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National
Qualifications
2016

Mark

X747/75/01

**Mathematics
Paper 1
(Non-Calculator)**

THURSDAY, 12 MAY

1:00 PM – 2:00 PM



* X 7 4 7 7 5 0 1 *

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day

Month

Year

Scottish candidate number

Total marks — 40

Attempt ALL questions.

You may NOT use a calculator.

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State the units for your answer where appropriate.

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* X 7 4 7 7 5 0 1 0 1 *

FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle: $A = \frac{1}{2}ab \sin C$

Volume of a sphere: $V = \frac{4}{3}\pi r^3$

Volume of a cone: $V = \frac{1}{3}\pi r^2 h$

Volume of a pyramid: $V = \frac{1}{3}Ah$

Standard deviation: $s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$

or $s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}}$, where n is the sample size.



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

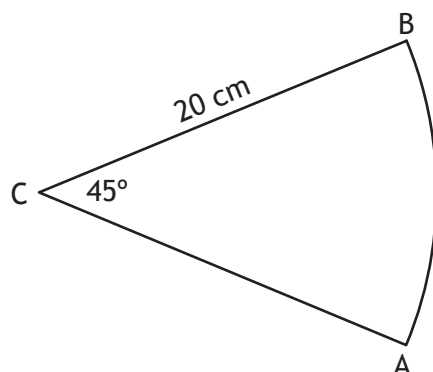
Give your answer in its simplest form.

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 $\pi = 3.14$.

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

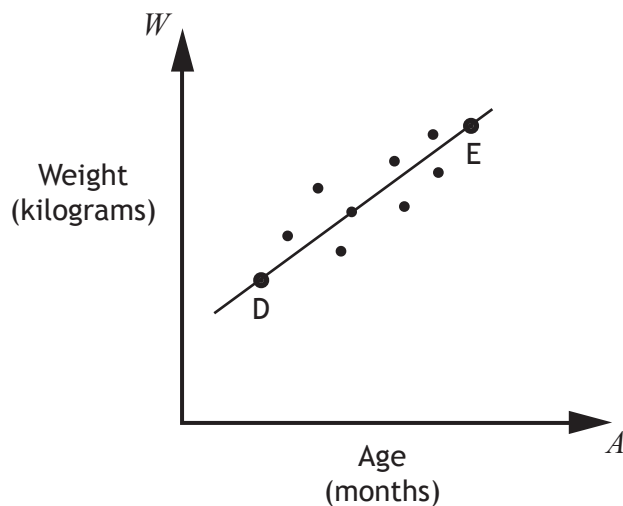
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* X 7 4 7 7 5 0 1 0 5 *

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



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5. (continued)

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

Show your working.

1

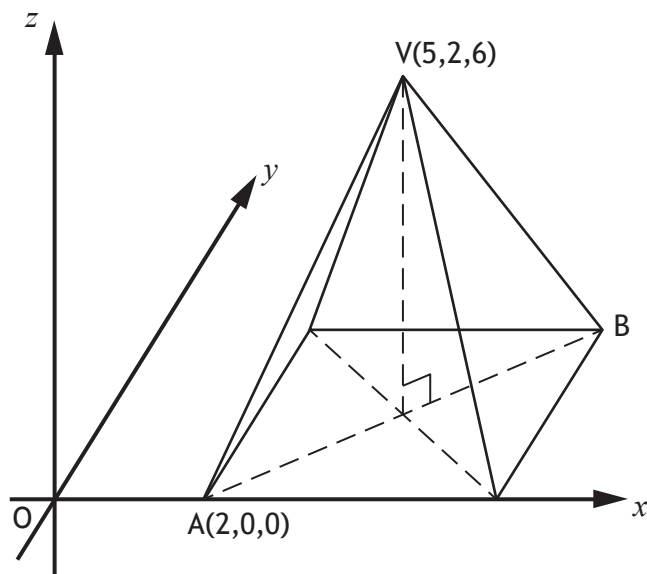
6. Determine the nature of the roots of the function $f(x) = 7x^2 + 5x - 1$.

2



* X 7 4 7 7 5 0 1 0 7 *

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



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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 $f(x) = \frac{2}{\sqrt{x}}$, $x > 0$.

