Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

C300UA0-1

A21-C300UA0-1

TUESDAY, 2 NOVEMBER 2021 – MORNING

MATHEMATICS – Component 1
Non-Calculator Mathematics
HIGHER TIER

2 hours 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**2**	
2.	**4**	
3.	**4**	
4.	**4**	
5.	**5**	
6.	**4**	
7.	**5**	
8.	**3**	
9.	**5**	
10.	**6**	
11.	**6**	
12.	**9**	
13.	**4**	
14.	**8**	
15.	**8**	
16.	**3**	
17.	**6**	
18.	**6**	
19.	**4**	
20.	**8**	
21.	**8**	
22.	**8**	
Total	**120**	

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.

A ruler, protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the need for good English and orderly, clear presentation in your answers.

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Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

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

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

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

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

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

$$v^2 = u^2 + 2as$$

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1. Zena is carrying out a survey to find out how people learn about **recent national political events**.

Here is her question.

Which method do you use to learn about politics?
Tick (✓) one box.

Social media ☐ Newspaper ☐ Radio ☐

Write a better version of Zena's question in the box below.
You must include response boxes. [2]

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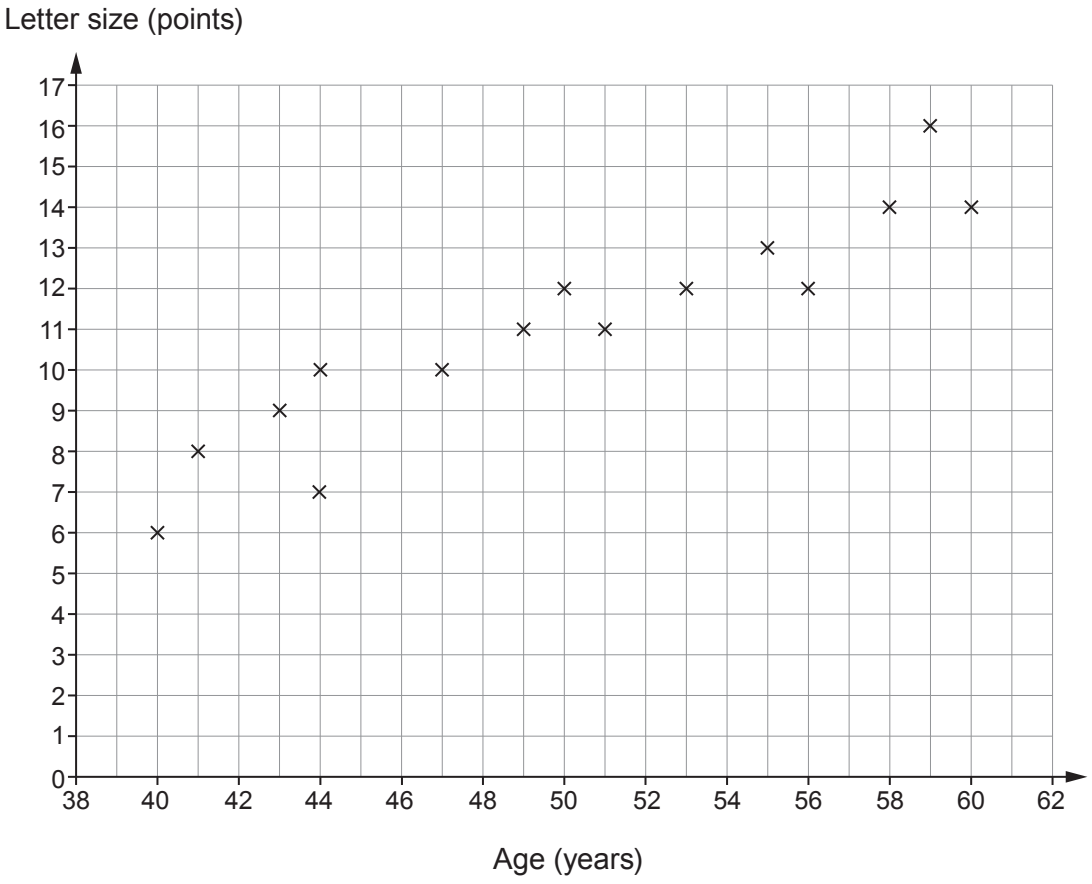
2. Fifteen people aged between 40 and 60 take an eye test as part of an experiment.

The test involves reading letters from a chart.
Each line of letters is smaller than the line above.
Letter size is measured in points.

The scatter graph below shows the age of and the smallest letter size read by each person.



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(a) The mean age is 50 years and the mean letter size is 11 points.

Using this information, draw a line of best fit on the scatter graph. [2]

(b) Use the scatter graph to answer each of the following questions.

(i) Estimate the smallest letter size which can be read by a person aged 52. [1]

.....

(ii) Jared is 30 years old.

