Total marks — 40

Attempt ALL questions

1. Given $\mathbf{p} = \begin{pmatrix} 4 \\ -6 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} -5 \\ -1 \end{pmatrix}$.

Find the resultant vector $\frac{1}{2}\mathbf{p} + \mathbf{q}$.

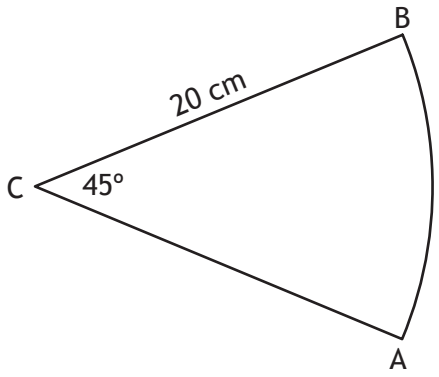
Express your answer in component form. **2**

2. Evaluate $\frac{3}{4}\left(\frac{1}{3} + \frac{2}{7}\right)$.

Give your answer in its simplest form. **2**

[Turn over

3. The diagram shows a sector of a circle, centre C.



The radius of the circle is 20 centimetres and angle ACB is 45°.

Calculate the area of the sector.

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

4. Charlie is making costumes for a school show.

One day he made 2 cloaks and 3 dresses.

The total amount of material he used was 9·6 square metres.

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

(b) The following day Charlie made 3 cloaks and 4 dresses.

The total amount of material he used was 13·3 square metres.

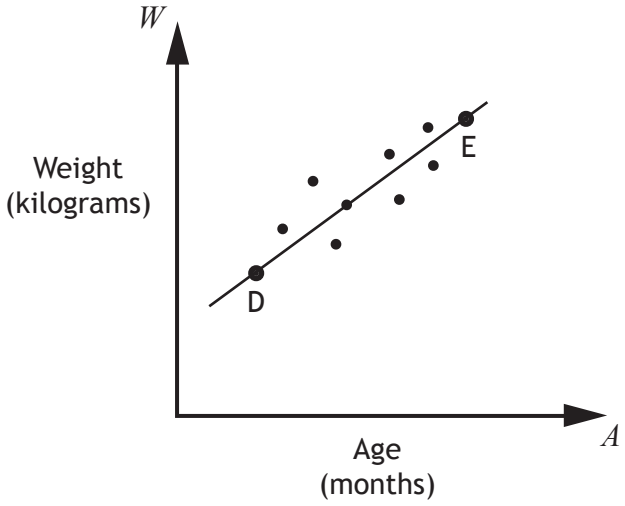
Write down an equation to illustrate this information. **1**

(c) Calculate the amount of material required to make one cloak and the amount of material required to make one dress. **4**

[Turn over

5. A cattle farmer records the weight of some of his calves.

The scattergraph shows the relationship between the age, A months, and the weight, W kilograms, of the calves.



A line of best fit is drawn.

Point D represents a 3 month old calf which weighs 100 kilograms.

Point E represents a 15 month old calf which weighs 340 kilograms.

(a) Find the equation of the line of best fit in terms of A and W.
Give the equation in its simplest form. **3**

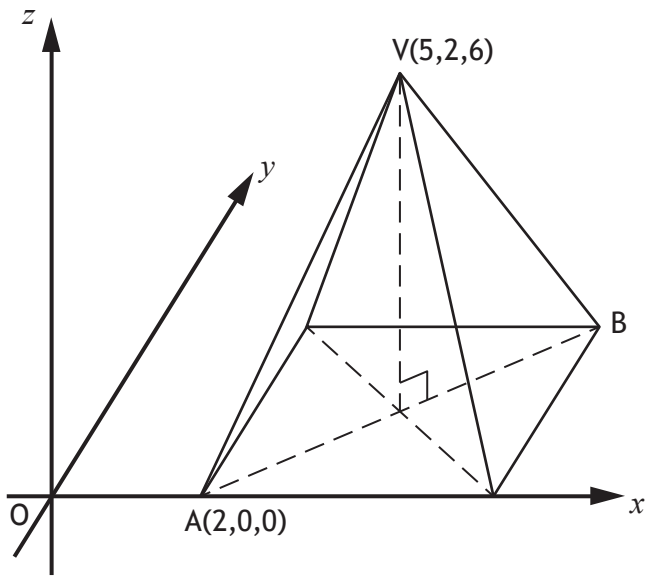
5. (continued)

