

**Dr Oliver Mathematics**  
**GCSE Mathematics**  
**2008 November Paper 3H: Non-Calculator**  
**1 hour 45 minutes**

The total number of marks available is 100.  
You must write down all the stages in your working.

1. (a) Simplify  $5bc + 2bc - 4bc$ . (1)

**Solution**

$$5bc + 2bc - 4bc = \underline{\underline{3bc}}.$$

- (b) Simplify  $4x + 3y - 2x + 2y$ . (2)

**Solution**

$$4x + 3y - 2x + 2y = \underline{\underline{2x + 5y}}.$$

- (c) Simplify  $m \times m \times m$ . (1)

**Solution**

$$m \times m \times m = \underline{\underline{m^3}}.$$

- (d) Simplify  $3n \times 2p$  (1)

**Solution**

$$3n \times 2p = \underline{\underline{6np}}.$$

2. A tin of cat food costs 40p.  
A shop has a special offer on the cat food.

*Dr. Oliver*

**Special offer**

Pay for 2 tins and get 1 tin free



Julie wants 12 tins of cat food.

- (a) Work out how much she pays.

(3)

**Solution**

She pays for 8 and the cost is

$$8 \times 40 = \underline{\underline{320 \text{ p or } \pounds 3.20.}}$$

The normal price of a cat basket is £20.

In a sale, the price of the cat basket is reduced by 15%.

- (b) Work out the sale price of the cat basket.

(3)

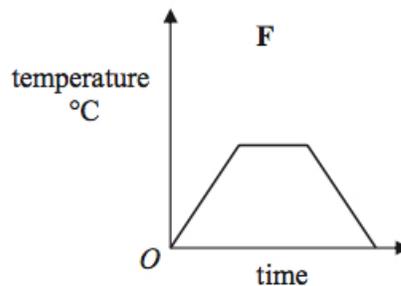
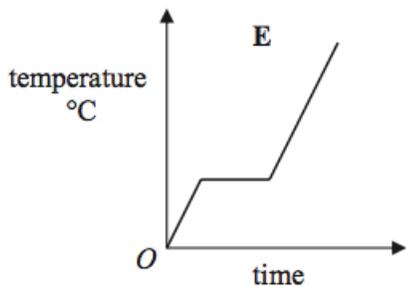
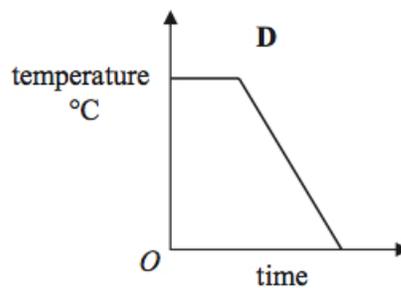
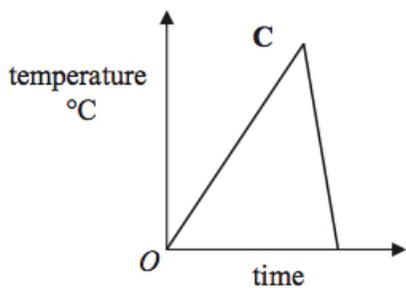
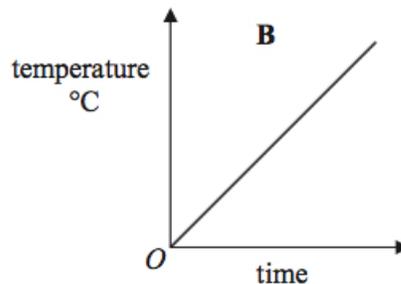
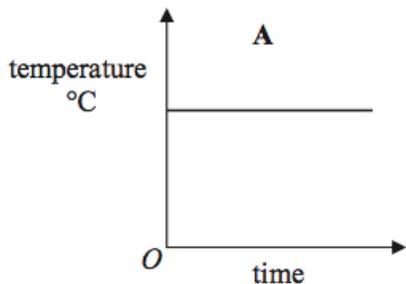
**Solution**

The sale price is 85% of what it was and the cost is

$$20 \times 0.85 = \underline{\underline{\pounds 17.}}$$

3. Here are six temperature/time graphs.

(3)



Each sentence in the table describes one of the graphs.  
Write the letter of the correct graph next to each sentence.  
The first one has been done for you.

---

The temperature starts at $0^{\circ}\text{C}$ and keeps rising	<b>B</b>
The temperature stays the same for a time and then falls	
The temperature rises and then falls quickly	
The temperature is always the same	
The temperature rises, stays the same for a time, and then falls	
The temperature rises, stays the same for a time, and then rises again	

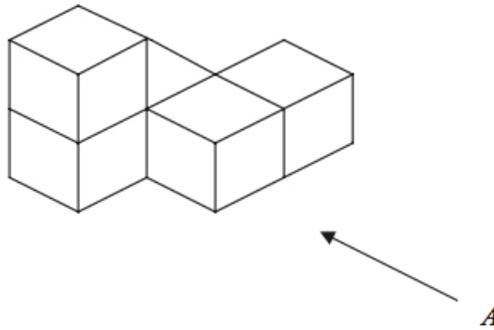
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**Solution**

The temperature starts at 0°C and keeps rising	<u>B</u>
The temperature stays the same for a time and then falls	<u>D</u>
The temperature rises and then falls quickly	<u>C</u>
The temperature is always the same	<u>A</u>
The temperature rises, stays the same for a time, and then falls	<u>F</u>
The temperature rises, stays the same for a time, and then rises again	<u>E</u>

4. The diagram represents a solid made from 5 identical cubes.

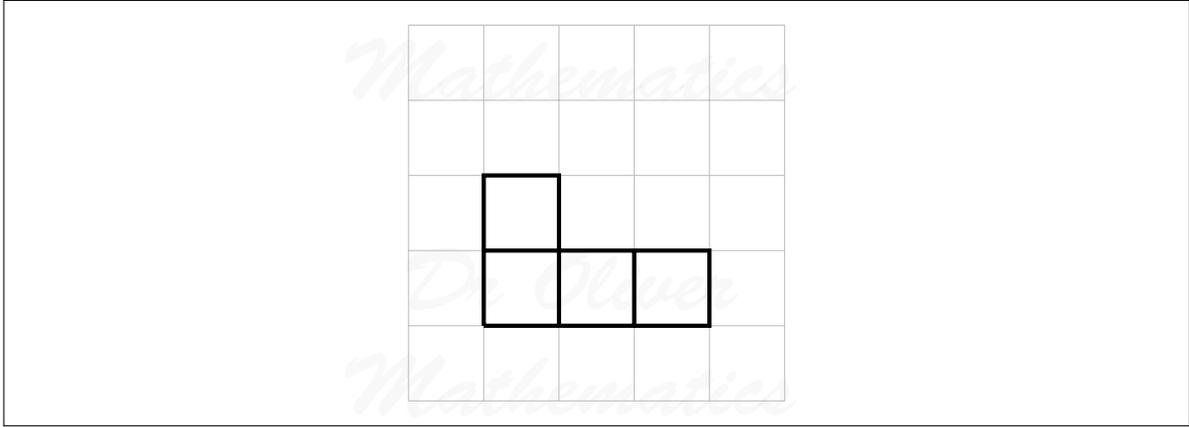
(2)



On the grid below, draw the view of the solid from direction A.