Should the scatter graph be used to estimate the smallest letter size that Jared can read?

Yes ☐ No ☐

Give a reason for your answer. [1]

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3. *(a)* Simplify $5\sqrt{7} + 3\sqrt{7}$. [1]

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(b) Work out the value of $6 + \sqrt[3]{8000}$. [1]

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(c) Work out the value of $3^{20} \div 3^{18}$. [2]

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4. A company logo is printed on cards and letters.

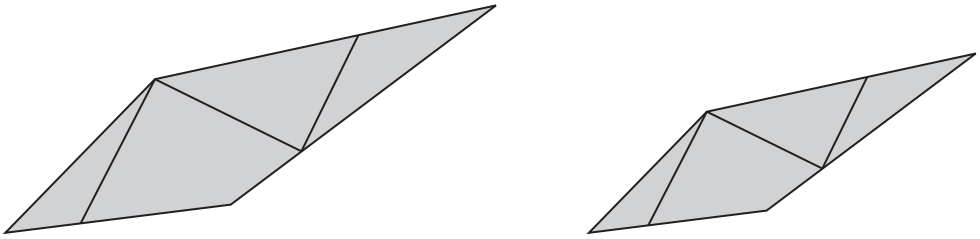

Diagram not drawn to scale

Each line in the larger logo has a corresponding line in the smaller one.
The lengths of the corresponding lines are all in the ratio 5 : 2.

(a) (i) Complete the following statement with a single mathematical word. [1]

'The two logos are ..... because corresponding lines are in the same proportion.'

(ii) Complete the following statement with a number. [1]

'The larger logo is an enlargement of the smaller logo using a scale factor of ..... .'

(b) One of the lines on the larger logo is 7·5 cm long.

How long is the corresponding line on the smaller logo? [2]

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5. A running club has 125 members.
Each member is either a sprinter, a middle-distance runner or a long-distance runner.

82 members are seniors.
45 members are long-distance runners and 5 of these are juniors.
28 members are senior middle-distance runners.
There are 3 more junior sprinters than senior sprinters.

A person is selected at random from the club.

Find the probability that this person is a junior middle-distance runner.
Use this table to help you. [5]

	Sprinter	Middle-distance runner	Long-distance runner	Total
Senior				
Junior				
Total				

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Probability .....

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6. A catering company made 40 trays of sandwiches for a party buffet.
Each tray contained the same number of sandwiches.

They made trays of egg, trays of cheese and trays of meat sandwiches in the ratio

egg : cheese : meat = 1 : 3 : 4.

At the end of the party, 20% of the egg sandwiches, 10% of the cheese sandwiches and 25% of the meat sandwiches were uneaten.

How many trays of sandwiches were uneaten? [4]

..... trays of sandwiches

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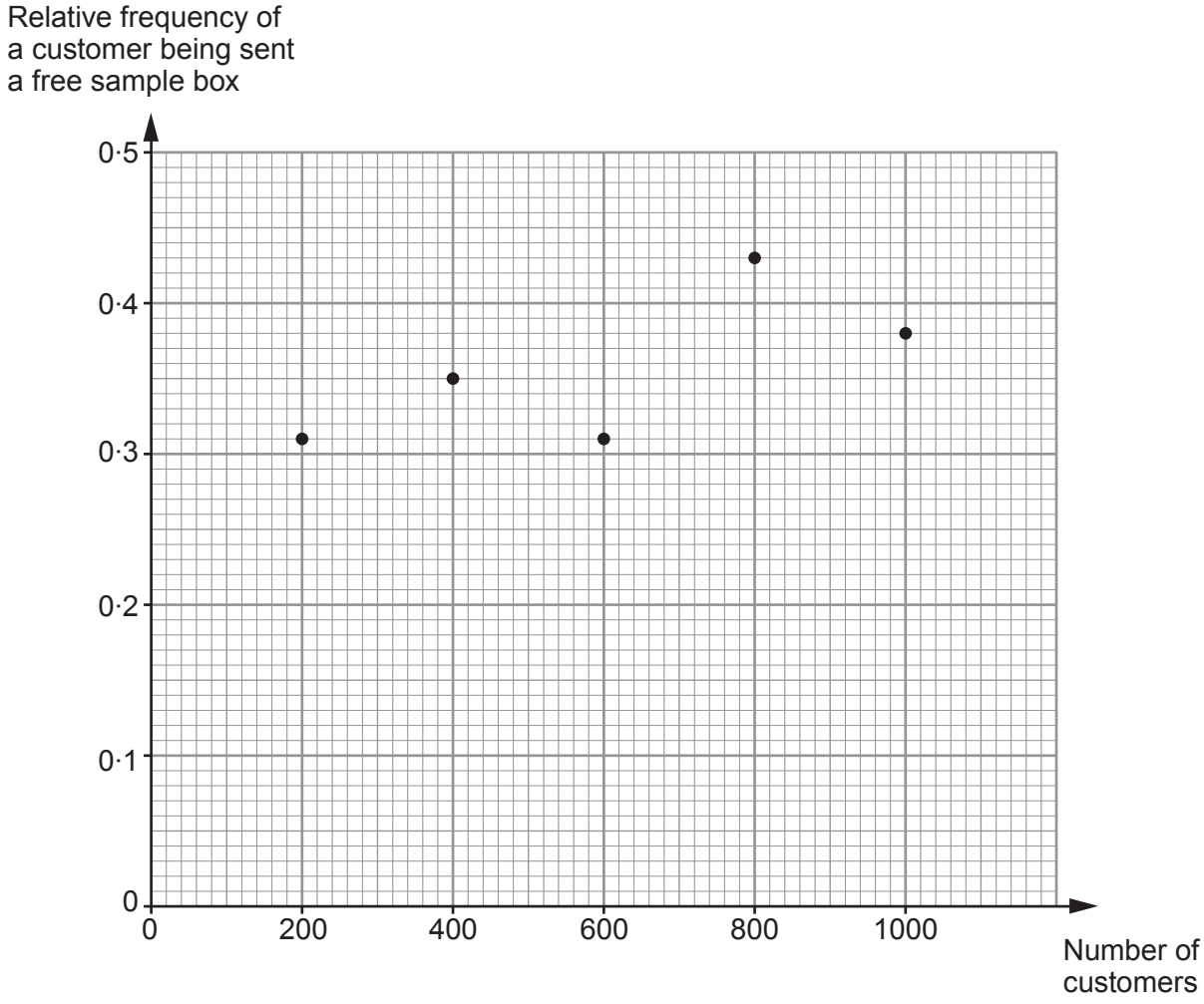
7. Novak's online chocolate company has a special offer.