(b) Use your equation from part (a) to estimate the weight of a one **year** old calf.

Show your working. **1**

6. Determine the nature of the roots of the function $f(x) = 7x^2 + 5x - 1$. **2**

7. The diagram shows a rectangular based pyramid, relative to the coordinate axes.



- A is the point (2,0,0).
- V is the point (5,2,6).

(a) Write down the coordinates of B. **1**

(b) Calculate the length of edge AV of the pyramid. **3**

8. Solve the equation

$$\frac{2x}{3} - \frac{5}{6} = 2x.$$

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

9. The function $f(x)$ is defined by $f(x) = \frac{2}{\sqrt{x}}, \quad x > 0.$

Express $f(5)$ as a fraction with a rational denominator. **2**

10. Sketch the graph of $y = (x-3)^2 + 1$.

On your sketch, show clearly the coordinates of the turning point and the point of intersection with the y–axis. **3**

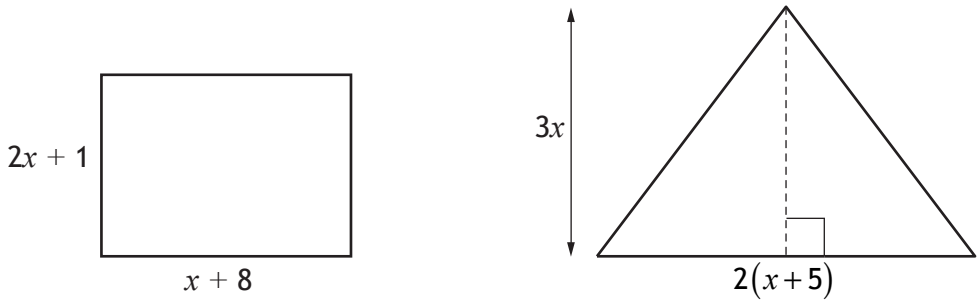
11. Simplify

$$\tan^2 x° \cos^2 x° .$$

Show your working. **2**

12. The diagrams below show a rectangle and a triangle.

All measurements are in centimetres.



(a) Find an expression for the area of the **rectangle**. **1**

(b) Given that the area of the rectangle is equal to the area of the triangle, show that $x^2 - 2x - 8 = 0$. **3**

12. (continued)

(c) Hence find, **algebraically**, the length and breadth of the rectangle. **3**

[END OF QUESTION PAPER]

Total marks — 50

Attempt ALL questions

1. A drinks manufacturer is reducing the sugar content of one of their fizzy drinks by 8% per year over the next 3 years.

The sugar content of a standard can is currently 35 grams.

Calculate the sugar content of a standard can after 3 years. **3**

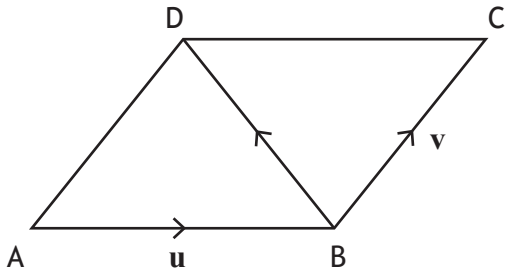
2. A pollen sample weighs 12 grams

and contains $1{\cdot}5 \times 10^9$ pollen grains.

Calculate the weight of **one** pollen grain in grams.

