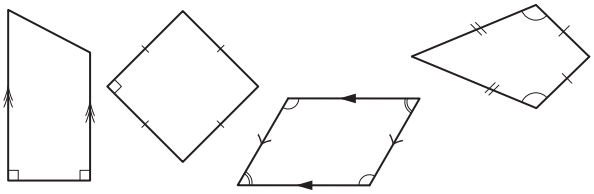
22. [Shape]

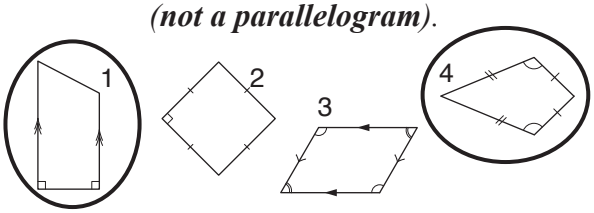
Skill 22.1 Recognising polygons, quadrilaterals and triangles.

- Consider the definition of a polygon. (see Glossary, page 396)
- Consider the properties of a parallelogram:
  - both pairs of opposite sides are parallel and equal in length.
- Consider the properties of an isosceles triangle:
  - two sides and two corresponding angles are equal.

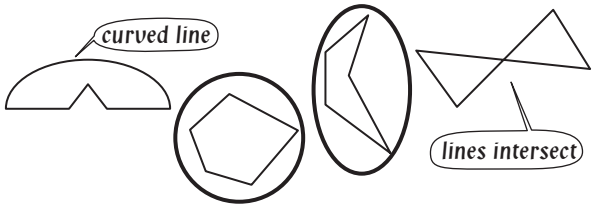
Q. Circle the shapes that are **not** parallelograms.



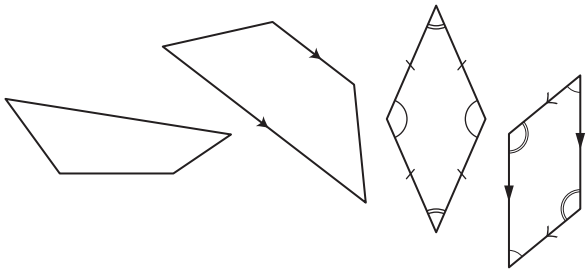
A. *1st shape - has only two opposite sides parallel (**not a parallelogram**).*
2nd shape - has both pairs of opposite sides equal in length (parallelogram).
3rd shape - has both pairs of opposite sides parallel (parallelogram).
*4th shape - doesn't have any parallel sides (**not a parallelogram**).*



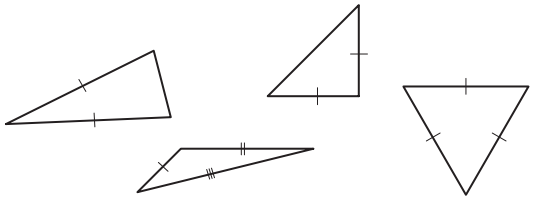
a) Circle the shapes that are polygons.



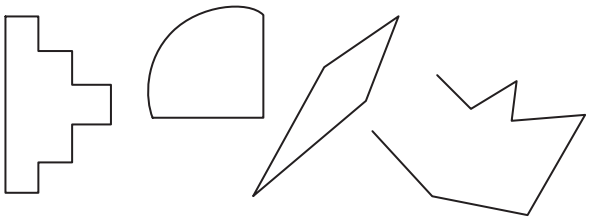
b) Circle the shapes that are **not** parallelograms.



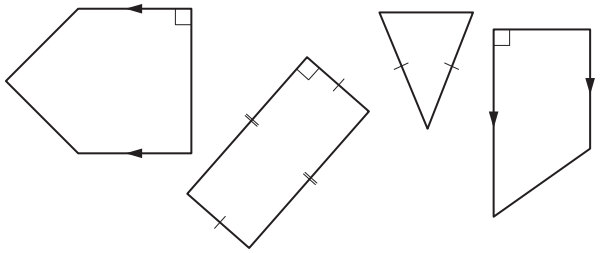
c) Circle the shape that is **not** an isosceles triangle.