Novak records the number of free sample boxes he sends to his customers.

The graph shows the relative frequency that a customer has been sent a free sample box after 200, 400, 600, 800 and 1000 customer orders.



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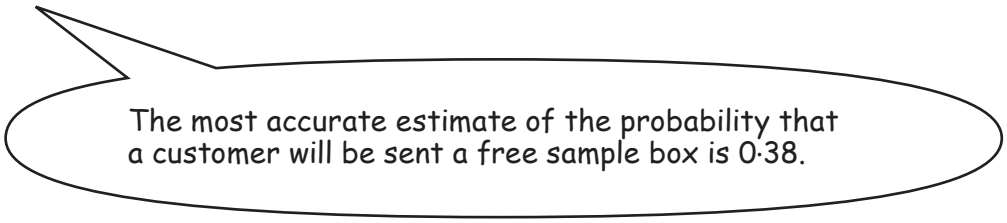
(a) What is the total value of the free sample boxes that Novak sent his first 400 customers? [4]

Total value of free sample boxes is £ .....

(b) Novak says:



Is he correct?

Yes ☐ No ☐

Explain how you decide. [1]

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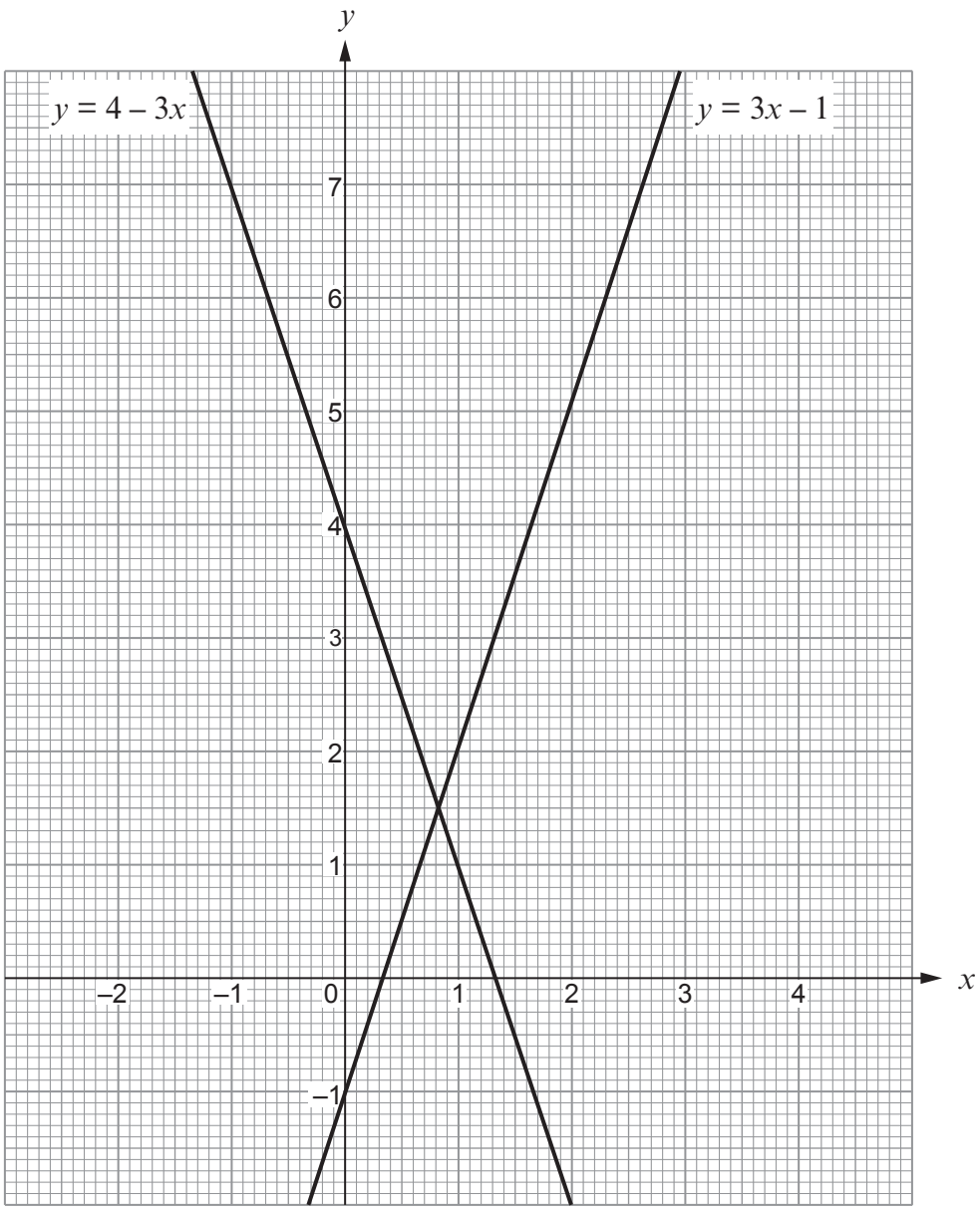
8. *(a)* The diagram shows the graphs of $y = 3x - 1$ and $y = 4 - 3x$.



(i) Use the graphs to write down an **approximate** solution of the equation $3x - 1 = 4 - 3x$. [1]

.....

x = ...

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(ii) Circle the equation that represents a line parallel to $y = 3x - 1$. [1]

