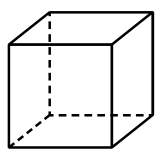
3D shapes – types and properties

1 **How do 3D shapes differ from 2D shapes? Imagine you're giving an explanation to a younger child. What would you say and/or draw?**

Remember the **surfaces** of a 3D shape are 2D shapes. Where 2 surfaces meet is called the **edge**. The **point** where 2 or more surfaces meet is called the **vertex**. If we are talking about more than one vertex we call them **vertices**.

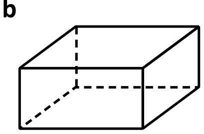
2 **How many surfaces, edges and vertices does each of these shapes have?**

a



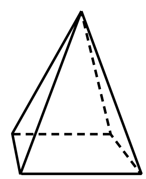
_________ faces
_________ edges
_________ vertices

b



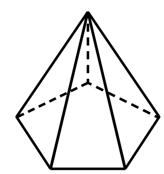
_________ faces
_________ edges
_________ vertices

c



_________ faces
_________ edges
_________ vertices

d



_________ faces
_________ edges
_________ vertices

Some 3D shapes are **polyhedrons**. This means each surface is a polygon. The polyhedrons we most commonly come across are pyramids and prisms.

Prisms have identical parallel faces joined by rectangles. Most prisms are named after their end faces.

Pyramids have a base with 3 or more straight sides. They have triangular faces which meet at a point. They are named after their bases.

Another group of 3D shapes has one or more curved surfaces (e.g. spheres, cones and cylinders).

3 **Complete the following:**

a Draw one type of prism. How many faces, edges and vertices does it have?

___ faces ___ edges ___ vertices

b Draw one type of pyramid. How many faces, edges and vertices does it have?

___ faces ___ edges ___ vertices

c Draw a shape with one or more curved surface. How many faces, edges and vertices does it have?

___ faces ___ edges ___ vertices

3D shapes – types and properties

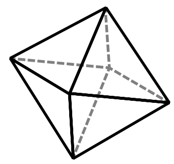
4 **You and a partner have 20 minutes to identify as many of these mystery 3D shapes as you can. Use whatever resources you have to assist you – math dictionaries, websites, Mathletics or solid shapes. Different shapes are assigned different point values, so decide which answers you will spend the most time on! You can score a possible 150 points. At the end of the 20 minutes your answers will be checked and your scores tallied.**

a I have 3 faces.
One of these is curved.
The other 2 faces are 2D circles.
These circles are parallel to each other.

I'm a

5

b This is an example of me:



I'm an

20

c I have a square base and 4 triangular faces.
The triangular faces meet together at one point.

I'm a

10

d I have 1 curved face, no vertices and no edges.
I roll well.

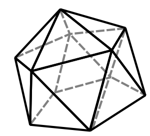
I'm a

5

e I have two names.
One of these is hexahedron.
I have 6 faces, 8 vertices and 12 edges.
Draw me.

10

f This is an example of me:



I have 20 faces, 12 vertices and 30 edges.

I'm an

10

g I'm a Platonic solid.
This means all my faces, angles, vertices and edges are identical.
I have 4 faces.

I'm a

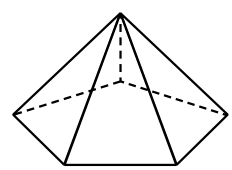
20

h I'm not a polyhedron.
I have a flat circular base and 1 curved face.
I have 1 vertex.

I'm a

10

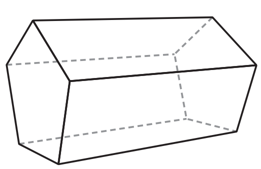
i This is an example of me:



I'm a

5

j This is an example of me:



I'm a

5

k This is an example of me:

What is my name (and it's not donut)?

I'm a

50

Our total score:

Did any pairs in the class score a perfect 150?

