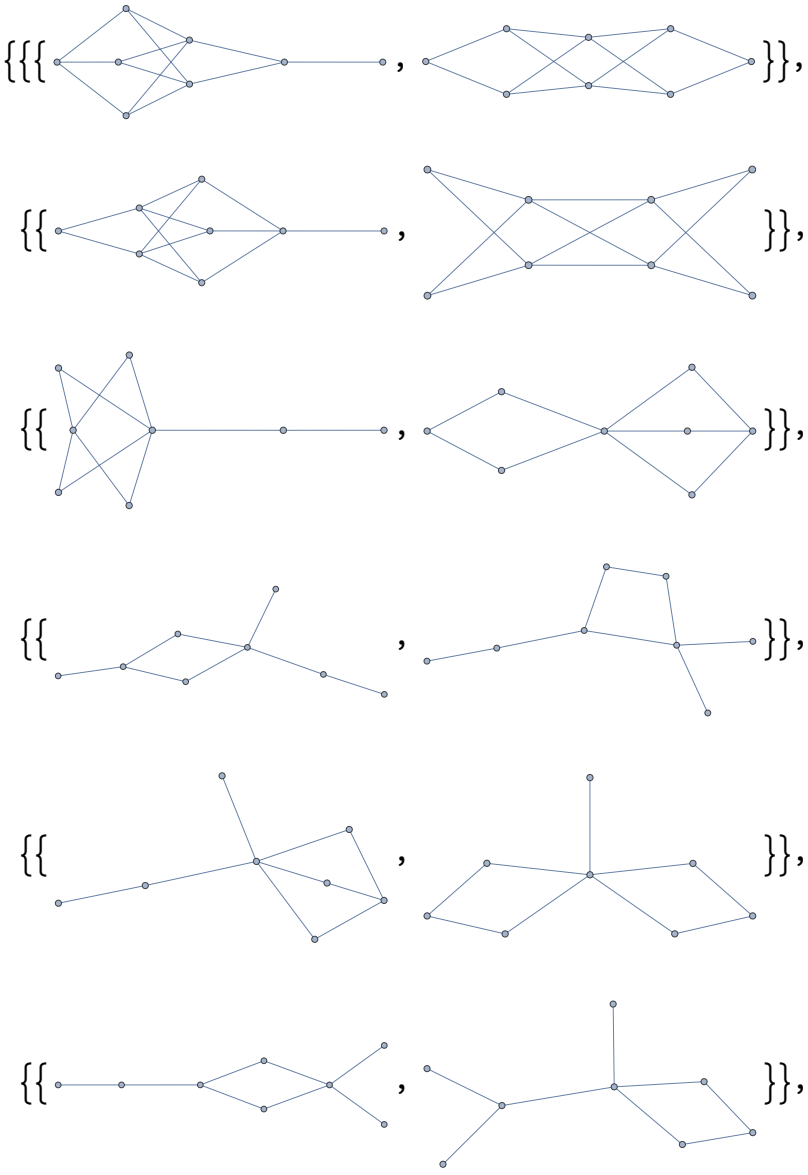


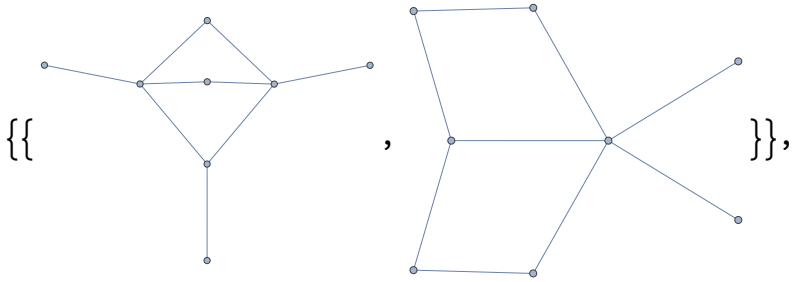


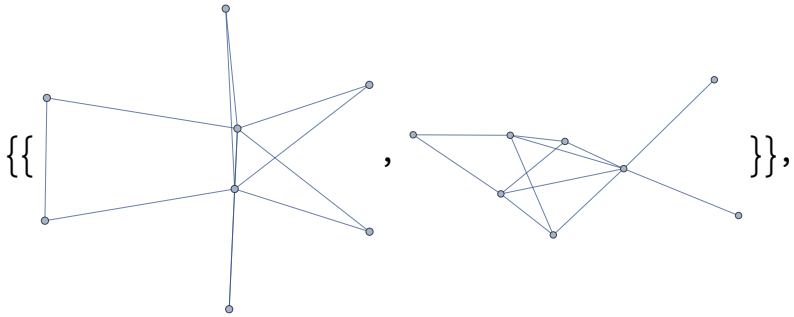


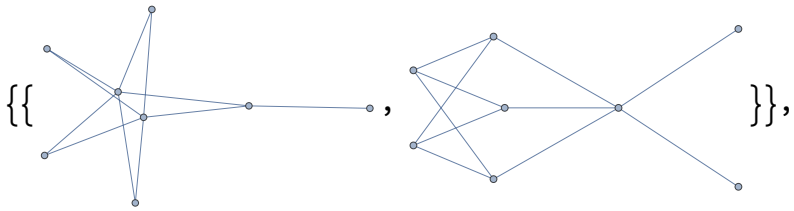


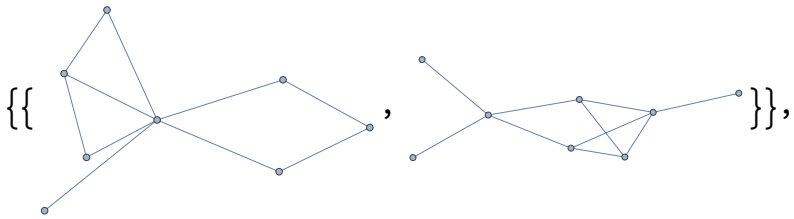
Checked isospectral pairs below.

