

PART A Mathematics

- 1 The surface area of a solid sphere of radius R is equal to the total surface area of 10 solid closed cylinders of radius r and height $4r$.

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

(The surface area of a sphere of radius R is $4\pi R^2$.)

- A $R = 5r$
- B $R = 12r$
- C $R = 2\sqrt{5}r$
- D $R = \frac{1}{2}\sqrt{10}r$
- E $R = \sqrt{10}r$
- F $R = \frac{3}{2}\sqrt{10}r$
- G $R = \sqrt{15}r$

- 2 Which of the following statements is/are correct?

1 $\frac{47}{93} \div \frac{33}{71} = \frac{71}{93} \div \frac{33}{47}$

2 $53\% \text{ of } 84 = 84\% \text{ of } 53$

3 $(2\sqrt{3})^2 = (3\sqrt{2})^2$

- A none of them
- B 1 only
- C 2 only
- D 3 only
- E 1 and 2 only
- F 1 and 3 only
- G 2 and 3 only
- H 1, 2 and 3

- 3 Which of the following is a correct rearrangement of

$$y = p - \frac{q-r}{s-x}$$

to make x the subject?

A $x = s - \frac{q-r}{p+y}$

B $x = \frac{q-r}{p+y} - s$

C $x = s - \frac{q-r}{p-y}$

D $x = \frac{q-r}{p-y} - s$

E $x = s - \frac{q-r}{y-p}$

F $x = \frac{q-r}{y-p} - s$

- 4 Six numbers in increasing order are:

2, x , x , y , 23.5, 27.5

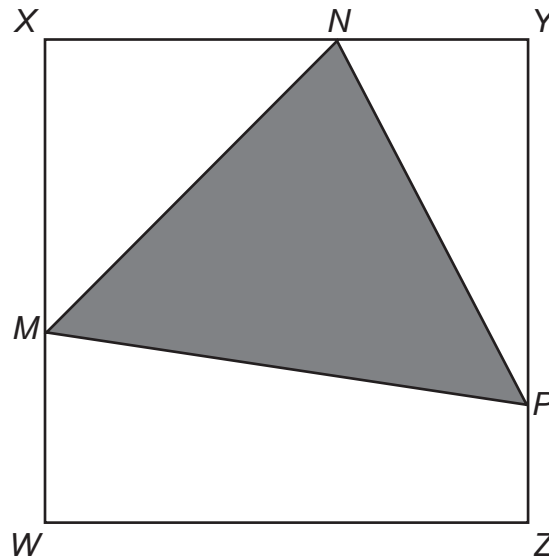
The mean of the six numbers is 12.

The median of the six numbers is 7.25.

What is the mode of the six numbers?

- A** 4.5
B 4.75
C 5
D 9.625
E 10
F 11.75

5



[diagram not to scale]

$WXYZ$ is a square of side length 1.

$$WM:MX = 1:2$$

$$XN:NY = 3:1$$

$$YP:PZ = 4:1$$

What is the area of triangle MNP ?

- A $\frac{1}{3}$
- B $\frac{2}{5}$
- C $\frac{9}{20}$
- D $\frac{1}{30}$
- E $\frac{19}{60}$
- F $\frac{23}{60}$

- 6 Which of the following is a simplification of

$$\frac{4x-8}{x^2+4x-12} \div \frac{x-6}{x^3-36x}$$

- A $\frac{1}{4}$
B $\frac{1}{4x}$
C 4
D $4x$
E $\frac{4x(x+6)}{(x-6)}$
F $\frac{4x(x-6)}{(x+6)}$
G $\frac{4}{x(x+6)^2}$
H $\frac{4}{x(x-6)^2}$

- 7 Given that

$$\frac{27^{2(x-2)}}{9^{(2x-3)}} = (81)^{\frac{3}{2}}$$

what is the value of x ?

- A 0
B 2.5
C 3
D 6
E 7.5
F 9
G 10.5
H 12

- 8 The solutions of the equation $3x^2 - 6x - 2 = 0$ are p and q , where $p > q$.

What is the value of $3p + 2q$?

- A $-10 - \frac{2}{3}\sqrt{15}$
- B $-10 - \frac{2}{3}\sqrt{3}$
- C $-5 - \frac{1}{3}\sqrt{15}$
- D $-5 - \frac{1}{3}\sqrt{3}$
- E $5 + \frac{1}{3}\sqrt{15}$
- F $5 + \frac{1}{3}\sqrt{3}$
- G $10 + \frac{2}{3}\sqrt{15}$
- H $10 + \frac{2}{3}\sqrt{3}$

- 9 Last year, the salary of the coach of a football club was 80% of the salary of the star player.

At the start of the new year, the coach received a 15% increase in salary and the star player received a 38% increase in salary.

What percentage of the star player's new salary is the coach's new salary?

