

# 3 colour dodecahedron

Instructions to make a 3 colour dodecahedron

## 3 colour dodecahedron

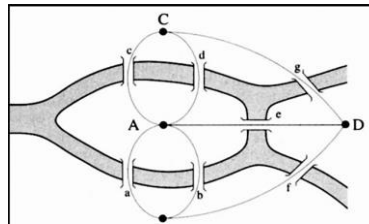
- You only need to do this step if you want to colour your dodecahedron with 3 colours with 3 different colours at each vertex.
- To be achieve this, we need to be able to draw the dodecahedron.
- To do this we will represent the dodecahedron using it's graph, or projection.

# Graph Theory

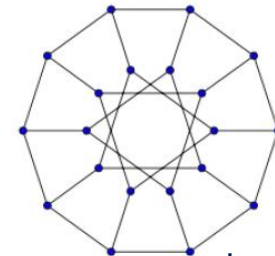
- A graph is a way of showing how things are connected, for example roads connecting towns, tube lines connecting stations or servers connecting computers. Here are some examples



Graph of train connections

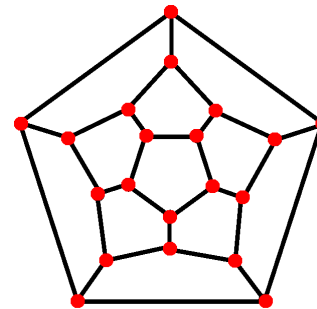


Graph of bridges in a town



Desargues graph, used in theoretical mathematics

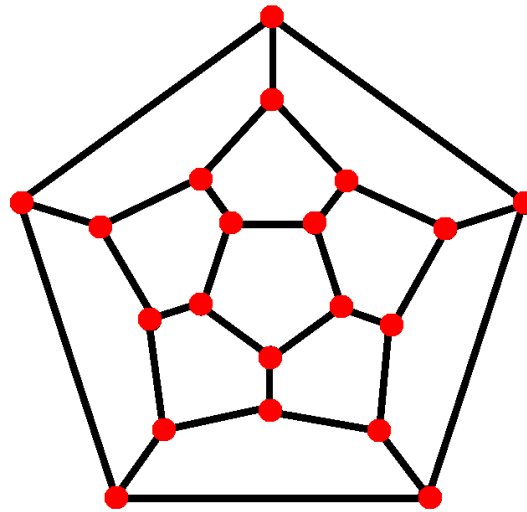
- This is a graph of a dodecahedron, where the red dots are the vertices, the black lines are the edges and the faces are enclosed.



Graph by Tomruen at English Wikipedia, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=17022620>

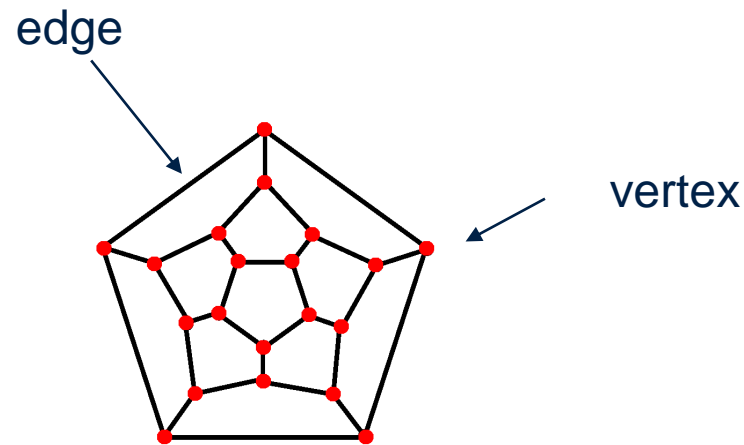
# Graph of a dodecahedron

- Can you count the faces? What's missing? How is it represented on the graph?



# Graph Theory

- To colour the graph, we need some vocabulary

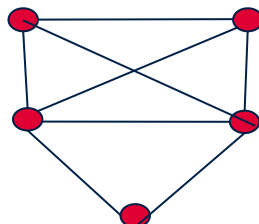


Path = travelling along the edges between the vertices

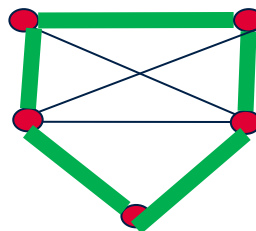
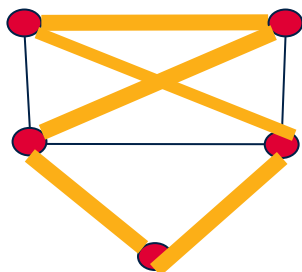
Cycle = travelling along the edges between the vertices and return to the start

# Hamiltonian Cycle

- A Hamiltonian cycle is one that goes along the edges through every vertex of the graph once and returns to the start, without going over any edge twice.
- For example, in this graph

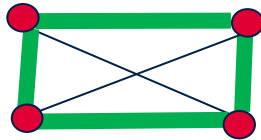


a Hamiltonian cycle could be the path in yellow or the path in green

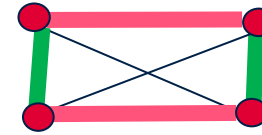


## Colouring the edges

- Find a Hamiltonian path in the graph of the dodecahedron
- On the Hamiltonian path, take two different colours and colour each edge in alternate colours – for example



would become



- This is now your guide to the colours for your dodecahedron – each vertex will have the 3 different colours (with your edges not in the Hamiltonian cycle as the final colour)

# A possible solution

