Total marks — 50

Attempt ALL questions

1. Given that $f(x) = 5x^3$, evaluate $f(-2)$.

2

2. Evaluate $\dfrac{3}{8} \times 1\dfrac{5}{7}$.
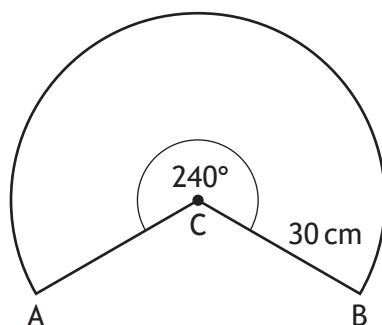
Give your answer in its simplest form.

2

3. Expand and simplify $(x+5)(2x^2-7x-3)$.

3

4. The diagram below shows a sector of a circle, centre C.

The radius of the circle is 30 centimetres.

Calculate the length of the major arc AB.

Take $\pi = 3{\cdot}14$.

3

5. The midday temperatures in Grantford were recorded over a nine day period.

The temperatures, in °C, were

$$4 \quad 7 \quad 4 \quad 3 \quad 6 \quad 10 \quad 9 \quad 5 \quad 3$$

(a) Calculate the median and semi-interquartile range for these temperatures. **3**

Over the same nine day period the midday temperatures in Endoch were also recorded.

The median temperature was 8 °C, and the semi-interquartile range was 1·5 °C.

(b) Make two valid comments comparing the midday temperatures of Grantford and Endoch during this period. **2**

6. The fuel consumption of a group of cars is recorded.

The scattergraph shows the relationship between the fuel consumption, F kilometres per litre, and the engine size, E litres, of the cars.
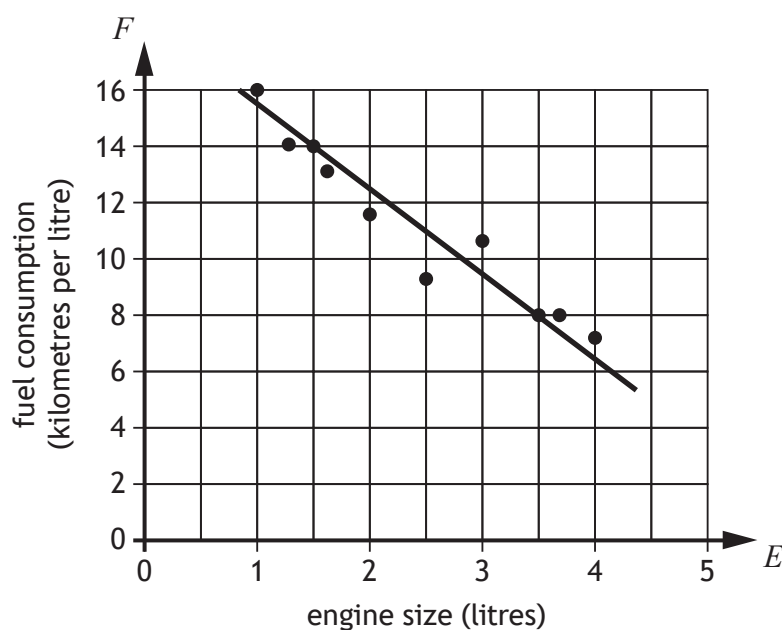
A line of best fit has been drawn.

(a) Find the equation of the line of best fit in terms of F and E.

Give the equation in its simplest form. **3**

6. (continued)

Amaar's car has an engine size of 1·1 litres.

(b) Use your equation from part (a) to estimate how many kilometres per litre he should expect to get. **1**

7. The area of a trapezium is given by the formula

$$A = \frac{1}{2}h(x+y).$$

Make x the subject of the formula. **3**

8. John bought 7 bags of cement and 3 bags of gravel.

The total weight of these bags was 215 kilograms.

(a) Write down an equation to illustrate this information. **1**

Shona bought 5 bags of cement and 4 bags of gravel.

The total weight of her bags was 200 kilograms.

