Surname	Other Names

Mathematics

November 2022 Practice Paper 1 (Non-Calculator)

Higher Tier

Time: 1 hour 30 minutes

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
 – there may be more space than you need.
- **Calculators may not be used**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
 – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Higher Tier Formulae Sheet

Perimeter, area and volume

Where a and b are the lengths of the parallel sides and h is their perpendicular separation:

$$\text{Area of a trapezium} = \frac{1}{2}(a + b)\,h$$

Volume of a prism = area of cross section × length

Where r is the radius and d is the diameter:

$$\text{Circumference of a circle} = 2\pi r = \pi d$$

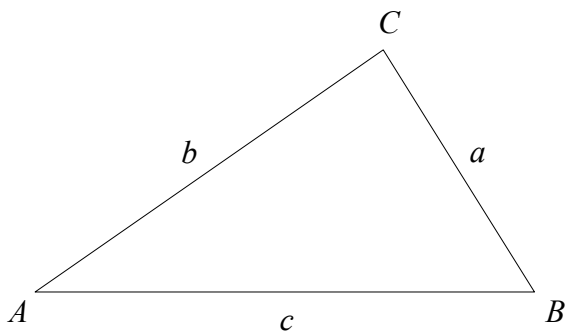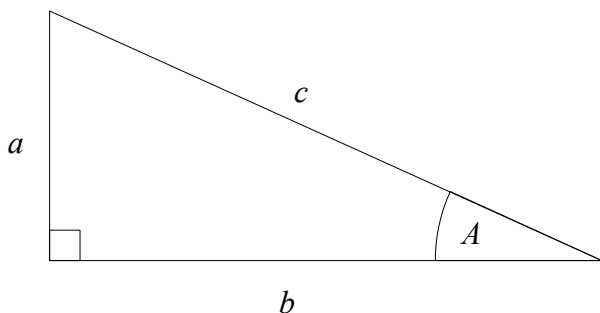$$\text{Area of a circle} = \pi r^2$$

Quadratic formula

The solution of $ax^2 + bx + c = 0$

where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Pythagoras' Theorem and Trigonometry

In any right-angled triangle where a, b and c are the length of the sides and c is the hypotenuse:

$$a^2 + b^2 = c^2$$

In any right-angled triangle ABC where a, b and c are the length of the sides and c is the hypotenuse:

$$\sin A = \frac{a}{c} \qquad \cos A = \frac{b}{c} \qquad \tan A = \frac{a}{b}$$

In any triangle ABC where a, b and c are the length of the sides:

sine rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

Area of triangle $= \dfrac{1}{2} ab \sin C$

Compound Interest

Where P is the principal amount, r is the interest rate over a given period and n is number of times that the interest is compounded:

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

Probability

Where P (A) is the probability of outcome A and P (B) is the probability of outcome B:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

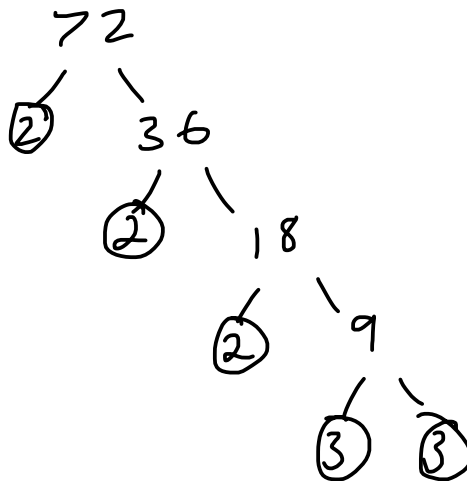$$P(A \text{ and } B) = P(A \text{ given } B)\, P(B)$$

END OF EXAM AID

1 Work out 37.1×9.3

$$
\begin{array}{r}
371 \\
\times\ 93 \\
\hline
1113 \\
33390 \\
\hline
34503
\end{array}
$$

345.03

(Total for Question 1 is 2 marks)

2 Write 72 as a product of its prime factors.

2 × 2 × 2 × 3 × 3

(Total for Question 2 is 2 marks)

3   Sam is ordering pizza for all the people in her company.

Sam takes a sample of 50 people in the company.
She asks them which pizza they would like to order.

The table shows information about the results.

Pizza	Number of People
Margarita	19
Vegetable	13
Pineapple	8
Pepperoni	10

There are 600 people in the company

(a) Work out how many Pineapple pizzas Sam should order

$$\frac{8}{50} = \frac{96}{600}$$

×12

×12

.... 96 ....