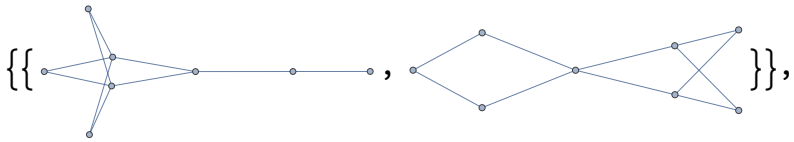


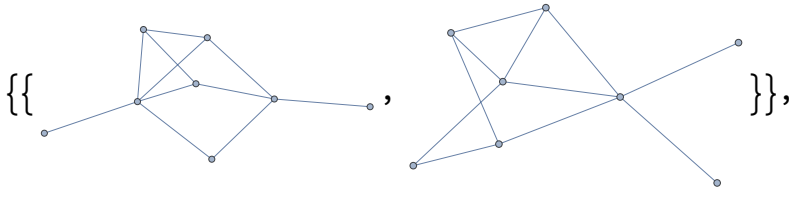


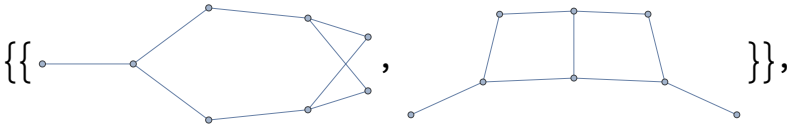


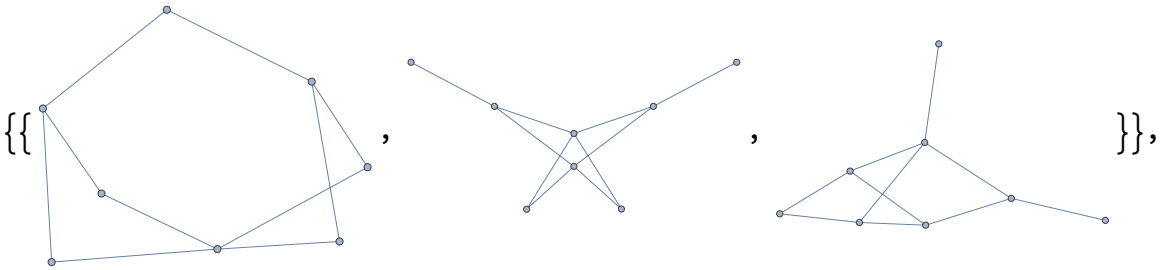


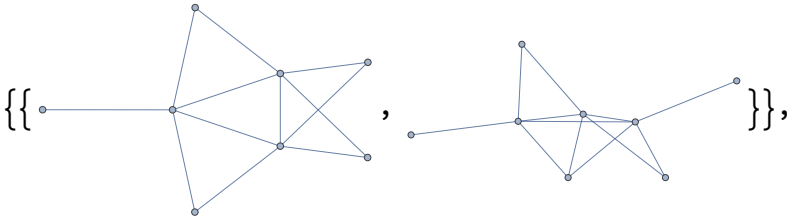


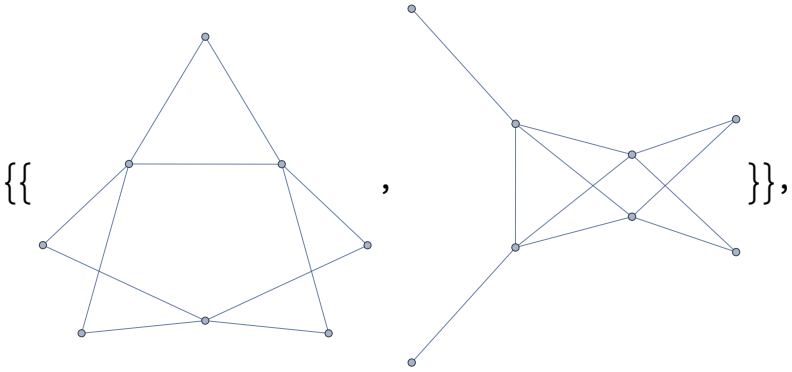


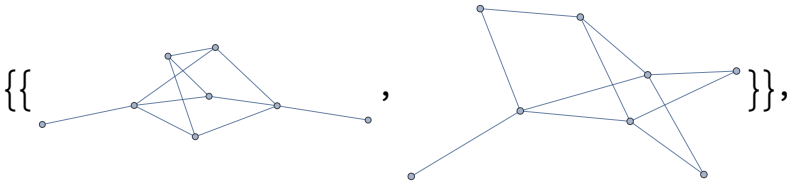


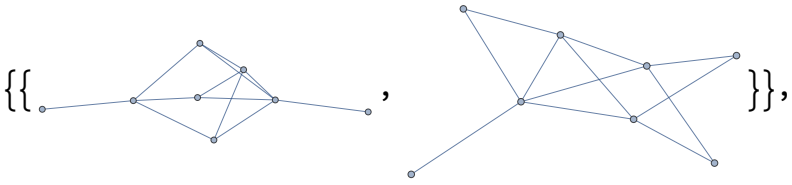


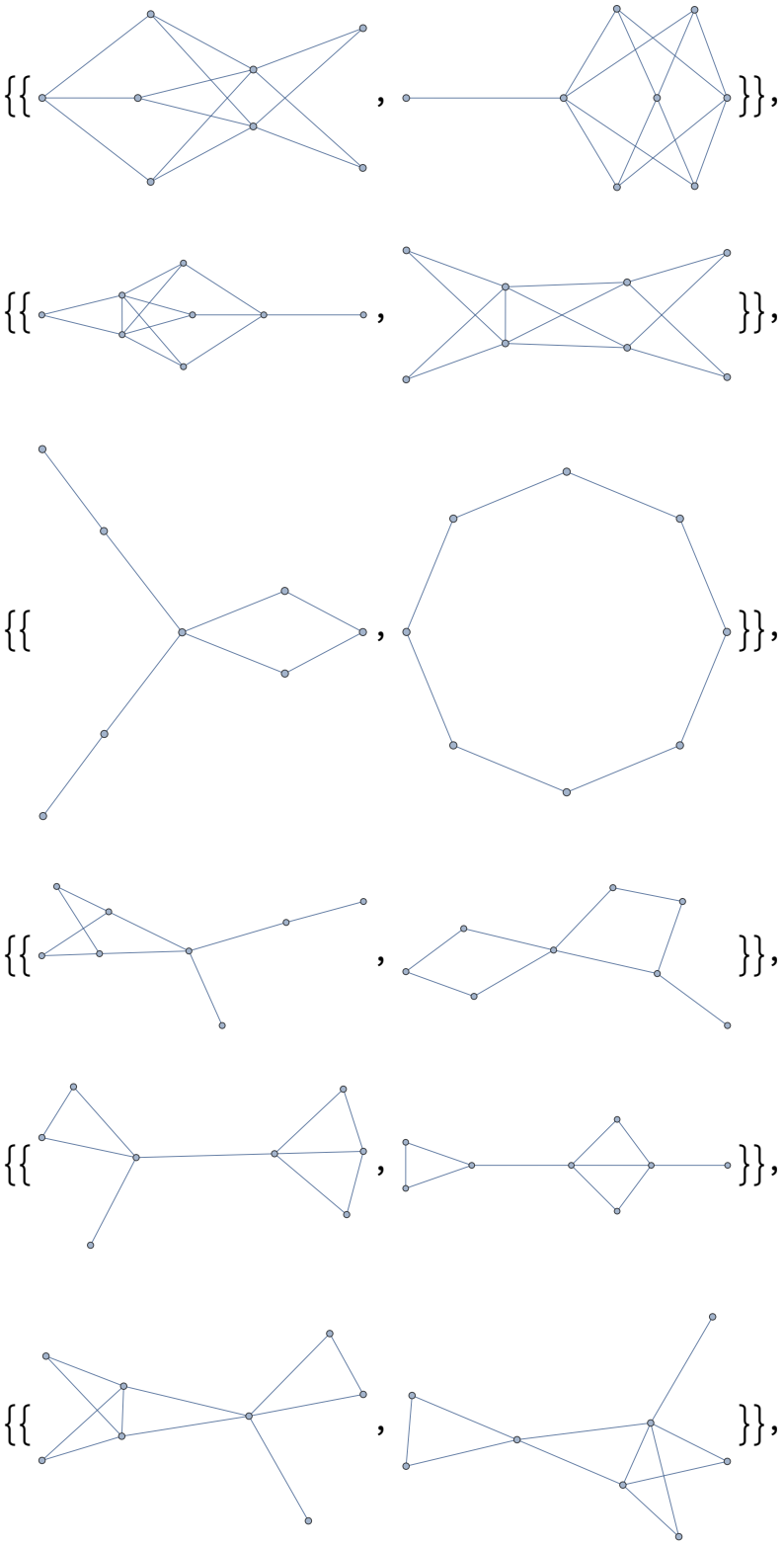


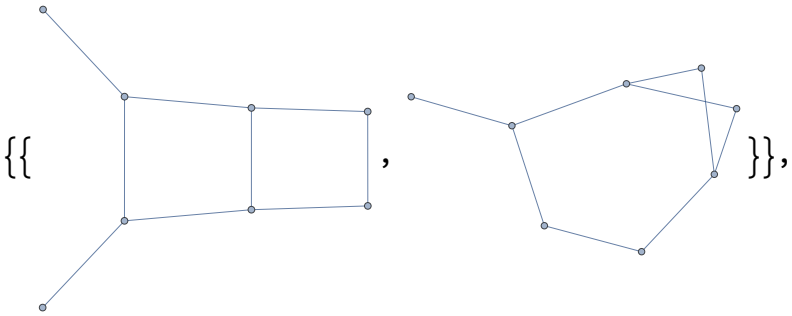