**Solution**



5. Work out

$$\frac{2}{5} + \frac{1}{7}$$

(2)

**Solution**

$$\begin{aligned} \frac{2}{5} + \frac{1}{7} &= \frac{14}{35} + \frac{5}{35} \\ &= \frac{19}{35} \end{aligned}$$

6. Work out the area of the shape.

(4)

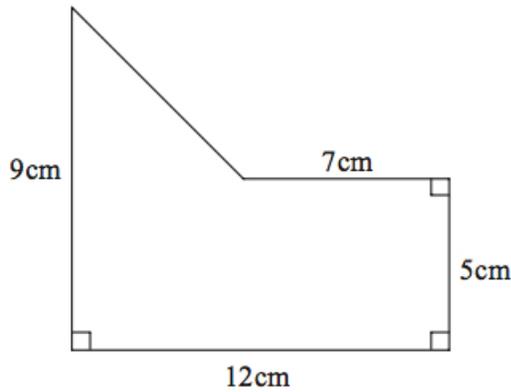
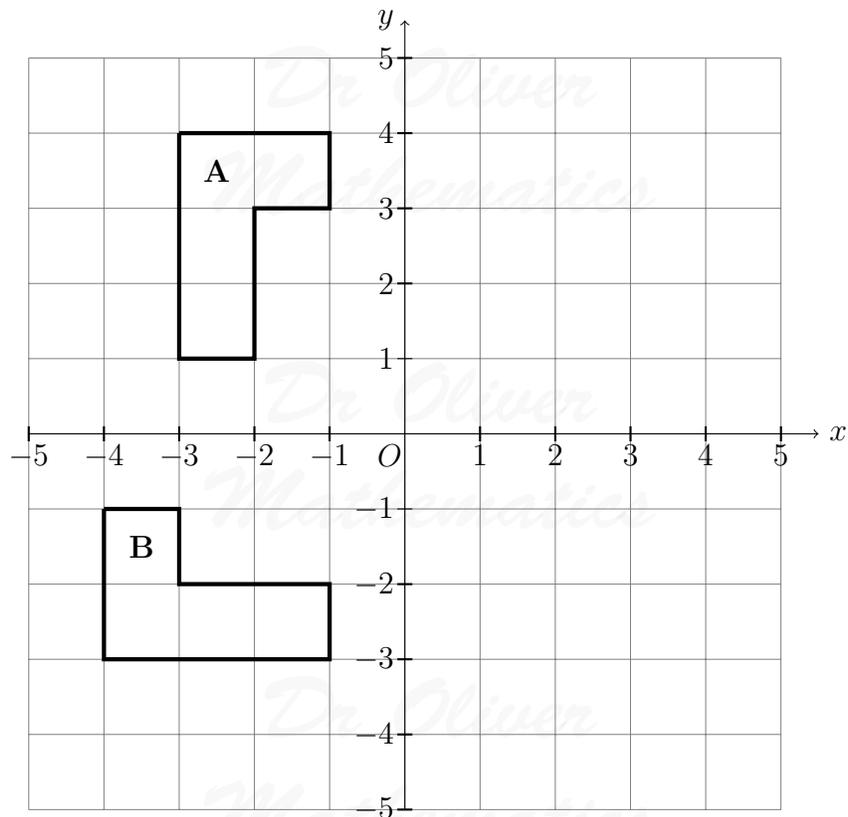


Diagram **NOT** accurately drawn

**Solution**

$$\begin{aligned}\text{Area} &= \text{triangle} + \text{rectangle} \\ &= \frac{1}{2} \times (12 - 7) \times (9 - 5) + 12 \times 5 \\ &= \frac{1}{2} \times 5 \times 4 + 60 \\ &= 10 + 60 \\ &= \underline{70 \text{ cm}^2}.\end{aligned}$$

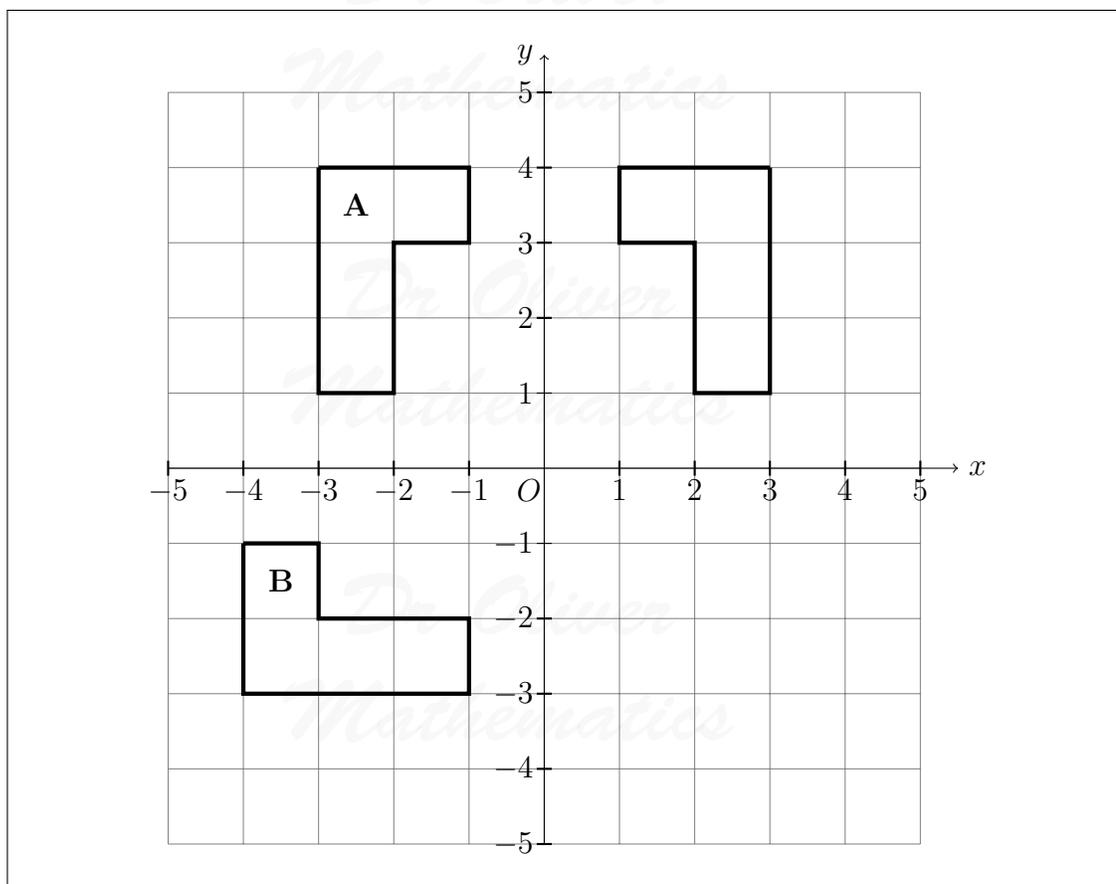
7. Here are two shapes.