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

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(b) Circle the equation where y is directly proportional to x. [1]

$y = \frac{5}{x}$ $\quad x + y = 1$ $\quad 7 = xy$ $\quad y = 3x^2$ $\quad y = 4x$

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9. *(a)* Emily walks to school.
She measures her speed, s, as 1·4 metres per second, correct to 1 decimal place.

Write an inequality to show the range of possible values for her speed. [2]

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(b) After school, Emily goes to her grandmother's house by car.
It takes 25 minutes to travel the 15 miles.

What is the average speed for the car journey?
Give your answer in miles per hour. [3]

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..... mph

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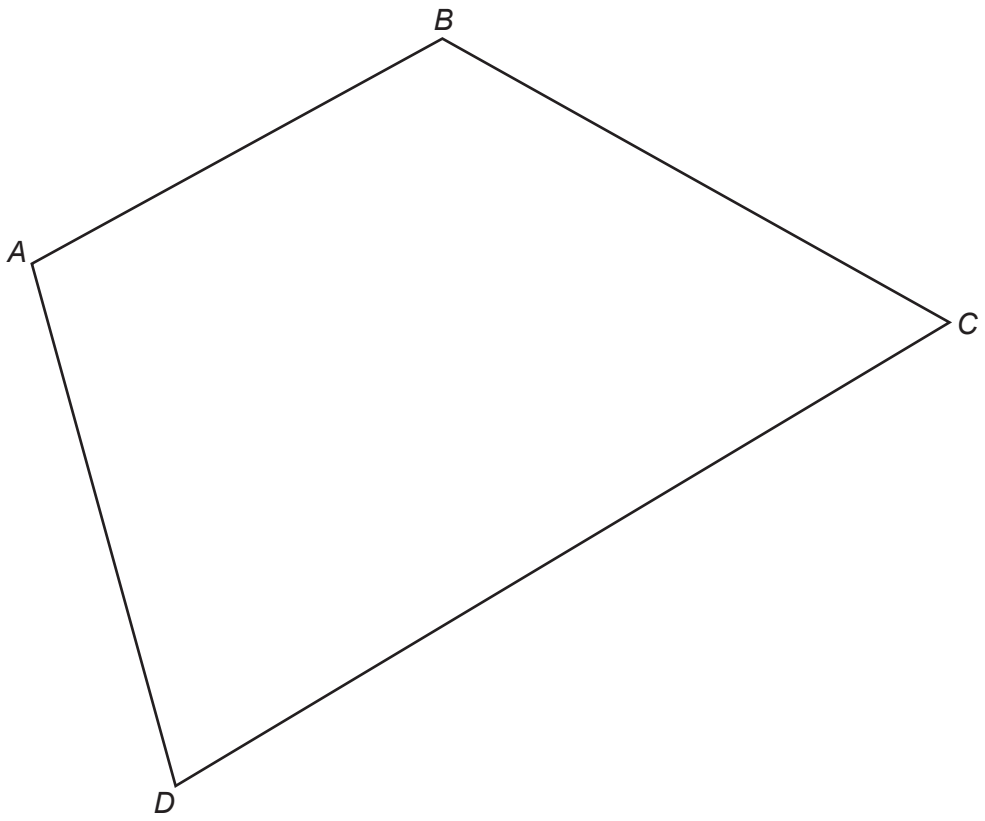
10. The diagram shows a quadrilateral, *ABCD*.



