# *Mathematical Formulae*

*Compound interest*

$$\textit{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

*Mensuration*

Curved surface area of a cone = $\pi rl$

Surface area of a sphere = $4\pi r^2$

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

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

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

Arc length = $r\theta$, where $\theta$ is in radians

Sector area = $\frac{1}{2}r^2\theta$, where $\theta$ is in radians

*Trigonometry*

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

$$a^2 = b^2 + c^2 - 2bc\cos A$$

*Statistics*

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f}-\left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

**1** **(a)** $z = \sqrt{x + y^2}$

**(i)** Calculate the value of $z$ when $x = 136$ and $y = \frac{9}{2}$.

*Answer* ..... [2]

**(ii)** Express $x$ in terms of $z$ and $y$.

*Answer* ..... [2]

**(b)** Factorise $x^2 - 5x - 6$.

*Answer* ..... [2]

**2** **(a)** Figure 1 shows a solid cone with radius 5 cm and slant height 13 cm.

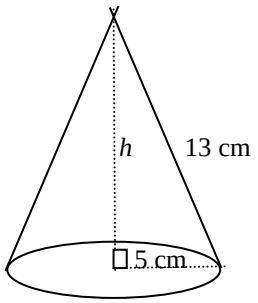



Figure 1

**2** **(a)** Calculate the

**(i)** height, *h*, of the cone,

*Answer* ……*cm* [1]

**(ii)** volume of the cone.

*Answer* ……. [2]

**(b)** The solid cone is melted down and poured into a cylindrical mould with base radius of 6 cm as shown in Figure 2.

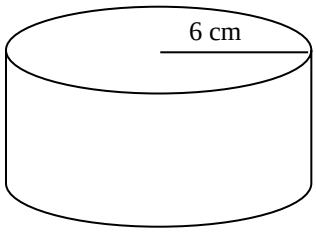



Figure 2

**(i)** Calculate the height of the cylindrical mould.

*Answer* ……. [1]

**2 (b) (ii)** The solid is made from a material with density 1.2 g/cm$^3$.

Calculate the mass of the solid.

*Answer* ……. [2]

**3** Solve the simultaneous equations.

$$2x + 3y = 9$$
$$4x - y = -17$$

*Answer* $x =$…….

$y =$……. [3]

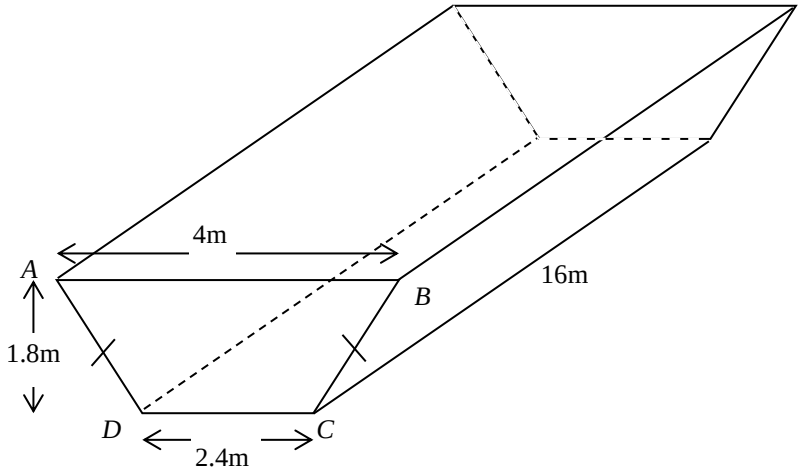
**4** **(a)** Factorise completely $x^2 - x - xy + y$.

*Answer* ..... [1]

**(b)** Hence, express as a single fraction $\frac{2x}{x^2 - x - xy + y} - \frac{y}{x-1}$.

Answer ..... [4]

**5** A water tank, shown in the diagram, is in the shape of a prism. The trapezium, *ABCD* is vertical.




Calculate

**(a)** angle *CBA*,

Answer ……° [2]

**(b)** the area of trapezium *ABCD*,

Answer …… $m^2$ [2]

**(c)** the volume of the water tank.

Answer …… $m^3$ [2]

**6** The table below shows the population, given to the nearest thousand, of some countries.

| **Country** | **Population in 2019** | **Population in 2020** |
|---|---|---|
| Korea | 185 133 000 | 188 169 000 |
| Japan | 1 393 784 000 | 1 402 007 000 |
| Australia | 67 223 000 | ? |

**(a)** The population of Australia in 2020 was $6.74\times10^7$.
Complete the table, expressing Australia's population in 2020 as an ordinary number.