(a) Reflect shape **A** in the  $y$ -axis.

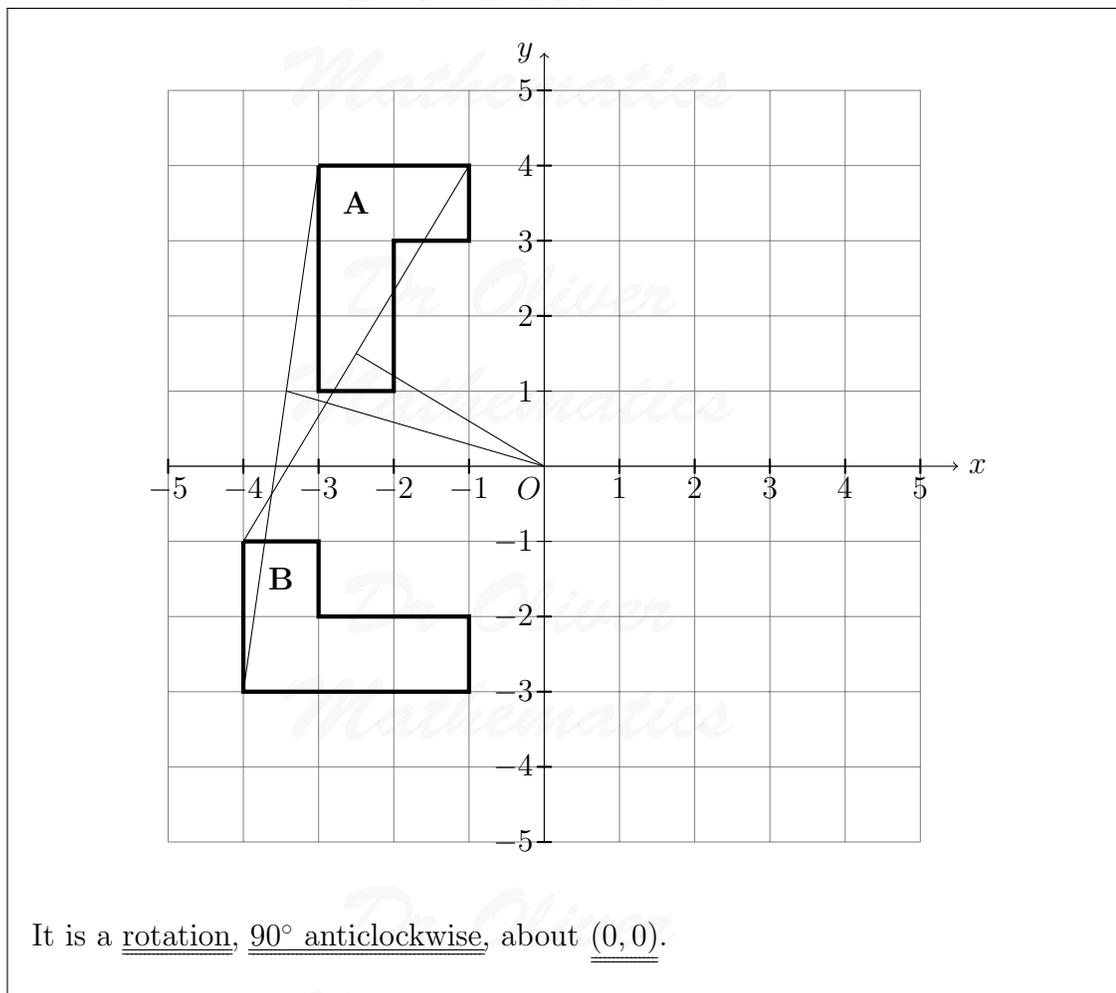
(2)

**Solution**



- (b) Describe fully the **single** transformation which takes shape **A** to shape **B**. (3)

**Solution**



8. Naomi wants to find out how often adults go to the cinema.  
She uses this question on a questionnaire.

“How many times do you go to the cinema?”

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not very often	Sometimes	A lot

- (a) Write down **two** things wrong with this question.

(2)

**Solution**

E.g., no time period, non-exhaustive response boxes, labels too vague, etc.

- (b) Design a better question for her questionnaire to find out how often adults go to the cinema. (2)  
You should include some response boxes.

**Solution**

A suitable question with a time frame, e.g., “Did you go to the cinema last week/last month/last six months? Tick the appropriate box.”

At least three exhaustive and non-overlapping tick boxes (best defined using inequality notation): for example, 0, 1-3, 4-6, 7 or more.

9. (a) Factorise  $5m + 10$ . (1)

**Solution**

$$5m + 10 = \underline{\underline{5(m + 2)}}.$$

- (b) Factorise  $y^2 - 3y$ . (1)

**Solution**

$$y^2 - 3y = \underline{\underline{y(y - 3)}}.$$

10. Sidra and Gemma share £48 in the ratio 5 : 3. (3)  
Work out how much more money Sidra gets than Gemma gets.

**Solution**

$5 + 3 = 8$  and Sidra gets

$$48\left(\frac{5}{8} - \frac{3}{8}\right) = 48 \times \frac{1}{4} = \underline{\underline{£12}}$$

more than Gemma.

11. The diagram shows part of a **regular** 10-sided polygon. (3)



Diagram **NOT**  
accurately drawn

Work out the size of the angle marked  $x$ .

**Solution**

$$\frac{360}{10} = 36$$

and the size of the angle marked  $x$  is

$$180 - 36 = \underline{\underline{144}}.$$

12. The diagram shows a triangle.

(3)

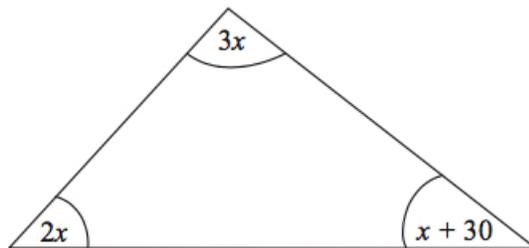


Diagram **NOT**  
accurately drawn

The sizes of the angles, in degrees, are  $3x$ ,  $2x$ , and  $x + 30$ .  
Work out the value of  $x$ .

**Solution**

$$\begin{aligned} 3x + 2x + (x + 30) &= 180 \Rightarrow 6x + 30 = 180 \\ &\Rightarrow 6x = 150 \\ &\Rightarrow \underline{\underline{x = 25}}. \end{aligned}$$

13.  $-2 < n \leq 4$ .  
 $n$  is an integer.

