Surname	Centre Number	Candidate Number
Other Names		0

GCSE

S18-C300UA0-1

C300UA0-1

MATHEMATICS – Component 1
Non-Calculator Mathematics
HIGHER TIER

THURSDAY, 24 MAY 2018

– MORNING

2 hours 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**9**	
3.	**4**	
4.*(a)*(b)*(i)	**3**	
4.*(b)*(ii)	**1**	
5.	**1**	
6.	**4**	
7.	**3**	
8.*(a)*	**2**	
8.*(b)*	**4**	
9.	**5**	
10.	**3**	
11.	**8**	
12.	**7**	
13.	**5**	
14.	**3**	
15.	**3**	
16.	**4**	
17.	**5**	
18.	**6**	
19.	**4**	
20.	**3**	
21.	**4**	
22.	**4**	
23.	**6**	
24.	**6**	
25.	**3**	
26.	**6**	
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.

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 continuation page at the back of the booklet, taking care to number the question(s) correctly.

Take π as 3·14.

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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01

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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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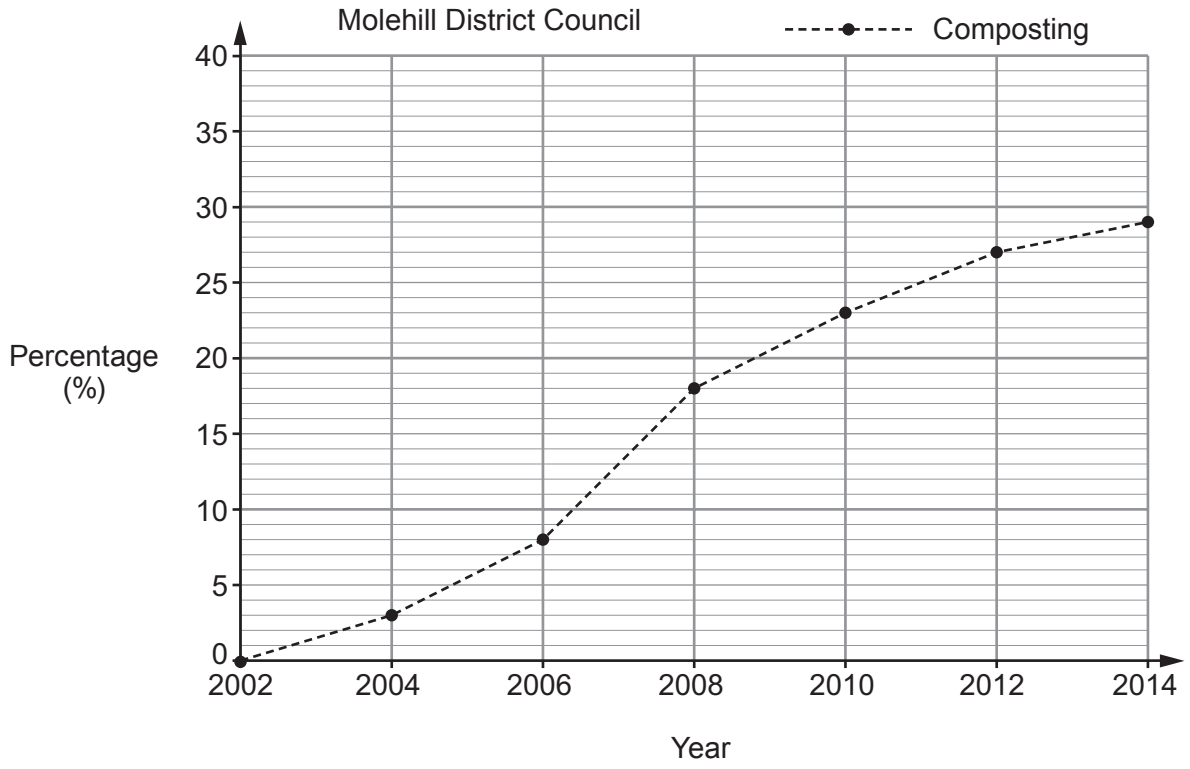
1. The graph shows information about the percentage of waste **composted** by Molehill District Council from 2002 to 2014.



The table shows information about the percentage of waste **recycled** by Molehill District Council from 2002 to 2014.

Year	2002	2004	2006	2008	2010	2012	2014
Recycling (%)	15	18	32	36	32	30	27

(a) On the grid above, plot the data for recycling. [1]

(b) (i) The mayor of Molehill says,

'One year, the percentage of waste recycled was 6 times the percentage of waste composted.'

Write down the year for which this comment is correct. [1]

.....

(ii) Between which two years did the percentage of waste composted increase the most? [1]

Between ..... and .....

(iii) Using the information provided, write one comment, **comparing** how the percentages of waste recycled **and** composted have changed between 2002 and 2014. [1]

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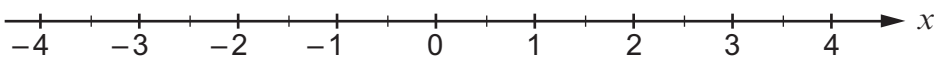
2. *(a)* Solve $12x - 9 = 6 + 7x$. [2]

(b) Solve $10(x + 2) - (2x - 9) = 30$. [3]

(c) (i) Solve the inequality $10x - 7 \leqslant 8$. [2]

(ii) Represent your answer to part *(c)*(i) on the number line below. [1]



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(d) Gracie is trying to solve the equation $x^2 - 5x + 6 = 0$.

Here is her work.