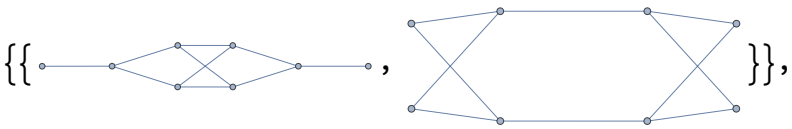


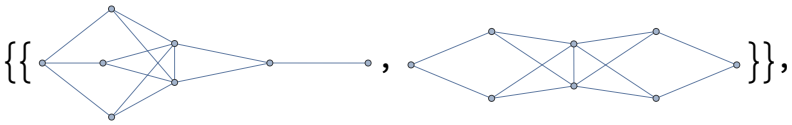


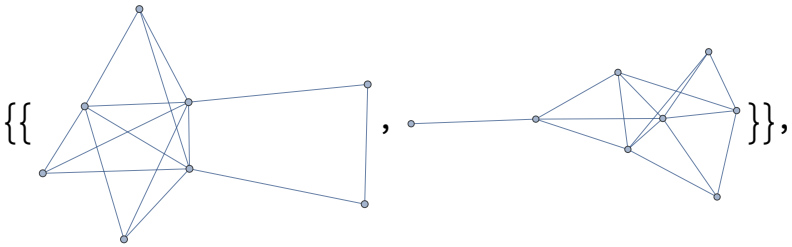


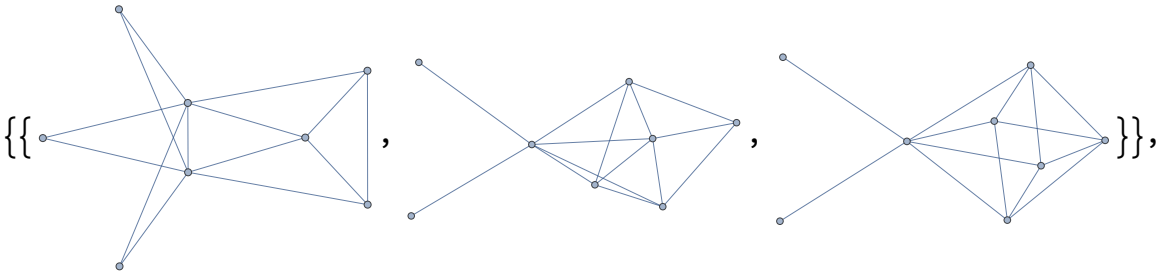


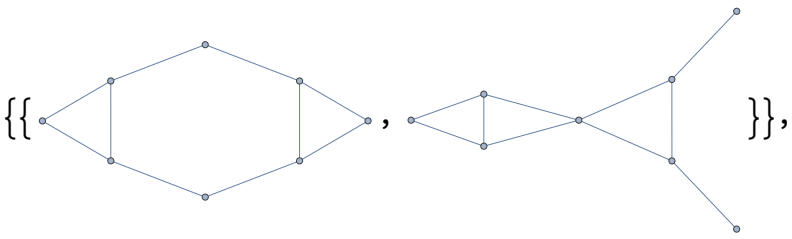


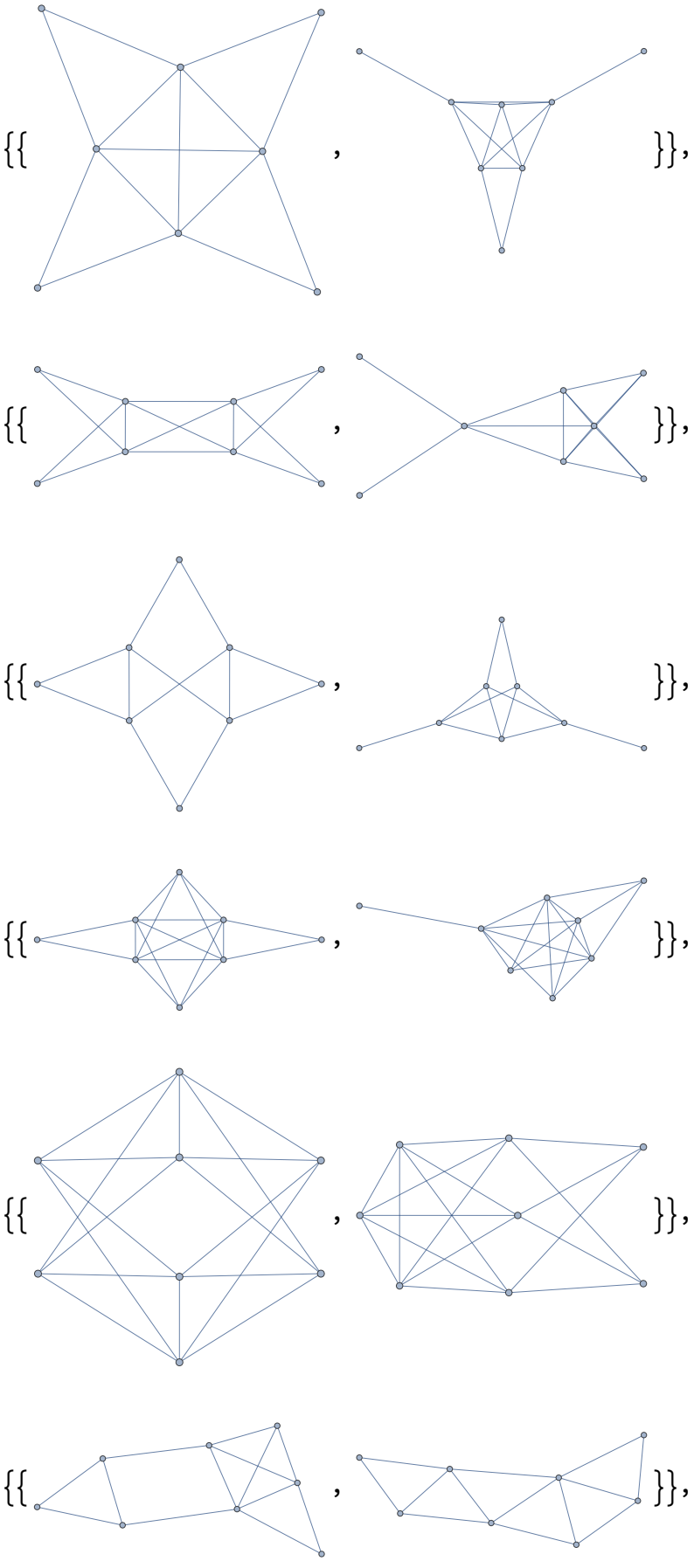


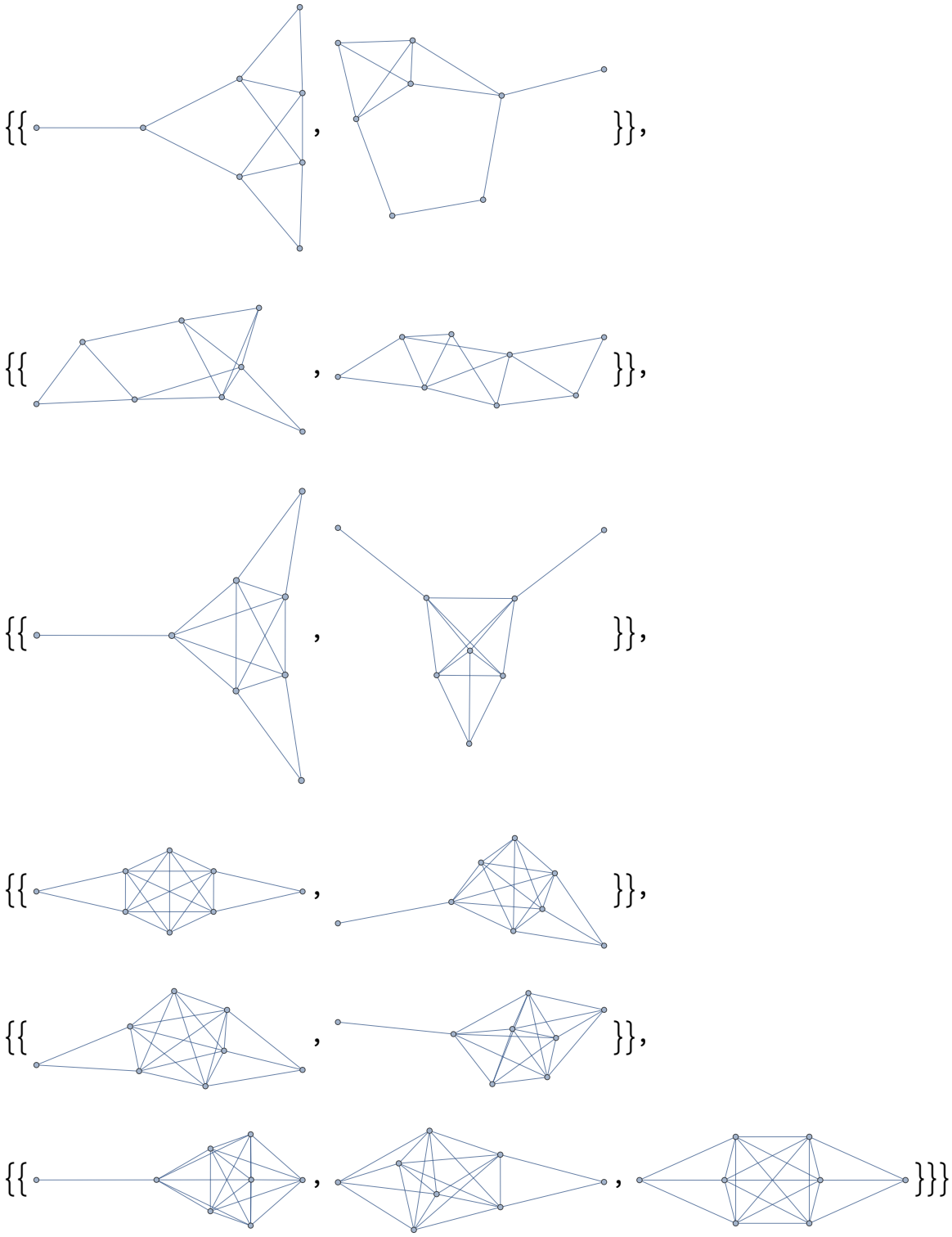






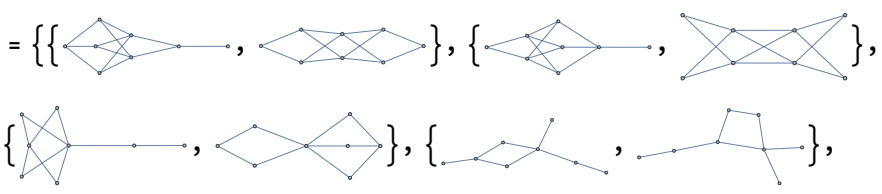


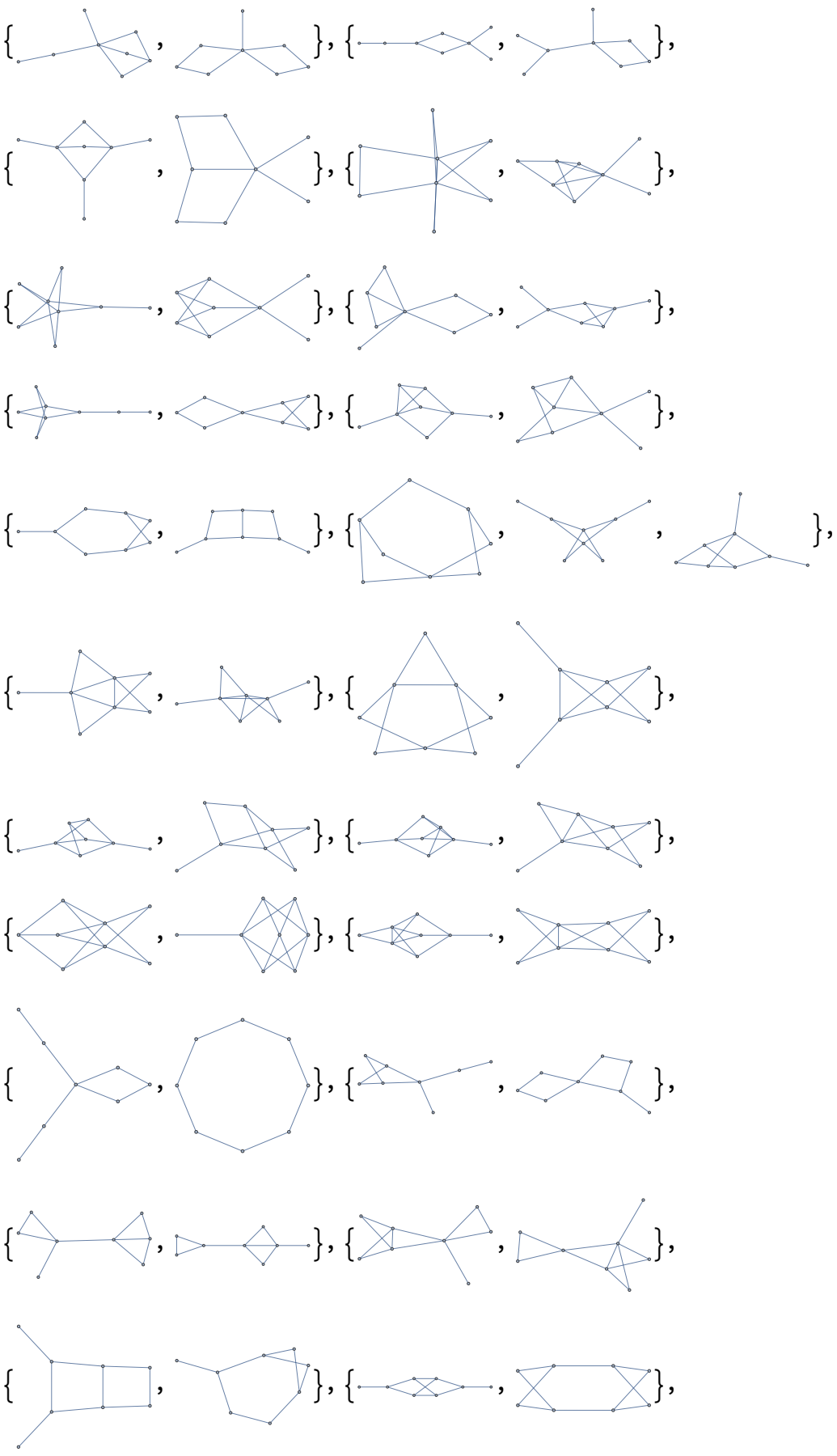


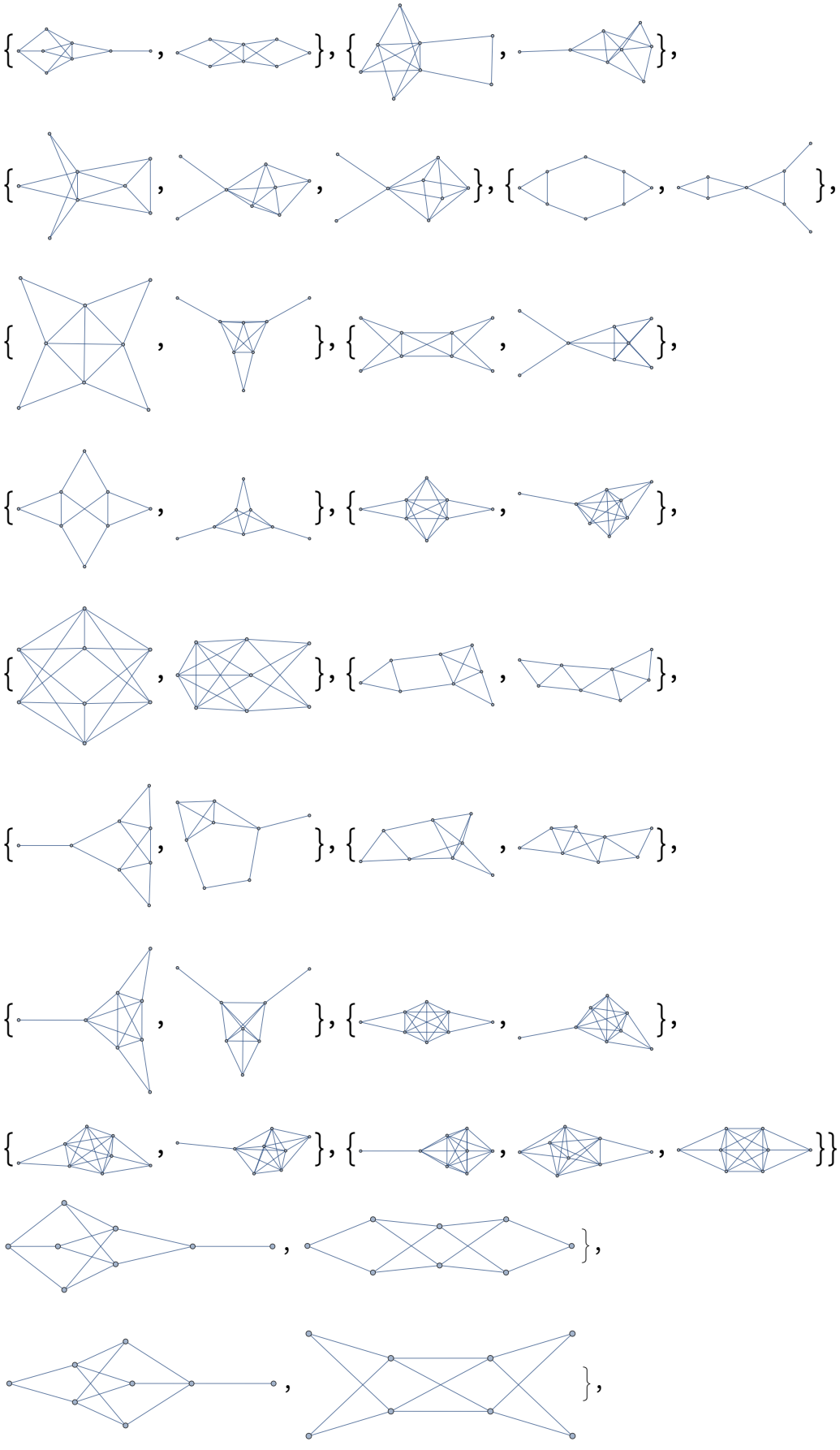


Checked pairs below, beautified.