(2)

(b) Write down any assumption you made and explain how this could affect your answer.

I assumed the 50 people in the sample are representitive of all the people in the company. If they are not the answer would not be accurate.

(1)

(Total for Question 3 is 3 marks)

4 In a bag there are blue sweets, red sweets and green sweets.
The ratio of blue sweets to red sweets to green sweets is 5:3:2

What fraction of the sweets are green?

$$\frac{2}{10}$$

(Total for Question 4 is 2 marks)

5 (a) Work out $\frac{5\times 3}{5\times 4} - \frac{7 \times 2}{10 \times 2}$

$$\frac{15}{20} - \frac{14}{20}$$

$$\frac{1}{20}$$

(2)

(b) Work out $2\frac{1}{3} \times \frac{3}{5}$

Give your answer as a mixed number in its simplest form.

$$\frac{7}{3_1} \times \frac{3^1}{5} = \frac{7}{5} = 1\frac{2}{5}$$

$$1\frac{2}{5}$$

(2)

(Total for Question 5 is 4 marks)

6 A block exerts a force of 84 Newtons on a table.
The pressure on the table is 112 N/m^2.

Work out the area of the box that is in contact with the table.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$area = \frac{force}{pressure}$

$= \frac{84}{112} = \frac{42}{56} = \frac{21}{28} = \frac{3}{4}$

................0.75................ m^2

(Total for Question 6 is 2 marks)

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7 Andy and Bruce share some sweets in the ratio 9:4.   13 parts   x7
Andy gets A sweets
Bruce gets B sweets

Carla and David share the <u>same amount of</u> sweets as Andy and Bruce.
They share their sweets in the ratio 5:2.   7 parts   x 13

Carla gets C sweets
David gets D sweets

Find $A:B:C:D$

$A : B$ $C : D$
$9 : 4$ $5 : 2$
$63 : 28$ $65 : 26$

$A : B : C : D$
$63 : 28 : 65 : 26$

................63 : 28 : 65 : 26................

(Total for Question 7 is 3 marks)

8
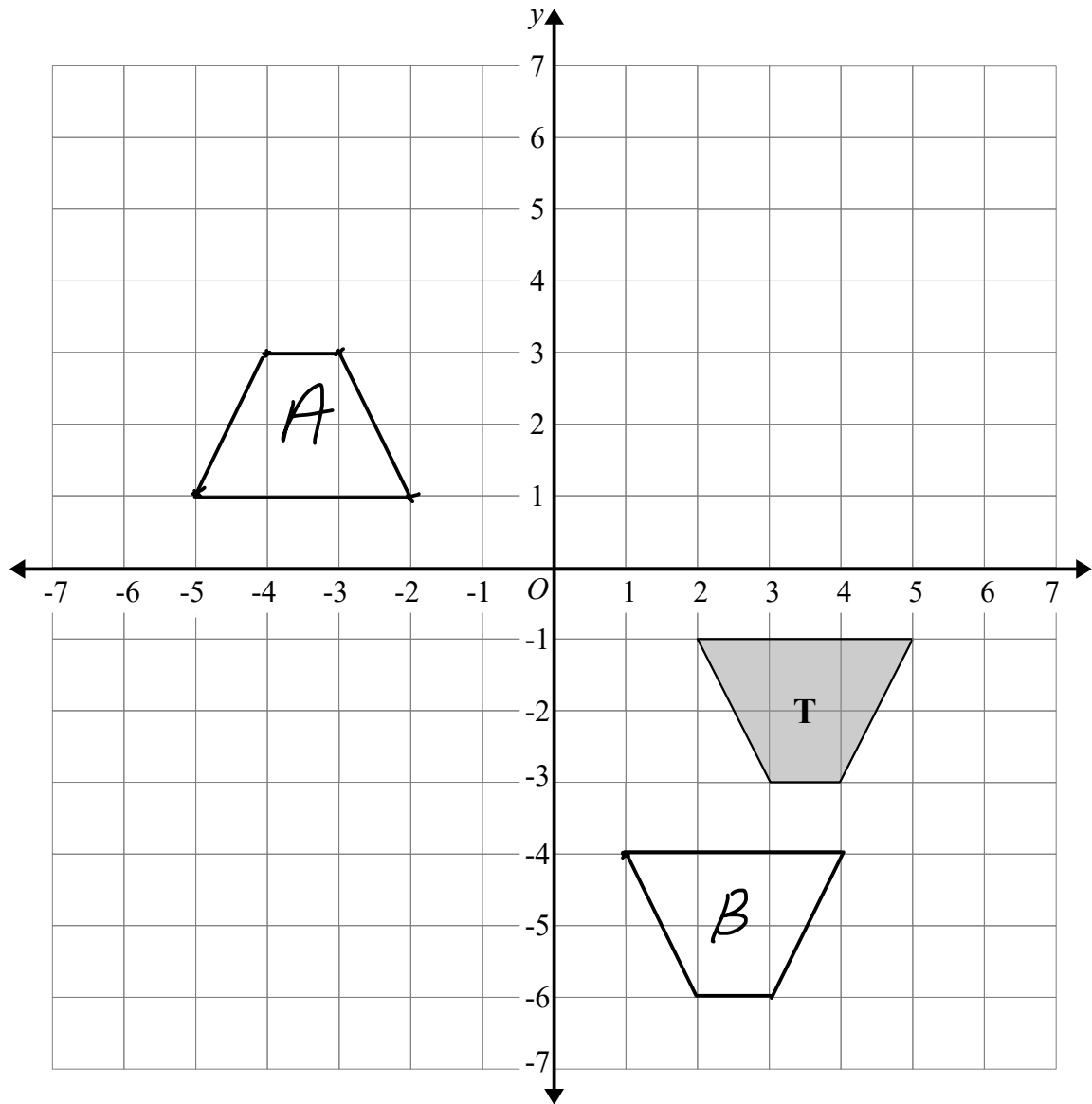
(a) Rotate trapezium **T** 180° about the origin.
Label the new trapezium **A**.