$x^2 - 5x + 6 = 0$

$(x - 3)(x - 2) = 0$

$x - 3 \quad x - 2$

$x = -3, \quad x = -2$

Is Gracie's work correct?

Yes ☐ No ☐

Show clearly how you decide. [1]

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3. *(a)* Find an expression for the nth term of this sequence. [2]

3 11 19 27 35

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(b) The nth term of a different sequence is $2n^3 + 3$.
Write down the first 3 terms of this sequence. [2]

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4. *(a)* One Saturday, Alfie records the amount of money each customer spends in a charity shop.
He presents his data in a grouped frequency table, as shown below.

Money spent (£)	Frequency
0 to 20	62
20 to 40	8
40 and over	1

State one criticism of the way Alfie has presented his data. [1]

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(b) The charity has a Fun Day to raise money.

(i) Alfie is in charge of a game of chance.

- A fair spinner is marked with the numbers 1 to 10.
- A player spins once and wins £2 if the spinner lands on 6.

Liam plays the game exactly twice.
Work out the probability that Liam wins £4. [2]

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(ii) Alfie counts the money raised by the cake stall, raffle stall and refreshments stall. He finds an estimate of the takings. To do this, he rounds the total from each stall down to the nearest pound and adds the 3 amounts together.

Alfie's estimate is £686.

Complete the following inequality to show the interval for the total raised by the three stalls. [1]

£686 $\leqslant$ total $\leqslant$ .....

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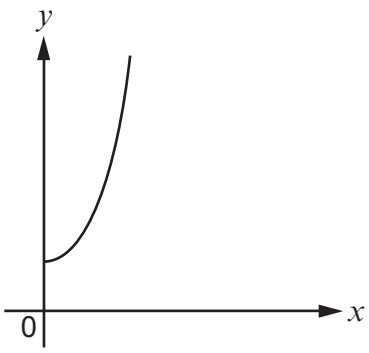
5. Tick (✓) the box below the graph that shows y is inversely proportional to x. [1]



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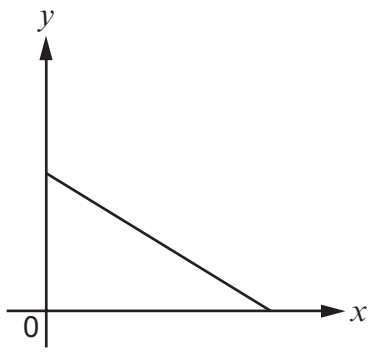

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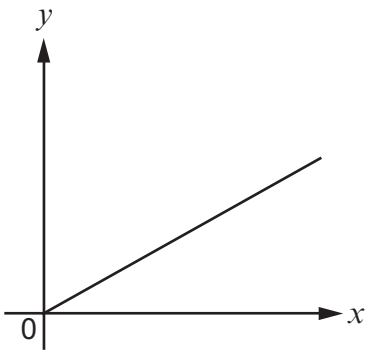

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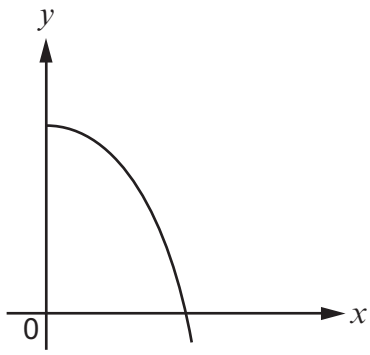

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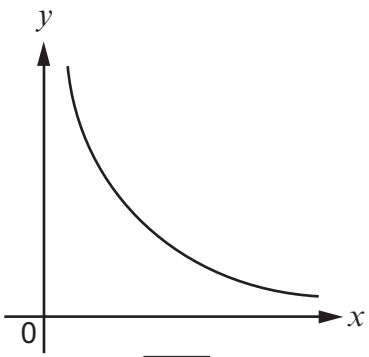

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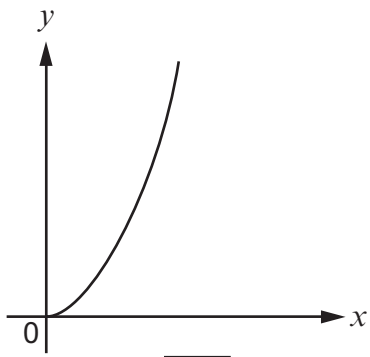