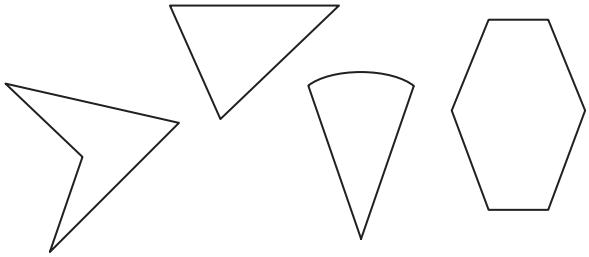
d) Circle the shapes that are **not** polygons.



e) Circle the shape that is a parallelogram.



f) Circle the shape that is **not** a polygon.



Skill 22.2 Classifying triangles.

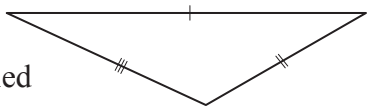
- Look for equal sides or equal angles.
- Look at the types of angles inside the triangle. (see skill 23.4, page 239)

Sides and angles	Triangle type
no equal sides/angles	**scalene**
two equal sides/angles	**isosceles**
three equal sides/angles	**equilateral**

Angles	Triangle type
all acute angles	**acute-angled**
one right angle	**right-angled**
one obtuse angle	**obtuse-angled**

Q. Which two options describe this triangle?

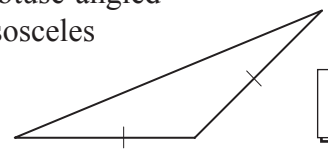
A) scalene
B) equilateral
C) obtuse-angled



A. *A) scalene (no equal sides/angles) ⇒ true*
B) equilateral (all equal sides) ⇒ false
C) obtuse-angled (1 obtuse angle) ⇒ true
A** and **C

a) Which two options describe this triangle?

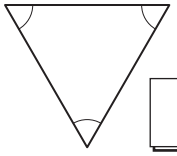
A) right-angled
B) obtuse-angled
C) isosceles



B and C

b) Which two options describe this triangle?

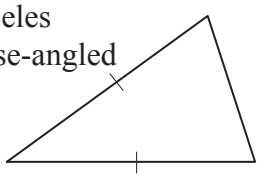
A) equilateral
B) scalene
C) acute-angled



and

c) Which two options describe this triangle?

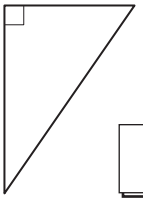
A) acute-angled
B) isosceles
C) obtuse-angled



and

d) Which two options describe this triangle?

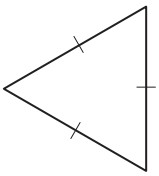
A) acute-angled
B) right-angled
C) scalene



and

e) Which two options describe this triangle?

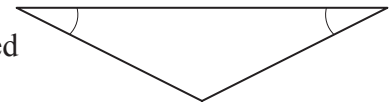
A) acute-angled
B) scalene
C) equilateral



and

f) Which two options describe this triangle?

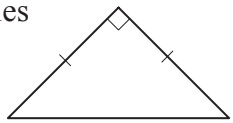
A) isosceles
B) obtuse-angled
C) right-angled



and

g) Which two options describe this triangle?

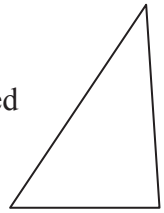
A) acute-angled
B) right-angled
C) isosceles



and

h) Which two options describe this triangle?

A) scalene
B) isosceles
C) acute-angled



and

Skill 22.3 Describing the properties of quadrilaterals.

- Consider the properties of squares, rectangles, rhombi, parallelograms, kites and trapeziums. (see Glossary, page 401)

Q. I am a quadrilateral whose diagonals are not equal in length and bisect each other at right angles. What am I?

A) square
B) parallelogram
C) rhombus
D) kite

A. *A) diagonals are equal ⇒ A false*
B) diagonals don't bisect each other at right angles ⇒ B false
C) diagonals are not equal and bisect each other at right angles ⇒ C true
D) diagonals don't bisect each other ⇒ D false

The answer is ***C***

a) I am a two-dimensional shape with 4 sides. My diagonals are not equal in length and bisect each other but not at right angles. What am I?