E is the point that is:

- equidistant from *A* and *B*,
- equidistant from *AD* and *DC*.

(a) Show accurately the position of point *E*.
You must use a ruler and a pair of compasses to construct suitable arcs and lines. [5]

(b) *EF* is the shortest distance from *E* to *AB*.

Mark the position of point *F* on the diagram. [1]

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11. *(a)* Here is an identity in terms of the variable x and the constant m.

$$x + 21 \equiv 5 + m(2x + 32)$$

Write down the value of m. [1]

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$m =$ .....

(b) Solve $2x + 1 \leqslant 5x + 7$. [2]

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(c) (i) Solve $n^2 \leqslant 9$. [2]

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(ii) S is the set of solutions for $n^2 \leqslant 9$ where n is an integer.

Complete set S. [1]

$S =$ { ..... }

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12. *(a)*

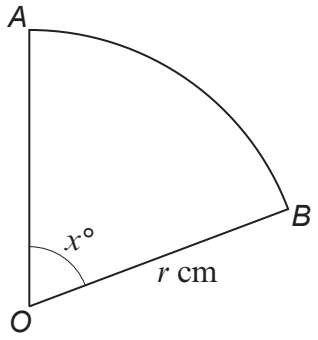

Diagram not drawn to scale

The diagram shows a sector of the circle with centre *O* and radius r cm.

The length of the arc, *AB*, is $\frac{1}{6} \times \pi \times r$.

Work out the value of x. [3]

(b) A cone has a radius of 6 cm and a slant height of 52 cm.

Show that the curved surface area of the cone must be a multiple of 13π. [2]

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(c) Jupiter is a planet.

The radius of Jupiter is 7×10^4 km.
You may assume the radius of Jupiter is constant.

Work out the surface area of Jupiter.
Give your answer in the form $k\pi$, where k is in standard form. [4]

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..... km^2

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13. Make y the subject of this formula. [4]

$$x + y = \frac{wy + 7}{3}$$

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14. *(a)* Estimate the value of $\sqrt[5]{33}$. [1]

(b) Find the value of $\left(\frac{5}{4}\right)^{-2}$, giving your answer as a decimal. [3]

(c) Find the value of $49^{\frac{3}{2}}$. [2]

(d) Write $0{\cdot}0\dot{8}\dot{3}$ as a fraction. [2]