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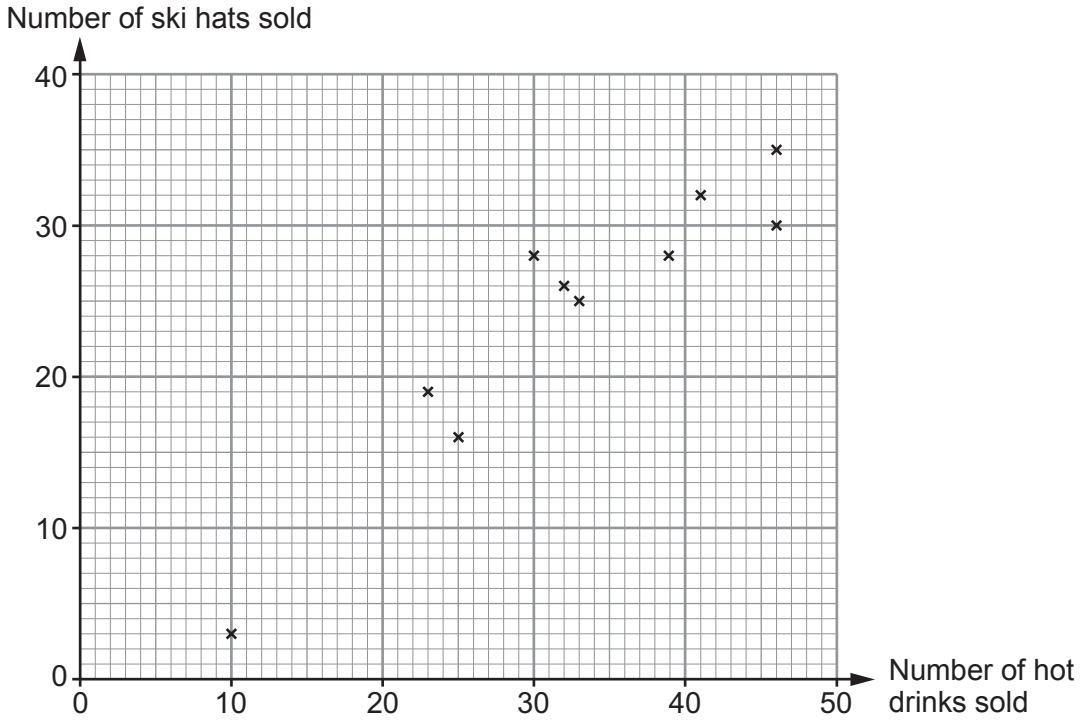
6. *The Shorts Hut* is a shop that sells sports clothing and has a customer café.

(a) The manager plots some sales data in a scatter graph.

The graph shows the number of hot drinks sold and the number of ski hats sold each day for 10 days.



The manager says that this graph shows that an increase in the sale of hot drinks causes an increase in the sale of ski hats because the correlation is positive.

Explain why the manager is incorrect. [1]

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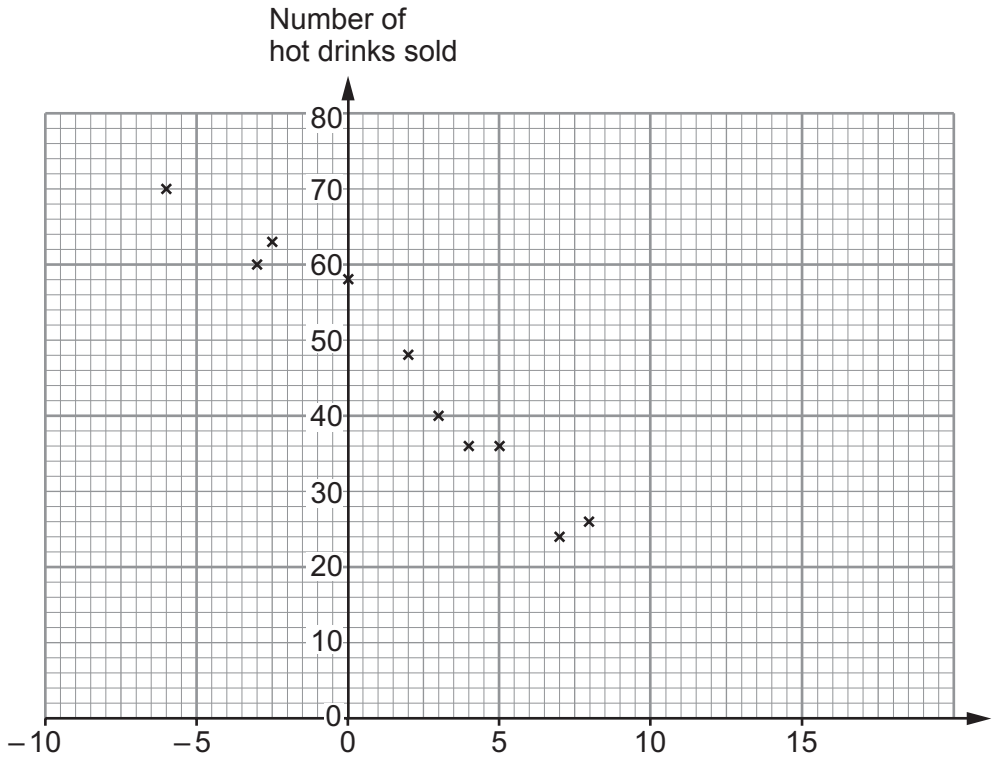
(b) The manager plots another scatter graph showing the temperature, in °C, at 9 a.m. and the number of hot drinks sold during the first hour on each of 10 days.



(i) Draw a line of best fit on the scatter graph. [1]

(ii) Estimate the number of hot drinks the café will sell when the temperature is 6°C. [1]

.....

(iii) Comment on how suitable the graph is for estimating the number of hot drinks sold when the temperature is more than 17°C.
You must give a reason for your answer. [1]

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7. Nia and David are trying to work out the area of this sector of a circle.
They must give the answer as a multiple of π.

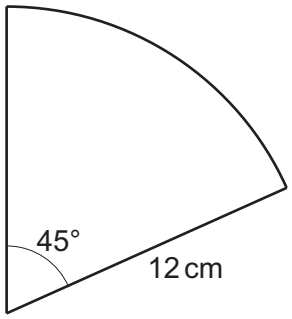

Diagram not drawn to scale

Here is Nia's answer.

Step 1 $360 \div 45 = 8$

Step 2 Area of whole circle = $\pi \times 24$

Step 3 Area of sector = $\frac{1}{8}$ of $24\pi = \frac{24\pi}{8}$

Step 4 Answer = 3π cm^2

David looks at Nia's answer and says,

'Your answer is wrong.'

