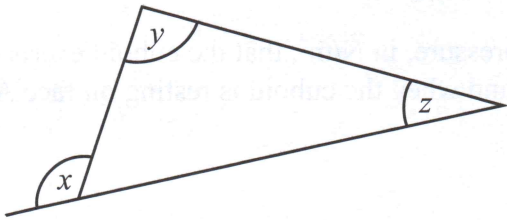


Geometry

- 1 A triangle is shown in the diagram below.



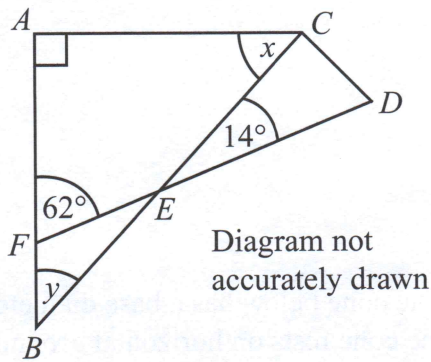
Prove that $x = y + z$.

[Total 3 marks]

- 2 *DEF* and *BEC* are straight lines that cross at *E*.
AFB and *AC* are perpendicular lines.



- a) Find angle x .
Give a reason for each stage of your working.



$x = \dots\dots\dots^\circ$
[2]

- b) Hence show that $y = 48^\circ$.

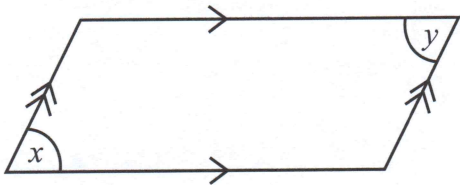
[2]

[Total 4 marks]

- 3 The diagram shows a parallelogram.

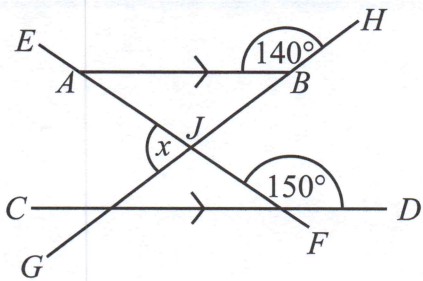


Prove that $x = y$.



[Total 3 marks]

- 4 *AB* and *CD* are parallel lines. *EF* and *GH* are straight lines. 3



Work out the size of angle *x*.
Give reasons for each stage of your working.

Diagram not accurately drawn

.....
[Total 4 marks]

- 5 Lines *AB* and *DE* are parallel and *ABC* is a straight line. Lines *AE*, *BC* and *BD* are of equal length. 4

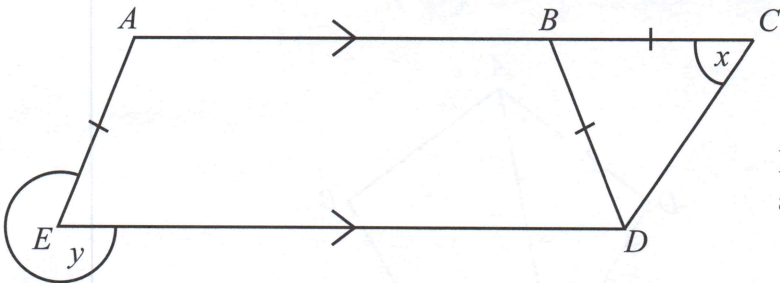
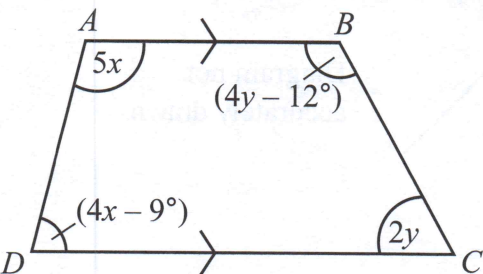


Diagram not accurately drawn

Find an expression for *y* in terms of *x*.

.....
[Total 5 marks]

- 6 *ABCD* is a trapezium. Lines *AB* and *DC* are parallel to each other. 4



Find the values of *x* and *y*.

Diagram not accurately drawn

$x = \dots\dots\dots^\circ$ $y = \dots\dots\dots^\circ$
[Total 4 marks]

Exam Practice Tip

If you find yourself staring at a geometry problem in the exam not knowing where to start, just try finding any angles you can — don't worry toooooo much at first about the particular angle you've been asked to find. Go through the rules of geometry one at a time, and apply them wherever you can.

Score

23



Polygons

- 1
- One of the angles in a rhombus is 62° .
- What are the sizes of its other three angles?



..... $^\circ$, $^\circ$ and $^\circ$
[Total 2 marks]

- 2
- $ABCD$ is a kite. Line DX is the same length as line AD .
- Find the size of angle DAB .

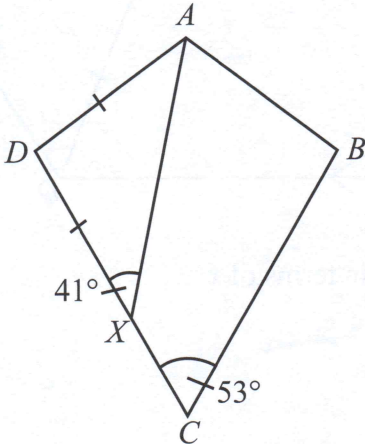


Diagram not accurately drawn

..... $^\circ$
[Total 3 marks]

- 3
- Part of a regular polygon is shown below. Each interior angle is 150° .

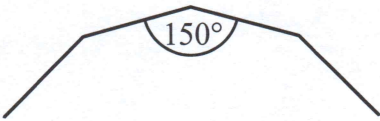


Diagram not accurately drawn



Calculate the number of sides of the polygon.

.....
[Total 3 marks]

- 4 The diagram shows a regular octagon. AB is a side of the octagon and O is its centre.