A) rhombus
B) parallelogram
C) kite
D) trapezium

B

b) I am a quadrilateral with both pairs of opposite sides parallel and diagonals equal in length. What am I?

A) rhombus
B) trapezium
C) parallelogram
D) rectangle

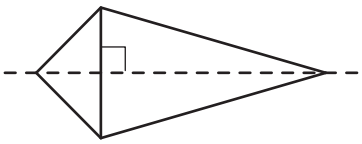
c) I am a two-dimensional shape with 4 sides. Adjacent angles are not equal and I have two axes of symmetry. What am I?

A) trapezium
B) kite
C) rhombus
D) rectangle

d) I am a quadrilateral with both pairs of opposite sides equal in length, but no axis of symmetry. What am I?

A) square
B) trapezium
C) parallelogram
D) rhombus

e) Name and draw the quadrilateral whose diagonals are perpendicular, but has only one axis of symmentry.



kite

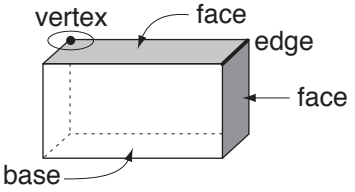
f) Name and draw the quadrilateral whose diagonals are equal in length and bisect each other at right angles.

g) Name and draw the quadrilateral whose pairs of opposite angles are equal, but doesn't have any axis of symmetry.

h) Name and draw the quadrilateral whose diagonals bisect each other at right angles and has two axes of symmetry.

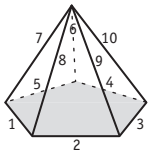
Skill 22.4 Describing the properties of three-dimensional shapes.

- Count the number of: - faces
  - edges
  - vertices (points/corners)

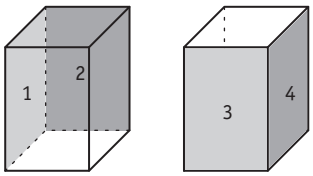


Q. How many edges does a pentagonal pyramid have?

A. *Count the number of edges, or straight lines in the pyramid: five edges in the base and five vertical edges.*
The answer is ***10***



a) Of the 6 faces of a square prism, how many are rectangles?

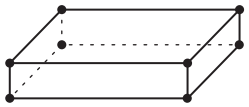


4

b) Of the 7 faces of a pentagonal prism, how many are rectangles?

c) How many vertices does a triangular prism have?

d) How many vertices does a rectangular prism have?



e) How many edges does a tetrahedron have?

f) How many edges does a rectagular pyramid have?

g) How many faces does a pentagonal pyramid have?

h) How many faces does a triangular prism have?

i) Name and sketch the three-dimensional shape that has 6 faces, all of which are squares.

j) Name and sketch the three-dimensional solid that has 4 faces, all of which are triangles.

k) Name and sketch the three-dimensional shape that has 6 faces, five of which are triangles.

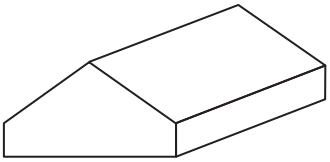
l) Name and sketch the three-dimensional solid that has 6 faces, all of which are rectangles.

Skill 22.5 Using Euler's formula for polyhedra.

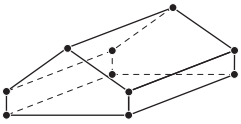
Euler's formula for any polyhedra: **Edges** = **Vertices** + **Faces** – 2 OR **E** = **V** + **F** – 2

Q. Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for this solid:

☐ = ☐ + ☐ – 2



A.

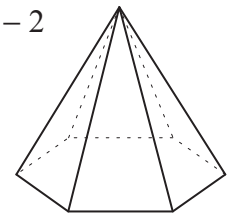


E = 15
V = 10
F = 7
E = V + F – 2
15 = 10 + 7 – 2 (Substitute 15, 10, 7 into Euler's formula)
15 = 15 (true)

15 = ***10*** + ***7*** – ***2***

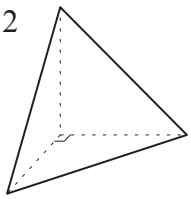
a) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for a hexagonal pyramid:

12 = 7 + 7 – 2



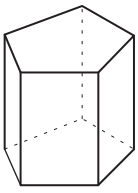
b) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for a triangular pyramid:

☐ = ☐ + ☐ – 2



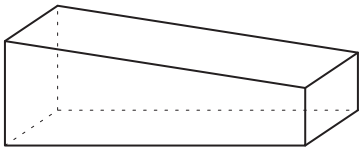
c) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for a pentagonal prism:

☐ = ☐ + ☐ – 2



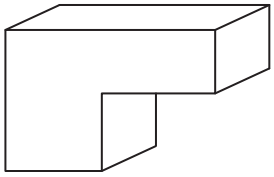
d) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for this prism:

☐ = ☐ + ☐ – 2



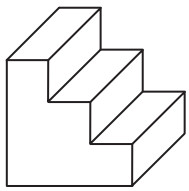
e) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for this prism:

☐ = ☐ + ☐ – 2



f) Euler's formula, **E** = **V** + **F** – 2 defines the relationship between **E**dges, **V**ertices and **F**aces of any polyhedron. Verify Euler's formula for this prism:

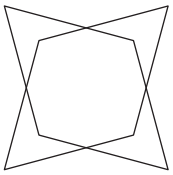
☐ = ☐ + ☐ – 2



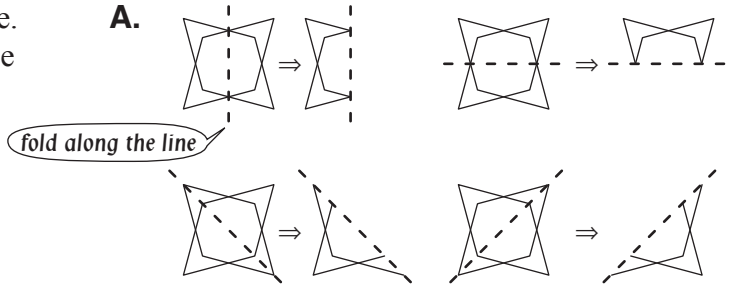
Skill 22.6 Recognising line symmetry in two-dimensional shapes.

- Imagine along which line the shape can be folded to have one part fit exactly over the other part.

Q. Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?

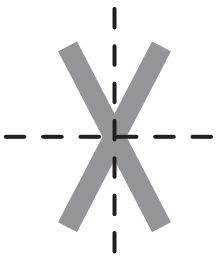


A.



4 axes of symmetry

a) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



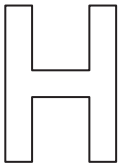
2

b) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?

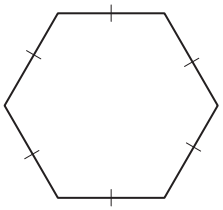
c) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?

d) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?

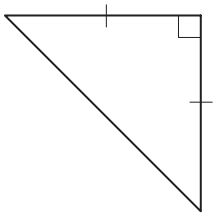
e) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



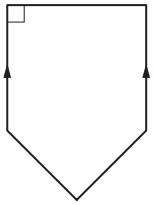
f) Draw all the axes of symmetry for this shape. How many axes of symmetry does this regular hexagon?



g) Name and draw the shape formed if this triangle is folded along its axis of symmetry.



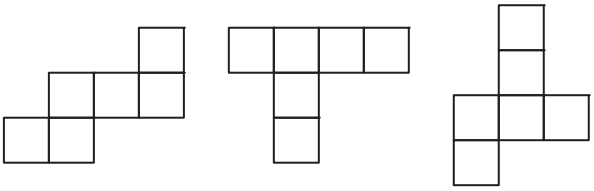
h) Name and draw the shape formed if this shape is folded along its axis of symmetry.



Skill 22.7 Recognising nets of three-dimensional shapes.

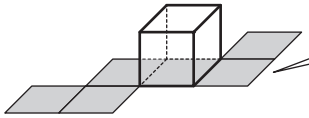
- Identify the shapes in the net.
- Imagine the shape folded. OR Make a model by tracing, cutting out and folding the net.