- (a) Write down all the possible values of  $n$ . (2)

**Solution**

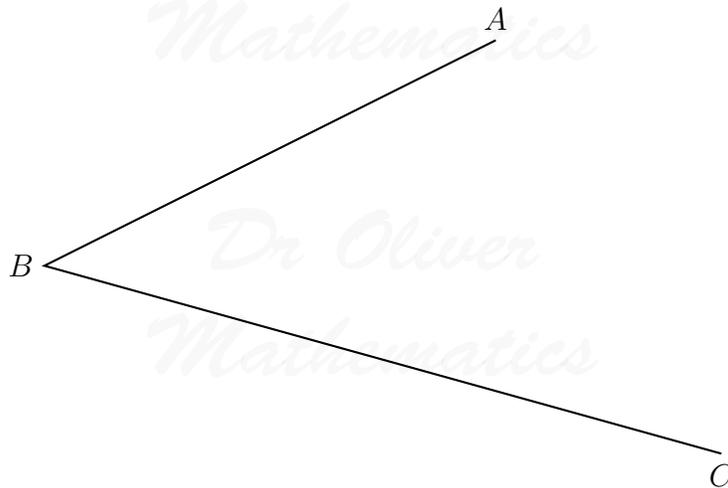
$-1, 0, 1, 2, 3, 4.$

- (b) Solve the inequality  $6x - 3 < 9$ . (2)

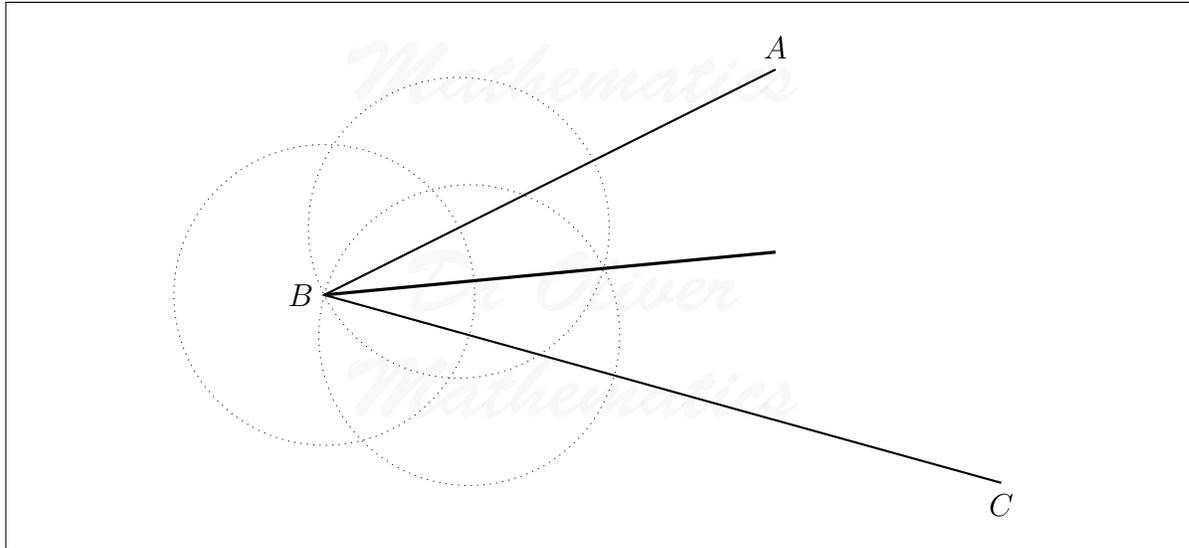
**Solution**

$$\begin{aligned} 6x - 3 < 9 &\Rightarrow 6x < 12 \\ &\Rightarrow \underline{\underline{x < 2.}} \end{aligned}$$

14. Use ruler and compasses to construct the bisector of angle  $ABC$ .  
You must show all your construction lines. (2)



**Solution**



15. (a) Express 84 as a product of its prime factors. (3)

**Solution**

$$\begin{array}{r|l}
 & 84 \\
 2 & 42 \\
 2 & 21 \\
 3 & 7 \\
 7 & 1
 \end{array}$$

and so

$$\begin{aligned}
 84 &= 2 \times 2 \times 3 \times 7 \\
 &= \underline{2^2} \times 3 \times 7.
 \end{aligned}$$

- (b) Find the Highest Common Factor (HCF) of 84 and 35. (2)

**Solution**

Now,

$$35 = 5 \times 7$$

and so the HCF is 7.

16.  $v^2 = u^2 + 2as$ .  
 $u = 6$ .

$$a = 2.5.$$

$$s = 9.$$

(a) Work out a value of  $v$ .

(3)

**Solution**

$$\begin{aligned}v^2 &= u^2 + 2as \Rightarrow v^2 = 6^2 + 2 \times 2.5 \times 9 \\&\Rightarrow v^2 = 36 + 2 \times 2.5 \times 9 \\&\Rightarrow v^2 = 36 + 45 \\&\Rightarrow v^2 = 81 \\&\Rightarrow \underline{\underline{v = \pm 9}}.\end{aligned}$$

(b) Make  $s$  the subject of the formula  $v^2 = u^2 + 2as$ .

(2)

**Solution**

$$\begin{aligned}v^2 &= u^2 + 2as \Rightarrow 2as = v^2 - u^2 \\&\Rightarrow \underline{\underline{s = \frac{v^2 - u^2}{2a}}}.\end{aligned}$$

17. (a) Write the number 39 000 in standard form.

(1)

**Solution**

$$39\,000 = \underline{\underline{3.9 \times 10^4}}.$$

(b) Write  $7.21 \times 10^{-3}$  as an ordinary number.

(1)

**Solution**

$$7.21 \times 10^{-3} = \underline{\underline{0.007\,21}}.$$

18. The table shows information about the amount spent by 100 customers in a supermarket.

Amount spent (£ $n$ )	Frequency
$0 < n \leq 20$	18
$20 < n \leq 40$	22
$40 < n \leq 60$	35
$60 < n \leq 80$	15
$80 < n \leq 100$	8
$100 < n \leq 120$	2