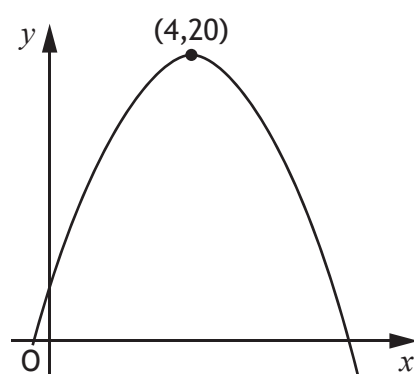(b) Write down an equation to illustrate this information. **1**

(c) Calculate the weight of one bag of cement and the weight of one bag of gravel. **4**

9. The graph shows a parabola.

The maximum turning point has coordinates (4,20) as shown in the diagram.

(a) Write down the equation of the axis of symmetry of the graph.   **1**

The equation of the parabola is of the form $y = b - (x + a)^2$.
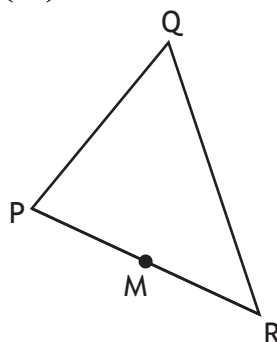
(b) State the values of

(i) a **1**

(ii) b.   **1**

10. In triangle PQR, $\overrightarrow{PR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$ and $\overrightarrow{RQ} = \begin{pmatrix} -1 \\ 8 \end{pmatrix}$.

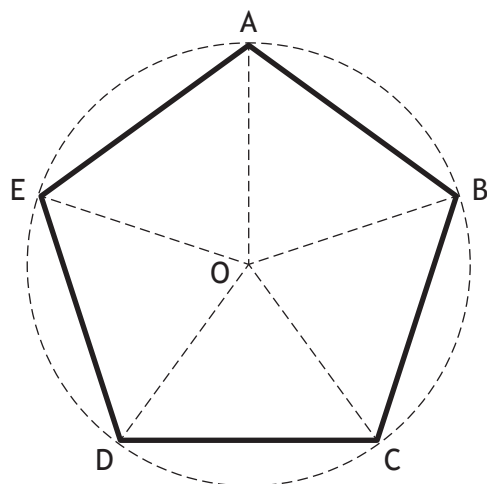(a) Express $\overrightarrow{PQ}$ in component form.   **1**

M is the midpoint of PR.

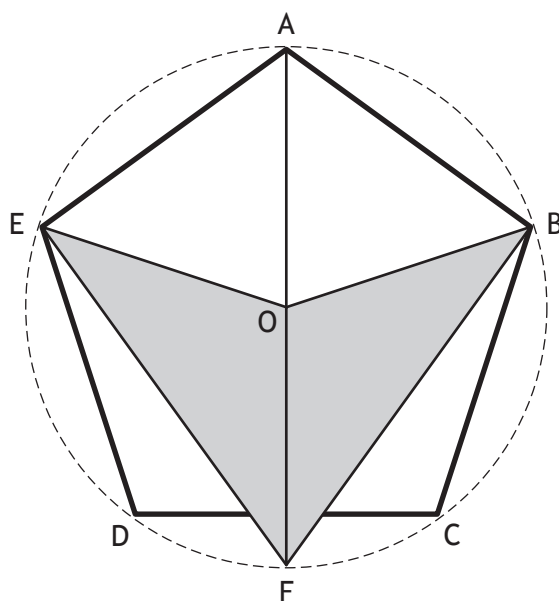(b) Express $\overrightarrow{MQ}$ in component form.   **2**

11. Pam is designing a company logo.

She starts by drawing a regular pentagon ABCDE.

The vertices of the pentagon lie on the circumference of a circle with centre O.

She then adds to the design as shown in the diagram below.

AF is a diameter of the circle.
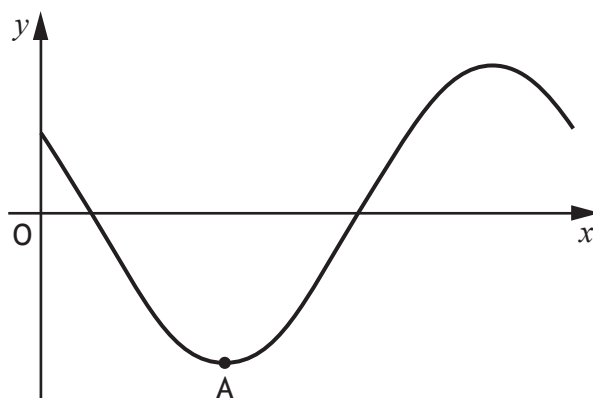
Calculate the size of angle OFB.