Answer ……. [1]

**(b)** Calculate the difference in population between Japan and Korea in 2020.
Give your answer in standard form, correct to three significant figures.

Answer ……. [2]

**7** $y$ is inversely proportional to the square of $x$ and $y = 3$ when $x = 8$.

**(a)** Express $y$ in terms of $x$.

Answer ……. [2]

**(b)** Find the new value of $y$ when $x$ increases by 100%.

Answer ……. [2]

**8** \$450 is divided between Anna, Sally and Nina in the ratio of $5 : x : 4x$.

**(a)** Express, as a single fraction in terms of $x$, the amount that Sally received.

Answer ……. [2]

**(b)** **Hence**, given that Sally received \$85, evaluate Anna's share.

Answer ……. [3]

**9** Answer the whole of this question on a single sheet of graph paper.

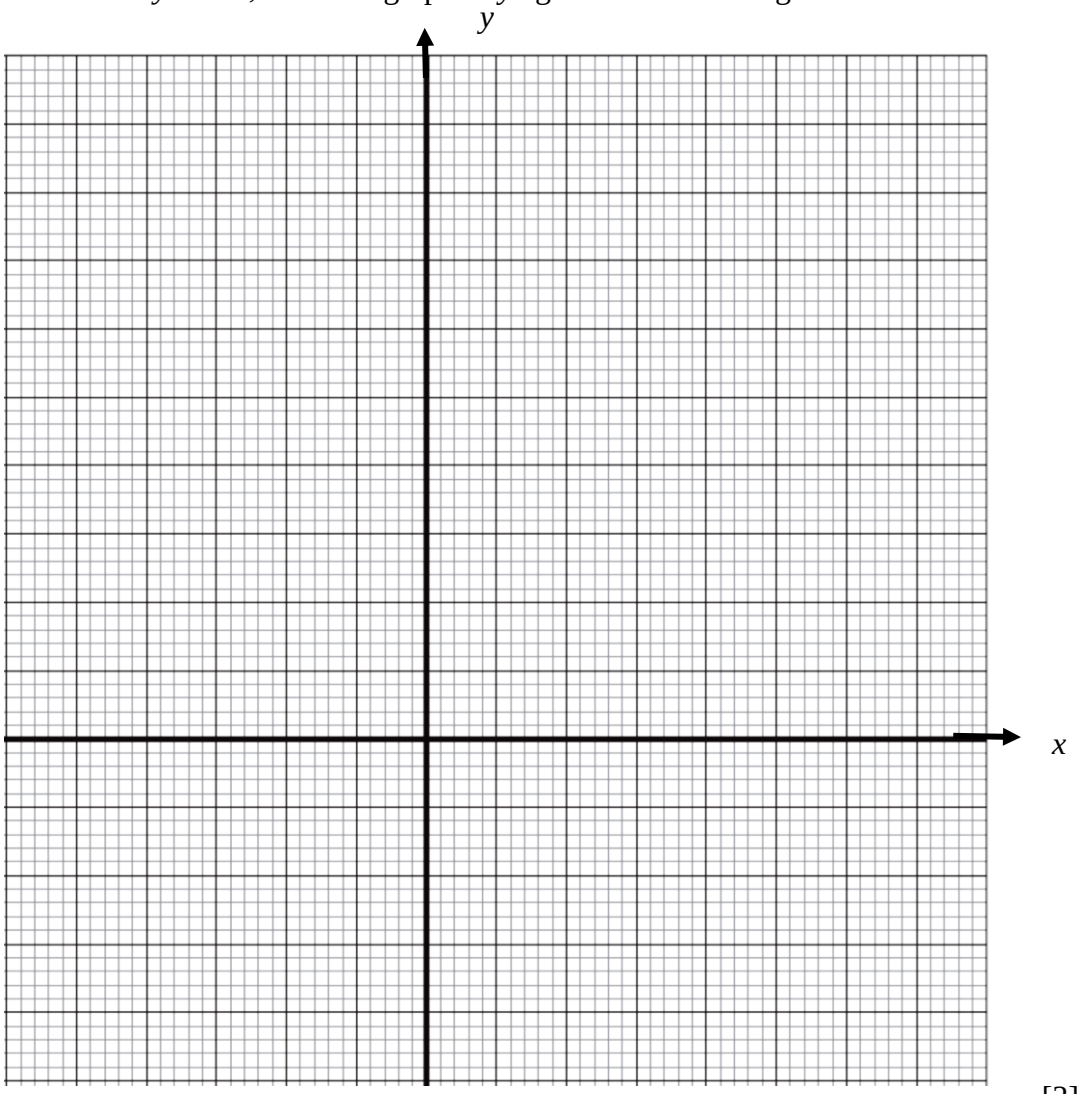
The table below is for $y = 2x^2 - 5x - 3$.

