

**Dr Oliver Mathematics**  
**GCSE Mathematics**  
**2013 November Paper 1H: 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. This is a list of ingredients for making chicken soup for 4 people. (3)

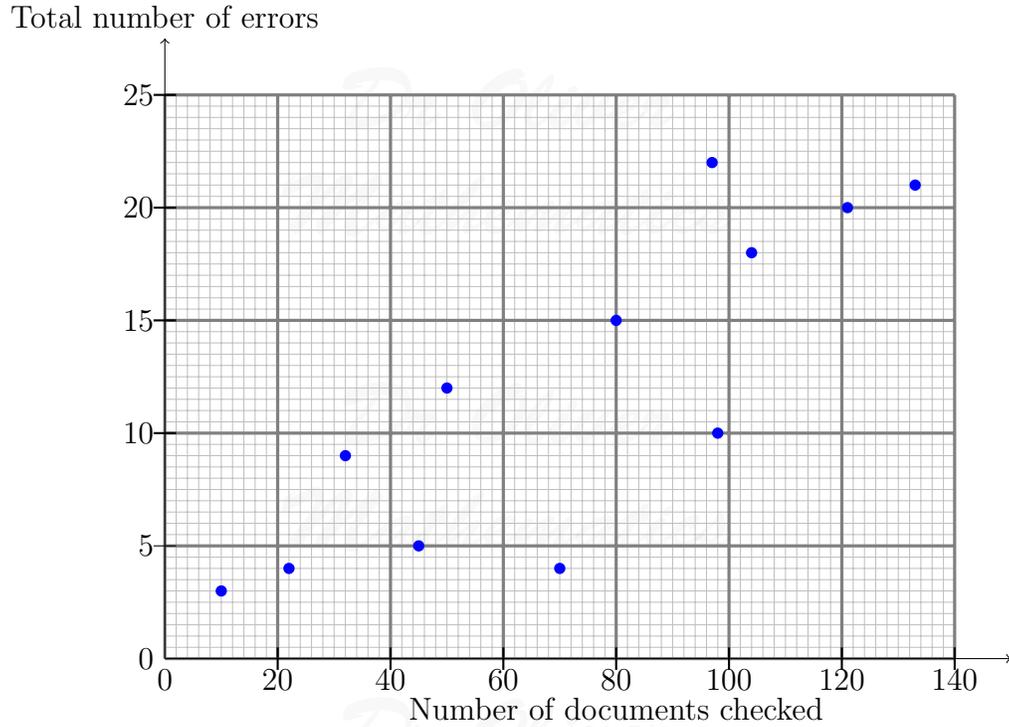
Ingredients for 4 people	
60 g	butter
300 g	chicken
150 ml	cream
1	onion
640 ml	chicken stock

Bill is going to make chicken soup for 6 people.

Work out the amount of each ingredient he needs.

<b>Solution</b>	
<u>Butter:</u>	$\frac{3}{2} \times 60 = \underline{\underline{90 \text{ g}}}$ .
<u>Chicken:</u>	$\frac{3}{2} \times 300 = \underline{\underline{450 \text{ g}}}$ .
<u>Cream:</u>	$\frac{3}{2} \times 150 = \underline{\underline{225 \text{ ml}}}$ .
<u>Onion:</u>	$\frac{3}{2} \times 1 = \underline{\underline{1\frac{1}{2} \text{ onions}}}$ .
<u>Chicken stock:</u>	$\frac{3}{2} \times 640 = \underline{\underline{960 \text{ ml}}}$ .

2. A publisher checks documents for errors.  
 He records the number of documents that are checked each day.  
 He also records the total number of errors in the documents each day.  
 The scatter graph shows this information.