(b) Translate trapezium **T** by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$
Label the new trapezium **B**.

(Total for Question 8 is 2 marks)

9 $\mathbf{A} = 2^2 \times 3 \times 5^2$ $\mathbf{B} = 2^3 \times 3^2 \times 7$

(a) Write down the highest common factor (HCF) of **A** and **B**.

$2^2 \times 3$

................12................
(1)

(b) Find the lowest common multiple (LCM) of **A** and **B**.

$2^3 \times 3^2 \times 5^2 \times 7$

$8 \times 9 \times 25 \times 7$

72×175

$$\begin{array}{r} 175 \\ \times 72 \\ \hline 350 \\ 12250 \\ \hline 12600 \end{array}$$

................12600................
(2)

(Total for Question 9 is 3 marks)

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10 $s = ut + \dfrac{1}{2}at^2$

$u = -5$
$a = 4$
$t = 3$

Work out the value of s.

$S = (-5)(3) + \frac{1}{2}(4)(3)^2$

$= -15 + 2(9)$

$= {}^-15 + 18$

$= 3$

$s = $ ....3................

(Total for Question 10 is 2 marks)

11   Sweets are sold in small packs and in big packs.
There is a total of 175 sweets in 4 small packs and 3 big packs.
There is a total of 154 sweets in 5 small packs and 2 big packs.
Work out the number of sweets in each small pack and in each big pack.

$$4s + 3b = 175 \quad \times 2$$
$$5s + 2b = 154 \quad \times 3$$

$$8s + 6b = 350$$
$$15s + 6b = 462$$

$$7s = 112$$
$$s = \frac{112}{7}$$

$$5(16) + 2b = 154$$
$$80 + 2b = 154$$
$$2b = 74$$
$$b = 37$$

$$7\overline{\smash{\big)}\,1\,1\,2}^{\,0\,1\,6}$$

$$s = 16$$

Small Pack ....16................

Big Pack ....37................

(Total for Question 11 is 3 marks)

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12   Given that $3 \times \sqrt{27} = 3^n$
Find the value n.

$$\sqrt{27} = \sqrt{3^3} = 3^{\frac{3}{2}}$$

$$3^1 \times 3^{\frac{3}{2}} = 3^{\frac{5}{2}}$$

................$\frac{5}{2}$................

(Total for Question 12 is 2 marks)

13 (a) Complete the table of values for $y = x^3 + 3x$

x	-2	-1	0	1	2
y	-14	-4	0	4	14

(2)