3D shapes – types and properties

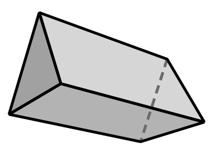
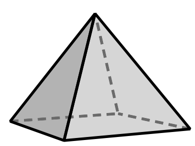
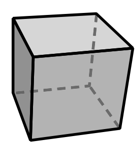
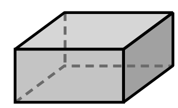
A Swiss mathematician called Leonhard Euler, found a mathematical rule that was so important, it was named after him. He wasn't just a pretty face …

He discovered a connection between the number of faces (F), number of edges (E) and number of vertices (V) of polyhedrons.

Here is part of Euler's rule: F + V – E = $\boxed{?}$

5 **Your job is to try and work out what should go in the box. Because we are incredibly nice people we'll give you the following hints:**

- The answer is a number.
- You should find the missing information in the table below. Use solids to help you.
- Then, for each shape, try F + V – E and see what your answer is. It should always be the same. If not, you've gone wrong somewhere.

Polyhedron	Triangular prism	Square based pyramid	Cube	Rectangular prism
Number of faces (F)				
Number of vertices (V)				
Number of edges (E)				
Formula	 F + V – E = ___ + ___ – ___ = ___	 F + V – E = ___ + ___ – ___ = ___	 F + V – E = ___ + ___ – ___ = ___	 F + V – E = ___ + ___ – ___ = ___

What is Euler's formula? F + V – E = ____________

6 **Find 2 more polyhedrons to test this out on:**

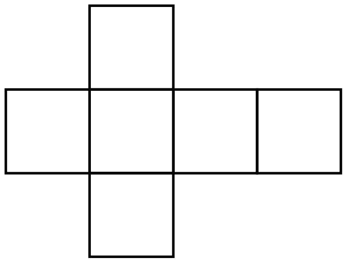
It took Euler years to work this out and you've done it straight away. Well done! We suggest you take the rest of the day off. Just run it by your teacher, we're sure they'll be up for it.

3D shapes – nets

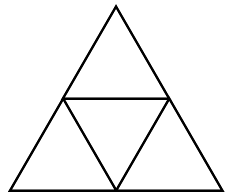
A net is the pattern of a 3D shape, unfolded and laid flat. It helps to visualise how nets fold up to create a 3D shape.

1 **Fold each net 'in your head' then write its letter in the correct shape name box at the bottom of the page:**