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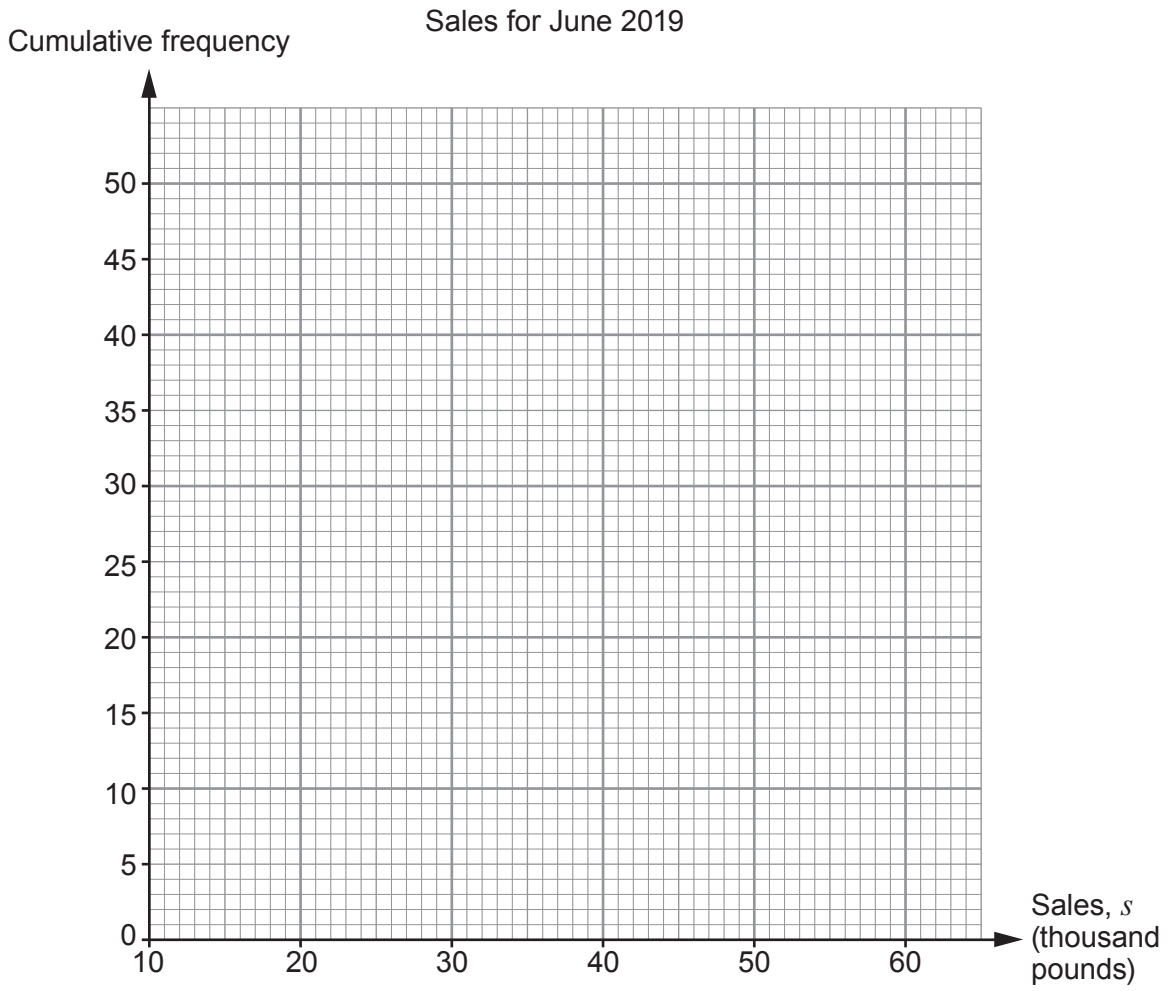
15. The owner of a double glazing company employs 50 salespeople.
For the month of June 2019, the total sales made by each salesperson is recorded in the table.

Sales, s (thousand pounds)	$10 < s \leqslant 20$	$20 < s \leqslant 30$	$30 < s \leqslant 40$	$40 < s \leqslant 50$	$50 < s \leqslant 60$
Frequency	0	8	15	18	9

(a) Complete the following cumulative frequency table. [1]

Sales, s (thousand pounds)	$s \leqslant 20$	$s \leqslant 30$	$s \leqslant 40$	$s \leqslant 50$	$s \leqslant 60$
Cumulative frequency	0	8			

(b) On the grid below, draw a cumulative frequency diagram to show these results. [3]



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(c) The owner gives monthly bonuses to the salespeople who have the highest value sales.

	Bonus
Top 10% of salespeople	Gold
Next 20% of salespeople	Silver

(i) Use your graph to find the minimum value of sales needed to earn each bonus in June 2019. [2]

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Gold bonus £ ..... Silver bonus £ .....

(ii) Explain why your answers to part *(c)*(i) may not be accurate. [1]

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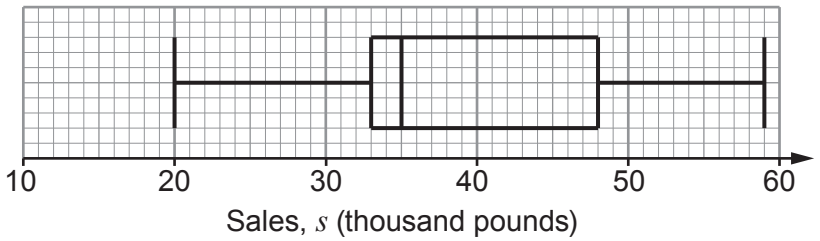
(d) The box plot shows summary statistics for the month of September 2019.



The owner is considering closing the business for 2 days of staff training next year. This can take place in either June or September.

Using the sales data from 2019, should the owner choose to train her staff in June or September?

June ☐ September ☐

Show how you decide. [1]

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16.