Q. Circle the net below that **cannot** be folded to make a model of a cube.

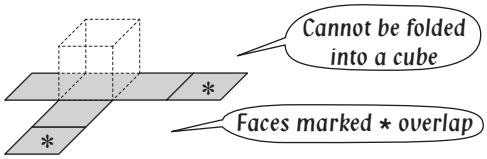


A. *Enlarge, trace and cut out the shape, folding to try to form a cube.*
OR Imagine the shape folded:

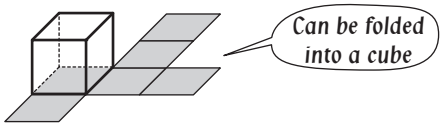
1)

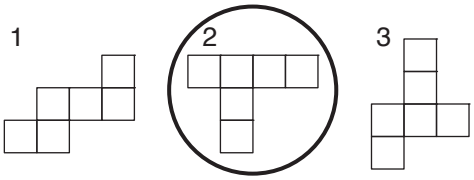


2)

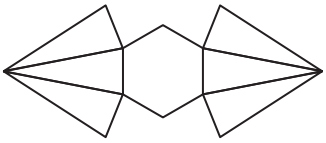


3)



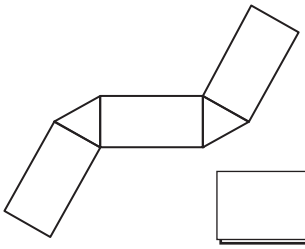


a) What three-dimensional shape can this net be used to make?

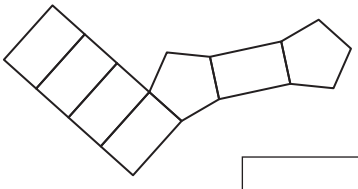


hexagonal pyramid

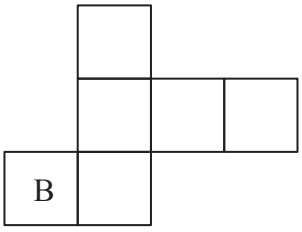
b) What three-dimensional shape can this net be used to make?



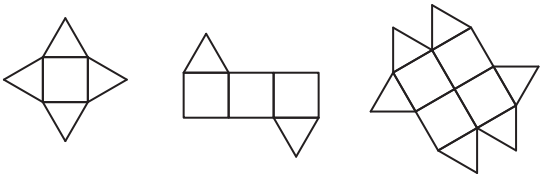
c) What three-dimensional shape can this net be used to make?



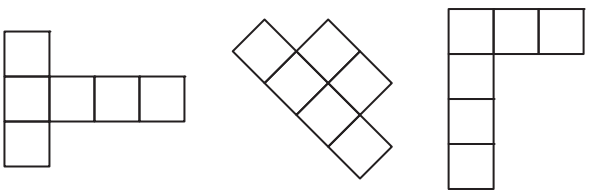
d) On this net of a cube, a face is marked B. Label the opposite face with a T.



e) Circle the net below that **cannot** be folded to make a model of a three-dimensional shape.



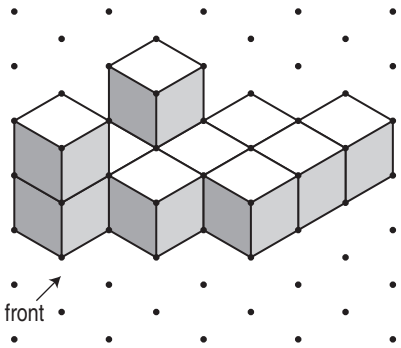
f) Circle the net below that **can** be folded to make a model of a cube.

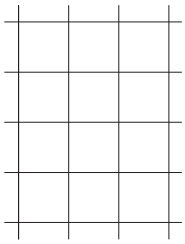


Skill 22.8 Drawing two-dimensional views of three-dimensional shapes.

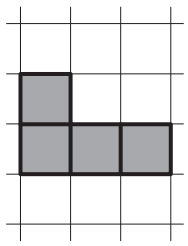
- To draw the top view of a 3D shape, imagine what you would see if you were looking at the solid from directly above.
- To draw the side view of a 3D shape, imagine what you would see if you were looking at one of the sides of the solid.
- To draw the front view of a 3D shape, imagine what you would see if you were looking at the front of the solid.