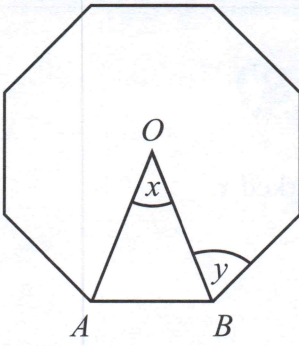


Diagram not accurately drawn



- a) Work out the size of the angle marked x .

$$x = \dots\dots\dots^\circ$$

[2]

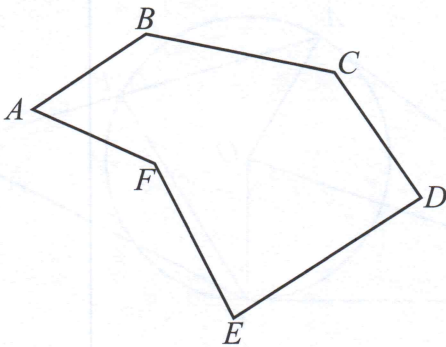
- b) Work out the size of the angle marked y .

$$y = \dots\dots\dots^\circ$$

[2]

[Total 4 marks]

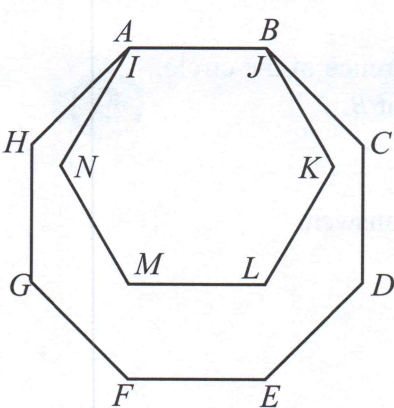
- 5 Shape $ABCDEF$ is an irregular hexagon.



Prove that the sum of the interior angles of the shape is 720° .
Show all your working.

[Total 3 marks]

- 6 The diagram below shows a regular hexagon inside a regular octagon. Vertices A and B coincide with vertices I and J respectively.



Find the size of angle CBK .

$$\dots\dots\dots^\circ$$

[Total 2 marks]

Exam Practice Tip

You need to know the number of sides of a regular polygon to work out its interior and exterior angles — so make sure you've swotted up on the different types of polygon. Altogether now: equilateral triangle (3), square (4), pentagon (5), hexagon (6), heptagon (7), octagon (8), nonagon (9), decagon (10).

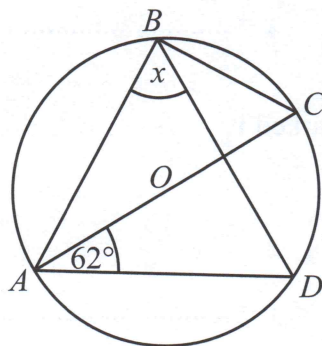
Score

17



Circle Geometry

- 1
- The diagram below shows a circle with centre O . A, B, C and D are points on the circumference of the circle and AOC is a straight line.
- GRADE 8



Not to scale



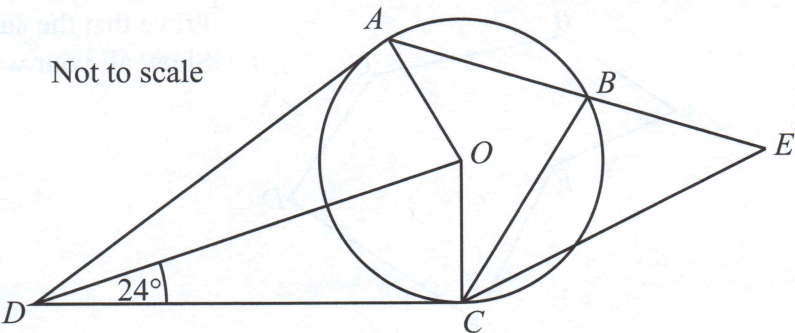
Work out the size of the angle marked x .

$x = \dots\dots\dots^\circ$
[Total 3 marks]

- 2
- The diagram shows a circle with centre O . A, B and C are points on the circumference. AD and CD are tangents to the circle and ABE is a straight line. Angle CDO is 24° .
- GRADE 8

Find the size of angle CBE .

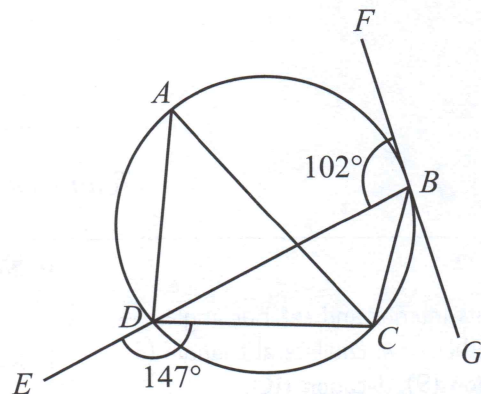
Not to scale



$\dots\dots\dots^\circ$
[Total 5 marks]

- 3
- In the diagram below, A, B, C and D are points on the circumference of the circle. EDB is a straight line and FG is the tangent to the circle at point B . Angle FBD is 102° and angle EDC is 147° .
- GRADE 9

Find the size of angle CAD . Give reasons for each step of your answer.

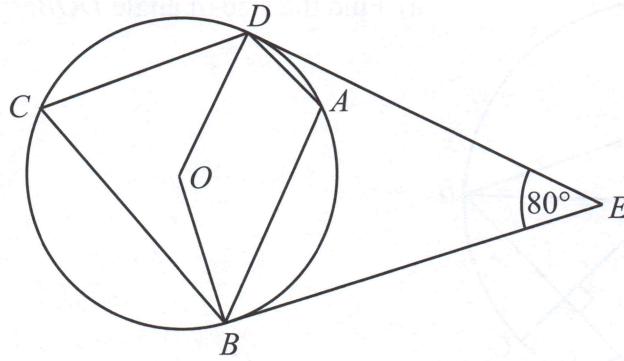


$\dots\dots\dots^\circ$
[Total 4 marks]

- 4 In the diagram, O is the centre of the circle. A, B, C and D are points on the circumference of the circle and DE and BE are tangents. Angle DEB is 80° .