- Explain the error that Nia has made.
- Calculate the correct answer as a multiple of π. [3]

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8. Jamil is taking a group of students on a camping trip.

(a) He buys tins of soup and bottles of water.
He needs to buy the same number of tins as bottles.
Tins of soup are sold in packs of 12 and bottles of water are sold in packs of 15.

What is the smallest number of packs of each that Jamil can buy? [2]

Number of **packs** of soup ..... Number of **packs** of water .....

(b) Jamil buys packs of sausages and packs of burgers for the trip in the ratio 3 : 4.
The cost of a pack of sausages is 75% of the cost of a pack of burgers.
Jamil buys 16 packs of burgers.
Each pack of burgers costs £x.
He spends £125 in total.

How much does Jamil pay for each pack of sausages? [4]

Each pack of **sausages** costs £ .....

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9. The scale diagram below shows a railway station *P* and two hilltops, *A* and *B*.
Two new stations are to be built at *R* and *S*.

(a) Station *R* is to be
- no more than 6 km from *P* and
- the same distance away from *A* as it is from *B*.

Using a ruler and a pair of compasses, show accurately on the diagram all the positions where station *R* may be built.

Scale: 1 cm represents 1 km. [4]

A •

• *B*

P •

(b) A train travelling between station *R* and station *S* will always be the same distance away from *A* as it is from *B*.
When the train arrives at station *S*, it will be as near as possible to hilltop *A*.

Mark the position of station *S* on the diagram in part *(a)*. [1]

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10.

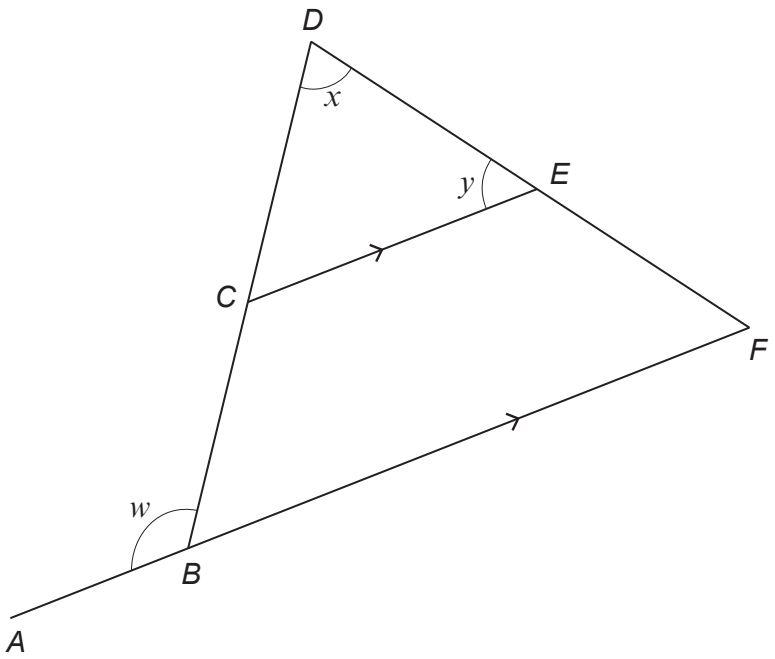

Diagram not drawn to scale

The diagram shows a triangle *BDF*.
The straight lines *CE* and *ABF* are parallel.

Prove that $w = x + y$.
Give a reason for each statement you make in your proof. [3]

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11. *(a)* The costs of building a single-storey house extension are in the ratio

labour : materials : professional fees = 7 : 5 : 1.

The cost of materials is £6400 **more than** the amount paid in professional fees.

Work out the total cost of building this house extension. [4]

(b) Ten years ago, the costs of converting a loft to a bedroom were £7200 for labour, £6000 for materials and £1200 for professional fees.

Today, the same loft conversion would cost a total of £30800.

- Labour costs are $1\frac{2}{3}$ times as much.
- Materials costs have **increased** by 150%.

Show that the amount paid in professional fees is just over 3 times as much. [4]

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12. *(a)* Find the value of each of the following.

(i) $9^{-\frac{1}{2}}$ [1]

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(ii) $625 \times \frac{5^6}{5^9}$ [2]

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(b) Simplify $(2ab^3)^4$. [2]

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(c) Estimate the value of $76^{\frac{2}{3}}$. [2]

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Estimate .....

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Turn over.

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13. Rearrange $x + y = \sqrt{2(xy + w)}$ to make x the subject. [5]