Q. Draw the front view of this solid.

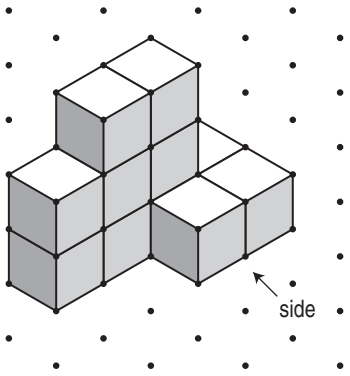


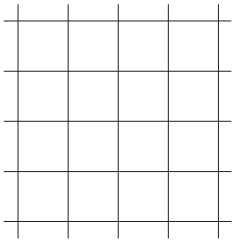


A.

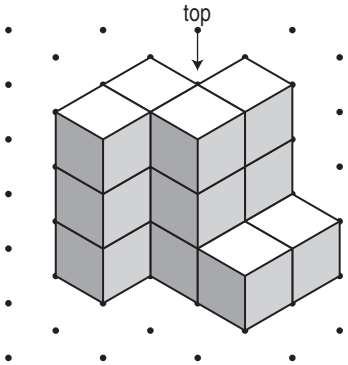


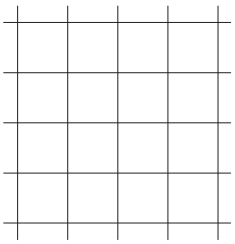
a) Draw the side view of this solid.



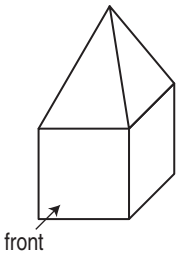


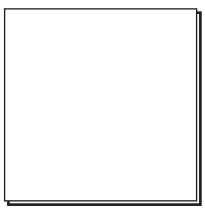
b) Draw the top view of this solid.



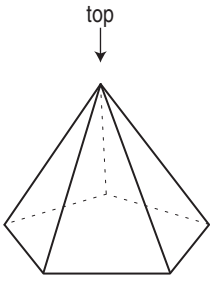


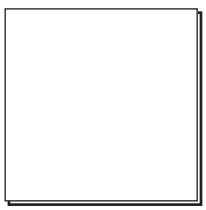
c) Draw the front view of this solid.



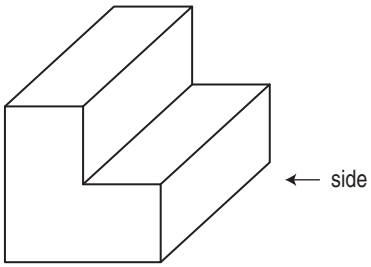


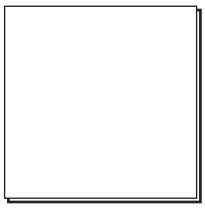
d) Draw the top view of this solid.



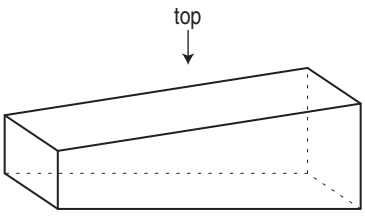


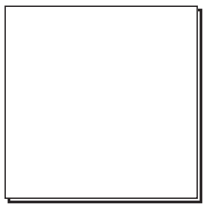
e) Draw the side view of this solid.





f) Draw the top view of this solid.

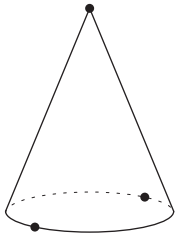




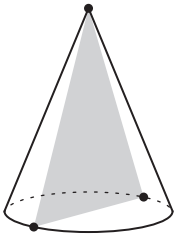
Skill 22.9 Recognising the shape of cross sections through three-dimensional shapes.

- To name the shape of a cross section through a 3D shape, imagine that you cut the solid through that section, then separate the two parts and look at the shape of the slice.
- To draw a cross section of a 3D shape through given points, join these points inside the solid.
  Hint: The cross section of a sphere is always a disc, no matter the angle of the cut.