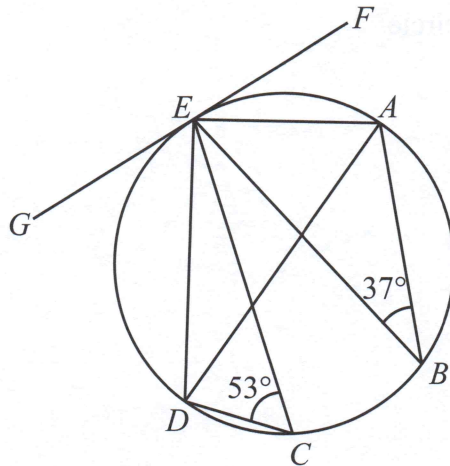
Not to scale



Work out the size of angle DAB , giving reasons for each step in your working.

.....
[Total 4 marks]

- 5 Points A, B, C, D and E lie on the circumference of the circle shown in the diagram below. Angle ABE is 37° and angle DCE is 53° . FG is the tangent to the circle at point E .



Not to scale

Prove that the chord AD passes through the centre of the circle.

[Total 3 marks]

- 6
- A, B, C and D are points on the circumference of the circle with centre O . FE is the tangent to the circle at D and angle $BDE = 53^\circ$.
- GRADE 8

a) Find the size of angle DOB .

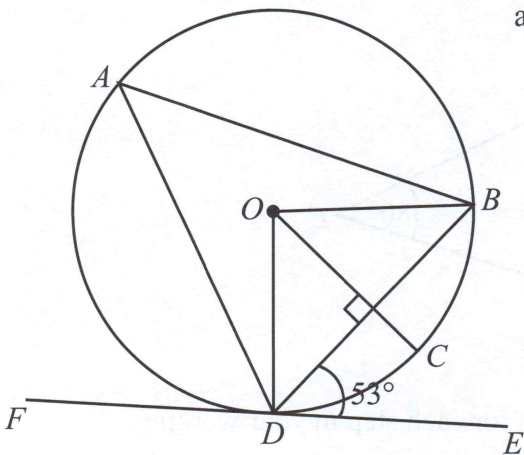


Diagram not accurately drawn

[2]

b) Explain why angle COB is half the size of angle DOB

.....

.....

.....

[2]

[Total 4 marks]

- 7
- A, B, C and D are points on the circumference of the circle shown below.
- GRADE 9

Show that X is not the centre of the circle.

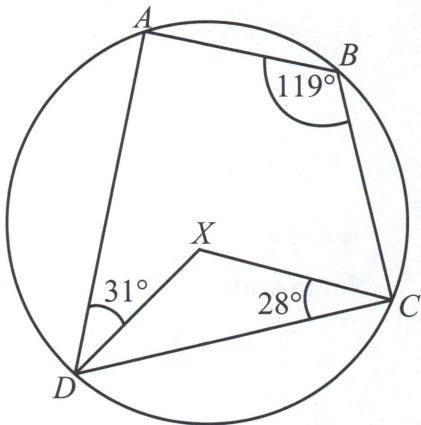


Diagram not accurately drawn

[Total 3 marks]

Exam Practice Tip

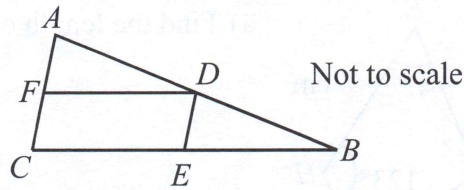
Make sure you know the rules about circles really, really well. Draw them out and stick them all over your bedroom walls, your fridge, even your dog. Then in the exam, go through the rules one-by-one and use them to fill in as many angles in the diagram as you can. Keep an eye out for sneaky isosceles triangles too.

Score

26

Congruent Shapes

- 1 ABC is a triangle. $FDEC$ is a parallelogram such that F is the midpoint of AC , D is the midpoint of AB and E is the midpoint of BC .



Prove that triangles AFD and DEB are congruent.

F is the midpoint of AC so $AF = \dots\dots\dots$, and opposite sides of a parallelogram are equal so $\dots\dots\dots = FC$. Therefore $AF = \dots\dots\dots$

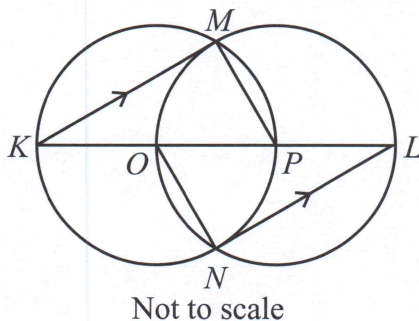
E is the midpoint of CB so $\dots\dots\dots = EB$, and opposite sides of a parallelogram are equal so $\dots\dots\dots = FD$. Therefore $FD = \dots\dots\dots$

D is the midpoint of AB , so $AD = \dots\dots\dots$

Satisfies condition $\dots\dots\dots$ so triangles are congruent.

[Total 4 marks]

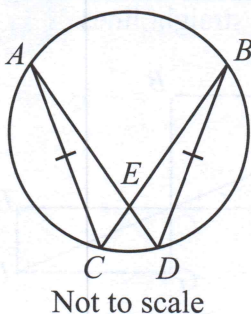
- 2 The diagram shows two overlapping circles, with centres O and P . The circles intersect at M and N , and the centre of each circle is a point on the circumference of the other circle. $KOPL$ is a straight line. KM and NL are parallel to each other.



Prove that triangles KMP and LNO are congruent.

[Total 4 marks]

- 3 A, B, C and D are points on a circle. AED and BEC are straight lines. AC and BD are the same length as each other.



Prove that triangles AEC and BED are congruent.

[Total 3 marks]

Exam Practice Tip

To prove two triangles are congruent, you need to show that three pairs of angles or sides are the same. Give a reason for each step of working — to get all the marks you need to explain why things are equal. Then give the condition for congruence that you've satisfied (SSS, AAS, SAS or RHS).