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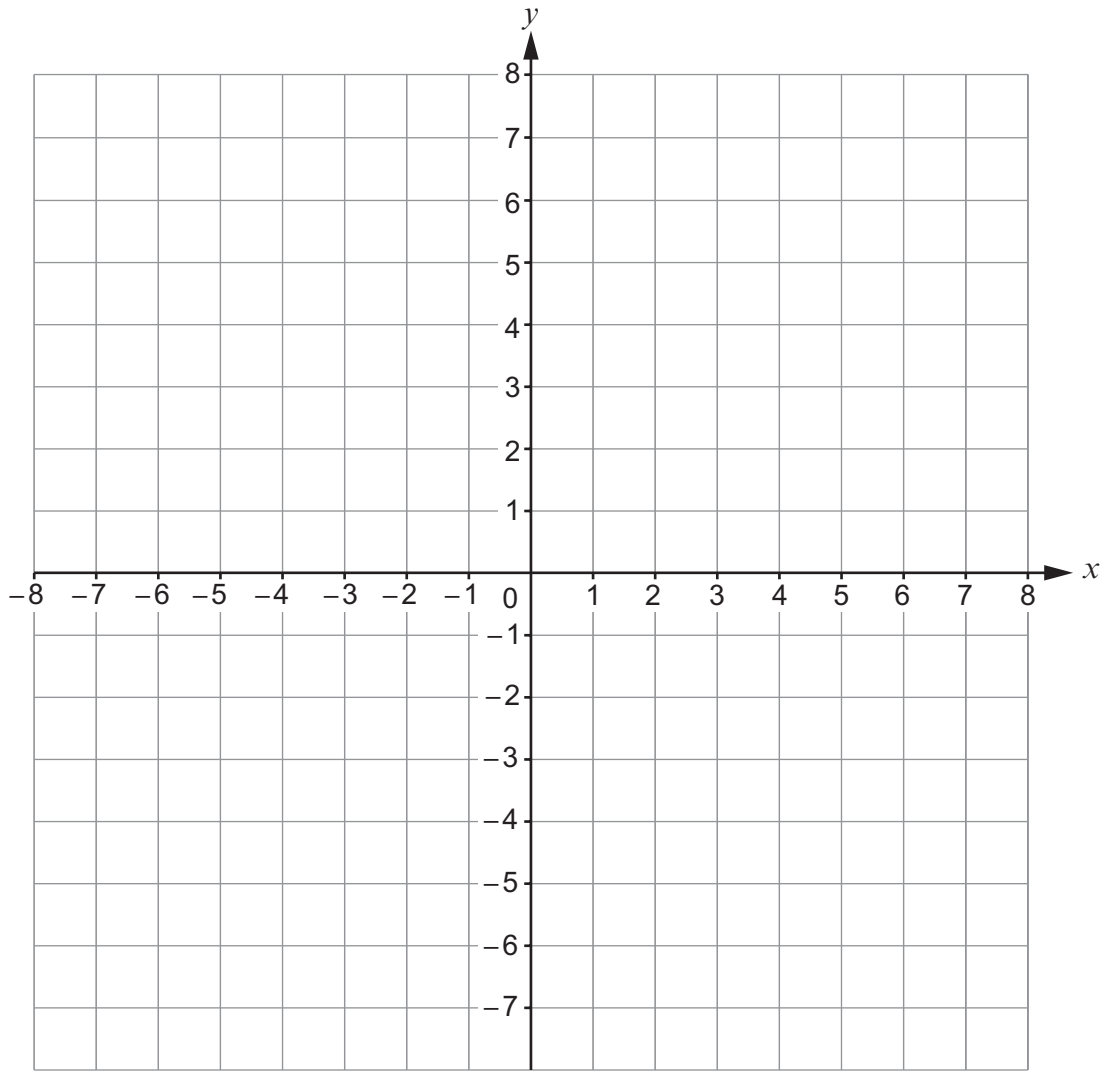
14. A scalene triangle is

rotated 90° clockwise about (0, 0) then translated through $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$.

Describe the **single** transformation that is equivalent to these 2 transformations. [3]

You may use this blank grid to help you.



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15. The diagram shows a trapezium, *ABCD*, with *AD* parallel to *BC*.

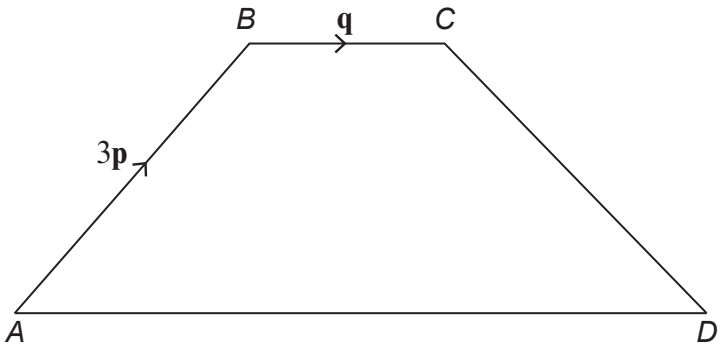

Diagram not drawn to scale

The vectors **AB** and **BC** are shown in the diagram.
The side *AD* is 3 times the length of the side *BC*.

Find **DC** in terms of $\mathbf{p}$ and $\mathbf{q}$.
Give your answer in its simplest form. [3]

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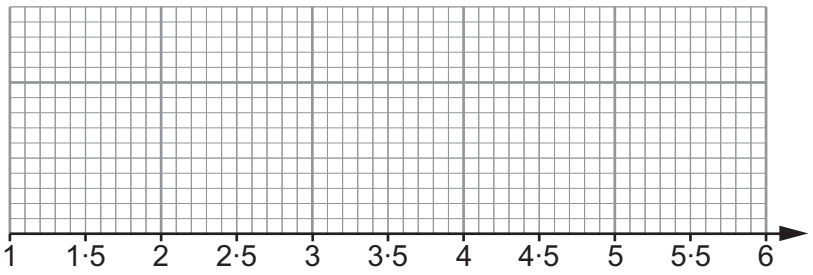
16. Teddy and Ellie play computer games.
Each day they record how many hours they have spent playing computer games.