(b) On the grid, draw the graph of $y = x^3 + 3x$

(2)
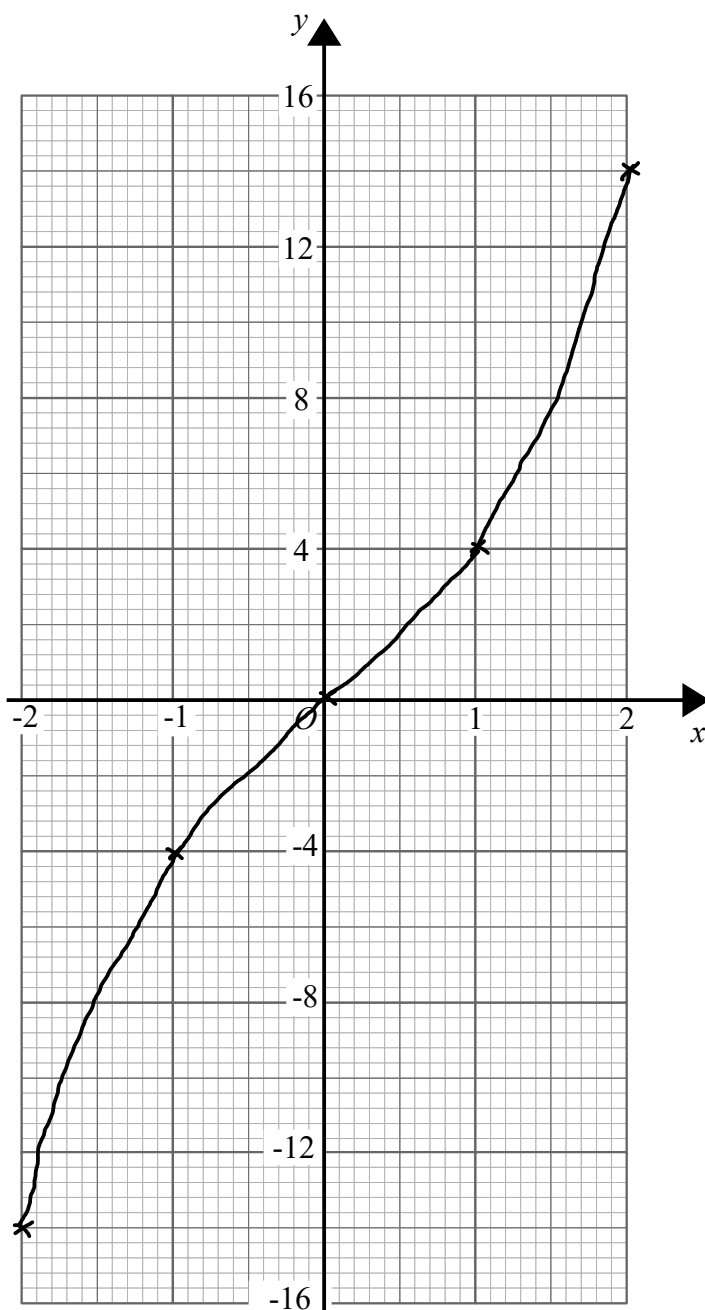
(Total for Question 13 is 4 marks)

14 In a bag there are only red counters, blue counters, green counters and yellow counters.

A counter is taken at random from the bag.

The table shows the probabilities that the counter will be green or will be yellow.

Colour	Red	Blue	Green	Yellow
Probability	$2x$	x	0.35	0.20

21

The probability that the counter will be red is twice the probability that the counter will be blue.

There are 21 green counters in the bag.

Work out the number of red counters in the bag.

$$2x + x + 0.35 + 0.2 = 1$$
$$3x + 0.55 = 1$$
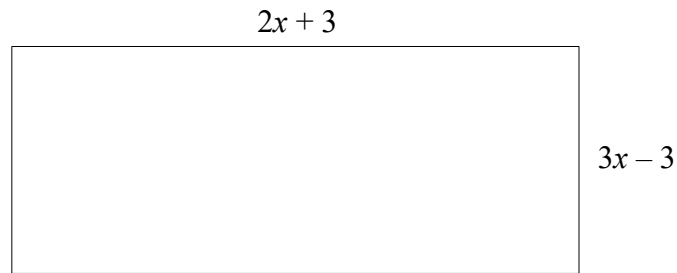$$3x = 0.45$$
$$x = 0.15$$
$$2x = \underline{0.3}$$

$\div 7$ $\quad$ 35% of counters = 21 $\quad \div 7$
$\quad$ 5% of counters = 3

$$21 - 3 = 18$$

30% of counters = $\underline{\underline{18}}$

.............*18*.............

