

PART A Mathematics

- 1 Which one of the following is a simplification of

$$y \left(\frac{3x^{\frac{1}{2}}z}{y^3} \right)^2$$

- A** $\frac{3xz^2}{y^4}$
- B** $\frac{3xz^2}{y^5}$
- C** $\frac{9x^{\frac{1}{2}}z^2}{y^5}$
- D** $\frac{9xz^2}{y^4}$
- E** $\frac{9xz^2}{y^5}$
- F** $\frac{9x^{\frac{5}{2}}z^2}{y^5}$

- 2 Triangle PQR has a right angle at Q .

The point T lies on QR such that $QT = \frac{1}{4}QR$

$$PT = 6 \text{ cm}$$

$$PR = 12 \text{ cm}$$

What is the length of QT , in cm?

- A** 2
- B** $2\sqrt{3}$
- C** $\frac{3}{2}\sqrt{2}$
- D** $\frac{6}{5}\sqrt{5}$
- E** $\frac{2}{7}\sqrt{21}$

- 3 Find the complete set of values of x that satisfy the inequality

$$\frac{3}{4}(5-x) - \frac{1}{2}(6-x) - x < 0$$

A $x < \frac{1}{3}$

B $x > \frac{1}{3}$

C $x < \frac{3}{5}$

D $x > \frac{3}{5}$

E $x < \frac{3}{4}$

F $x > \frac{3}{4}$

G $x < \frac{3}{2}$

H $x > \frac{3}{2}$

- 4 I have two fair dice, X and Y, each of which has six sides.

The faces on X are labelled 1, 1, 2, 3, 4, 5.

The faces on Y are labelled 2, 3, 4, 5, 6, 6.

I roll the dice together and calculate my total score by adding the number rolled on X to the number rolled on Y.

What is the probability that my total score is greater than 9?

A $\frac{1}{4}$

B $\frac{1}{6}$

C $\frac{1}{9}$

D $\frac{5}{12}$

E $\frac{5}{36}$

- 5** Rob keeps a record of what he earns each day.

On Monday, he earned 50% less than he earned on Sunday.

On Tuesday, he earned 20% more than he earned on Monday.

On Wednesday, he earned 30% less than he earned on Tuesday.

On Wednesday, he earned £84.

How much did Rob earn on Sunday?

- A** £15.12
- B** £35.28
- C** £117.60
- D** £200
- E** £210
- F** £300
- G** £1200

- 6** The n^{th} term of a sequence T is $(n - 3)^2$, where n is a positive integer.

The n^{th} term of another sequence V is $3n + p$, where p is a constant and n is a positive integer.

The 10th term in T is equal to twice the 5th term in V.

What is the 4th term in V?

- A** -16
- B** 4
- C** 16.5
- D** 21.5
- E** 31
- F** 46
- G** 95

- 7 Which one of the following is a simplification of

$$\frac{5x^2 - 17x - 12}{25x^2 - 9} \div \frac{x^2 + x - 12}{x^2 - x - 6}$$

- A** $\frac{(x-4)(x+2)}{(x-3)(x+4)}$
B $\frac{(x-3)(x+2)}{(5x-3)(x+3)}$
C $\frac{(x-4)(x+2)}{(5x-3)(x+4)}$
D $\frac{(x-4)(x-3)}{(5x-3)(x-6)}$
E $\frac{(x+2)}{(5x+3)}$
F $\frac{(x+4)(x-6)}{(5x+3)(x+2)}$
G $\frac{(x-3)(x+2)}{(5x+3)(x+3)}$

- 8 S is a list of six numbers:

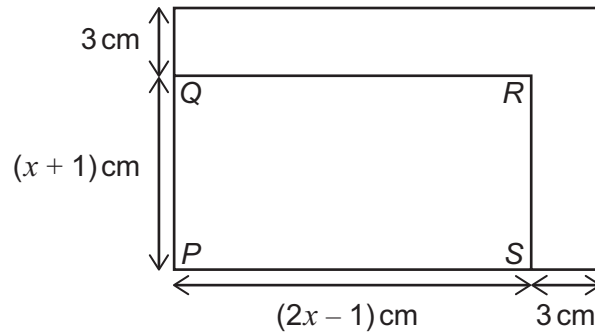
$$1, 2, x, x + 1, x + 1, 15 \quad \text{where } 2 \leq x \leq 14$$

The mean of S is one more than the median of S.