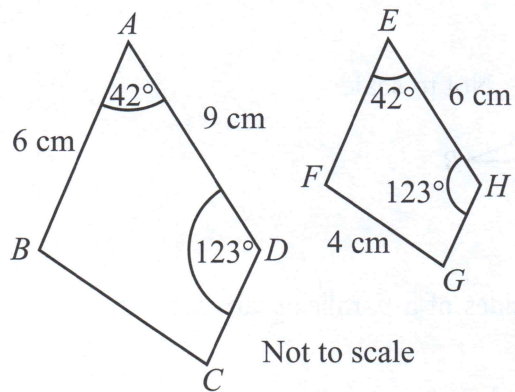
Score

11



Similar Shapes

- 1
- The shapes $ABCD$ and $EFGH$ are mathematically similar.
- GRADE 4



a) Find the length of EF .

..... cm
[2]

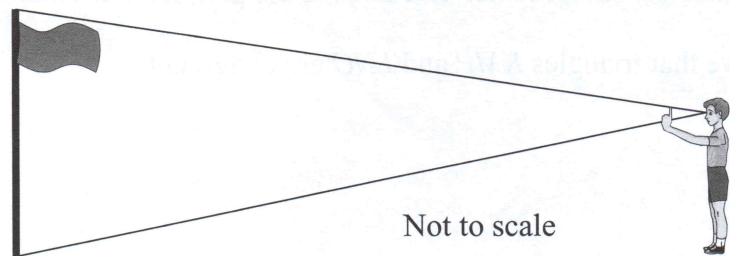
b) Find the length of BC .

..... cm
[1]

[Total 3 marks]

- 2
- James wants to estimate the height of a flagpole in his local park. He finds that if he stands a horizontal distance of 63 m away from the flagpole and holds his index finger up in front of him it exactly covers the flagpole.
- GRADE 5

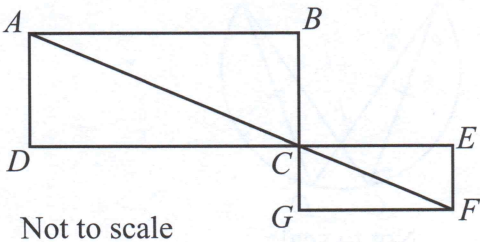
James' finger is 8 cm long and he holds it at a horizontal distance of 60 cm away from his body. Use this information to find an estimate for the height of the flagpole.



..... m
[Total 3 marks]

- 3
- $ABCD$ and $CEFG$ are rectangles that touch at C . DCE , BCG and ACF are straight lines.
- GRADE 6

Prove that triangles ABC and CEF are similar triangles.

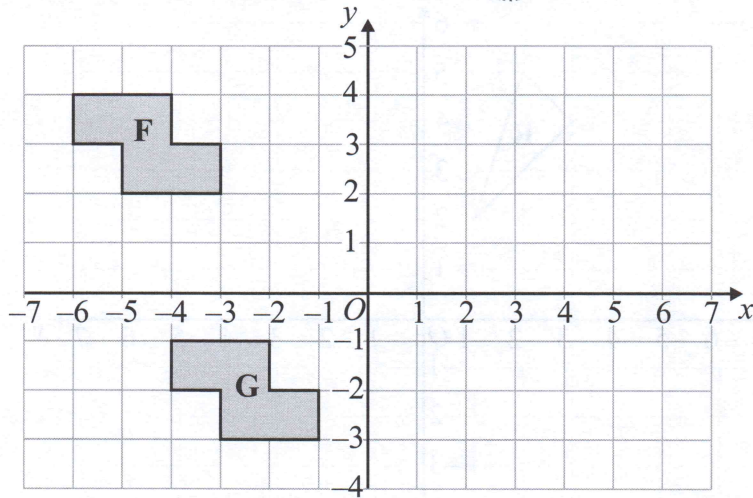


[Total 3 marks]

Score:
9

The Four Transformations

- 1 Shapes **F** and **G** have been drawn on the grid below.



- a) Write down the vector which describes the translation that maps **F** onto **G**.

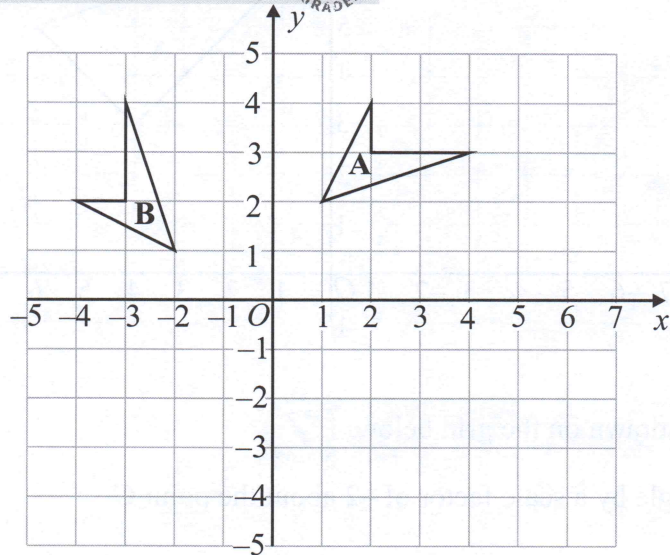
.....
[2]

- b) Rotate shape **F** by 90° clockwise around the point $(0, -2)$.
Label your image **H**.

[2]

[Total 4 marks]

- 2 In the diagram below, **B** is an image of **A**.



- a) Describe fully the single transformation that maps **A** onto **B**.

.....
[3]

- b) Translate shape **B** by the vector $\begin{pmatrix} -1 \\ -4 \end{pmatrix}$.
Label the image as **C**.