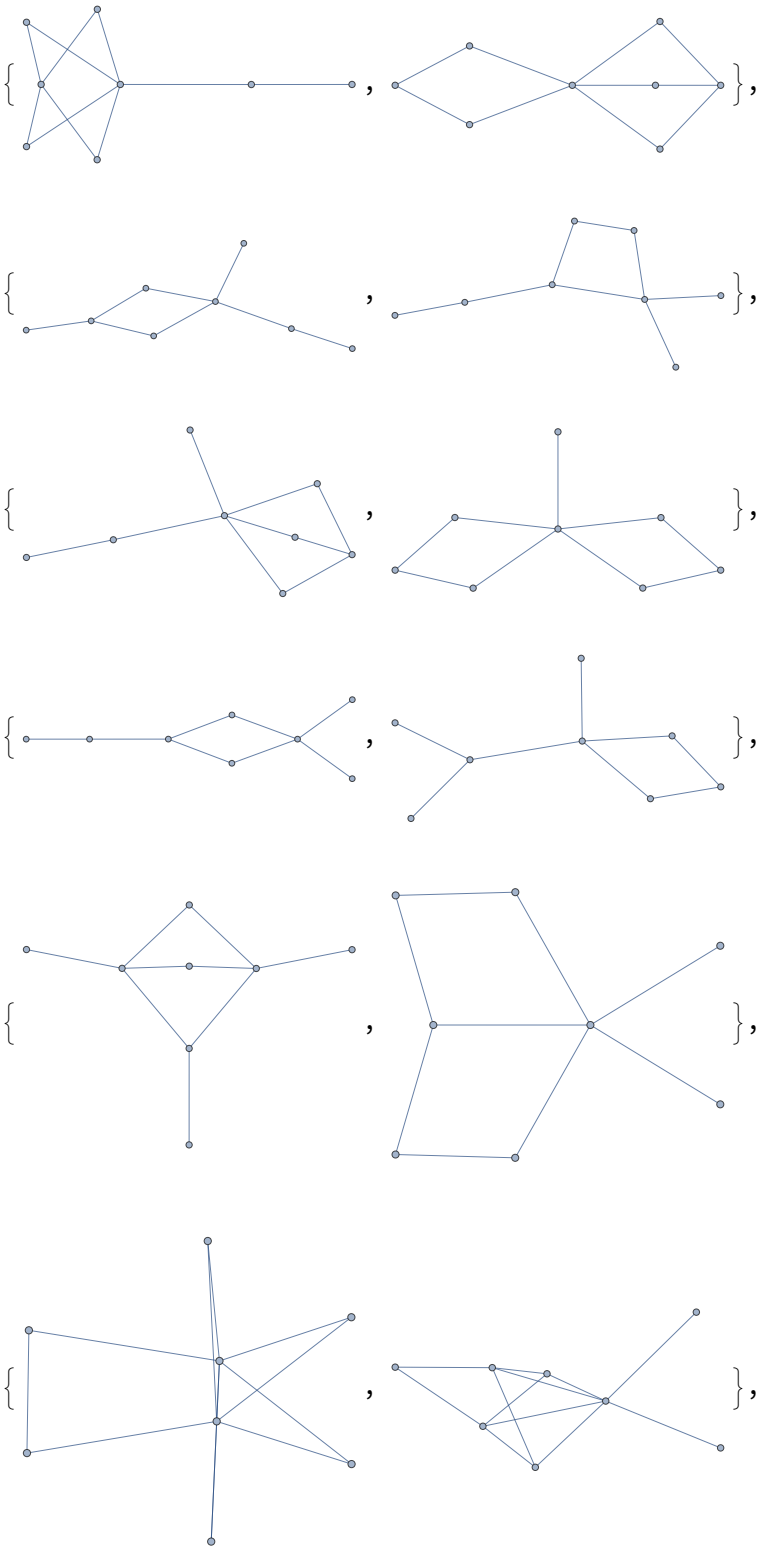
In[526]:= **cp** =

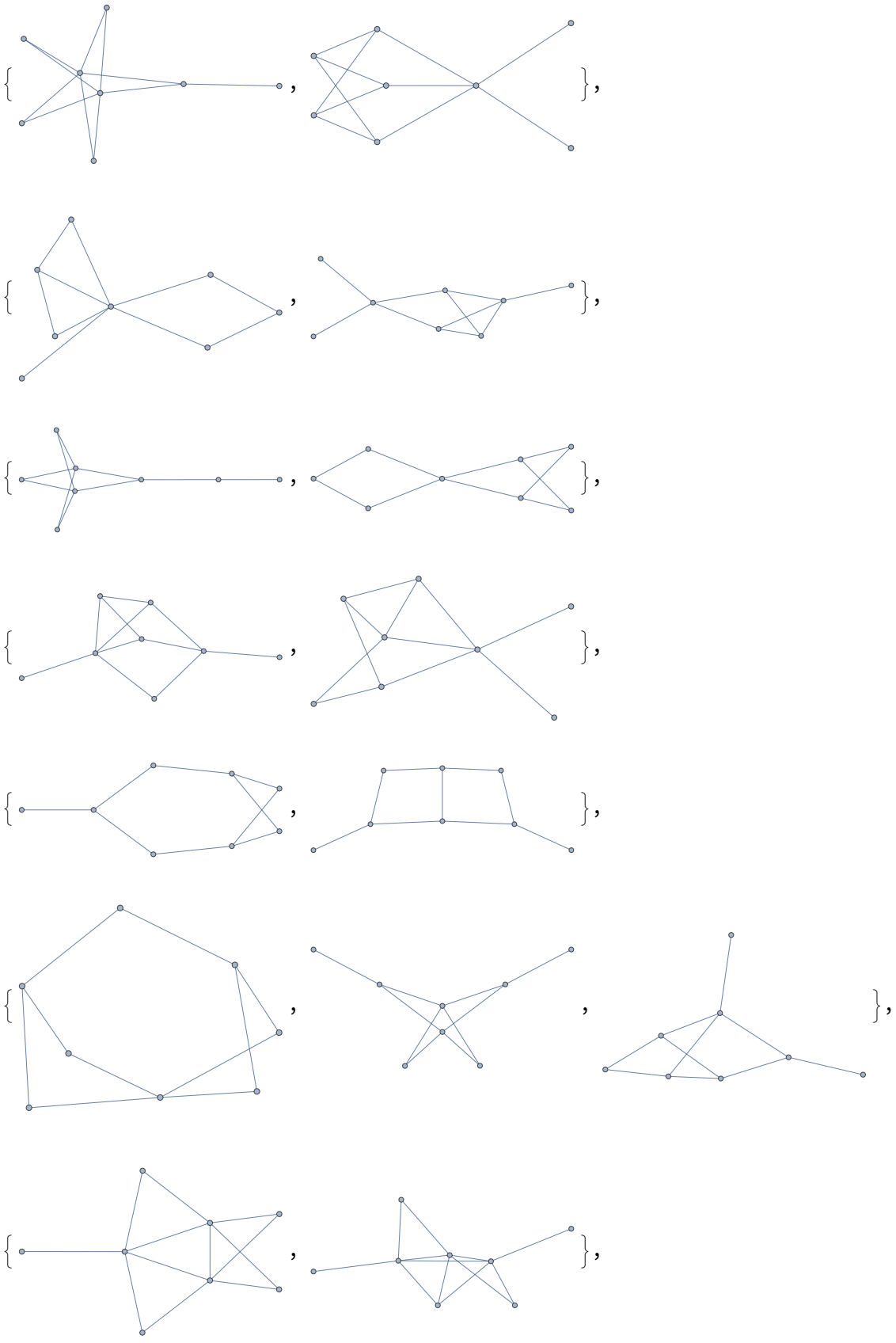


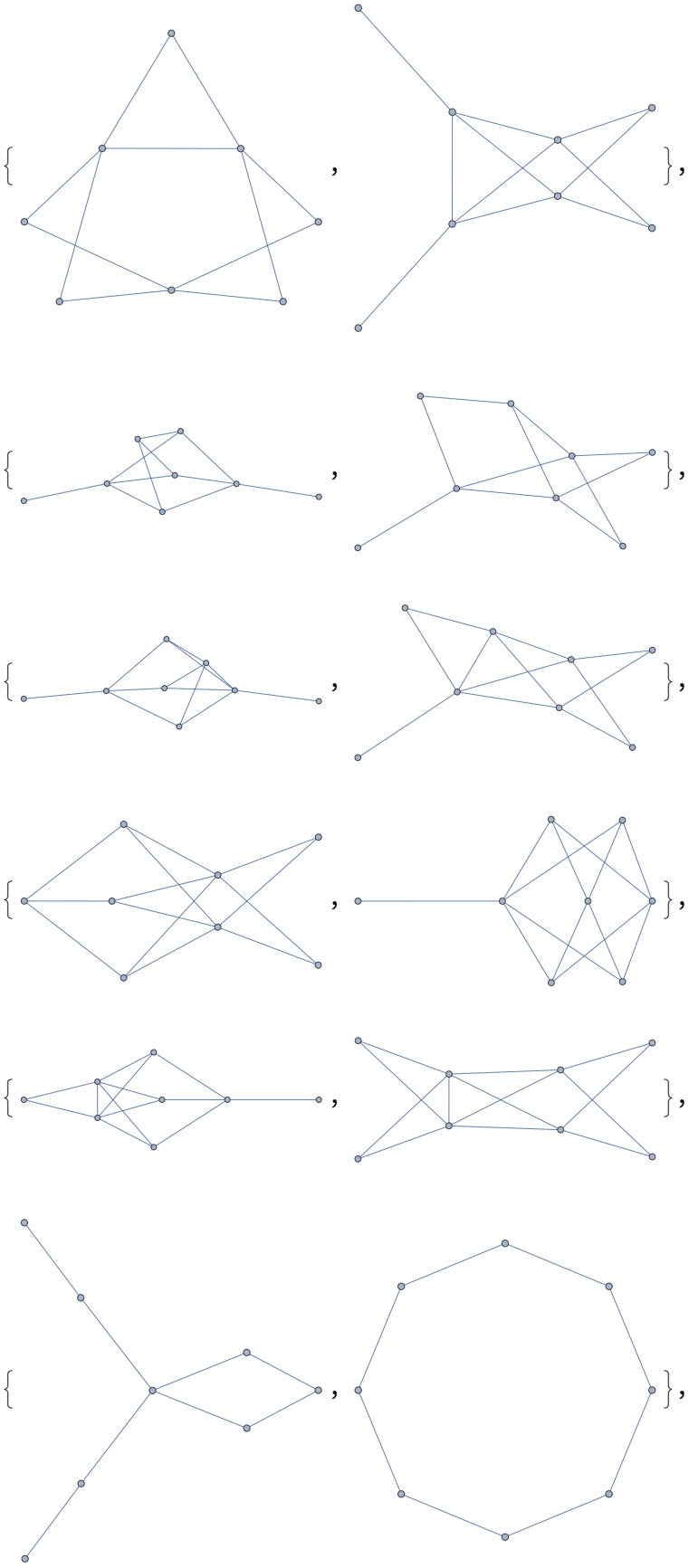


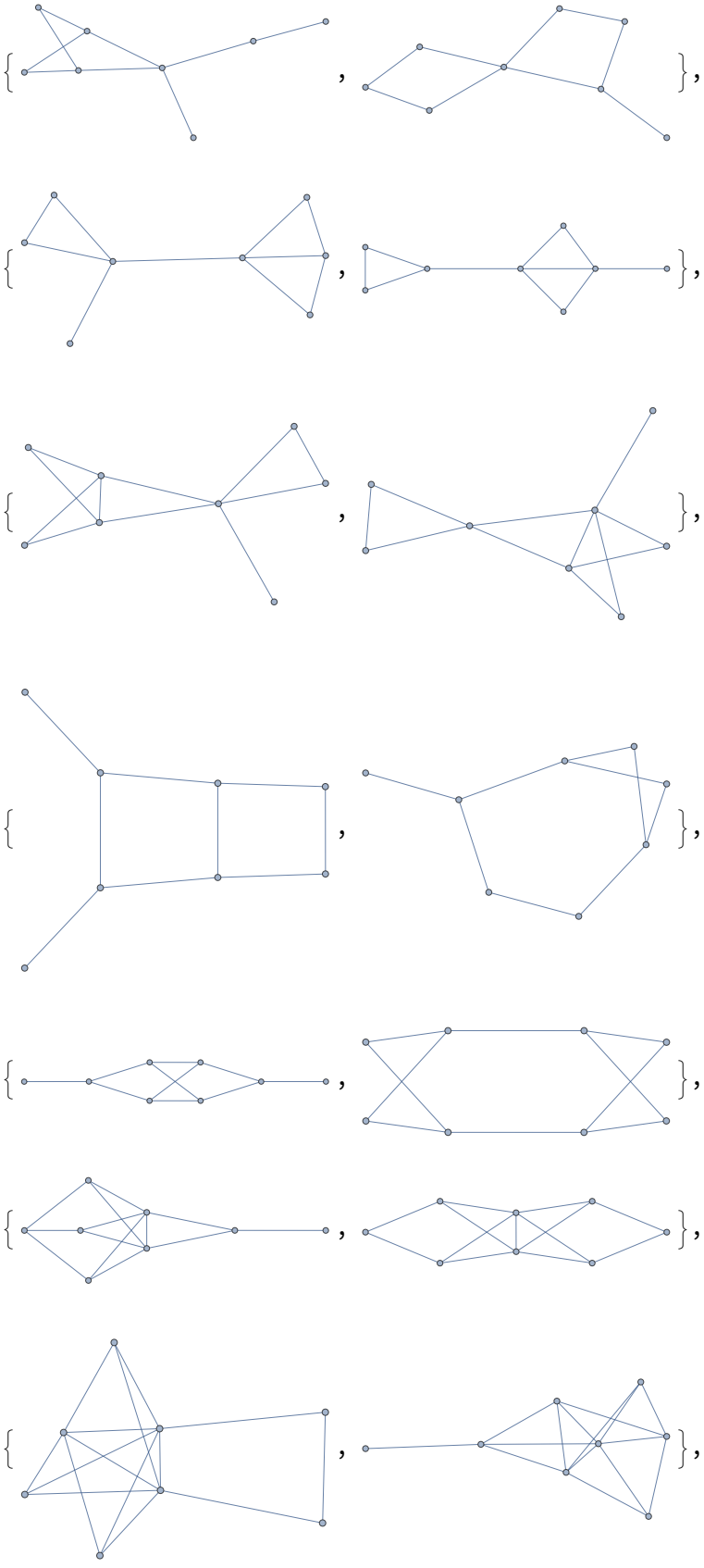


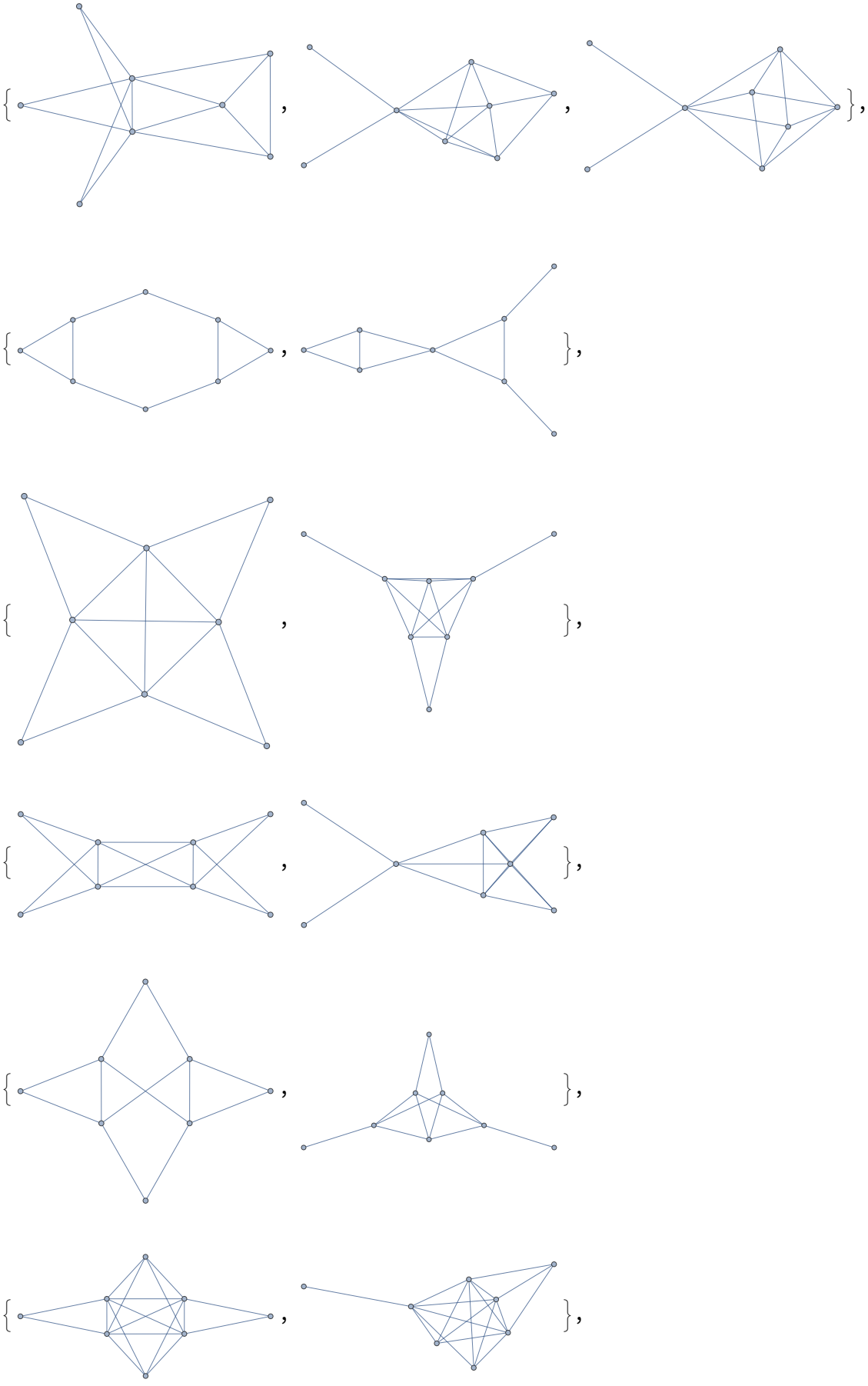
Out[526]=