3

12. Express $\dfrac{\sqrt{2}}{\sqrt{40}}$ as a fraction with a rational denominator.

Give your answer in its simplest form. **3**

13. Part of the graph of $y = 3\cos(x + 45)^\circ$ is shown in the diagram.

The graph has a minimum turning point at A.
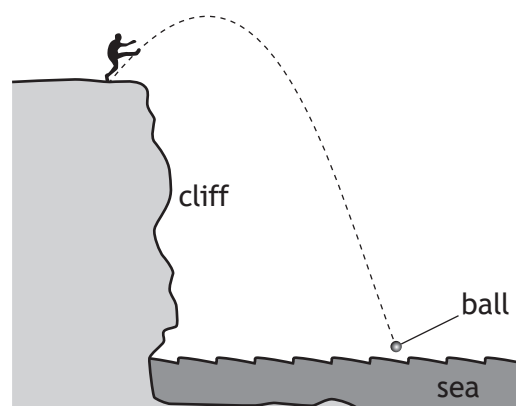
State the coordinates of A. **2**

14. Solve the equation $\dfrac{x}{2} - 1 = \dfrac{3-x}{5}$.

[Turn over

15. A ball is kicked from a clifftop.

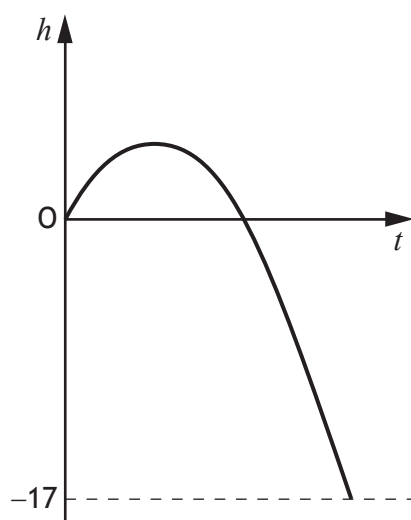The height, h metres, of the ball relative to the clifftop after t seconds is given by $h = 12t - 5t^2$.

(a) Calculate the height of the ball above the clifftop after 2 seconds. **1**

15. (continued)

The graph below represents the height, h metres, of the ball relative to the clifftop after t seconds.

The sea is 17 metres below the clifftop.

(b)   After how many seconds will the ball hit the sea?

4

[END OF QUESTION PAPER]

Total marks — 60

Attempt ALL questions

1. A charity distributed 80 000 emergency packages during 2018.

    This number is expected to increase by 15% each year.

    Calculate how many emergency packages the charity expects to distribute in 2021.
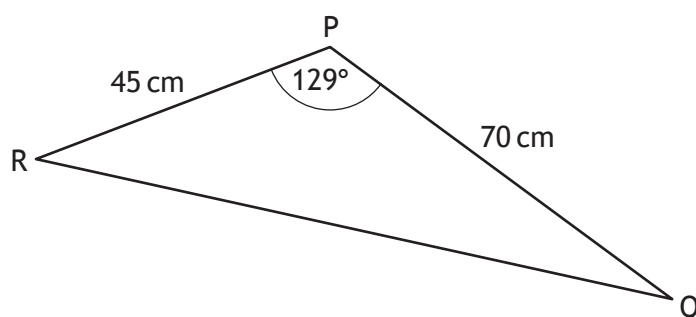
    3