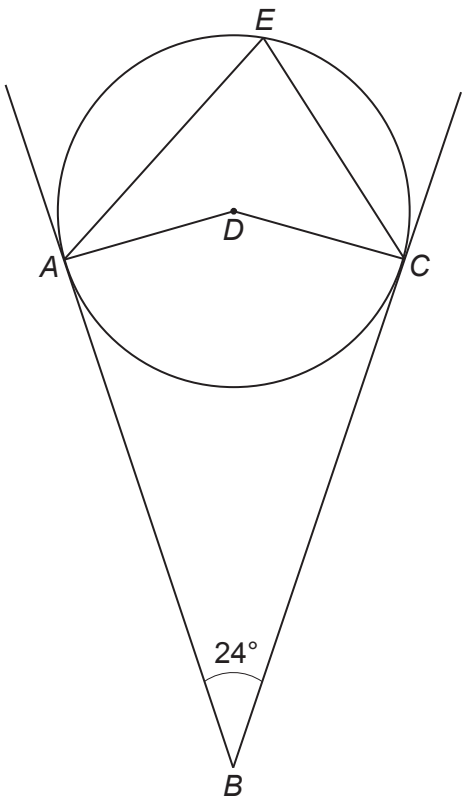

Diagram not drawn to scale

AB and *CB* are tangents to a circle with centre *D*.
E is a point on the circumference of the circle.
$A\hat{B}C = 24°$.

Find the size of $A\hat{E}C$.
You must give a reason for each step of your working. [3]

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17. The diagram shows the points $P(-5,16)$ and $Q(5,-4)$, joined by a straight line.

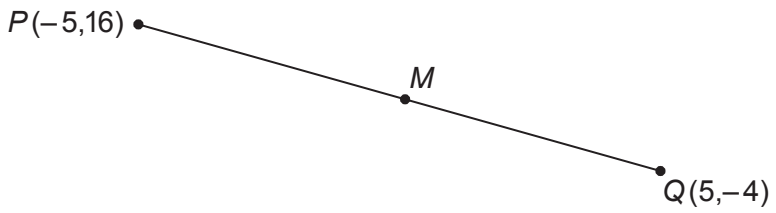

Diagram not drawn to scale

M is the midpoint of PQ.

By finding the gradient of PQ and the coordinates of M, show that the equation of the perpendicular bisector of PQ is $2y = x + 12$.
You must show all your working. [6]

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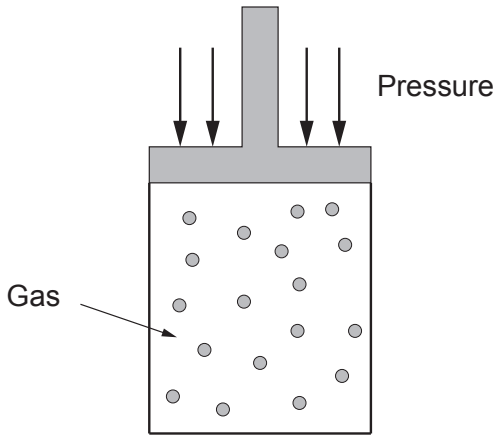
18. In an experiment, the volume, V, of gas in a container is inversely proportional to the pressure, P, put upon it.



At the start of the experiment, a gas has a volume of $4\,m^3$ when the pressure put upon it is $1020\,N/m^2$.

(a) Find the volume of this gas when the pressure put upon it is $1360\,N/m^2$. [4]

(b) Find the pressure put upon the gas when its volume is $1{\cdot}2\,m^3$. [2]

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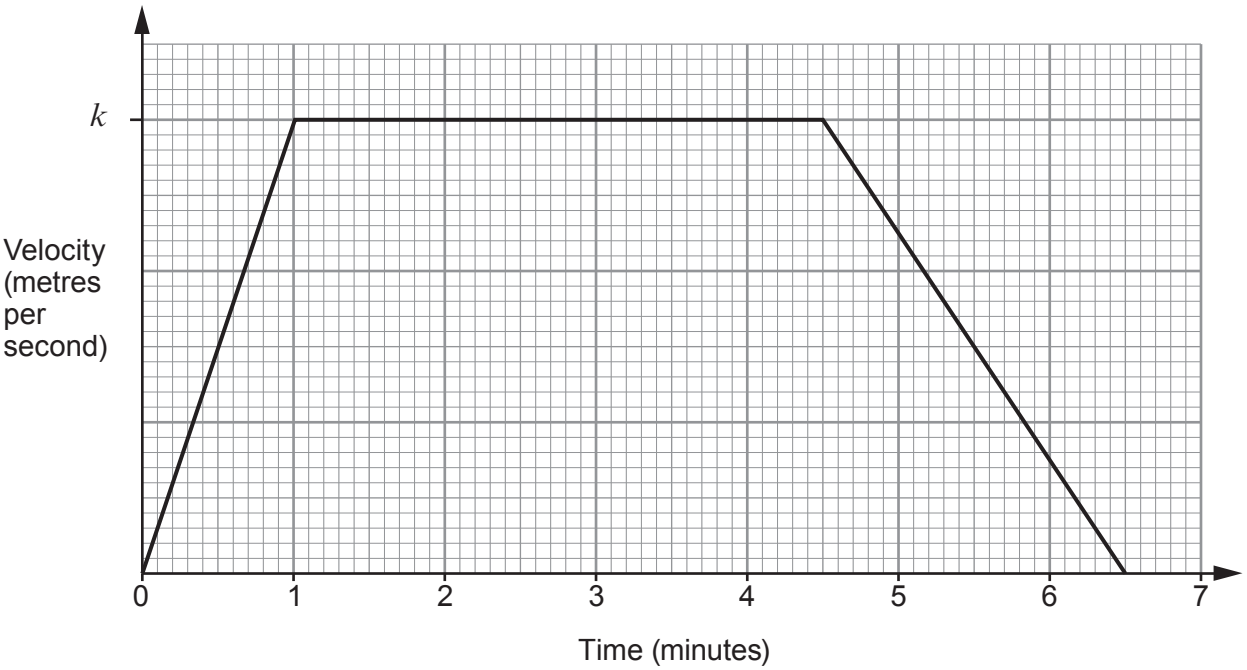
19. The diagram shows the velocity-time graph for the journey of a local train between Grangebrook station and Eastown station.