Q. Draw and name the shape of the cross section through the marked points in this cone.

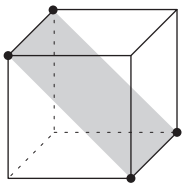


A. *Join the three points.*



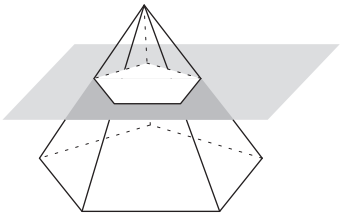
The shape of the cross section is an ***isosceles triangle****.*

a) Name the shape of the cross section drawn through this cube.

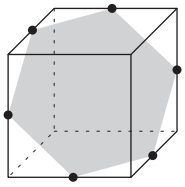


rectangle

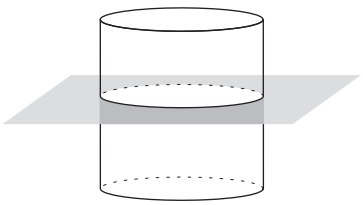
b) Name the shape of the cross section drawn through this pyramid.



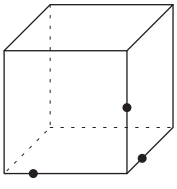
c) Name the shape of the cross section drawn through this cube.



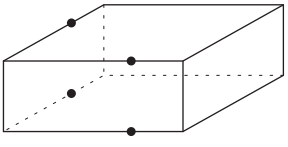
d) Name the shape of the cross section drawn through this cylinder.



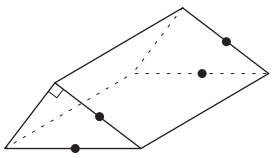
e) Draw and name the shape of the cross section through the marked points in this cube.



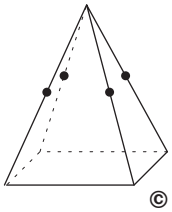
f) Draw and name the shape of the cross section through the marked points in this prism.



g) Draw and name the shape of the cross section through the marked points in this triangular prism.



h) Draw and name the shape of the cross section through the marked points in this square pyramid.

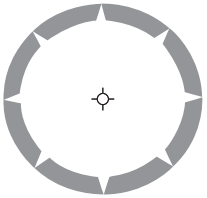


Skill 22.10 Recognising rotational symmetry in two-dimensional shapes.

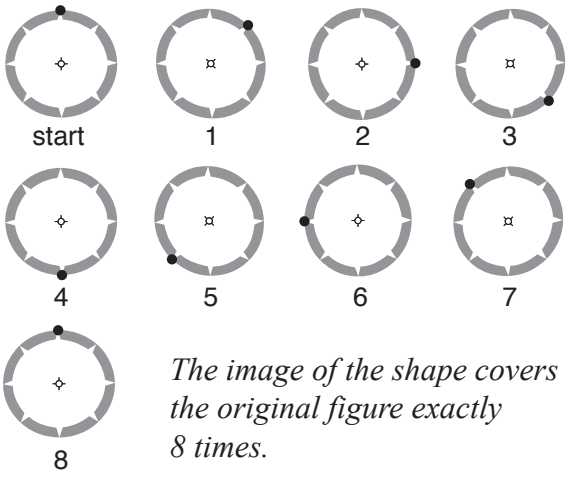
- Try to visualise the shape during a full turn of 360°.
- Count how many times during the full turn the image of the shape exactly covers the original shape.
- This number is called the order of rotational symmetry.

Hints: A shape doesn't have rotational symmetry if, during a full rotation of 360°, the image of the shape doesn't exactly cover the original shape.
To count how many times the image of the shape exactly covers the original shape, mark a point on the shape, so you know when the shape has done a complete rotation of 360°.

Q. What is the order of rotational symmetry for this shape?



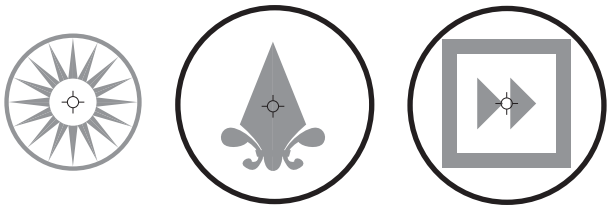
A.