What is the value of x ?

- A** $2\frac{2}{3}$
B $3\frac{2}{3}$
C $4\frac{2}{3}$
D $5\frac{2}{3}$
E $6\frac{2}{3}$

- 9 A rectangle $PQRS$ has length $(2x - 1)$ cm and width $(x + 1)$ cm as shown on the diagram. A larger rectangle is made by adding 3 cm to both the length and the width of $PQRS$, as shown. The larger rectangle has an area of 360 cm^2 .



[diagram not to scale]

What is the ratio of PQ to PS ?

- A 1:2
- B 4:7
- C 5:8
- D 7:11
- E 10:17
- F 17:31

- 10** t is inversely proportional to the square of w .

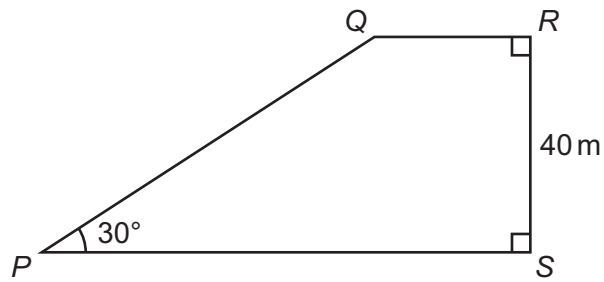
t and w are positive numbers.

$$t = 36 \text{ when } w = 2 \times 10^{-2}$$

What is the value of w when $t = 100$?

- A** 1.2×10^{-4}
- B** 1.2×10^{-2}
- C** 1.44×10^{-6}
- D** 1.44×10^{-3}
- E** $\frac{10}{3} \times 10^{-4}$
- F** $\frac{10}{3} \times 10^{-2}$
- G** 7.2×10^{-6}
- H** 7.2×10^{-3}

- 11 $PQRS$ is a trapezium as shown.



[diagram not to scale]

$$\tan RSQ = \frac{5}{8}$$

What is the length of PS , in metres?

- A 45
- B 65
- C 80
- D 120
- E $25 + \frac{40\sqrt{3}}{3}$
- F $40 + \frac{64\sqrt{3}}{3}$
- G $25 + 40\sqrt{3}$
- H $64 + 40\sqrt{3}$

- 12** A cyclist rides along a track to the top of a hill then immediately turns around and descends along the same track to her starting point.

She takes 40 minutes at an average speed of 12 km h^{-1} to reach the top.

Her average speed for the whole journey is 15 km h^{-1} .

What is the average speed of her descent?

- A** 16 km h^{-1}
- B** 18 km h^{-1}
- C** 20 km h^{-1}
- D** 24 km h^{-1}
- E** 30 km h^{-1}

- 13** A solid cylinder has radius r cm and height h cm.

A cube has side length $3r$ cm.

The total surface area of the cylinder is equal to four times the total surface area of the cube.

Which of the following is an expression for h in terms of r ?

- A** $\left(\frac{18}{\pi} - 2\right)r$
- B** $\left(\frac{18}{\pi} - 1\right)r$
- C** $\frac{27r}{\pi}$
- D** $\left(\frac{27}{\pi} - 1\right)r$
- E** $\left(\frac{27}{4\pi} - 1\right)r$
- F** $\frac{108r}{\pi}$
- G** $\left(\frac{108}{\pi} - 1\right)r$
- H** $\left(\frac{108}{\pi} - \frac{1}{2}\right)r$

- 14** Consider the equation $2x^2 + 4x + c = 0$, where c is a constant.

The positive difference between the roots of this equation is $\sqrt{10}$.

What is the value of c ?