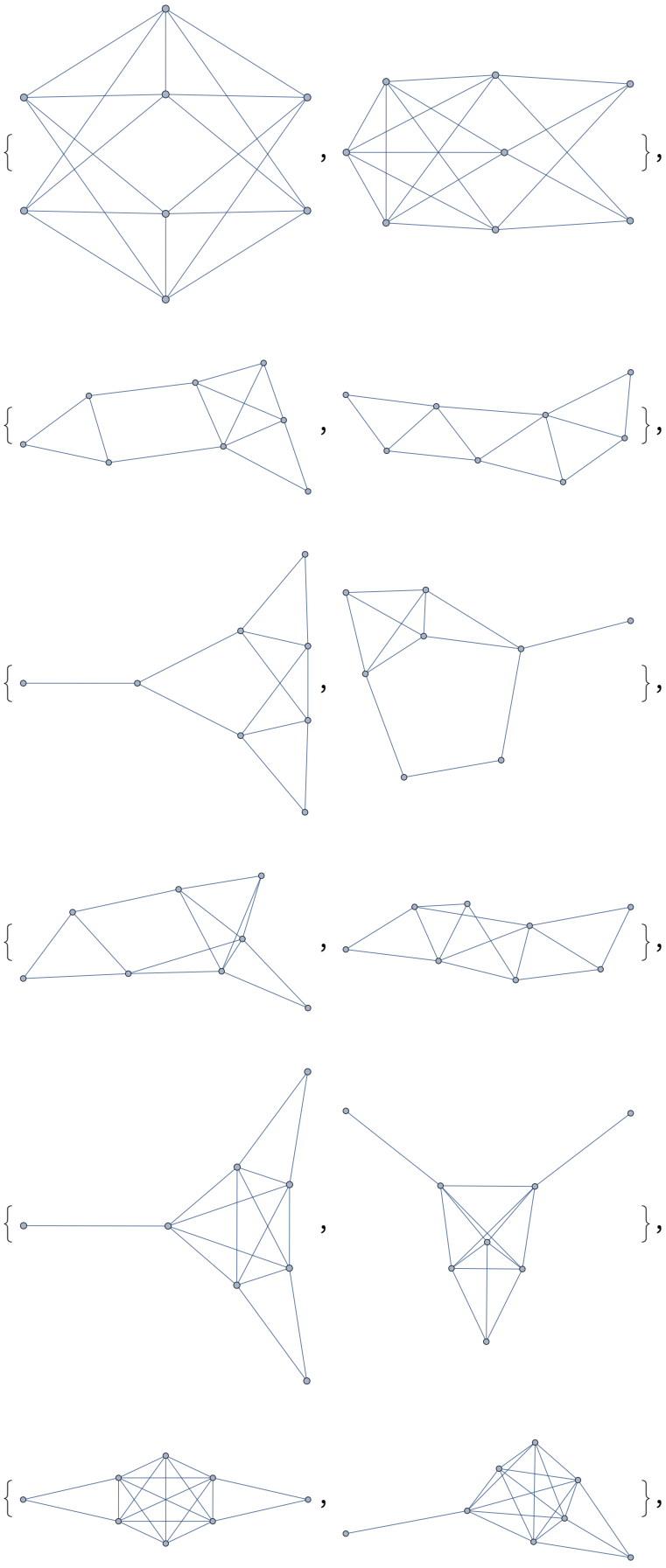


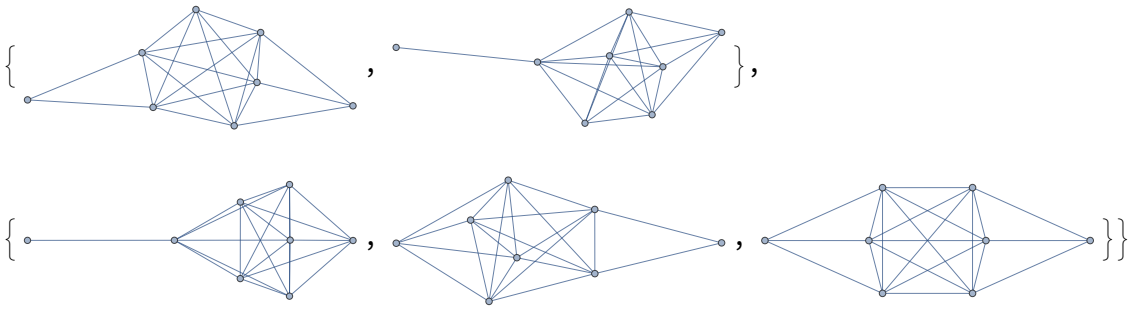












In[547]:=
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Map@(GraphPlot[#] &) /@ cp
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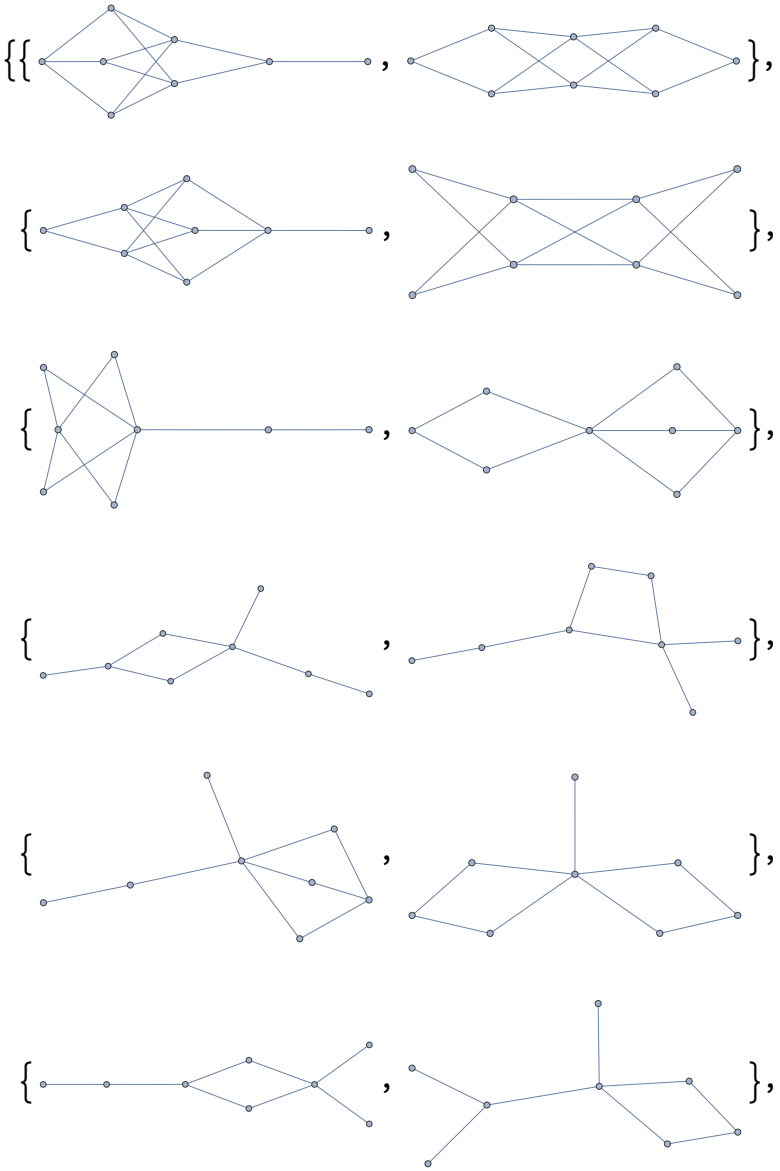