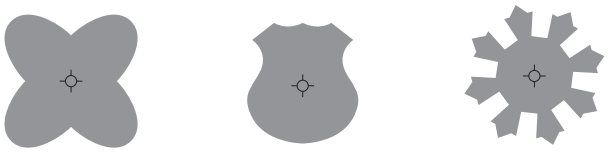
The image of the shape covers the original figure exactly 8 times.

The order of rotational symmetry = ***8***

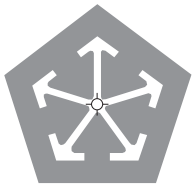
a) Circle the shapes that don't have rotational symmetry.



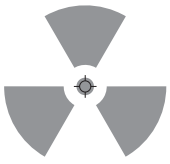
b) Circle the shapes that have rotational symmetry.



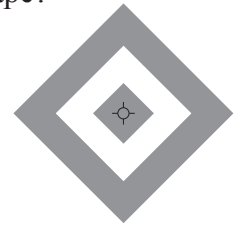
c) This shape has rotational symmetry. How many times during a full turn (360°) does the image of the shape exactly cover the original figure?



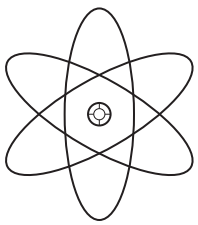
d) This shape has rotational symmetry. How many times during a full turn (360°) does the image of the shape exactly cover the original figure?



e) What is the order of rotational symmetry for this shape?



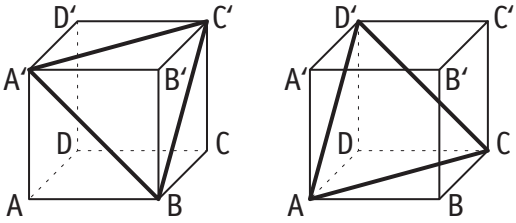
f) What is the order of rotational symmetry for this shape?



Skill 22.11 Finding angle size inside a cube.

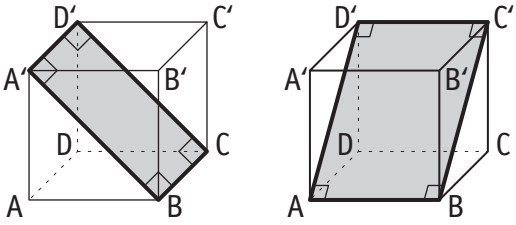
- Consider the definition and the properties of a cube:
  - all faces are squares
  - all edges are equal in length
  - diagonals of all six faces are equal in length.

Example 1:



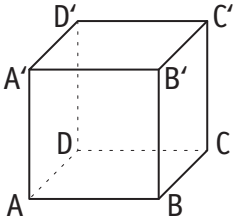
A′B = BC′ = C′A′ = AC = CD′ = D′A, so A′BC′ and ACD′ are equilateral triangles.

Example 2:

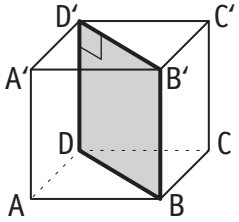


A′BCD′ and ABC′D′ are rectangles.

Q. How many degrees is ∠DD′B′ in this cube?

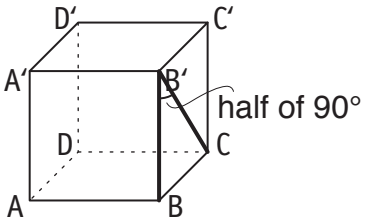


A.

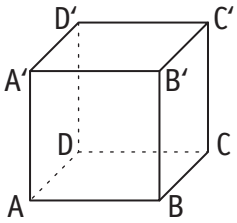


DBB′D′ is a rectangle ⇒
∠DD′B′ is a right angle ⇒
∠DD′B′ = ***90°***

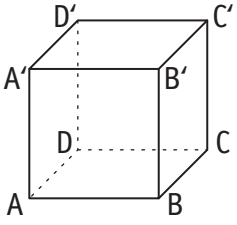
a) How many degrees is ∠BB′C in this cube?



b) How many degrees is ∠ABC′ in this cube?



c) How many degrees is ∠BB′D′ in this cube?



d) How many degrees is ∠BC′A′ in this cube?