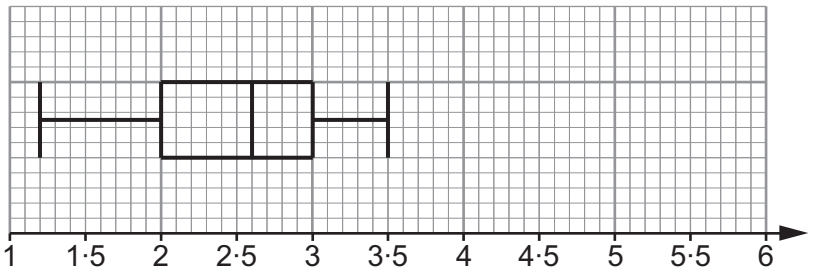
(a) Teddy keeps a record for 30 days.
The table shows a summary of his data.

Minimum	Maximum	Median	Upper Quartile	Interquartile range
1·5	5	4	4·5	2

Draw a box plot to represent Teddy's data on the grid below. [3]



(b) Here is a box plot of Ellie's data.



Is it possible to tell from the box plot the exact number of days for which Ellie recorded her times?

Yes ☐ No ☐

Explain how you decide. [1]

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17. *(a)* The pressure, P, in newtons per square metre, made by an object resting on a table-top is inversely proportional to the area, $A\,m^2$, of the object in contact with the table.

A book is placed on the table.
The area, A, of the book in contact with the table is $0{\cdot}08\,m^2$.
The pressure, P, made by the book on the table is $30\,N/m^2$.

Find the relationship between pressure and area for any object of this weight. [3]

(b) A different book of the same weight is placed on the table.
The pressure exerted on the table by the book is $80\,N/m^2$.

Find the area of this book that is in contact with the table. [2]

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18. *(a)* 5 waiters earn a total of £2500 for 2 weeks' work.

How much would 6 waiters earn for 3 weeks' work at the same pay rate?
You may assume that all the waiters earn the same amount each week. [3]

(b) x chefs earn a total of £m for 5 hours' work.
You may assume that all the chefs earn the same amount each hour.

(i) Find an algebraic expression for a chef's hourly rate of pay. [1]

(ii) The chefs get a pay increase of £y per hour.

Find an expression for the amount earned by a chef who works for 7 hours at this new pay rate. [2]

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19. The perpendicular height of a triangle is $\sqrt{5}$ cm.
The area of this triangle is $(10 - 3\sqrt{5})$ cm^2.

Find the length of the base of the triangle.
Give your answer in the form $p\sqrt{5} + q$ where p and q are integers. [4]

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20. *(a)* Write $\frac{1}{22}$ as a recurring decimal. [1]

(b) Write $5\cdot\dot{2}5\dot{8}$ as a fraction. [2]

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21. *(a)* How many different ways are there to arrange the letters A, B, C, D, E, F when each letter must be used exactly once? [2]

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(b) Find the total number of these arrangements that start with either the letter A or the letter E. [2]

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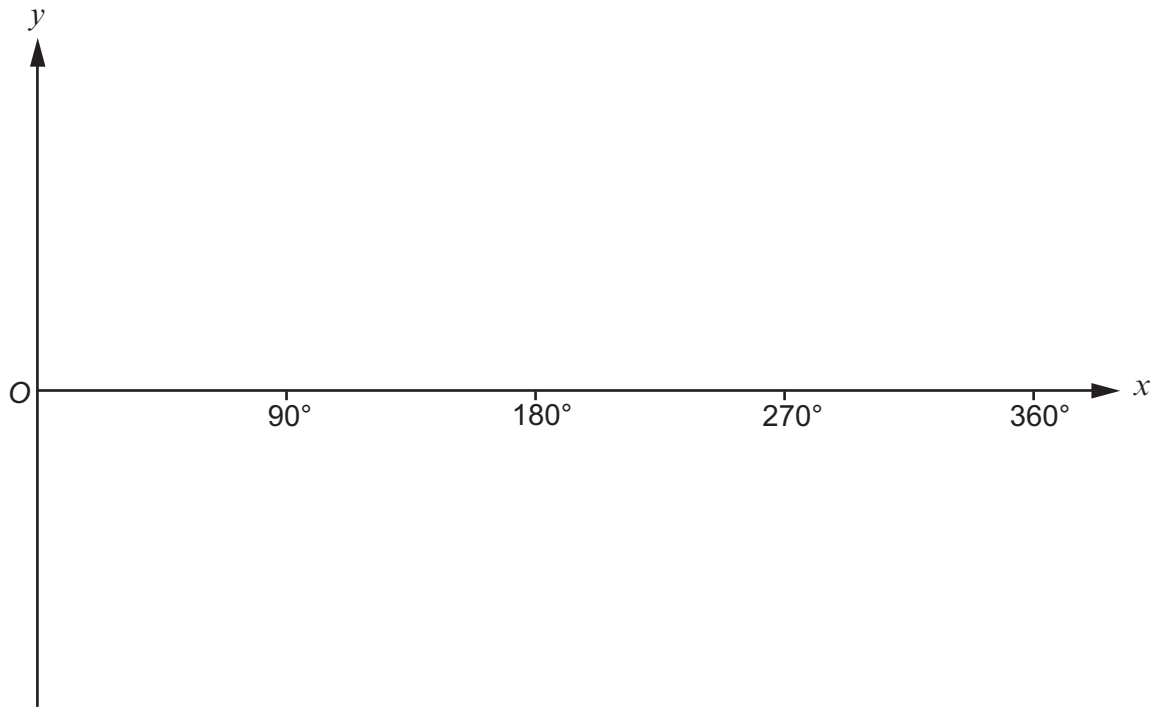
22. *(a)* On the axes below, sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$. [2]