| $x$ | $-2$ | $-1$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| $y$ | $p$ | 4 | $-3$ | $-6$ | $-5$ | 0 | 9 | 22 |

**(a)** Find the value of $p$.

Answer ..... [1]

**(b)** Using a scale of 2 cm to represent 1 unit on the $x-$axis and 2 cm to represent 5 units on the $y-$axis, draw the graph of $y$ against $x$ for the range $-2 \le x \le 5$.




[3]

**9** **(c)** From your graph, find the values of $x$ when $y = 5$.

Answer ……. [2]

**(d)** By drawing a tangent, find the gradient of the curve at the point where $x = 4$.

Answer ……. [2]

**(e)** From the graph, solve $2x^2 - 5x = 3$.

Answer ……. [2]

**10** The stem-and-leaf diagram shows the distribution of the ages of the contestants in a painting contest. The median and the range of the distribution are 32 and 22 years respectively.

| Stem | Leaf |
|---|---|
| 2 | 1 3 3 |
| 2 | 5 6 6 8 9 |
| 3 | 0 *m* 3 5 5 5 |
| 3 | 6 6 8 8 |
| 4 | 1 *n* |

Key: 2|1 represents 21 years

Find

**(i)** the values of *m* and *n*,

Answer *m* = …….

Answer *n* = ……. [2]

**(ii)** the modal age,

Answer ……. [1]

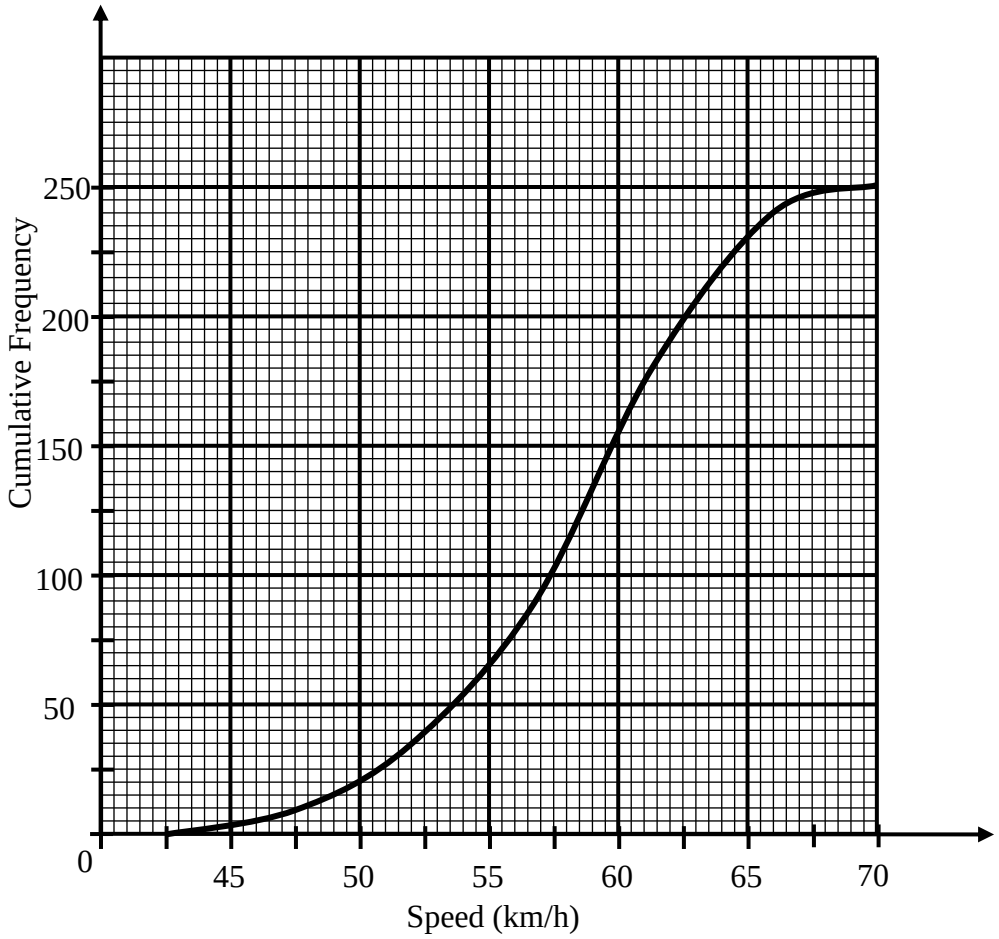
**(iii)** the interquartile range of the speed.