- A** -5
- B** -4.5
- C** -3
- D** -0.5
- E** 0.75
- F** 8

- 15** The variables x and y are related by the equation:

$$x = 5 - \frac{2y^3 + 1}{1 - 2y^3}$$

Which of the following is a rearrangement to make y the subject?

- A** $y = \sqrt[3]{\frac{x-4}{8x-48}}$
- B** $y = \sqrt[3]{\frac{x-6}{8x-32}}$
- C** $y = \sqrt[3]{\frac{x-2}{x-6}}$
- D** $y = \sqrt[3]{\frac{x-3}{x-4}}$
- E** $y = \sqrt[3]{\frac{x-4}{2x-12}}$
- F** $y = \sqrt[3]{\frac{x-6}{2x-8}}$

- 16 PQR is a triangle as shown.

S and T are points on the sides PQ and PR .

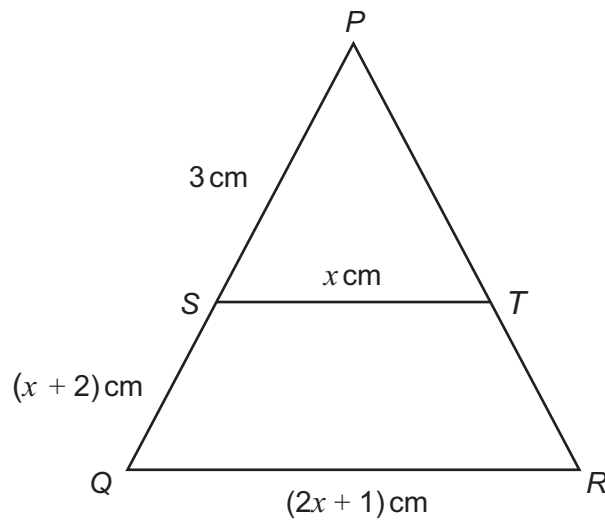
ST is parallel to QR .

$$PS = 3 \text{ cm}$$

$$ST = x \text{ cm}$$

$$QS = (x + 2) \text{ cm}$$

$$QR = (2x + 1) \text{ cm}$$



[diagram not to scale]

What is the length, in cm, of QR ?

- A $2 + \sqrt{5}$
- B $2 + \sqrt{13}$
- C $5 + 2\sqrt{7}$
- D $5 + 2\sqrt{11}$
- E 7
- F 9

- 17** Three different numbers are chosen at random from $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$.

What is the probability that the three numbers form the three sides of a right-angled triangle?

- A** $\frac{1}{15}$
- B** $\frac{1}{10}$
- C** $\frac{3}{10}$
- D** $\frac{1}{3}$
- E** $\frac{2}{5}$
- F** $\frac{2}{3}$
- G** $\frac{4}{5}$

- 18** P, Q and R are regular polygons.

Q has three times as many sides as P.

An interior angle of Q is 10° larger than an interior angle of P.

R has twice as many sides as Q.

How much larger is an interior angle of R than an interior angle of Q, in degrees?

- A** $2\frac{1}{2}$
- B** 5
- C** $6\frac{2}{3}$
- D** $7\frac{1}{2}$
- E** 10
- F** 15
- G** $16\frac{2}{3}$

- 19** The point $(-1, 5)$ is translated to the point $(3, 2)$ by two successive translations.

The first translation is by the vector $\begin{pmatrix} 3p \\ -4p \end{pmatrix}$

The second translation is by the vector $\begin{pmatrix} q \\ -2q \end{pmatrix}$

What is the value of $p + q$?

- A** -14
- B** -7
- C** -5
- D** -1
- E** 1
- F** 5
- G** 7
- H** 14

- 20** Consider the graphs of the form

$$y = x^2 + 2ax + a$$

What is the complete range of values of a for which the minimum point of the graph lies above the x -axis?

- A** There are no values of a
- B** $a < 0$
- C** $0 < a < 1$
- D** $-1 < a < 1$
- E** $a < -1$ or $a > 1$
- F** $a < 0$ or $a > 1$
- G** a can take any value