(Total for Question 14 is 4 marks)

15 The diagram shows a rectangle.

$$2x + 3$$

$$3x - 3$$

All the measurements are in centimetres.
The area of the rectangle is 75 cm²

Work out the value of x.
You must show all your working.

$$(2x + 3)(3x - 3) = 75$$

$$6x^2 - 6x + 9x - 9 = 75$$

$$6x^2 + 3x - 9 = 75$$

$$6x^2 + 3x - 84 = 0$$

$$2x^2 + x - 28 = 0$$

$$(2x - 7)(x + 4) = 0$$

$$x = \frac{7}{2} \qquad x = -4$$

✗
cannot have
negative lengths

.............................3.5.........................cm

(Total for Question 15 is 4 marks)

16 A population of bacteria is increasing by 10% each hour.

Find the percentage increase in the population every 3 hours.

$$\frac{100}{10} = 10 \qquad\qquad 110 \qquad\qquad 1 \text{ hour}$$

$$\frac{110}{10} = 11 \qquad\qquad 121 \qquad\qquad 2 \text{ hours}$$

$$\frac{121}{10} = 12.1 \qquad\quad 133.1 \qquad\qquad 3 \text{ hours}$$

$$\underline{\underline{33.1\%}}$$

...................33.1%

(Total for Question 16 is 2 marks)

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17 Show that $(3 - \sqrt{8})(5 + \sqrt{18})$ can be written in the form $a + b\sqrt{2}$

$$\sqrt{8} = \sqrt{4}\sqrt{2} = 2\sqrt{2}$$

$$\sqrt{18} = \sqrt{9}\sqrt{2} = 3\sqrt{2}$$

$$(3 - 2\sqrt{2})(5 + 3\sqrt{2})$$

$$15 + 9\sqrt{2} - 10\sqrt{2} - 12$$

$$\underline{\underline{3 - \sqrt{2}}}$$

(Total for Question 17 is 3 marks)

18 Sketch the graph of $y = \sin x°$ for $0 \leq x \leq 360$
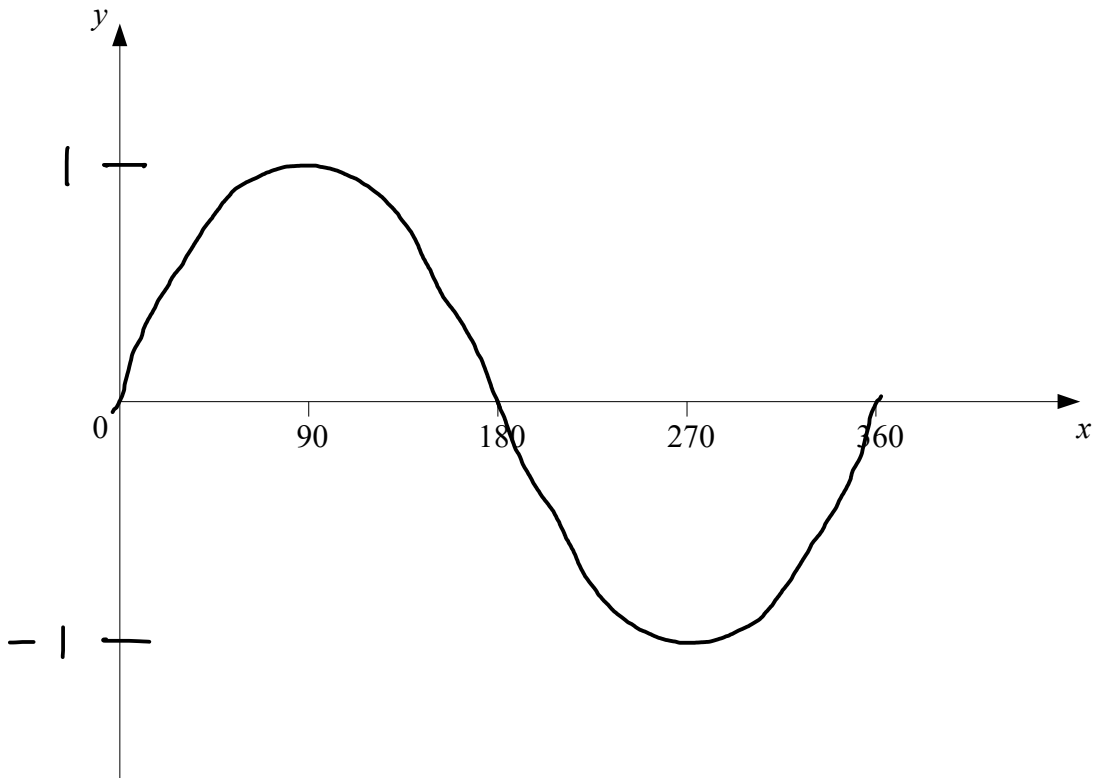
19 Solve $\dfrac{8}{3x-2} + \dfrac{6}{x+1} = 2$