(b) Find all solutions of the equation $\tan x = 1$ for $0° \leqslant x \leqslant 360°$. [2]

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23. *(a)* The functions $f(x)$ and $g(x)$ are defined, for $x \geqslant 0$, by

$$f(x) = x^2,$$

$$g(x) = \frac{x + 6}{5}.$$

(i) Find the value of $gf(8)$. [2]

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(ii) Find an expression for $g^{-1}(x)$. [2]

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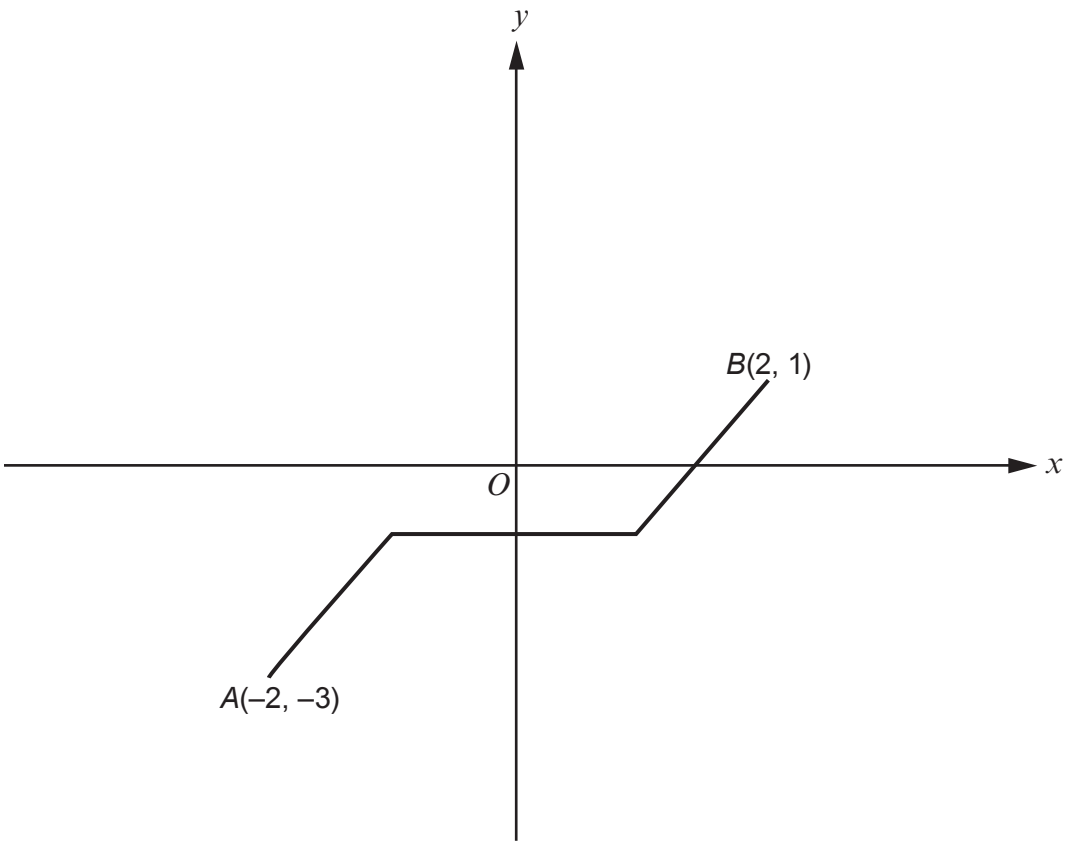
(b) The diagram shows a sketch of the graph of $y = h(x)$.
The point *A* has coordinates (–2, –3) and the point *B* has coordinates (2, 1).

On the same diagram, sketch the graph of $y = h(x) + 4$.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]



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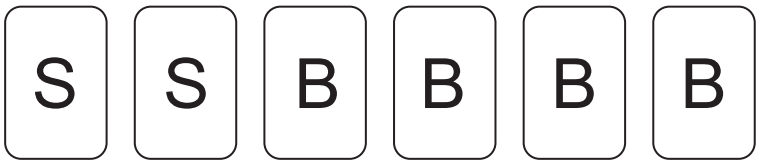
24. Steve and Bob are playing a card game with these 6 cards.



In each round of the game:
- the 6 cards are shuffled and turned face down on a table
- Steve picks one card at random and keeps it
- Bob picks a card at random from the 5 remaining.

At the end of each round, Steve and Bob compare cards.
When
- both cards are S then Steve wins the game,
- both cards are B then Bob wins the game,
- the letters are different then neither of them wins the game and they play another round.

(a) Show that the probability that neither of them wins the first round is $\frac{8}{15}$. [3]

(b) The game stops when someone wins.
Calculate the probability that Steve wins when exactly 2 rounds have been played. [3]