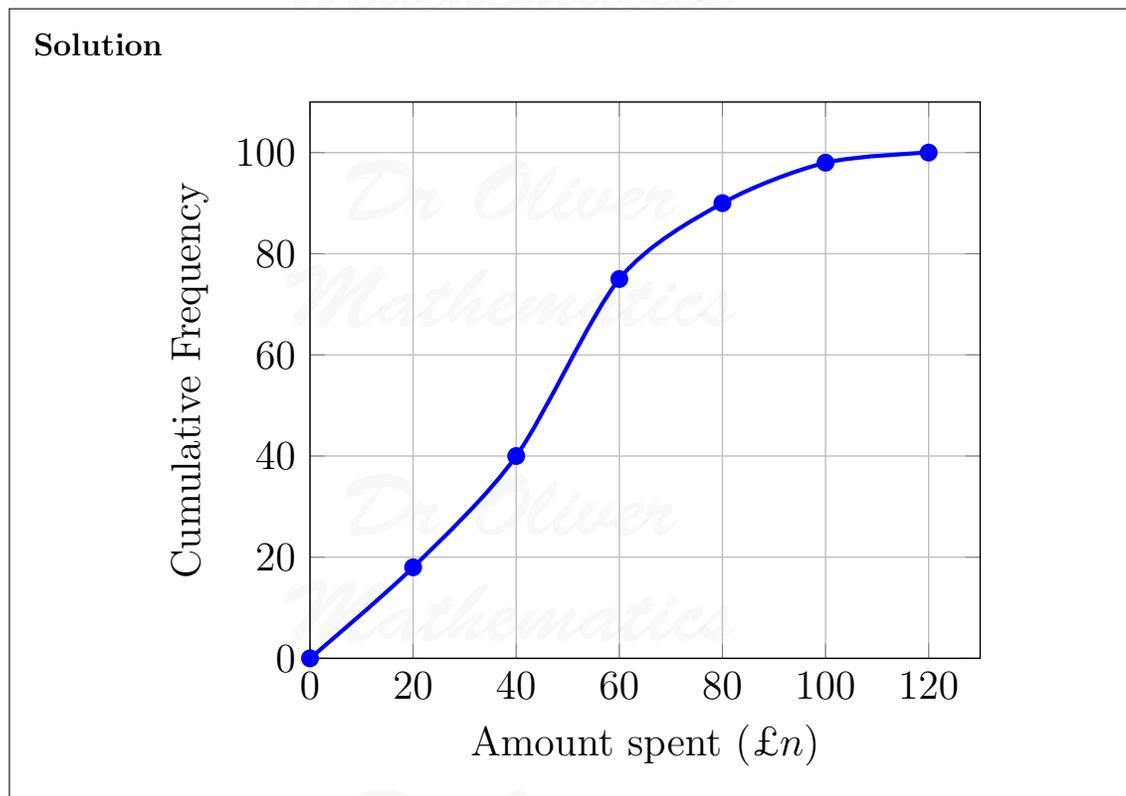
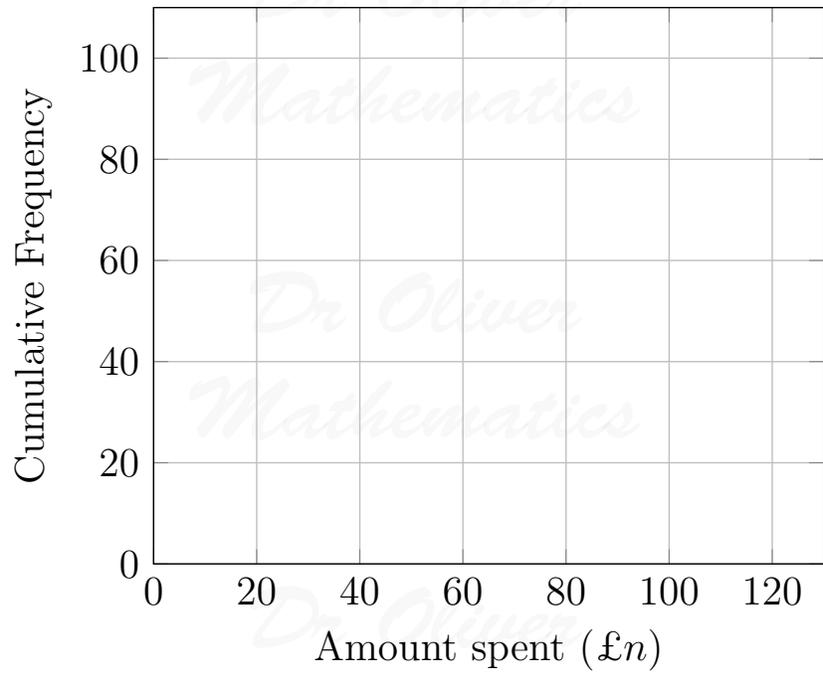
- (a) Complete the cumulative frequency table for this information (1)

Amount spent (£ $n$ )	Cumulative Frequency
$0 < n \leq 20$	18
$0 < n \leq 40$	
$0 < n \leq 60$	
$0 < n \leq 80$	
$0 < n \leq 100$	
$0 < n \leq 120$	

**Solution**

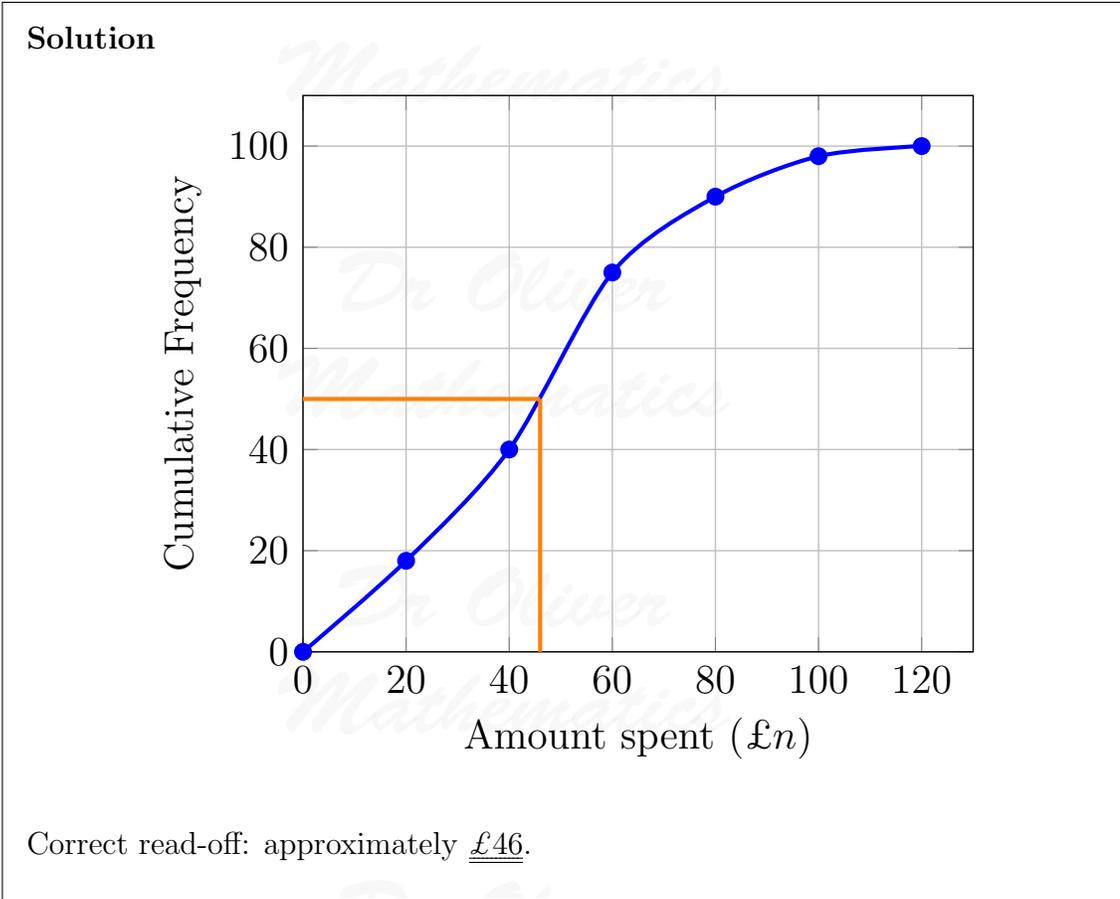
Amount spent (£ $n$ )	Cumulative Frequency
$0 < n \leq 20$	18
$0 < n \leq 40$	$18 + 22 = \underline{\underline{40}}$
$0 < n \leq 60$	$40 + 35 = \underline{\underline{75}}$
$0 < n \leq 80$	$75 + 15 = \underline{\underline{90}}$
$0 < n \leq 100$	$90 + 8 = \underline{\underline{98}}$
$0 < n \leq 120$	$98 + 2 = \underline{\underline{100}}$

- (b) On the grid, draw a cumulative frequency graph for your table. (2)



(c) Use your graph to find an estimate for the median amount spent.