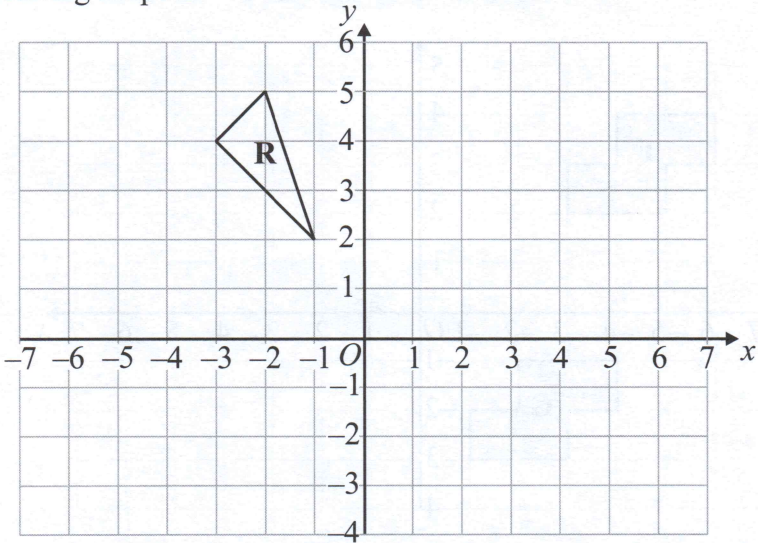
[1]

[Total 4 marks]

3 Triangle **R** has been drawn on the grid below.



Reflect triangle **R** in the line $y = x$ and then enlarge it with centre $(6, -3)$ and scale factor 3. Label the resulting shape **S**.

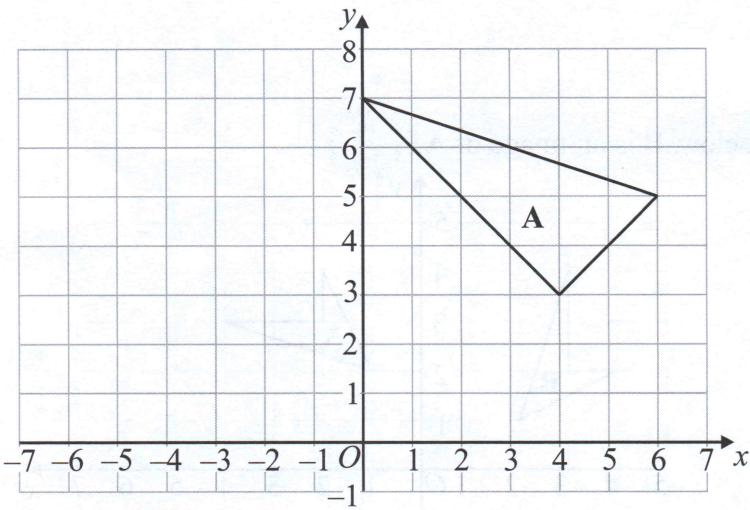


[Total 3 marks]

4 Triangle **A** has been drawn on the grid below.



Enlarge triangle **A** by scale factor $\frac{1}{2}$ with centre of enlargement $(-6, 1)$. Label your image **B**.

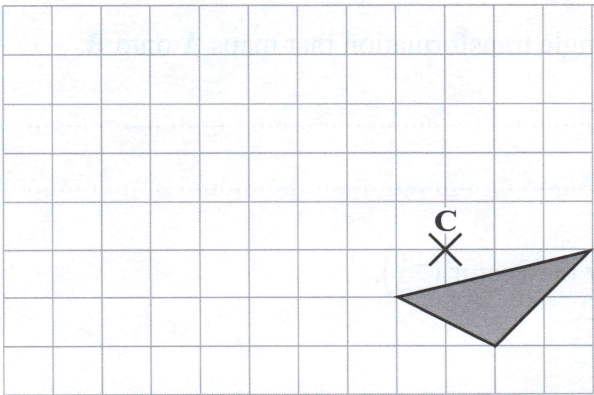


[Total 2 marks]

5 A triangle has been drawn on the grid below.



Enlarge the triangle by a scale factor of -2 about the point **C**.



[Total 2 marks]

Score:
15

Perimeter and Area

- 1 Lynn is designing a garden. The diagram shows her design. Lynn's garden will be rectangular, with a semicircular flowerbed at one end, and a matching semicircular patio at the other end. The rest of the space will be taken up by a lawn.

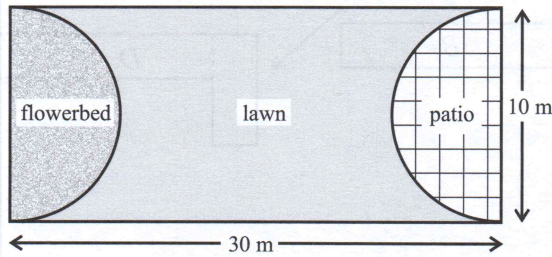


Diagram not accurately drawn

The grass seed that Lynn is planning to use comes in boxes that cost £7 each. Each box will cover 10 m^2 . How much will it cost Lynn to plant the lawn?

£
[Total 3 marks]

- 2 The diagram below shows an isosceles trapezium.



Find the area of the trapezium.

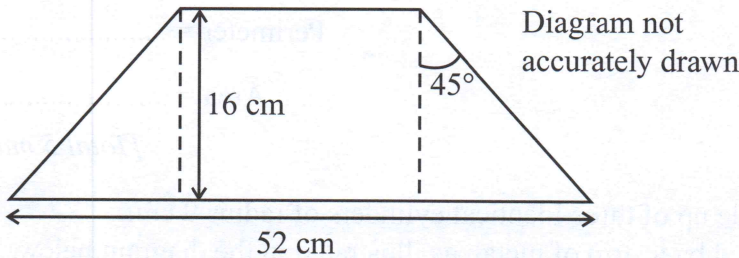


Diagram not accurately drawn

..... cm^2
[Total 2 marks]

- 3 Consider a square and a triangle. The sides of the square are $x \text{ cm}$ long. The base length and height of the triangle are equal, and are twice as long as the sides of the square. The area of the triangle is 9 cm^2 larger than the area of the square.