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

2



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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



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11. Simplify

$$\tan^2 x^\circ \cos^2 x^\circ .$$

Show your working.

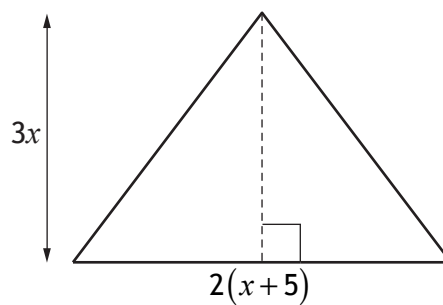
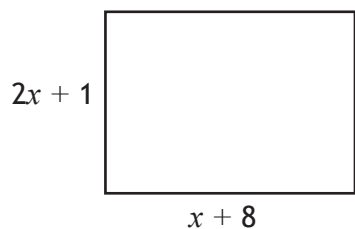
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* X 7 4 7 7 5 0 1 1 1 *

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



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12. (continued)

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

3

[END OF QUESTION PAPER]



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* X 7 4 7 7 5 0 1 1 6 *

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**Mathematics
Paper 2**

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2:20 PM – 3:50 PM



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* X 7 4 7 7 5 0 2 0 2 *

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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 1.5×10^9 pollen grains.



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

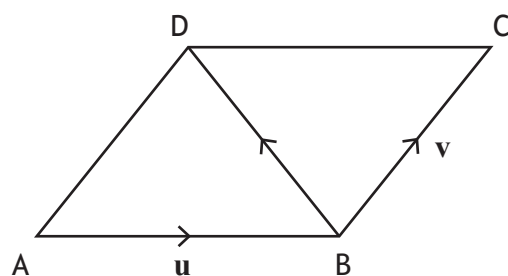
Give your answer in scientific notation.

2



* X 7 4 7 7 5 0 2 0 3 *

3. The diagram below shows parallelogram ABCD.



\vec{AB} represents vector \mathbf{u} and \vec{BC} represents vector \mathbf{v} .

Express \vec{BD} in terms of \mathbf{u} and \mathbf{v} .

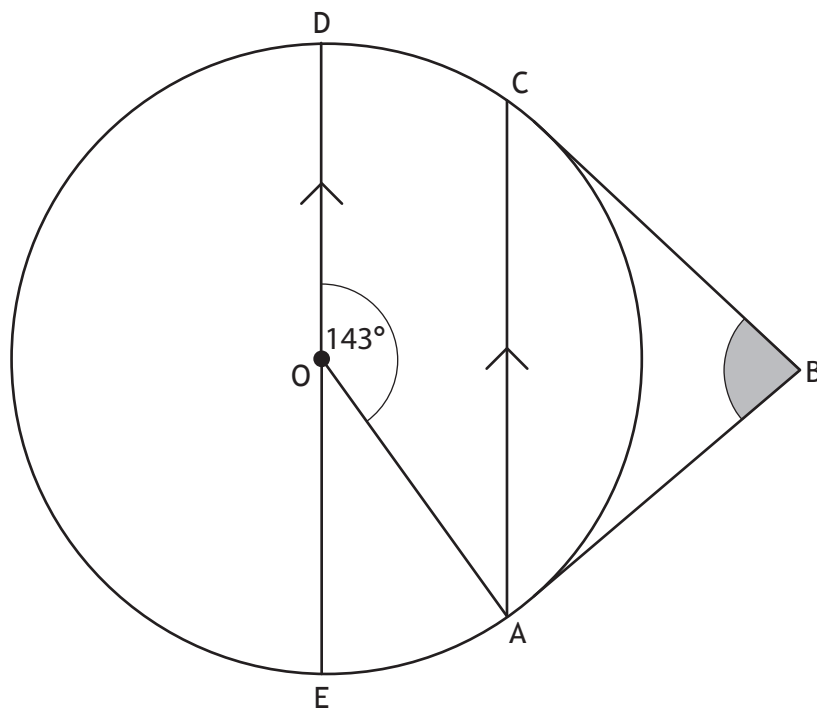
1

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



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6. (continued)

- (b) Sophie also called the same internet provider, on several occasions, to report connection problems.