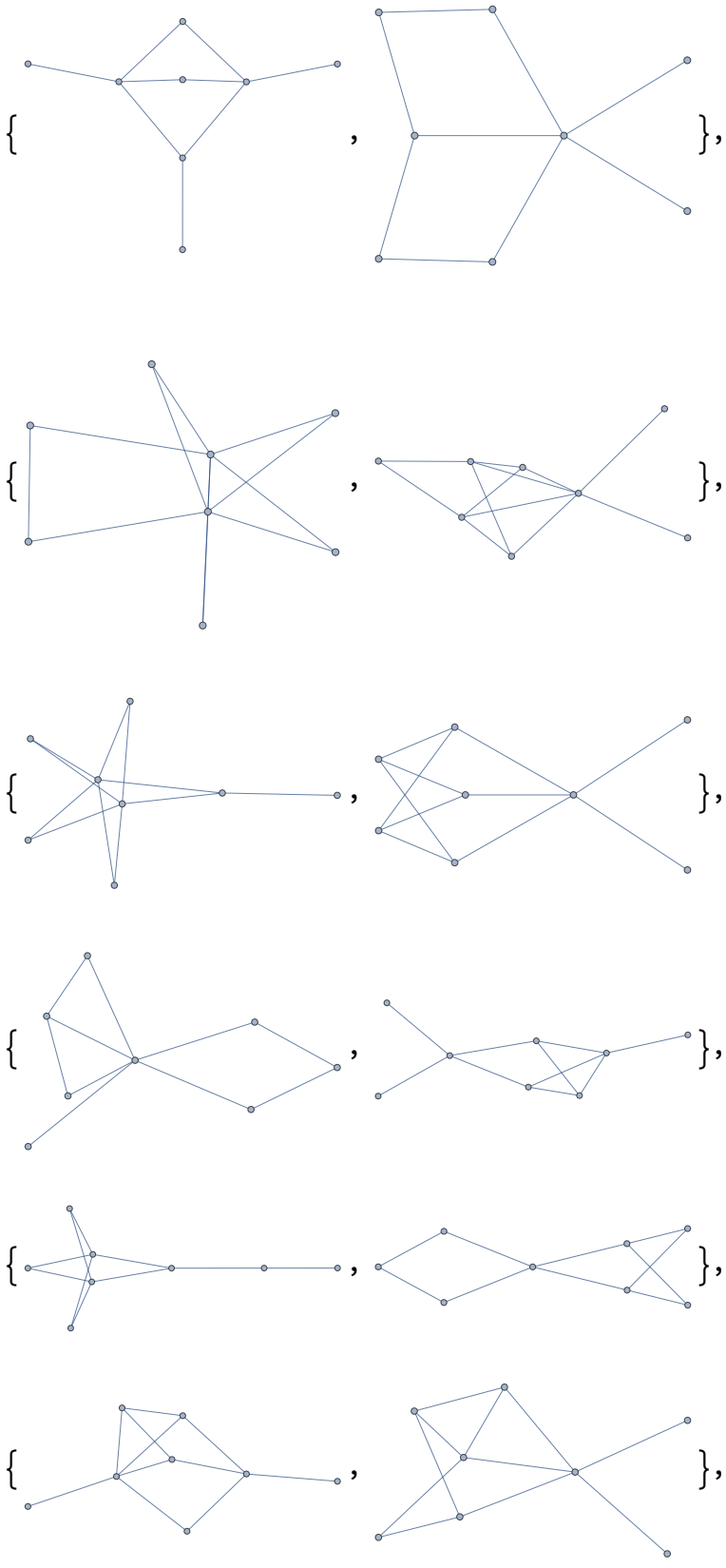
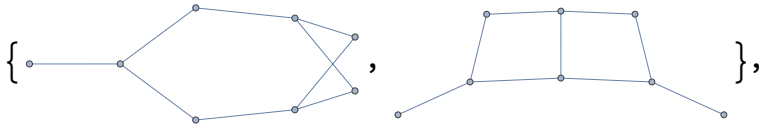
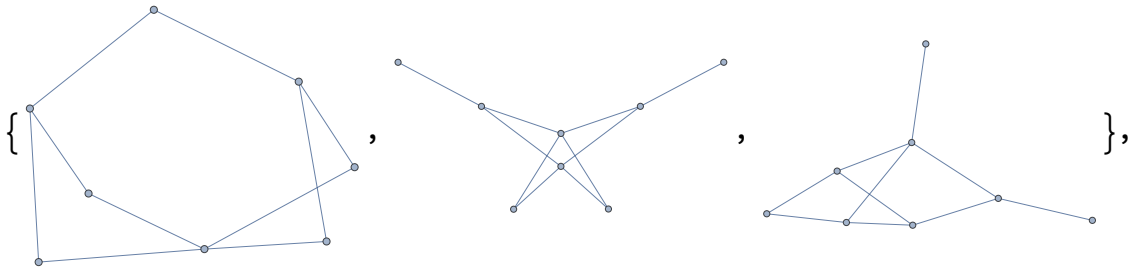
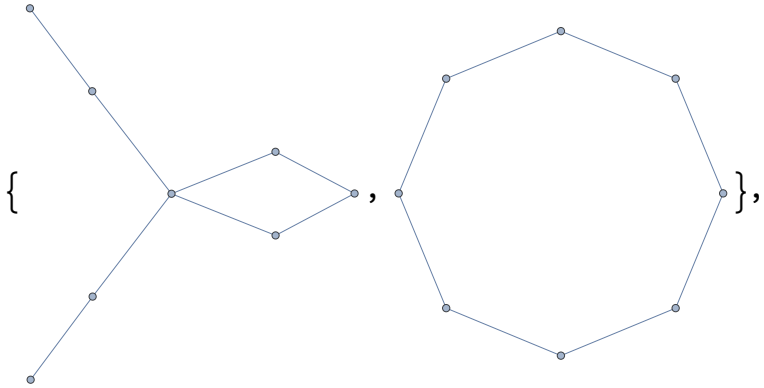
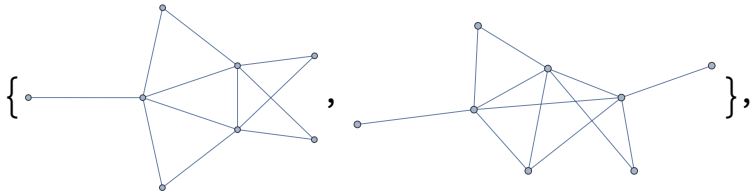