$$8(x+1) + 6(3x-2) = 2(3x-2)(x+1)$$
$$8x + 8 + 18x - 12 = 2(3x^2 + 3x - 2x - 2)$$
$$26x - 4 = 2(3x^2 + x - 2)$$
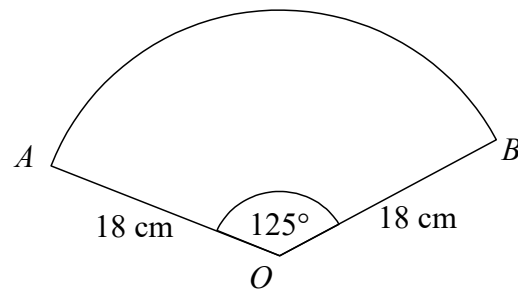$$13x - 2 = 3x^2 + x - 2$$
$$0 = 3x^2 - 12x$$
$$0 = 3x(x - 4)$$
$$x = 0 \qquad x = 4$$

$\underline{x = 0 \text{ or } x = 4}$

20 AOB is a sector of a circle, centre O and radius 18 cm.
The angle of the sector is 125°.

Calculate the length of the arc AB.
Give your answer in terms of π.

$$\frac{125}{360} \times 2\pi(18)$$

$$\frac{125}{360} \times 36\pi$$

$$\frac{125}{10} \times \pi$$

$$12.5\pi$$

.... 12.5π .... cm

(Total for Question 20 is 2 marks)

21 x is inversely proportional to the square root of y

When $x = 12$, $y = 9$

Find the value of x when $y = 81$

$$x = \frac{k}{\sqrt{y}}$$

$$12 = \frac{k}{\sqrt{9}}$$

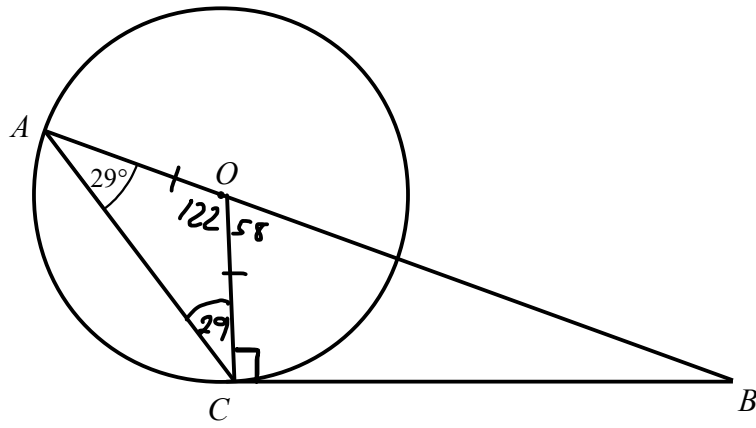$$12 = \frac{k}{3}$$

$$k = 36$$

$$x = \frac{36}{\sqrt{y}}$$

$$x = \frac{36}{\sqrt{81}}$$

$$= \frac{36}{9}$$

$$= 4$$

$x =$ .... 4 ....

(Total for Question 21 is 3 marks)

22

A and C are points on the circumference of a circle, centre O.
BC is a tangent to the circle.

Angle CAB = 29°

Find the size of angle ABC.
You must show all your working.

$OCB = 90°$ Tangent meets radius at 90°

$ACO = 29°$ Angles at the base of an isosceles triangle
are equal

$2 \times 29 = 58°$ Angles in a triangle add to 180°

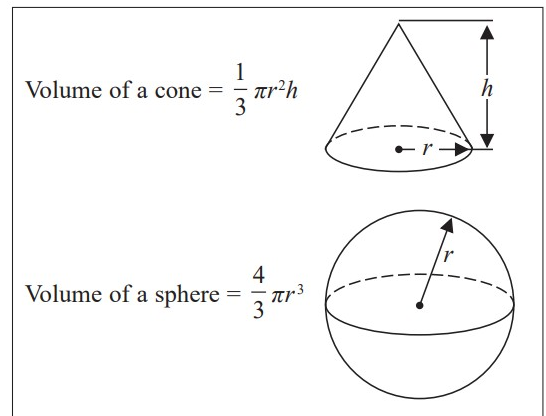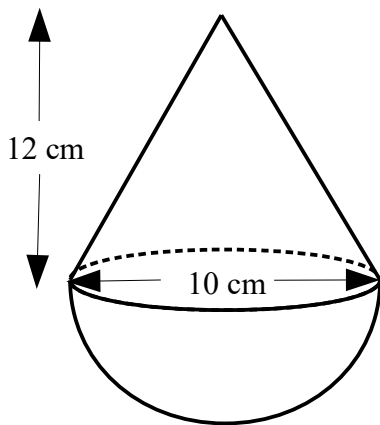$180 - 58 = 122°$ Angles on a straight line add to
180°