(1)



19. The table shows some expressions. (3)  
 $a, b, c,$  and  $d$  represent lengths.  
 $\pi$  and 2 are numbers that have no dimensions.

$abc$	$\frac{1}{2}ab$	$\pi bc$	$\pi d$	$ab + cd$	$\pi(a + b)$	$bc^2$
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**Three** of the expressions could represent areas.  
 Tick (✓) the boxes underneath these three expressions.

**Solution**

$abc$	$\frac{1}{2}ab$	$\pi bc$	$\pi d$	$ab + cd$	$\pi(a + b)$	$bc^2$
	✓	✓		✓		

20.  $A$ ,  $B$ , and  $C$  are points on the circumference of a circle, centre  $O$ .

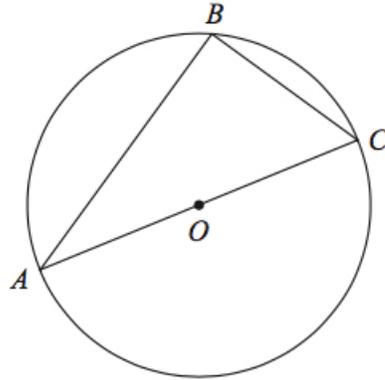


Diagram **NOT** accurately drawn

$AC$  is a diameter of the circle.

- (a) (i) Write down the size of angle  $ABC$ . (2)

**Solution**  
 $90^\circ$ .

- (ii) Give a reason for your answer.

**Solution**  
 It is a angle in a semi-circle and it equals  $90^\circ$ .

$D$ ,  $E$ , and  $F$  are points on the circumference of a circle, centre  $O$ .

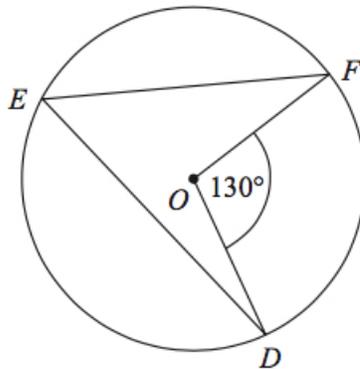


Diagram **NOT** accurately drawn

Angle  $DOF = 130^\circ$ .

- (b) (i) Write down the size of angle  $DEF$ . (2)

**Solution**

65°.

- (ii) Give a reason for your answer.

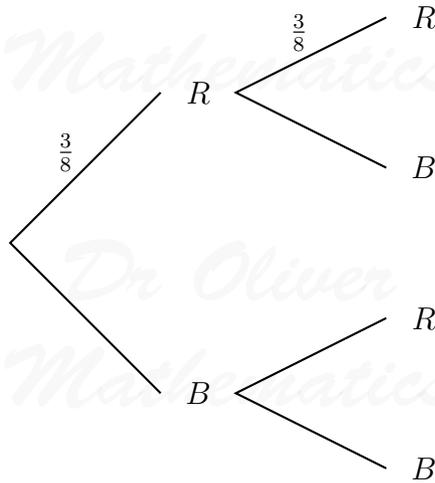
**Solution**

The angle at the circumference is twice the angle at the centre.

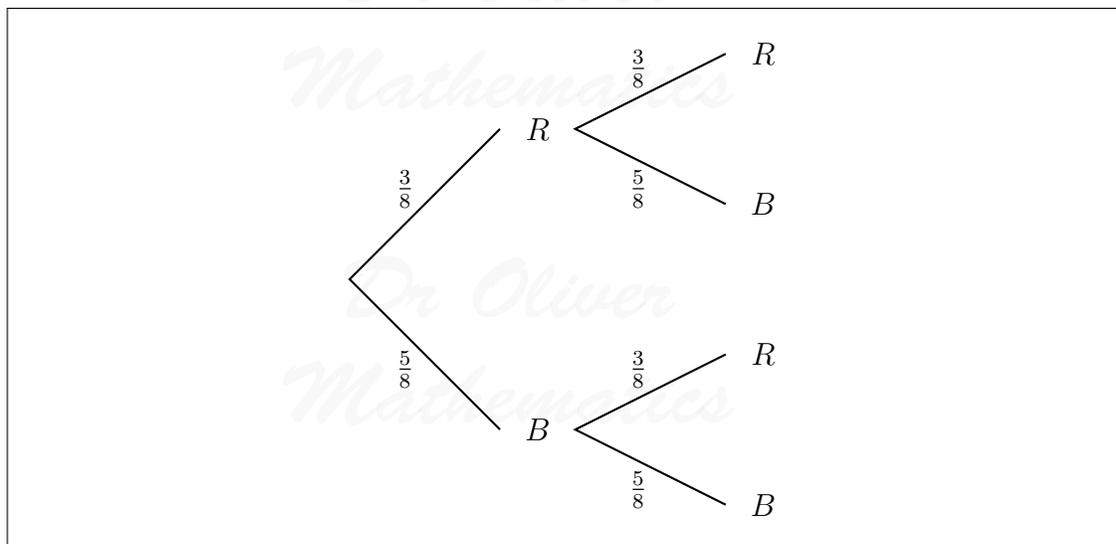
21. Matthew puts 3 red counters and 5 blue counters in a bag.  
He takes at random a counter from the bag.  
He writes down the colour of the counter.  
He puts the counter in the bag again.  
He then takes at random a second counter from the bag.

- (a) Complete the probability tree diagram.