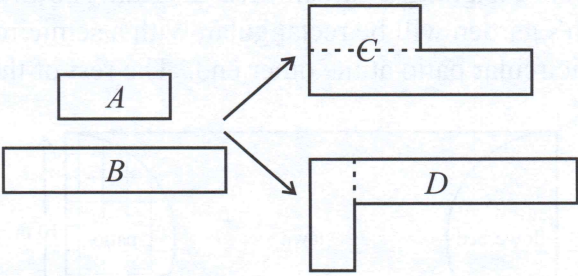


Find the perimeter of the square.

..... cm
[Total 4 marks]

- 4
- Rectangle B is twice as long as rectangle A . They have the same width. The two rectangles can be joined to make shape C , which has perimeter 28 cm. They can be joined in a different way to make shape D , which has perimeter 34 cm.
- GRADE 6

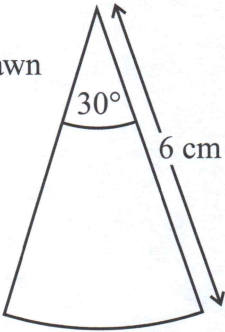
Find the perimeters of rectangles A and B .



Perimeter of A : cm
Perimeter of B : cm
[Total 6 marks]

- 5
- Look at the sector shown in the diagram below.
- GRADE 5

Diagram not accurately drawn

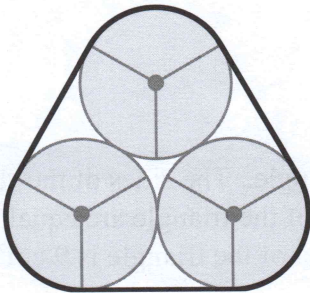


Find the perimeter and the area of the sector.
Give your answers to 3 significant figures.

Perimeter = cm
Area = cm²
[Total 5 marks]

- 6
- An industrial rolling machine is made up of three identical cylinders of radius 9 cm. The ends of the rollers are surrounded by a strip of metal, as illustrated in the diagram below.
- GRADE 5

Find the length of the metal strip, giving your answer correct to 1 d.p.



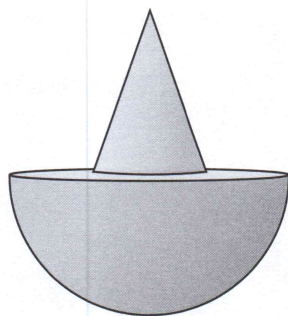
If you're struggling with the straight bits, try looking at the horizontal part first.

..... cm
[Total 4 marks]

Score:
24

3D Shapes — Surface Area and Volume

- 1 The diagram below shows a wooden spinning top made from a hemisphere and a cone.



The hemisphere has a diameter of 14 cm.

The slanting length of the cone is 12 cm and the radius of its base is 2 cm.

Work out the total surface area of the spinning top.

Give your answer to 3 significant figures.

..... cm²
[Total 4 marks]

- 2 The curved surface of a cone is made from the net below.

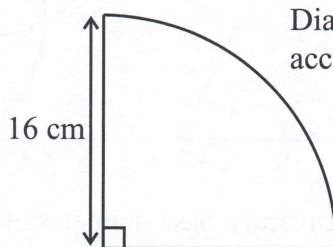


Diagram not
accurately drawn

The cone has a circular base.

Calculate the total surface area of the cone. Give your answer in terms of π .

..... cm²
[Total 5 marks]

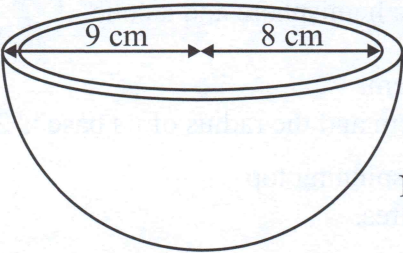
- 3 A spherical ball has volume 478 cm³.



Find the surface area of the ball, giving your answer correct to 1 d.p.

..... cm²
[Total 4 marks]

- 4 The diagram below shows a clay bowl in the shape of a hollow hemisphere. The radius of the inside surface is 8 cm. The radius of the outside surface is 9 cm.

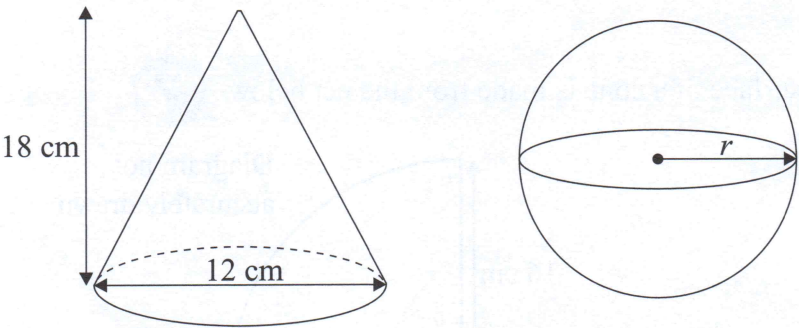


Not drawn accurately

What volume of clay is needed to make the bowl?
Give your answer to 3 significant figures.

..... cm³
[Total 3 marks]

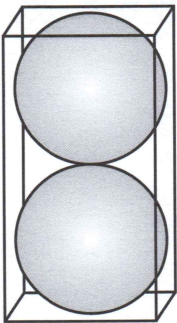
- 5 The cone and sphere in the diagram below have the same volume.



The cone has a vertical height of 18 cm and a base diameter of 12 cm.
Work out the radius, r , of the sphere. Give your answer to 3 significant figures.

..... cm
[Total 4 marks]

- 6 The diagram shows how two identical solid spheres fit **exactly** inside a cuboid box.



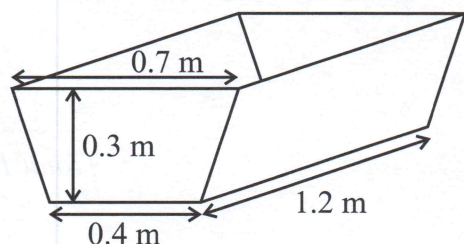
Find the percentage of the volume of the box which is occupied by the spheres.
Give your answer to 1 d.p.