Give your answer in scientific notation. **2**

3. The diagram below shows parallelogram ABCD.

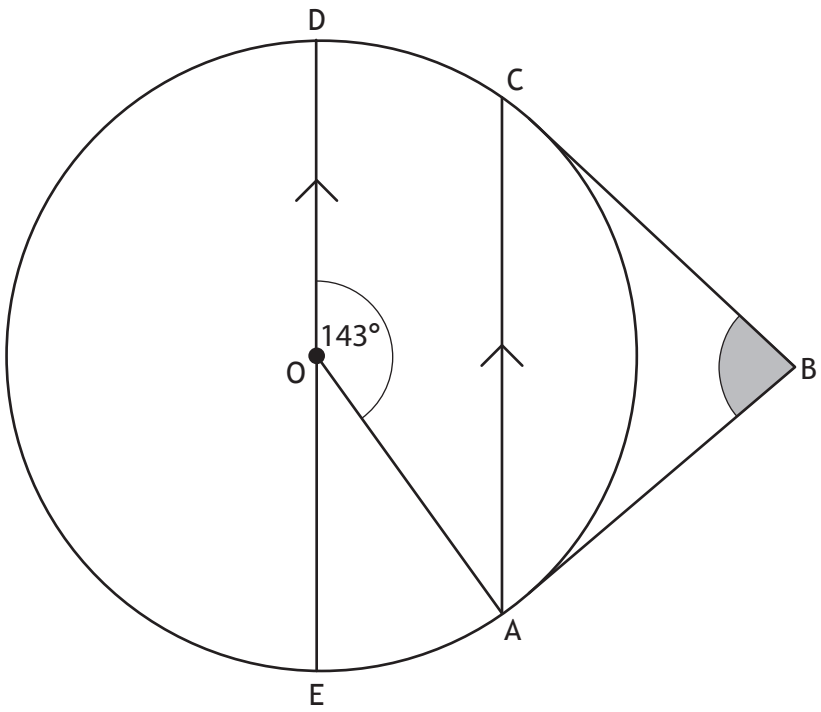


$\overrightarrow{AB}$ represents vector **u** and $\overrightarrow{BC}$ represents vector **v**.

Express $\overrightarrow{BD}$ in terms of **u** and **v**. **1**

4. Factorise fully $3x^2 - 48$. **2**

5. The diagram below shows a circle, centre O.



- AB and CB are tangents to the circle.
- AC and ED are parallel.
- Angle AOD is 143°.

Calculate the size of angle ABC. **3**

6. Jack called his internet provider on six occasions to report connection problems.

On each occasion he noted the length of time he had to wait before speaking to an adviser.

The times (in minutes) were as follows:

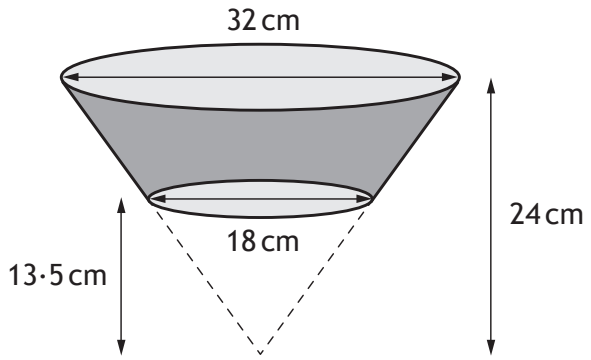
13 16 10 22 5 12

(a) Calculate the mean and standard deviation of these times. **4**

7. A carton is in the shape of a large cone with a small cone removed.

The large cone has diameter of 32 cm and height 24 cm.

The small cone has diameter of 18 cm and height 13·5 cm.

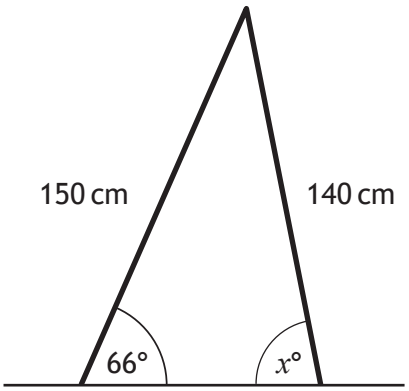


Calculate the volume of the carton.