Answer ……. [1]

**Section B** (8 marks)

Answer **one** question from this section. Each question carries 8 marks.

**10 (a)** The speeds, in km/h, of 250 vehicles travelling along a road were measured. The cumulative frequency curve summarises the results.




**(i)** Find the median speed.

*Answer* ……... [1]

**(ii)** Find the interquartile range of the speed.

*Answer* ……. [2]

**(iii)** Find the speed limit, in km/h, if 12% of the vehicles were found speeding.

*Answer* …… *km/h* [2]

**(b)** A bag contains 5 red balls, 6 blue balls and 1 green ball.
Two balls are drawn from the bag, one after the other, without replacement.

Calculate the probability that the two balls have

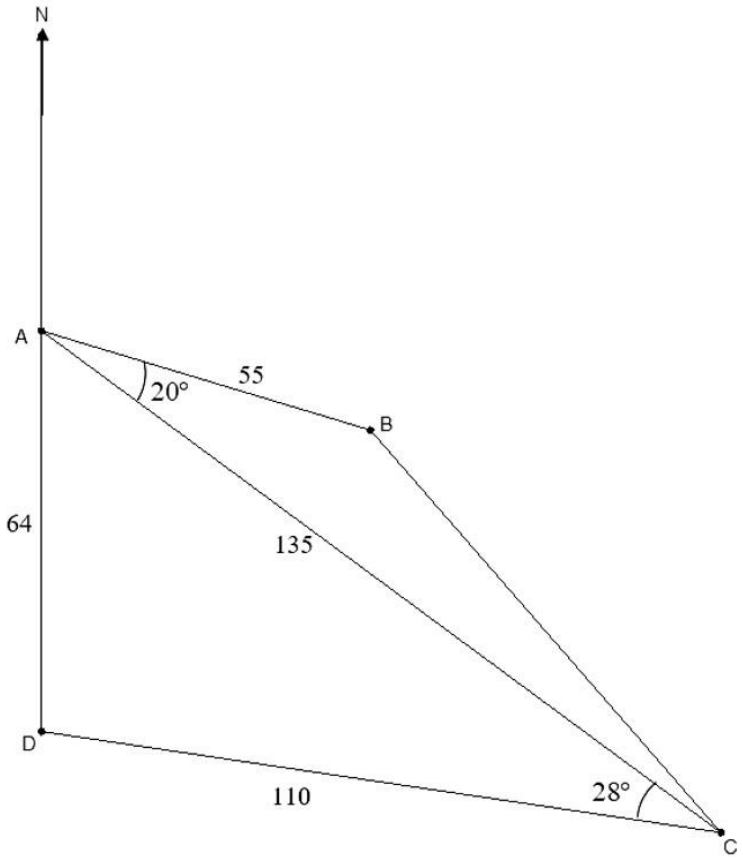
**(i)** the same colour,

*Answer* ……. [2]

**(ii)** different colours.

*Answer* ……. [1]

**11** $A$, $B$, $C$ and $D$ are four points on a grass field. $AB = 55\,\text{m}$, $AC = 135\,\text{m}$, $CD = 110\,\text{m}$, and $AD = 64\,\text{m}$. Angle $ACD = 28°$, angle $CAB = 20°$ and $D$ is due south of $A$.




**(a)** Find the distance $BC$.

*Answer* ……. [2]

**(b)** A building is erected at point $C$. The angle of elevation from point $D$ is $20°$.
What is the height of the building?

*Answer* ……. [2]

**(c)** Find the bearing of $C$ from $A$.

*Answer* ……. [3]

**(d)** Find the area enclosed by points *A, B* and *C*.

*Answer* ……. [1]

*End of Paper*