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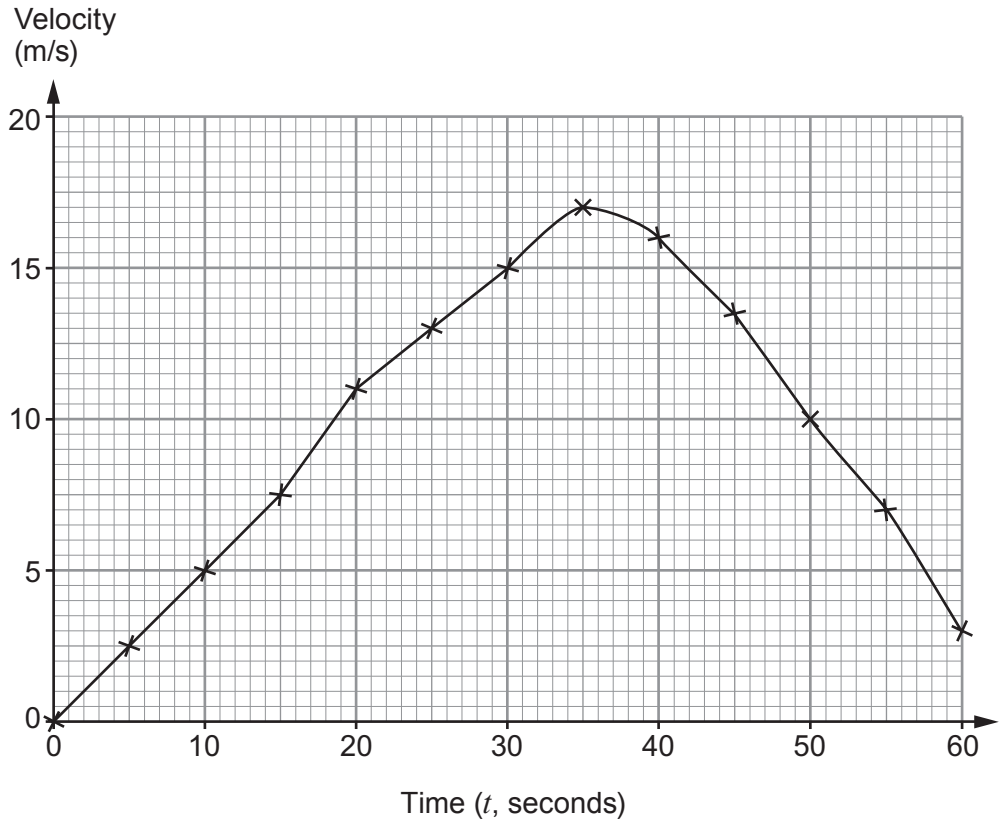
25. An engineer collects data about the velocity of a vehicle to check its performance.

The engineer draws a graph to show the velocity of the vehicle, in metres per second, t seconds after it begins to move. Her graph is shown below.



(a) The engineer then

- draws a tangent to the curve at the point where $t = 40$
- finds the gradient of the tangent.

What information has she estimated by carrying out this process? [1]

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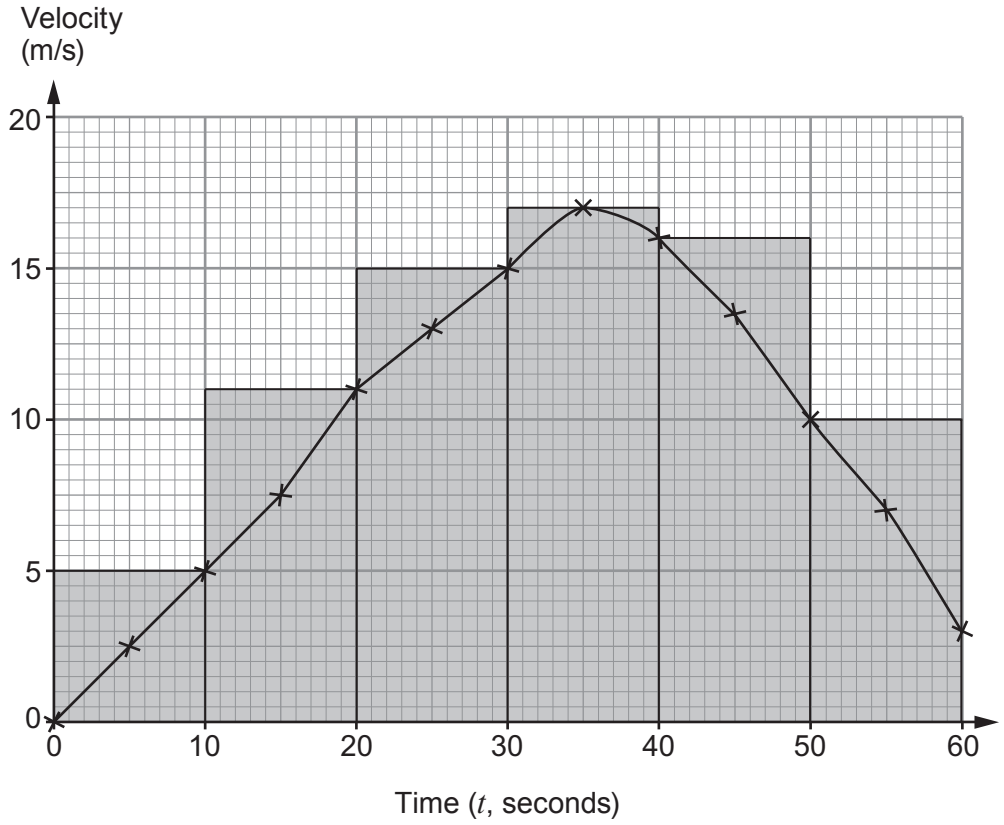
(b) She estimates the distance travelled by the vehicle by summing the areas of rectangles.

Her rectangles are shown on the graph and her answer is 740 metres.



(i) Explain why her method does not give a very good estimate of the distance travelled. [1]

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(ii) Suggest a change that she could make to her method to improve her answer. [1]

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26. Solve the equation

$$\frac{4}{2x-3}+\frac{12}{x+2}=7\,.$$ [6]

END OF PAPER

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