(2)



**Solution**



- (b) Work out the probability that Matthew takes two red counters. (2)

**Solution**

$$\frac{3}{8} \times \frac{2}{6} = \frac{1}{4}$$

22. (a) Factorise fully  $6x^2 + 9xy$ . (2)

**Solution**

$$6x^2 + 9xy = 3x(2x + 3y).$$

- (b) Expand and simplify  $(2x + 5)(x - 2)$ . (2)

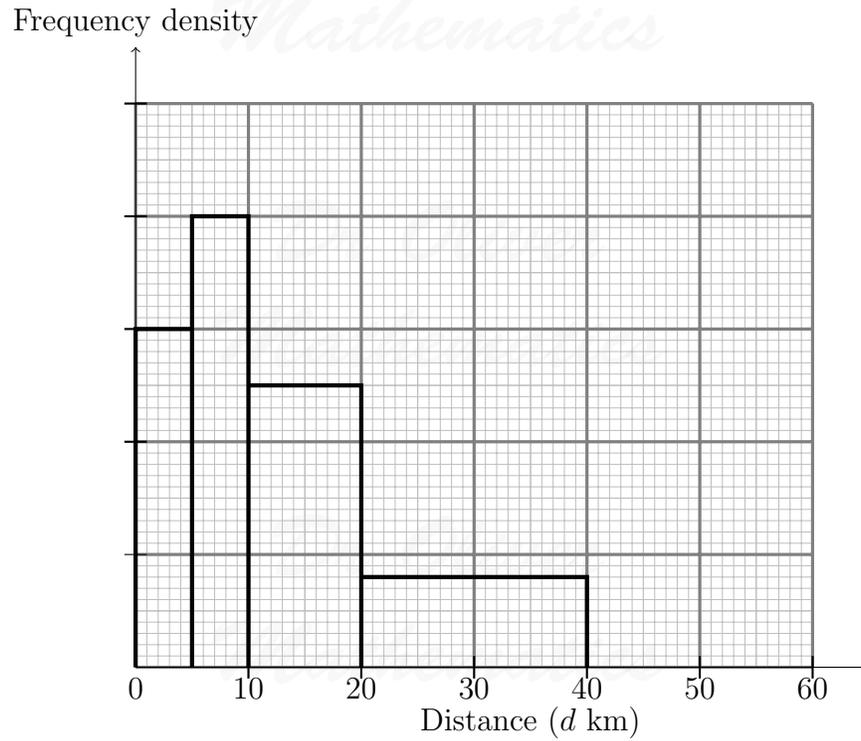
**Solution**

$$\begin{array}{r|rr} \times & 2x & +5 \\ \hline x & 2x^2 & +5x \\ -2 & -4x & -10 \\ \hline \end{array}$$

$$(2x + 5)(x - 2) = 2x^2 + x - 10.$$

23. The incomplete histogram and table give some information about the distances some

teachers travel to school.



(a) Use the information in the histogram to complete the frequency table. (2)

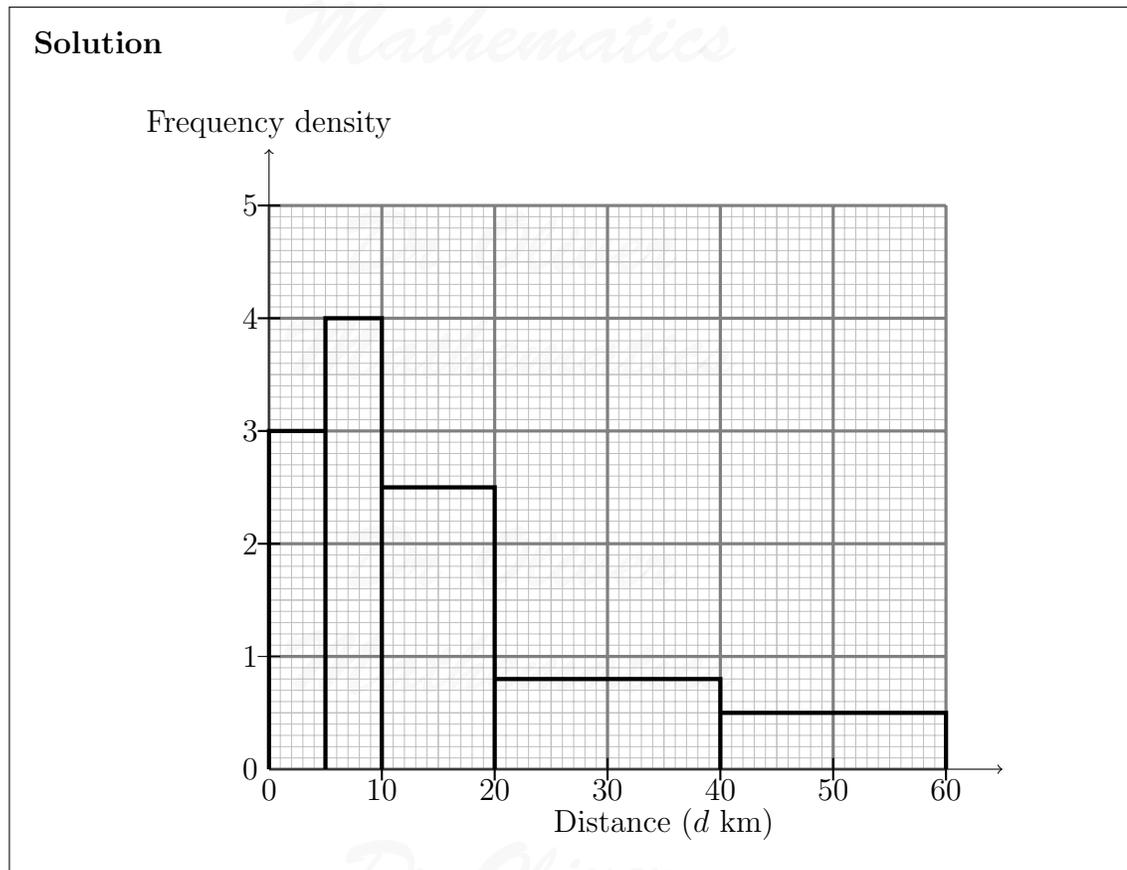
Distance ( $d$ km)	Frequency
$0 < d \leq 5$	15
$5 < d \leq 10$	20
$10 < d \leq 20$	
$20 < d \leq 40$	
$40 < d \leq 60$	10

**Solution**

Distance ( $d$ km)	Frequency	Width	Frequency density
$0 < d \leq 5$	15	5	$\frac{15}{5} = 3$
$5 < d \leq 10$	20	5	$\frac{20}{5} = 4$
$10 < d \leq 20$	<u>25</u>	10	$\frac{25}{10} = 2.5$
$20 < d \leq 40$	<u>16</u>	20	$\frac{16}{20} = 0.8$
$40 < d \leq 60$	10	20	$\frac{10}{20} = 0.5$

(b) Use the information in the table to complete the histogram.

(1)



24. Express the recurring decimal  $0.2\dot{1}\dot{3}$  as a fraction.

(3)

**Solution**

$x = 0.2\dot{1}\dot{3}$  and  $100x = 21.3\dot{1}\dot{3}$ . Now, subtract:

$$99x = 21.1 \Rightarrow 990x = 211$$

$$\Rightarrow \underline{\underline{x = \frac{211}{990}}}$$

25. (a) Write down the value of  $49^{\frac{1}{2}}$ .