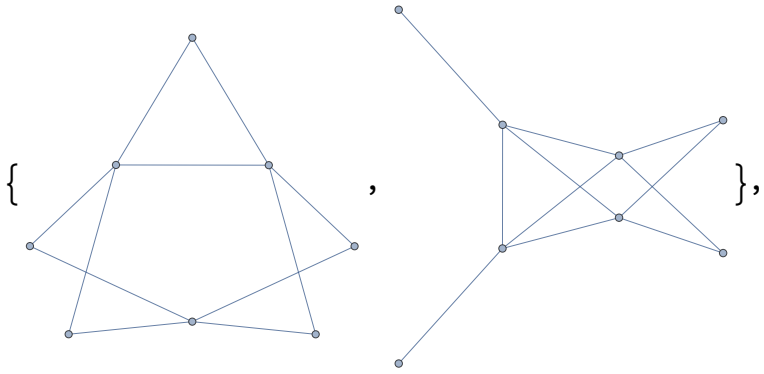


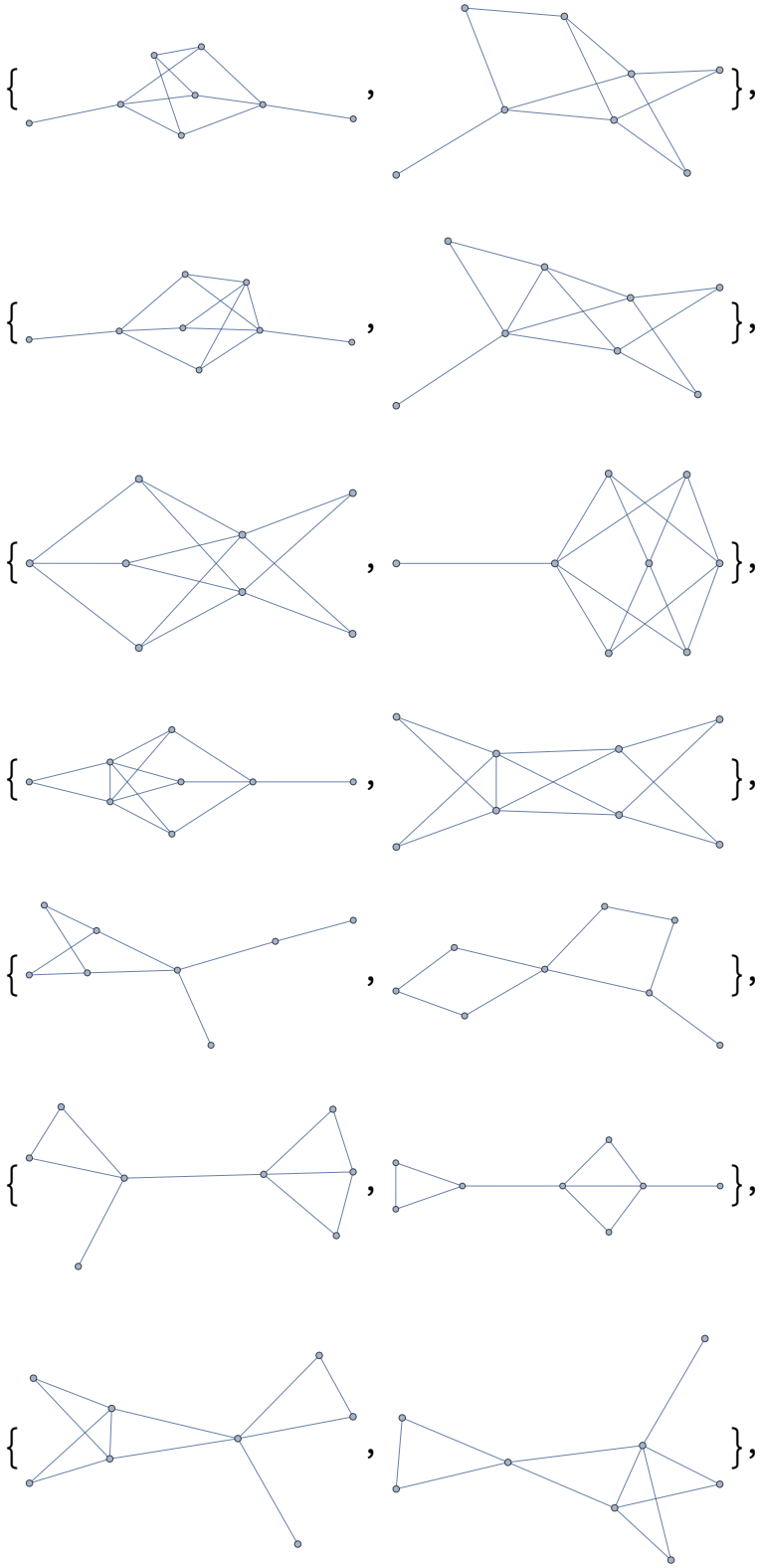


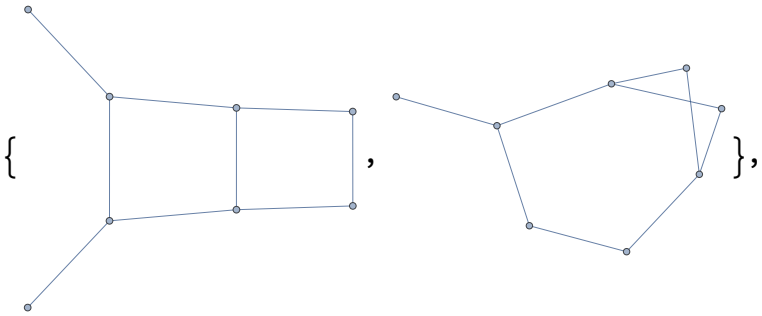


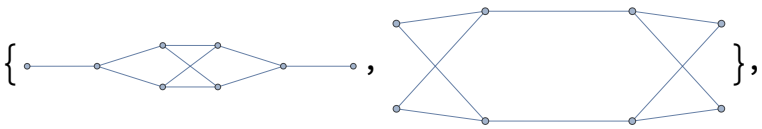


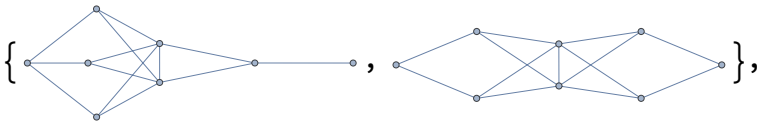


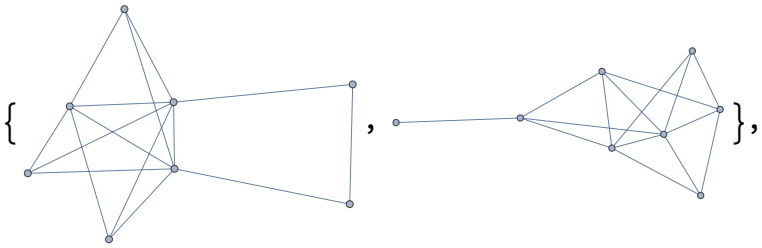


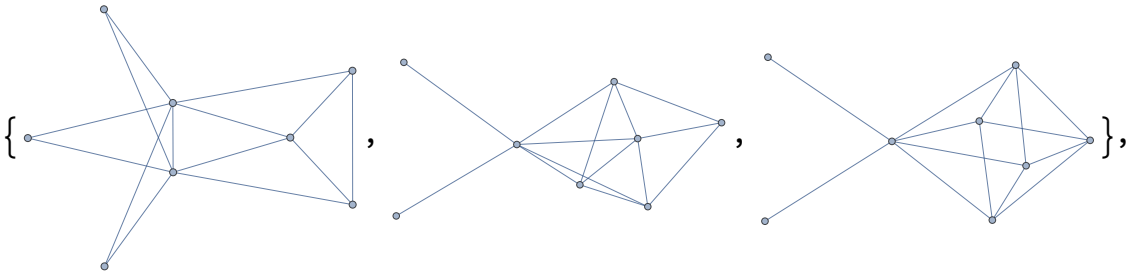


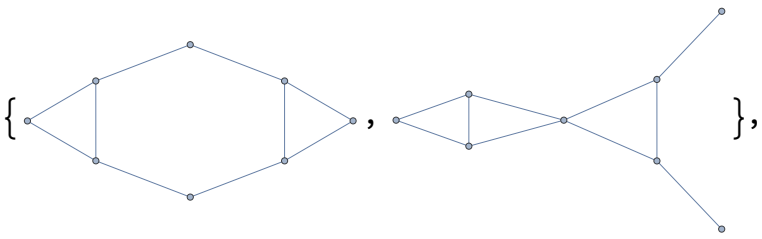


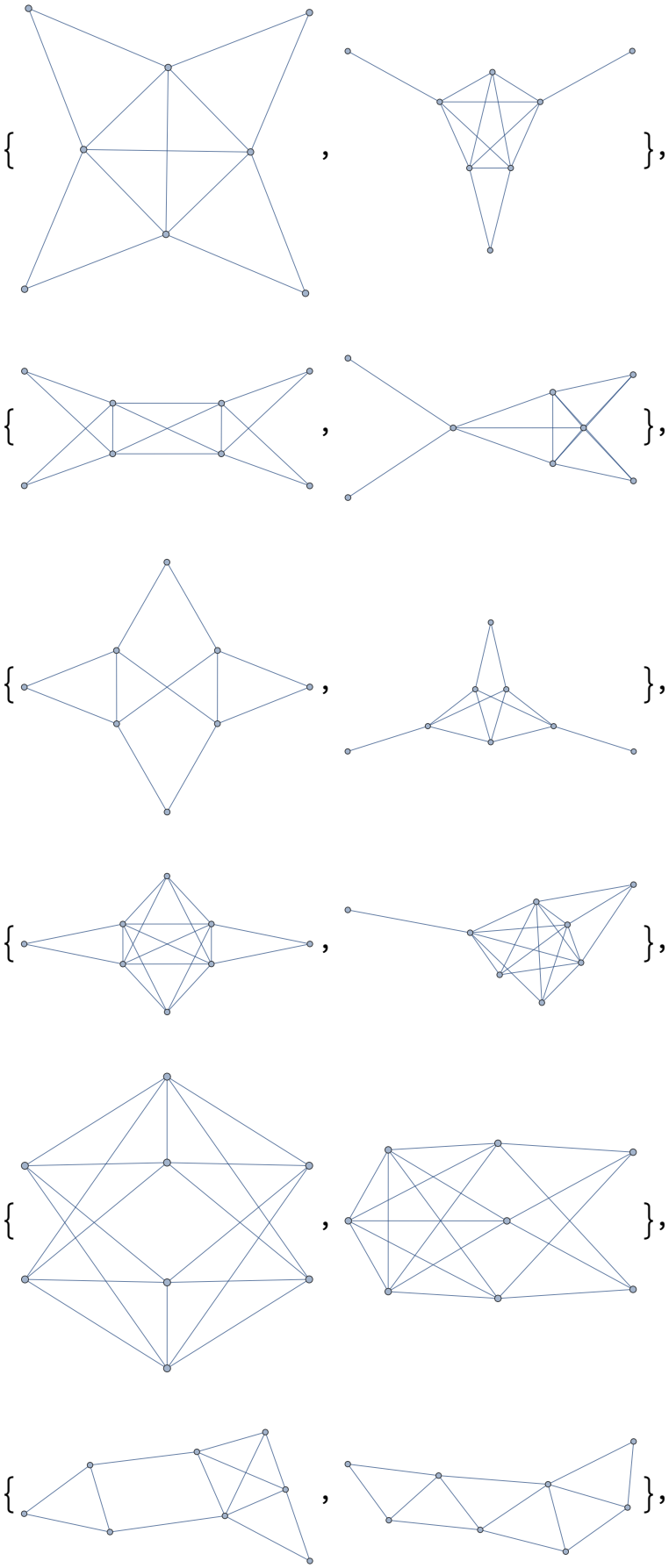


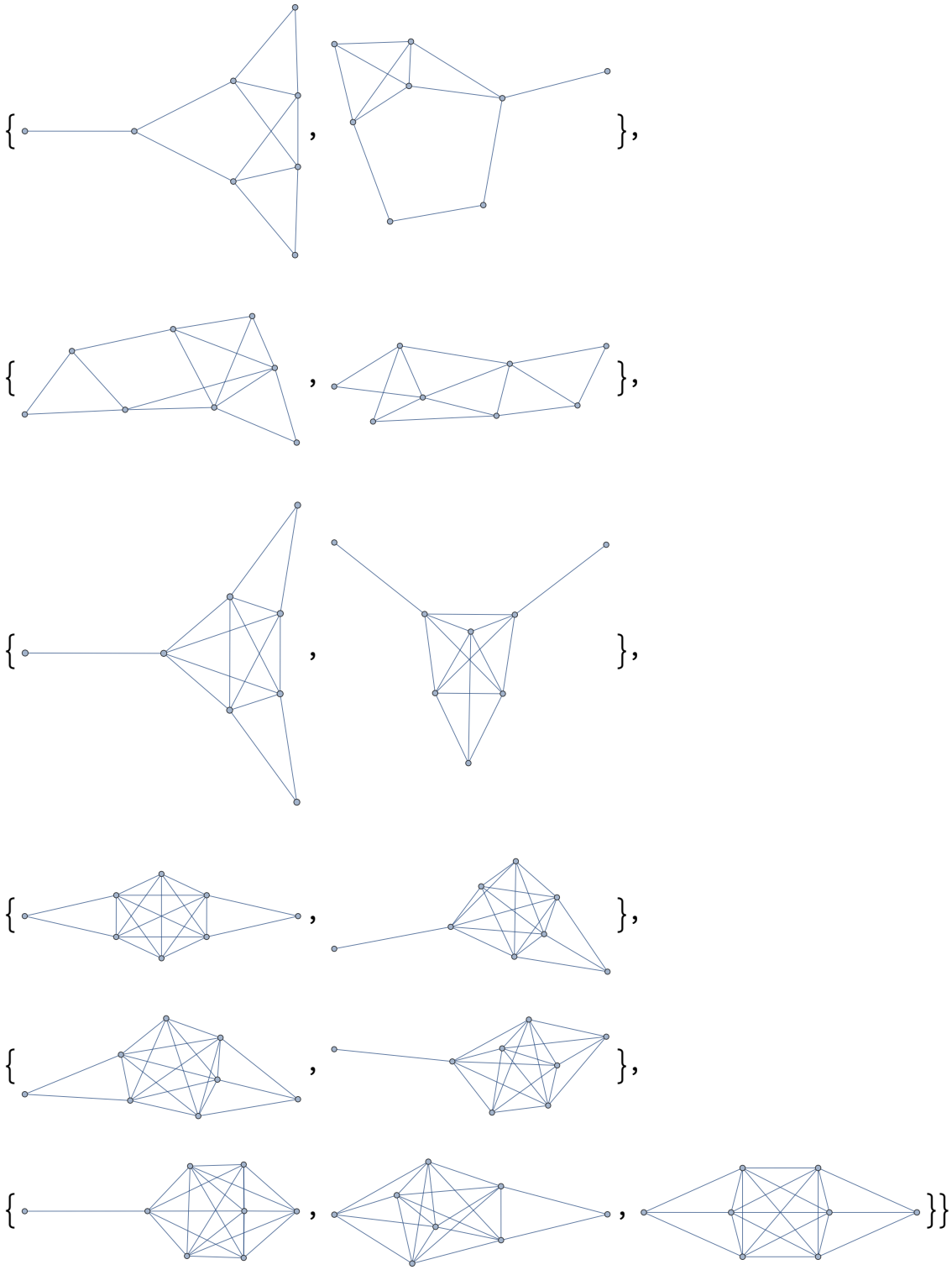


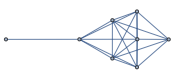


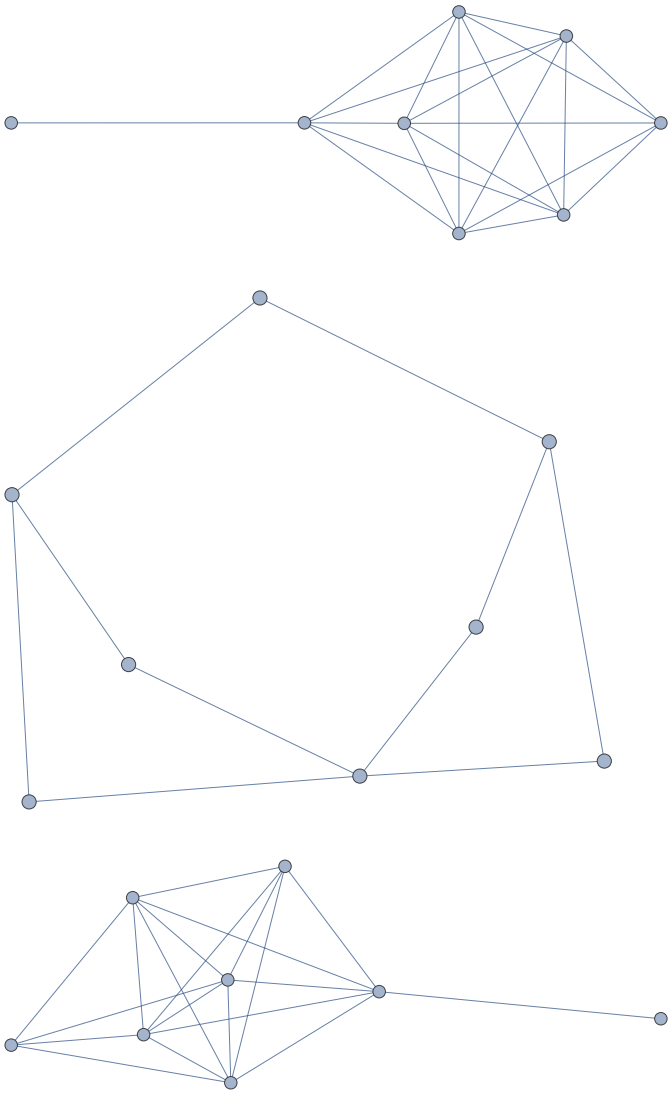








In[477]:= `GraphPlot[ // EdgeList, GraphLayout → "SpringElectricalEmbedding"]`



In[468]:=
```
graphtable // Length
```
Out[468]=
```
11 117
```

In[467]:=
```
graphtable
```

In[421]:=
```
Allconnected[[1]] // Head
```
Out[421]=
```
Graph
```

```
AdjacencyMatrix
```

In[258]:=
```
mm =.
Clear[ReadMatrix];
```

In[157]:=
```
IntegerDigits["00111111", 10, 8]
```
Out[157]=
```
IntegerDigits[00111111, 10, 8]
```

In[146]:=
```
IntegerDigits[00 111 111, 10, 8]
```
Out[146]=
```
{0, 0, 1, 1, 1, 1, 1, 1}
```