The train leaves Grangebrook station. It increases its speed for 1 **minute** until it reaches a speed of k metres per **second**.
It continues at this speed for 3·5 minutes and then slows down until it stops, 2 minutes later, at Eastown station.

(a) Write down what the gradient of the graph represents. [1]

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(b) The distance between Grangebrook station and Eastown station is 2400 metres.

Find the value of k. [3]

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k = ... metres per second

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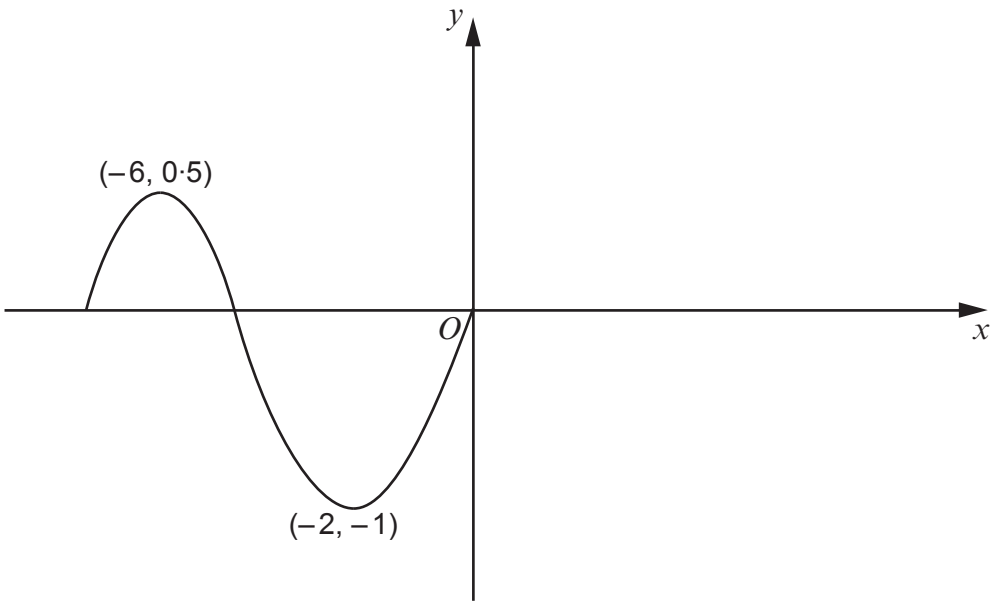
20. *(a)* The functions $f(x)$ and $g(x)$ are defined by

$$f(x) = \sin x°,$$
$$g(x) = x - 90.$$

Find the value of $fg(120)$. [2]

(b) The diagram shows a sketch of the graph of $y = h(x)$.



On the same diagram, sketch the graph of $y = -h(x)$.
Write down the coordinates of the maximum and minimum points of $y = -h(x)$. [2]

Maximum (..... , ...)

Minimum (..... , ...)

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(c) The function $k(x)$ is defined by

$$k(x) = x^3 - 23.$$

Solve $k^{-1}(x) = 5$. [4]

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21. *(a)* Expand and simplify $(3x + 2)^3$. [3]

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(b) Simplify $\dfrac{4x^2-1}{6x^2-13x+5}$. [5]

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22. *(a)* Write $\sqrt{245}+\sqrt{80}$ in the form $a\sqrt{5}$, where a is an integer. [2]

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(b) The length of a thin string is to be divided into two parts so that

$$\frac{\text{length of shorter part}}{\textbf{total} \text{ length of string}} = \frac{\sqrt{2}}{5+2\sqrt{2}} .$$

(i) Complete the following ratio. [1]

length of **shorter** part : length of **longer** part

..... : .....

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.....

(ii) The total length of the string is 17 cm.

Find the length of the shorter part of the string.
Give your answer in the form $b\sqrt{2}+c$, where b and c are integers. [5]

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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