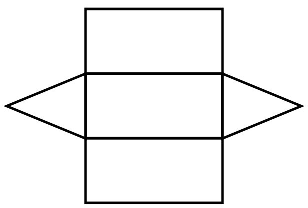
a



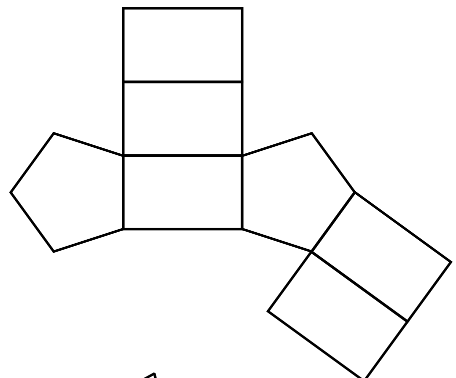
b



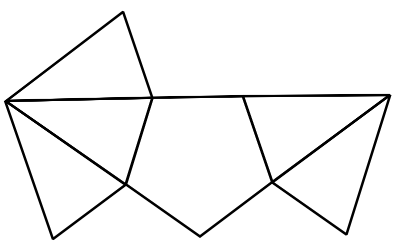
c



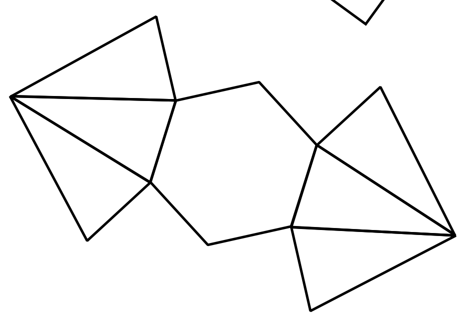
d



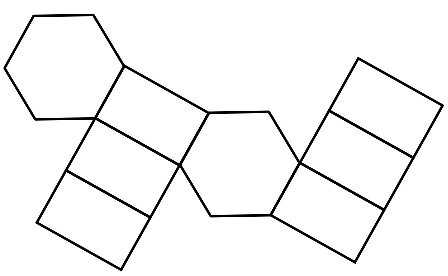
e

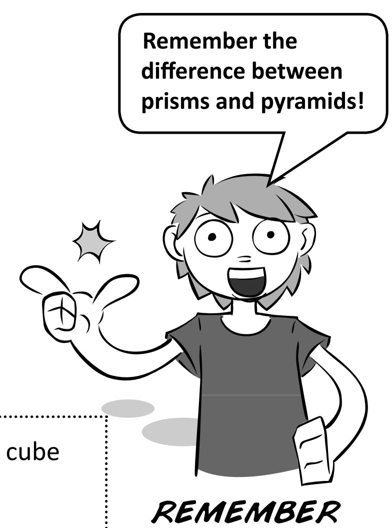


f



g

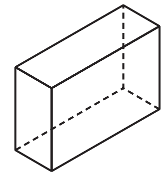




pentagonal pyramid	triangular pyramid	hexagonal prism	
triangular prism	pentagonal prism	hexagonal pyramid	cube

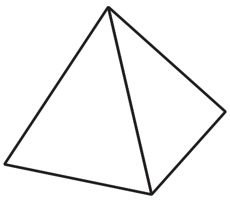
3D shapes – drawing 3D shapes

When we draw 3D shapes, we can draw dotted lines to indicate the surfaces, edges and vertices we can't see.



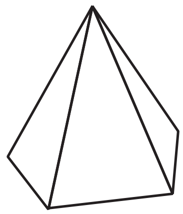
1 **Add the dotted lines to these shapes to reveal the missing edges and vertices. The name of the shape may guide you – a square based pyramid needs a square for its base and a rectangular prism has rectangles at each end.**

a



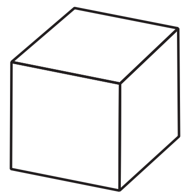
square based pyramid

b



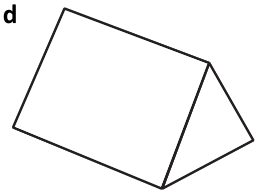
pentagon based pyramid

c



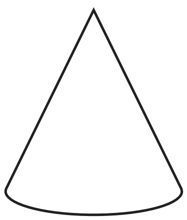
cube

d



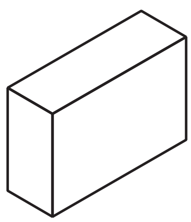
triangular prism

e



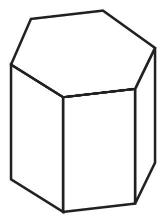
cone

f



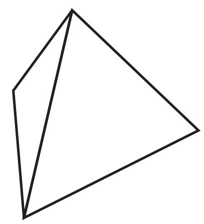
rectangular prism

g



hexagonal prism

h



triangular based pyramid

2 **Draw the following shapes:**

a triangular prism

a cylinder

a pentagonal based pyramid

a cone

3D shapes – drawing 3D shapes

3 **Use the following information to help you identify and draw this mystery shape:**