..... %
[Total 4 marks]

- 7 A farmer is filling a water trough for his cattle. The trough is the shape of a prism with a trapezium as its cross-section, as shown in the diagram below. Water flows into the trough at a rate of 9 litres per minute.



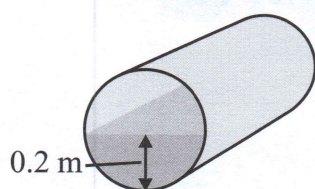
How long will it take to completely fill the trough?



..... minutes

[Total 4 marks]

- 8 Water is flowing through the cylindrical pipe shown in the diagram below. The radius of the pipe is 0.2 m, and the water comes halfway up the pipe.



- a) Find the cross-sectional area of the water in the pipe.

..... m^2
[1]

The water is flowing at a rate of 2520 litres per minute.

- b) Find the speed of the water in m/s to 3 s.f.

Convert rate of flow to m^3/s :

$$2520 \text{ litres/minute} = (2520 \div \text{.....}) \text{ litres/second} = \text{..... litres/second}$$

$$= \text{..... cm}^3/\text{s}$$

$$= \text{..... m}^3/\text{s}$$

Speed = Rate of flow \div cross-sectional area of water

$$= \text{..... m}^3/\text{s} \div \text{..... m}^2$$

$$= \text{..... m/s}$$

..... m/s
[4]

[Total 5 marks]

Exam Practice Tip

Rate of flow questions like Q8 can be pretty mind-boggling... Remember that rate of flow in m^3/s just means "volume moved per second". So dividing this by the cross-sectional area gives "distance moved per second" — and that's just speed. Don't rush into it though — make sure your units match up nicely first.

Score

33



More Enlargements

- 1
- The radius of a tennis ball and the radius of a basketball are in the ratio 1 : 7.
- GRADE 7

Assuming both balls are spheres, work out the ratio of the volume of a tennis ball to the volume of a basketball.

.....
[Total 1 mark]

- 2
- A parallelogram has an area of 7 cm².
- GRADE 7

The parallelogram is enlarged with scale factor 3. Work out the area of the enlarged parallelogram.

..... cm²
[Total 2 marks]

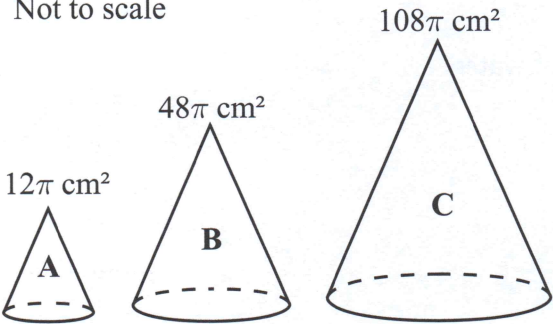
- 3
- Cylinder B is an enlargement of cylinder A.
The ratio of the volume of cylinder A to the volume of cylinder B is 27 : 64.
The surface area of cylinder A is 81π cm².
- GRADE 7

Find the surface area of cylinder B.

..... cm²
[Total 3 marks]

- 4
- A, B and C are three solid cones which are mathematically similar. The surface area of each cone is given below. The perpendicular height of A is 4 cm. The volume of C is 135π cm³.
- GRADE 7

Not to scale



a) Calculate the volume of A.

..... cm³
[4]

b) Calculate the perpendicular height of B.

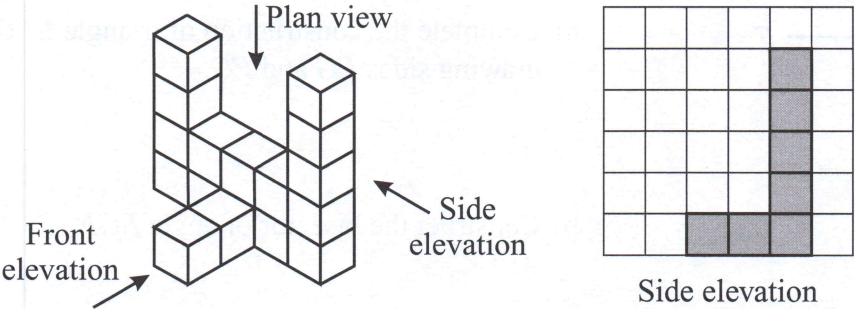
..... cm
[3]

[Total 7 marks]

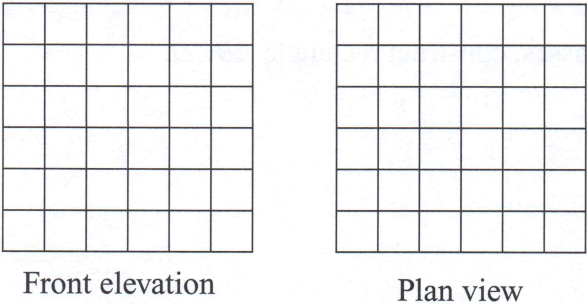
Score:
13

Projections

- 1
- The diagram below shows a solid made from identical cubes. The side elevation of the solid is drawn on the adjacent grid.
- GRADE 3



- a) On the grid below, draw the front elevation of the solid.
- [1]
- b) On the grid below, draw the plan view of the solid.
- [1]