$180 - 90 - 58 = \underline{\underline{32°}}$ Angles in a triangle
add to 180°

32 °

(Total for Question 22 is 4 marks)

23 The diagram shows a solid shape.
The shape is a cone on top of a hemisphere.

Volume of a cone = $\frac{1}{3}\pi r^2 h$	
Volume of a sphere = $\frac{4}{3}\pi r^3$	

The height of the cone is 12 cm.
The base of the cone has a diameter of 10 cm. $r = 5$
The diameter of the hemisphere is 10 cm.

Work out the total volume of the solid shape.
Give your answer in terms of π.

Hemisphere

$$V = \frac{2}{3}\pi r^3$$
$$= \frac{2}{3}\pi (5)^3$$
$$= \frac{2}{3}\pi (125)$$
$$= \frac{250}{3}\pi$$

Cone

$$V = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi (5)^2 (12)$$
$$= 4\pi (25)$$
$$= 100\pi$$

$$\text{Total } V = \frac{250}{3}\pi + 100\pi$$
$$= \left(\frac{250}{3} + \frac{300}{3}\right)\pi$$
$$= \frac{550}{3}\pi$$

$\frac{550}{3}\pi$ .... cm³

(Total for Question 23 is 4 marks)

24 The histogram shows information about the weight of pigs.

Weight (kg)
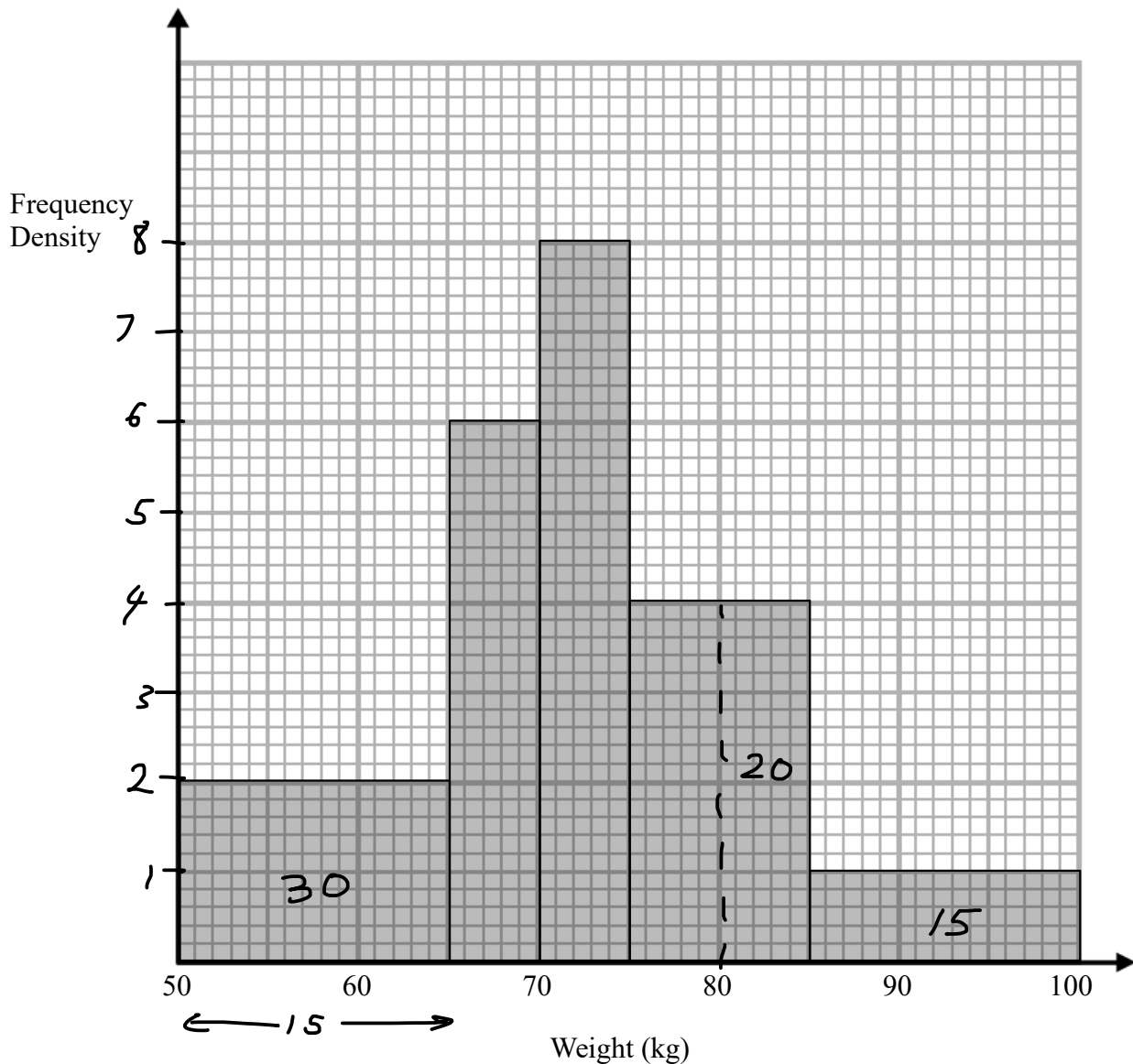
30 pigs weigh between 50 and 65 kg.