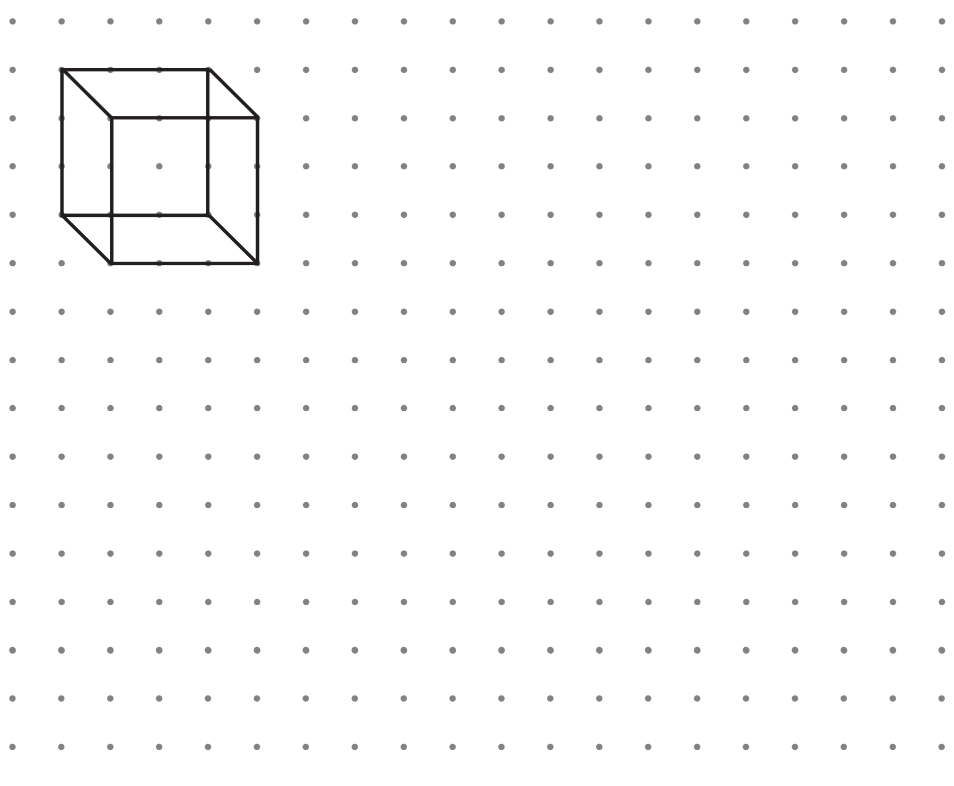
- I have 4 identical faces.
- I have 4 vertices and 6 edges.
- My base is a triangle.
- At each vertex, 3 faces meet.

I'm a ____

4 **Now choose your own 3D shape and write a set of directions so that a partner can identify and draw it:**

We can also use isometric dot paper or hexagonal grids to guide us when we draw 3D objects.

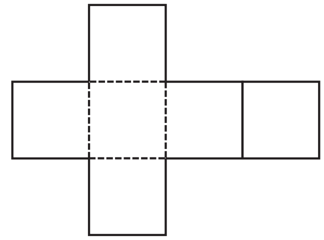
5 **Use the dot paper to draw a cube, a rectangular prism and a triangular pyramid. The first one has been done for you.**