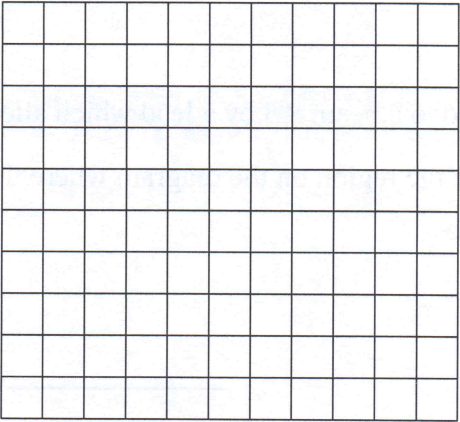
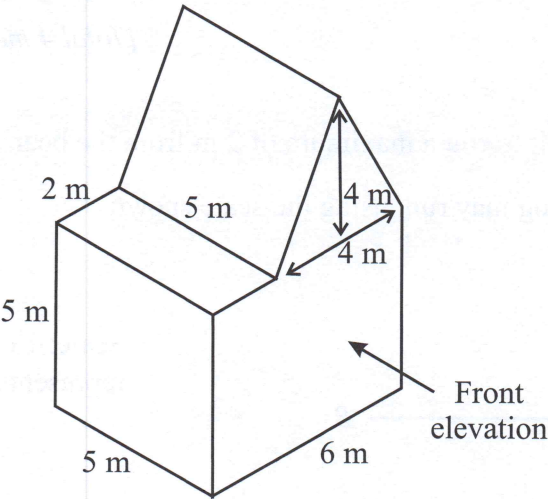


[Total 2 marks]

- 2
- The diagram shows a house made of a 5 m × 5 m × 6 m cuboid and a triangular roof of width 4 m, length 5 m and vertical height 4 m.
- GRADE 3




On the grid below, draw the front elevation of the house.
Use a scale of 1 square = 1 m.



[Total 2 marks]

Loci and Construction

- 1
- EFG is an isosceles triangle. Sides EG and FG are both 4.5 cm long.
- 

Side EF has been drawn here.

E ————— F


- a) Complete the construction of triangle EFG by drawing sides EG and FG.

[2]

- b) Construct the bisector of angle EGF.

[2]


[Total 4 marks]

- 2
- Rectangle ABCD has a perimeter of 18 cm. Side AB has been drawn below.
- 

Using a ruler and compasses, construct rectangle ABCD.

A ————— B

[Total 4 marks]

- 3
- A dog is tied to a beam AB by a lead which allows it to run a maximum of 2 m from the beam.
- 



Shade the region on the diagram where the dog may run, using the scale shown.

A ————— B

Scale: 1 cm
represents 1 m

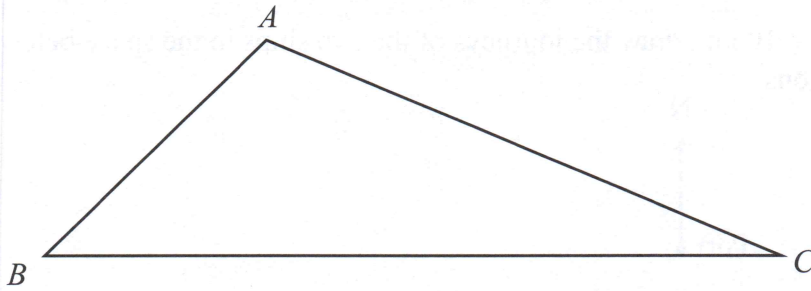
[Total 2 marks]

4

ABC is a triangle.



Find and shade the region inside the triangle which is **both** closer to the line AB than the line BC , **and** also more than 6.5 cm from the point C .



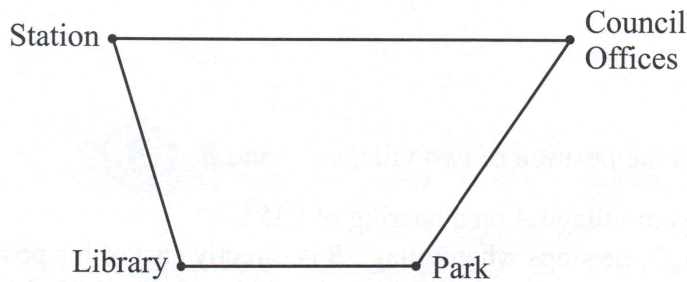
[Total 4 marks]

5

A town council are putting up a new visitor information board. They want it to be placed within the area shown, closer to the park than to the library, but also closer to the station than to the park.



The diagram below shows a scale map of the town centre. Shade in the region of the town where the board could be placed.



[Total 3 marks]

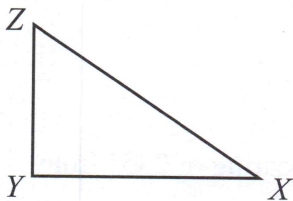
6

Triangle XYZ is shown below. It is rotated 180° clockwise about vertex X and then 90° clockwise about vertex Z .



Draw the locus of vertex Y .

Keep an eye on how vertex Y moves during each rotation.



[Total 3 marks]

Score:

20



Bearings

1

Two ships leave a port at the same time.
Ship *A* travels due west for 40 km. Ship *B* travels 60 km on a bearing of 110° .

3

a) Using a scale of 1 cm = 10 km, draw the journeys of the two ships in the space below and clearly mark their final positions.



- b) Measure the final bearing of Ship *B* from Ship *A*.
.....
[4]
- c) Calculate the final bearing of Ship *A* from Ship *B*.
.....
[1]
-
[2]

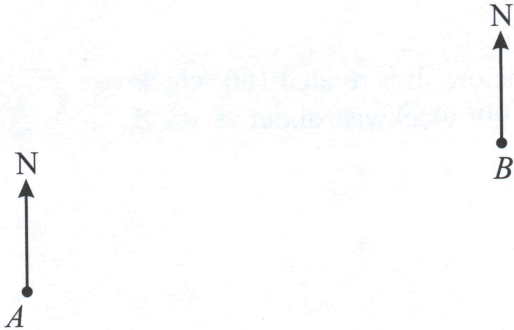
[Total 7 marks]

2

The diagram shows the position of two villages, *A* and *B*.

3

a) A walker hikes from village *A* on a bearing of 035° .
After an hour's walk he stops when village *B* is directly east of his position.
Mark the walker's position on the diagram with a cross (×) and label it *W*.



- b) Another village, *C*, is on a bearing of 115° from village *A*, and on a bearing of 235° from village *B*. Mark the location of village *C* with a cross (×) and label it *C*.
.....
[2]
- c) Use a protractor to measure the bearing that the walker must hike on from his position at *W*, in order to reach village *C*.
.....
[3]
-
[1]

[Total 6 marks]

Score:
13