Her mean waiting time was 15 minutes and the standard deviation was 4.3 minutes.

Make two valid comments comparing Sophie's waiting times with Jack's waiting times.

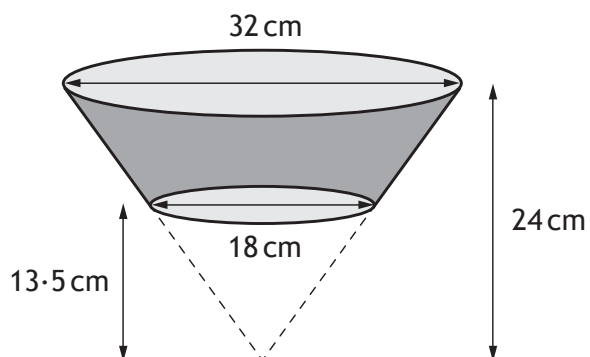
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* X 7 4 7 7 5 0 2 0 7 *

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.

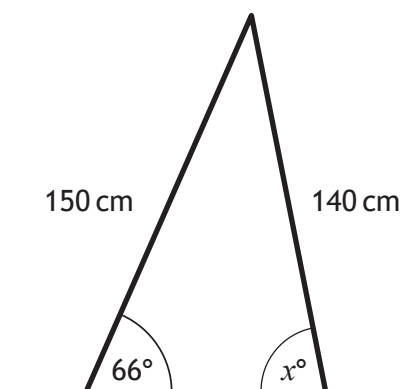
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8. A set of stepladders has legs 150 centimetres and 140 centimetres long.



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



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

2

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

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

3



* X 7 4 7 7 5 0 2 1 0 *

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



MARKS

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

3

13. Express

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

as a single fraction in its simplest form.

3



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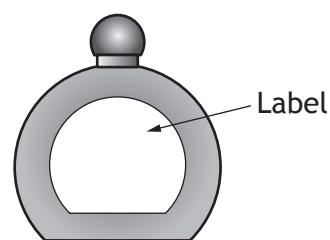
14. Solve the equation $2 \tan x^\circ + 5 = -4$, for $0 \leq x \leq 360$.

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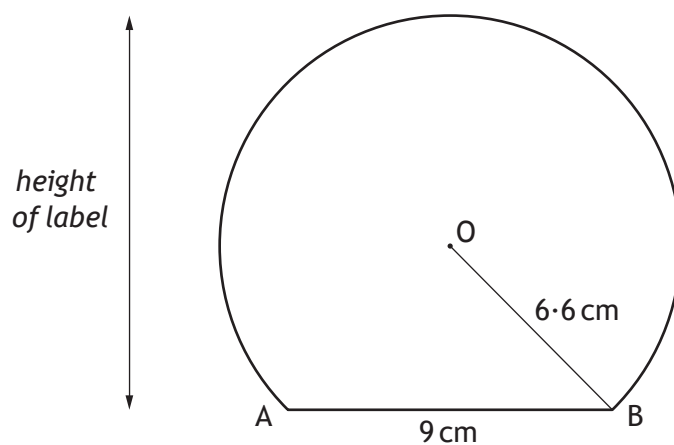


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15. This perfume bottle has a label in the shape of part of a circle.



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.

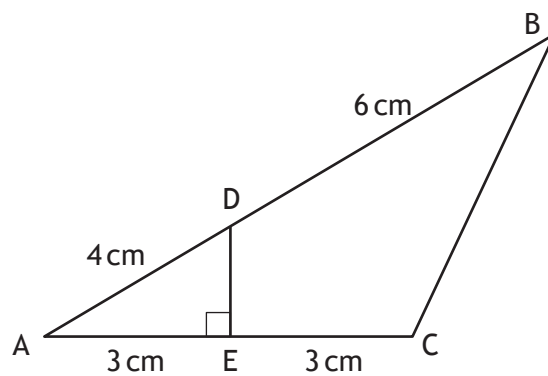
Find the height of the label.

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]



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* X 7 4 7 7 5 0 2 1 9 *

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* X 7 4 7 7 5 0 2 2 0 *