To cube or not to cube … investigate

Getting ready

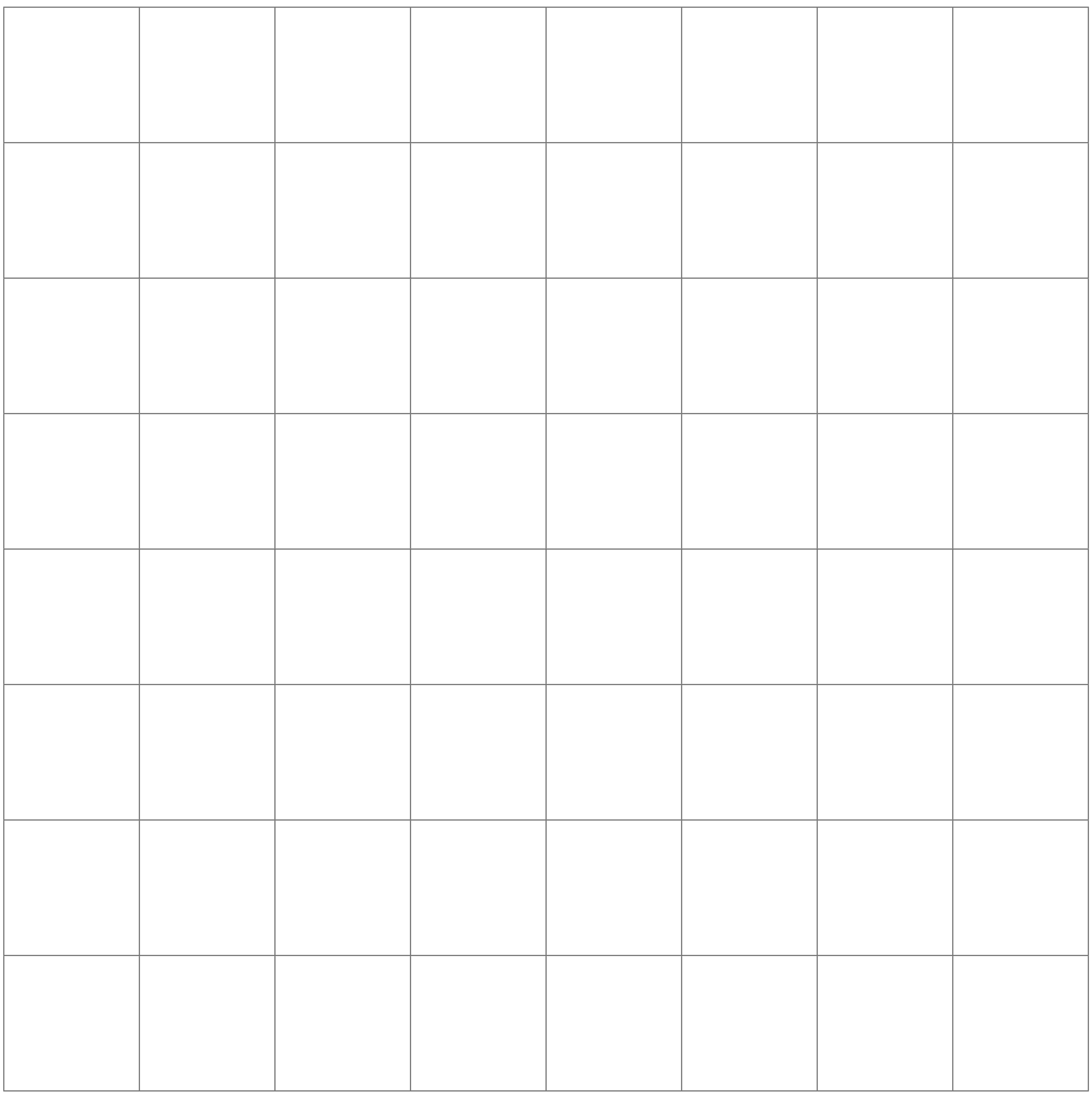
Cubes have six faces and can be created from a number of nets. Your job is to find them all. Work with a partner.



copy

What to do

How many nets can you find that will fold to make a cube? Use the grid below to help you draw and test your designs. You may need a few copies of the grid.



Form an orderly queue — apply

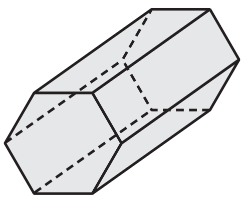
Getting ready

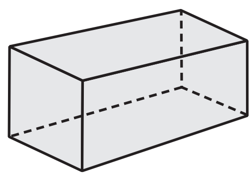
Look at the 3D shapes below. Can you line them up so each shape shares the same face with the one next to it? They don't have to be the same size, but the faces must match. It will help to use solids.

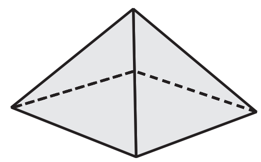
What to do

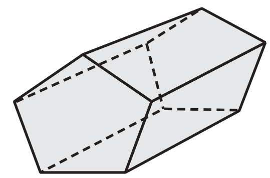
It may help to name each shape and list its 2D faces. The first one has been done for you.

Work with a partner and record your solution. You may like to describe it or perhaps take a digital photograph.

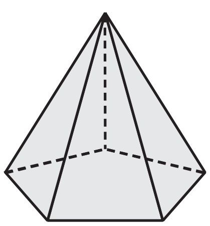


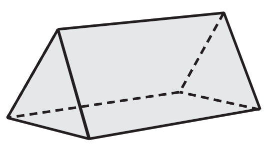


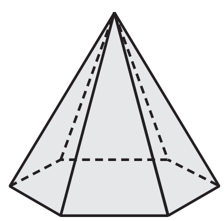


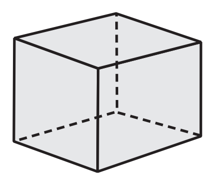


hexagonal prism
- *hexagon*
- *rectangle*









What to do next

Can you find more than one solution? How many can you find?

Can you make a loop with the shapes?