Give your answer correct to 2 significant figures. **5**

8. A set of stepladders has legs 150 centimetres and 140 centimetres long.

When the stepladder is fully open, the angle between the longer leg and the ground is 66°.



Calculate $x°$, the size of the angle between the shorter leg and the ground. **3**

9. Express $x^2 + 8x - 7$ in the form $(x+a)^2 + b$. **2**

10. Simplify $\left(n^2\right)^3 \times n^{-10}$.

Give your answer with a **positive** power. **3**

11. Two pictures are mathematically similar in shape.

100 cm

60 cm

The cost of each picture is proportional to its area.

The large picture costs £13·75.

Find the cost of the small picture. **3**

12. Change the subject of the formula $L = \sqrt{4kt - p}$ to k. **3**

13. Express

$$\frac{3}{x-2} + \frac{5}{x+1}, \qquad x \neq 2, x \neq -1$$

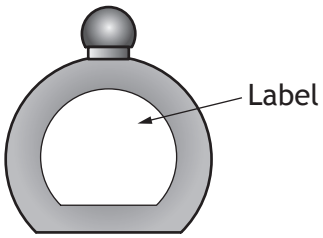
as a single fraction in its simplest form. **3**

MARKS | DO NOT WRITE IN THIS MARGIN

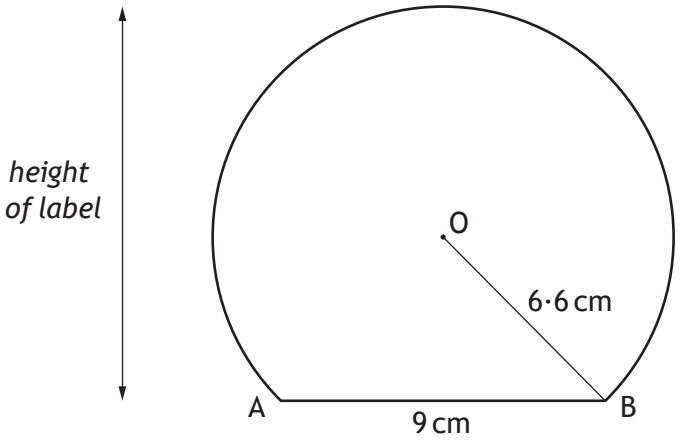
14. Solve the equation $2\tan x° + 5 = -4$, for $0 \leq x \leq 360$. **3**

[Turn over

15. This perfume bottle has a label in the shape of part of a circle.



A diagram of the label is shown below.

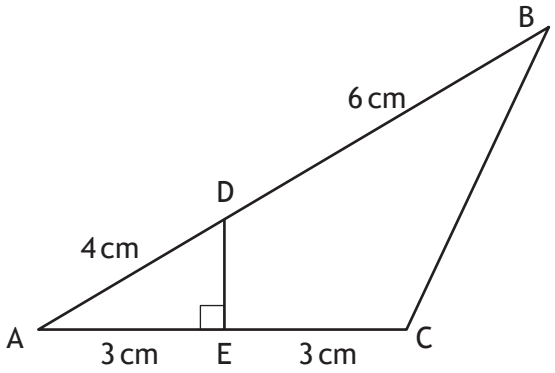


- The centre of the circle is O.
- The chord AB is 9 centimetres.
- The radius OB is 6·6 centimetres.

Find the height of the label. **4**

16. In the diagram below:

- DE is perpendicular to AC.
- AD = 4 centimetres.
- DB = 6 centimetres.
- AE = EC = 3 centimetres.



Calculate the length of BC.

Give your answer correct to one decimal place. **4**

[END OF QUESTION PAPER]