2. Find $|\mathbf{p}|$, the magnitude of vector $\mathbf{p} = \begin{pmatrix} 6 \\ 27 \\ -18 \end{pmatrix}$.

    2

3. The diagram shows triangle PQR.

- PR = 45 centimetres
- PQ = 70 centimetres
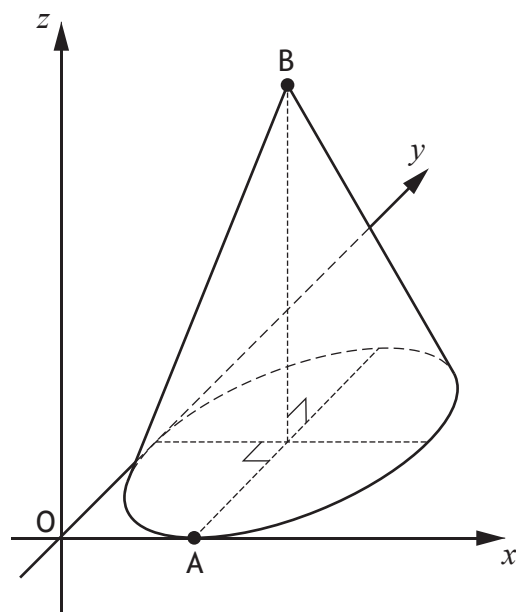- Angle QPR = 129°

Calculate the area of triangle PQR.

2

4. A sesame seed weighs $3 \cdot 6 \times 10^{-6}$ kilograms.

The weight of a poppy seed is 8% of the weight of a sesame seed.

Calculate the weight of a poppy seed in kilograms.

Give your answer in scientific notation.

2

5. The diagram shows a cone with diameter 6 units and height 8 units.

- The x-axis and the y-axis are tangents to the base
- A is the point of contact between the base and the x-axis
- B is directly above the centre of the base

Write down the coordinates of A and B.

2

6. Solve the equation $3x^2 + 9x - 2 = 0$.
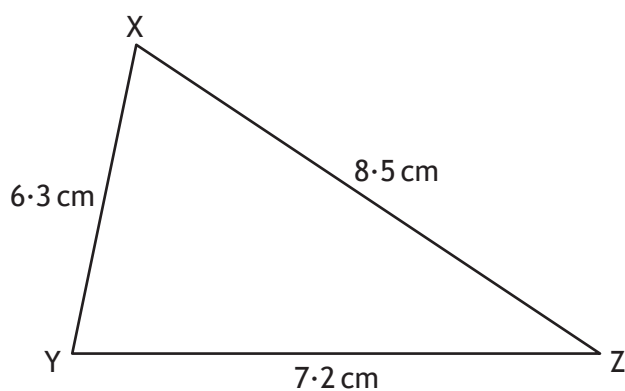
Give your answers correct to 1 decimal place.

7. Triangle XYZ is shown below.

Calculate the size of the smallest angle in triangle XYZ.

3
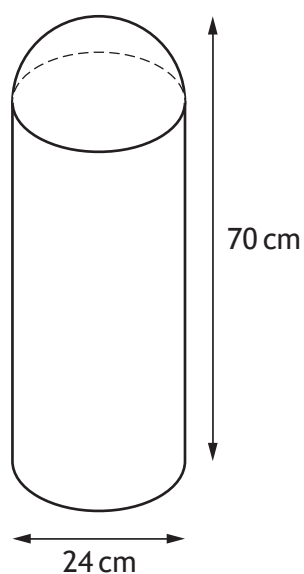
8. A traffic bollard is in the shape of a cylinder with a hemisphere on top.

The bollard has

- diameter 24 centimetres
- height 70 centimetres.

70 cm

24 cm

Calculate the volume of the bollard.

Give your answer correct to 3 significant figures. **5**

9. Georgie had her roof repaired.

She was charged an extra 2·5% for late payment.

She had to pay a total of £977·85.

Calculate how much she would have **saved** if she had paid on time.

3

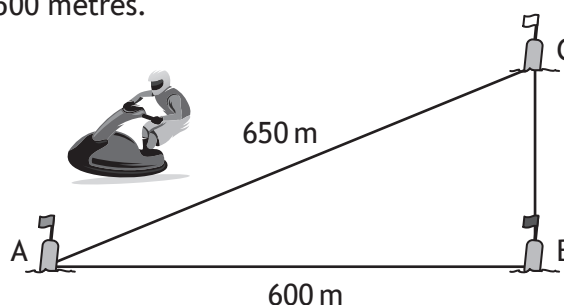**10.** Express $x^2 + 10x - 15$ in the form $(x + p)^2 + q$.