- A 46%
- B 57%
- C $61\frac{3}{5}\%$
- D $66\frac{2}{3}\%$
- E 77%
- F $83\frac{1}{3}\%$

- 10** Two of the angles of a triangle are 90° and θ , where

$$\tan \theta = \sqrt{2}$$

The length of the hypotenuse of the triangle is $3\sqrt{6}$ cm.

What is the area of the triangle, in cm^2 ?

- A** $\frac{9\sqrt{2}}{2}$
- B** $9\sqrt{2}$
- C** $9\sqrt{3}$
- D** $9\sqrt{6}$
- E** $18\sqrt{2}$
- F** $18\sqrt{3}$
- G** $18\sqrt{6}$

- 11** An athlete's training session consists of several complete repetitions of a three-part programme:

1. Walk 100 m at an average speed of 6 km h^{-1}
2. Jog 200 m at an average speed of 10 km h^{-1}
3. Run 100 m at an average speed of 20 km h^{-1}

What is the athlete's average speed for the complete training session, in km h^{-1} ?

- A** 7.2
- B** 9.6
- C** 11.5
- D** 12
- E** 14.4

- 12** The line joining the points with coordinates $(q, 2 - q)$ and $(2q + 2, q - 4)$ is perpendicular to the line with equation $3x - 4y + 5 = 0$

What is the value of q ?

- A** $-\frac{2}{5}$
- B** $-\frac{1}{6}$
- C** 1
- D** $\frac{18}{11}$
- E** $\frac{16}{7}$
- F** $\frac{5}{2}$
- G** 6

- 13** Two objects X and Y are similar.

The surface area of object Y is double the surface area of object X.

The volume of object Y is $7\sqrt{2} \text{ cm}^3$ more than the volume of object X.

What is the volume of object X, in cm^3 ?

- A** $14 - 7\sqrt{2}$
- B** $14 + 7\sqrt{2}$
- C** $\frac{42 - 7\sqrt{2}}{17}$
- D** $\frac{42 + 7\sqrt{2}}{17}$
- E** $\frac{7\sqrt{2}}{3}$
- F** $7\sqrt{2}$
- G** $4 - \sqrt{2}$
- H** $4 + \sqrt{2}$

- 14** x, y and z are positive variables.

y is inversely proportional to the square of x .

When $y = 20$, $x = 3$

z is directly proportional to x .

When $z = 1.2$, $x = 6$

What is z when $y = 80$?

- A** 0.0225
- B** 0.03
- C** 0.15
- D** 0.3
- E** 0.36
- F** 0.6
- G** 1.2

- 15** The equation

$$\left(\frac{a \times 10^4 + 2a \times 10^3}{3 \times 10^{-1}} \right)^2 = 8 \times 10^9$$

has two solutions for a .

What is the positive difference between these two solutions?

- A** 0
- B** $2\sqrt{5}$
- C** $4\sqrt{5}$
- D** $20\sqrt{5}$
- E** $40\sqrt{5}$
- F** $200\sqrt{5}$

- 16** For any real number x , the function $V(x)$ is defined as:

$$V(x) = 10^{x^2 + 6x + 7}$$

What is the smallest value of $V(x)$?

- A** 0.001
 - B** 0.01
 - C** 0.1
 - D** 1
 - E** 10
 - F** 100
 - G** 1000
- 17** X and Y are the end-points of a line segment.

Point P has coordinates $(-8, 5)$.

P lies on the line segment XY such that $XP:PY$ is $1:2$ and $\overrightarrow{XP} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$

A point Q is such that $\overrightarrow{QY} = \begin{pmatrix} 7 \\ 6 \end{pmatrix}$

What are the coordinates of point Q ?

- A** $(7, 5)$
- B** $(3, 8)$
- C** $(1, -12)$
- D** $(-3, -10)$
- E** $(-7, -7)$
- F** $(-11, -4)$

- 18** The 2nd term of a linear (arithmetic) sequence is equal to twice the 8th term.

The 5th term is $\frac{9}{4}$

What is the 20th term of the sequence?

A -9

B $-\frac{7}{4}$

C $-\frac{3}{2}$

D 6

E $\frac{31}{4}$

F $\frac{27}{2}$

- 19** Find the maximum value of

$$2^{\sin x} \times 3^{-\sin x}$$

where $0^\circ \leq x \leq 360^\circ$

A $\frac{2}{3}$

B 1

C $\frac{3}{2}$

D 2

E 3

F 6

- 20** Two bags contain counters which are identical except for colour.

The first bag contains 3 blue and 2 yellow counters.

The second bag contains x red, 1 blue and 2 yellow counters.

A counter is picked at random from the first bag and placed in the second bag.

A counter is then picked at random from the second bag. The probability that this counter is yellow is 0.2. What is the probability that this counter is red?

A $\frac{1}{4}$

B $\frac{3}{11}$

C $\frac{3}{10}$

D $\frac{1}{3}$

E $\frac{2}{3}$

F $\frac{7}{10}$

G $\frac{8}{11}$

H $\frac{3}{4}$