(a) Work out an estimate for the number of pigs which weigh more than 80kg.

$$\frac{30}{15} = 2$$

$$5 \times 4 = 20$$
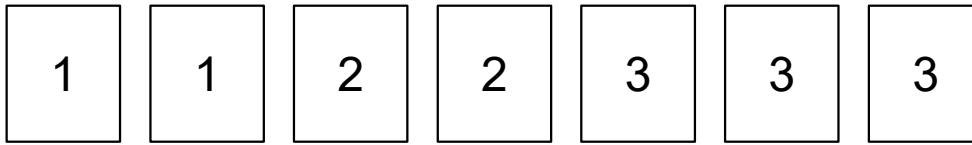$$15 \times 1 = 15$$

$$20 + 15 = 35$$

.........35.........

(3)

(b) Explain why your answer to part a is only an estimate.

We do not know how many pigs weigh between 80 and 85kg. We estimated it is half the 75kg to 85kg group.

(1)

(Total for Question 24 is 4 marks)

25 Here are seven number cards.

| 1 | 1 | 2 | 2 | 3 | 3 | 3 |

Helen takes a card at random.
She does not replace the card.

Helen then takes another card at random.

Calculate the probability that the number on the second card Helen takes is greater than the number on the first card she takes.
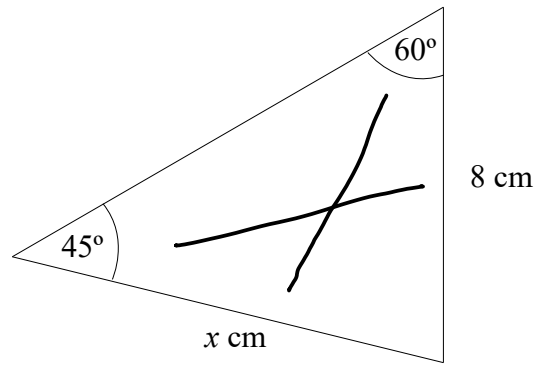
$$P(1,2) = \frac{2}{7} \times \frac{2}{6} = \frac{4}{42}$$

$$P(1,3) = \frac{2}{7} \times \frac{3}{6} = \frac{6}{42}$$

$$P(2,3) = \frac{2}{7} \times \frac{3}{6} = \frac{6}{42}$$

$$\frac{4}{42} + \frac{6}{42} + \frac{6}{42} = \frac{16}{42}$$

$$\frac{16}{42}$$

(Total for Question 25 is 4 marks)

26

60°

8 cm

45°

x cm

Work out the value of *x*.
Give your answer as a simplified surd.

$$\sin(60) = \frac{\sqrt{3}}{2}$$

$$\sin(45) = \frac{\sqrt{2}}{2}$$

$$\frac{x}{\sin(60)} = \frac{8}{\sin(45)}$$

$$\frac{x}{\sqrt{3}/2} = \frac{8}{\sqrt{2}/2}$$

$$x\left(\frac{\sqrt{2}}{2}\right) = 8\left(\frac{\sqrt{3}}{2}\right)$$

$$x\sqrt{2} = 8\sqrt{3}$$

$$x = \frac{8\sqrt{3}}{\sqrt{2}}$$

$$= \frac{8\sqrt{6}}{2}$$

$$= 4\sqrt{6}$$

$4\sqrt{6}$

(Total for Question 26 is 6 marks)