2

11. The diagram shows the course for a jet-ski race.

The course is indicated by markers A, B and C.

The total length of the course is 1500 metres.

- B is 600 metres from A
- C is 650 metres from A
- C is due north of B

650 m

A

B

C

600 m
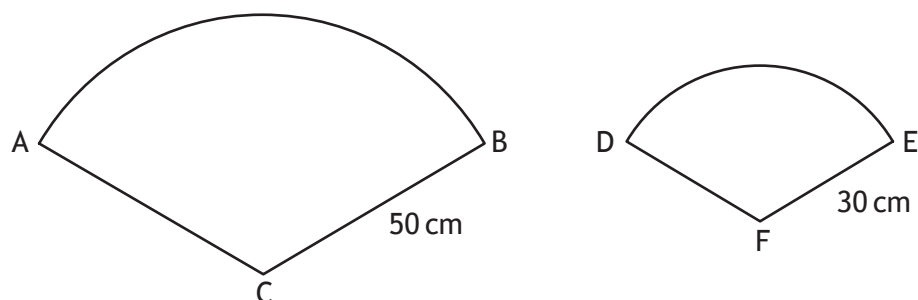
Determine whether B is due east of A.

Justify your answer. 4

12. In the diagram
- ABC is a sector of a circle, centre C
- DEF is a sector of a circle, centre F.

The sectors are mathematically similar.

The area of the larger sector, ABC, is 2750 square centimetres.

(a) Calculate the area of the smaller sector, DEF.　　**3**

(b) Calculate the size of angle ACB.　　**3**

13. Find an expression for the gradient of the line joining point A(6,9) to point B($4p,4p^2$).

Give your answer in its simplest form. **3**

14. Solve the equation $5\cos x° + 2 = 1$, $0 \leq x < 360$. **3**

15. Express

$$\frac{4}{x-2} - \frac{3}{x+5}, \quad x \neq 2, x \neq -5$$

as a single fraction in its simplest form.

3

16. Simplify $\dfrac{a^4 \times 3a}{\sqrt{a}}$.

3

17. Expand and simplify

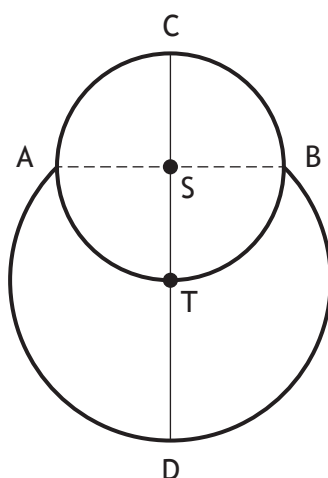$$\left(\sin x° + \cos x°\right)^2.$$

Show your working.

18. The picture shows a cartoon snowman.

The diagram below represents the snowman.

- The head is a small circle, centre S, with diameter 15 centimetres
- The body is part of a larger circle, centre T
- The point T lies on the circumference of the small circle
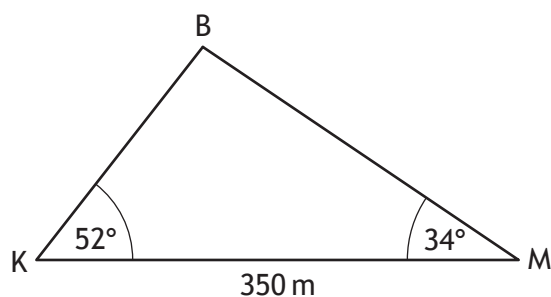- The points A and B lie on the circumferences of both circles

Calculate CD, the height of the snowman.

4

[Turn over for next question

19. Katy and Mona are looking up at a hot-air balloon.

In the diagram below, K, M and B represent the positions of Katy, Mona and the balloon respectively.

- The angle of elevation of the balloon from Katy is 52°

- The angle of elevation of the balloon from Mona is 34°

- Katy and Mona are 350 metres apart on level ground

Calculate the height of the hot-air balloon above the ground.

5