(1)

**Solution**

$$49^{\frac{1}{2}} = \sqrt{49} = \underline{\underline{7}}$$

- (b) Write  $\sqrt{45}$  in the form  $k\sqrt{5}$ , where  $k$  is an integer. (1)

**Solution**

$$\begin{aligned}\sqrt{45} &= \sqrt{9 \times 5} \\ &= \sqrt{9} \times \sqrt{5} \\ &= \underline{3\sqrt{5}}.\end{aligned}$$

26. In the diagram,  $AB = BC = CD = DA$ . (3)

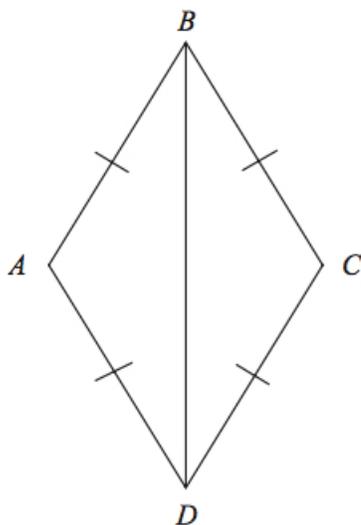


Diagram NOT  
accurately drawn

Prove that triangle  $ADB$  is congruent to triangle  $CDB$ .

**Solution**

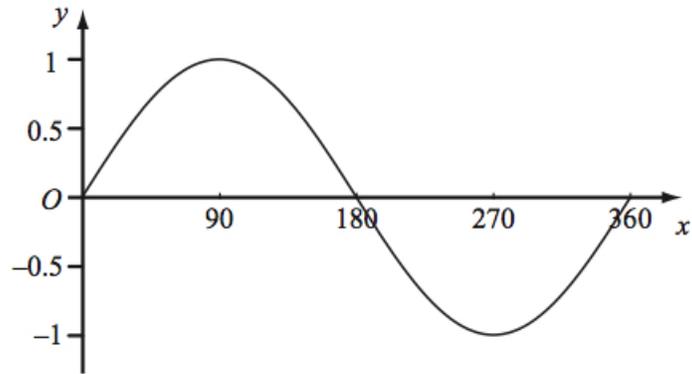
$AB = BC$  (given).

$CD = DA$  (given).

$BD$  is shared.

Thus, triangle  $ADB$  is congruent to triangle  $CDB$  (SSS).

27. The diagram shows a sketch of the curve  $y = \sin x^\circ$  for  $0 \leq x \leq 360$ .



The exact value of  $\sin 60^\circ = \frac{\sqrt{3}}{2}$ .

(a) Write down the exact value of

(2)

(i)  $\sin 120^\circ$ ,

**Solution**

$$\sin 120^\circ = \frac{\sqrt{3}}{2}$$

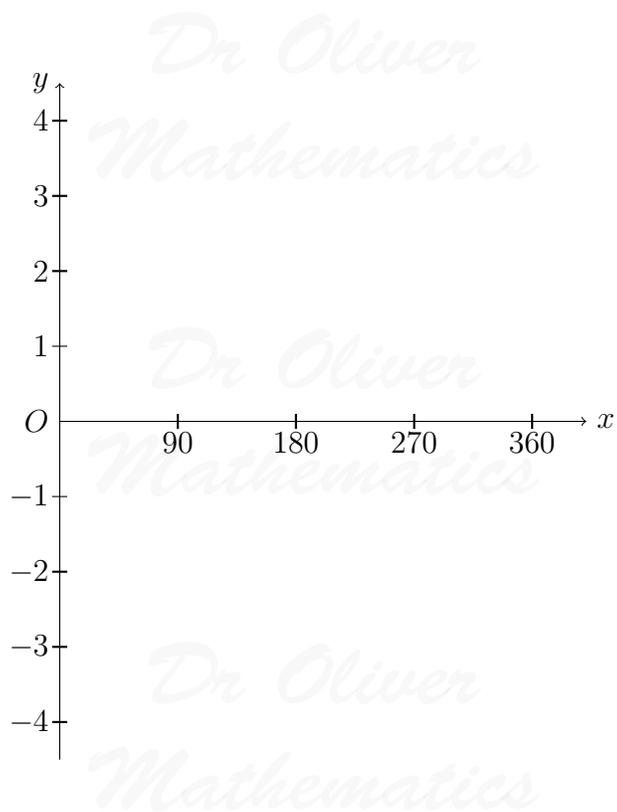
(ii)  $\sin 240^\circ$ .

**Solution**

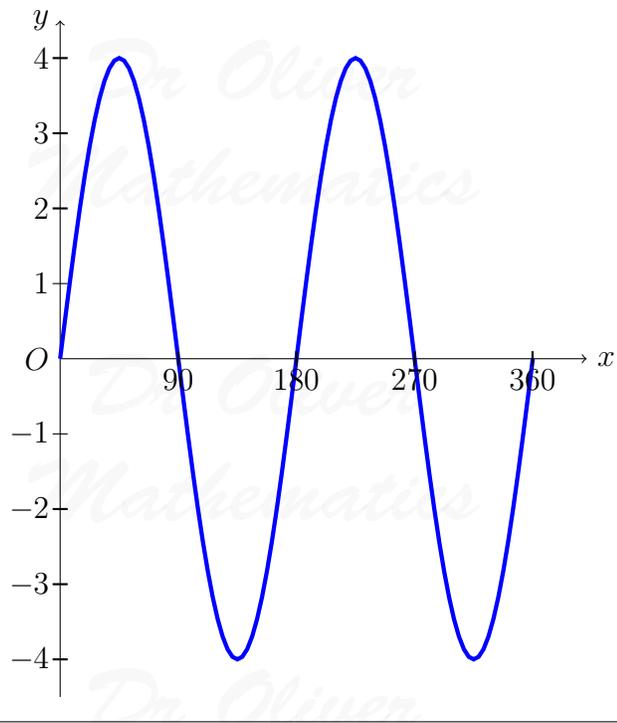
$$\sin 240^\circ = -\frac{\sqrt{3}}{2}$$

(b) On the grid below, sketch the graph of  $y = 4 \sin 2x^\circ$  for  $0 \leq x \leq 360$ .

(2)



**Solution**



28. Solve the simultaneous equations

(6)

$$\begin{aligned}x^2 + y^2 &= 5 \\ y &= 3x + 1.\end{aligned}$$

**Solution**

$$\begin{aligned}x^2 + (3x + 1)^2 &= 5 \Rightarrow x^2 + (9x^2 + 6x + 1) = 5 \\ &\Rightarrow 10x^2 + 6x - 4 = 0 \\ &\Rightarrow 5x^2 + 3x - 2 = 0 \\ &\Rightarrow (5x - 2)(x + 1) = 0 \\ &\Rightarrow x + 1 = 0 \text{ or } 5x - 2 = 0 \\ &\Rightarrow x = -1 \text{ or } x = \frac{2}{5} \\ &\Rightarrow y = -2 \text{ or } y = 2\frac{1}{5};\end{aligned}$$

hence,

$$\underline{\underline{x = -1, y = -2 \text{ or } x = \frac{2}{5}, y = 2\frac{1}{5}.$$