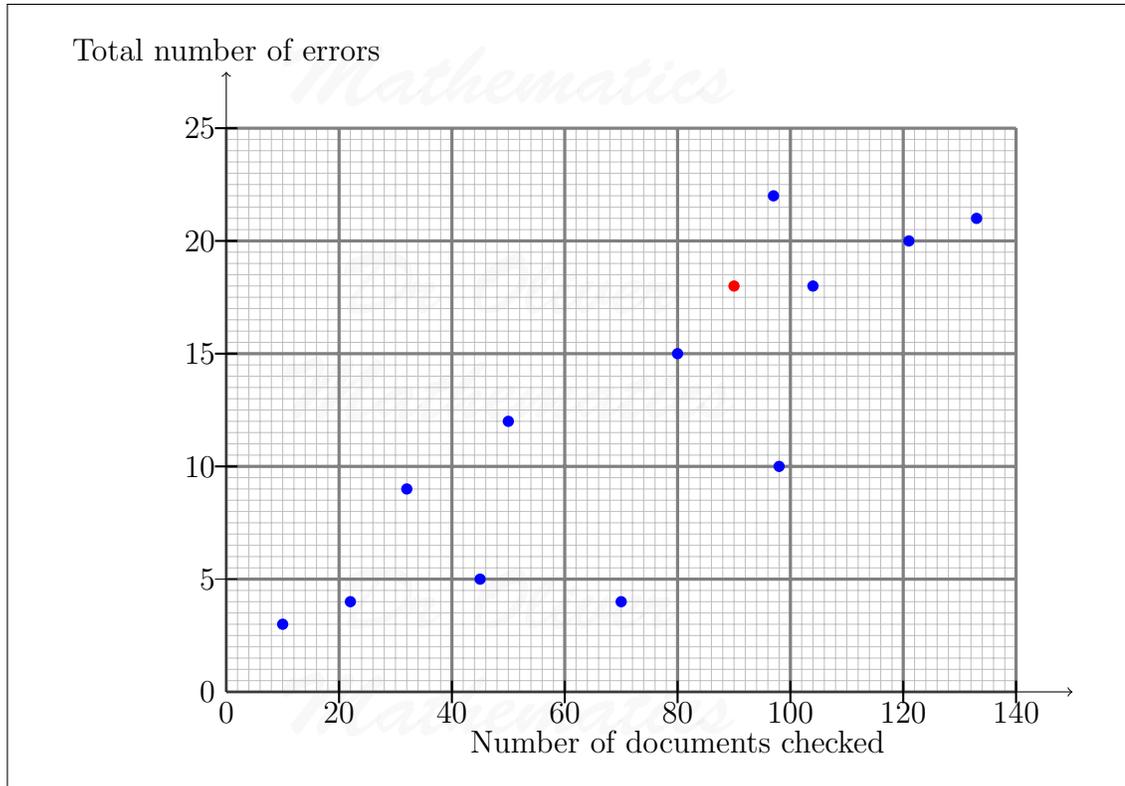


On another day 90 documents are checked.  
 There is a total of 17 errors.

- (a) Show this information on the scatter graph.

(1)

**Solution**



- (b) Describe the correlation between the number of documents checked and the total number of errors. (1)

**Solution**

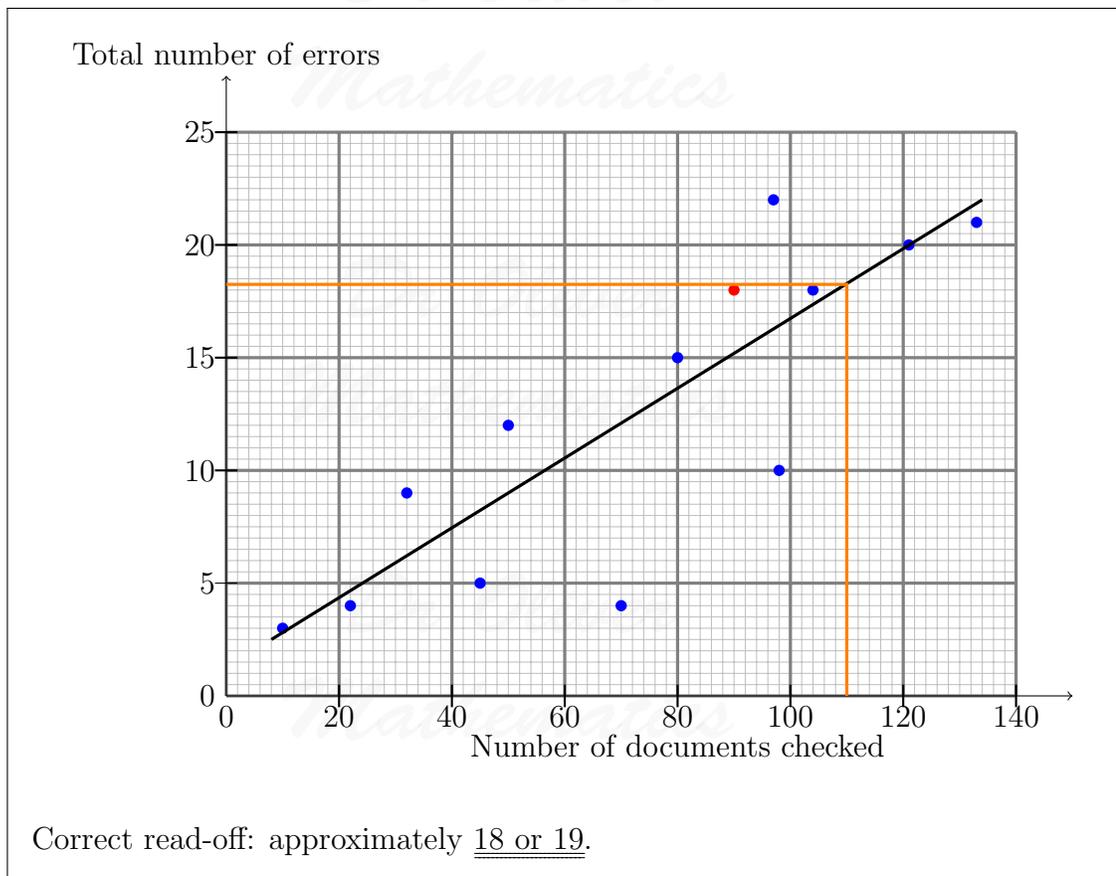
There is a positive correlation, i.e., the greater the documents checked, the greater the number of errors.

One day 110 documents are checked.

- (c) Estimate the total number of errors in these documents. (2)

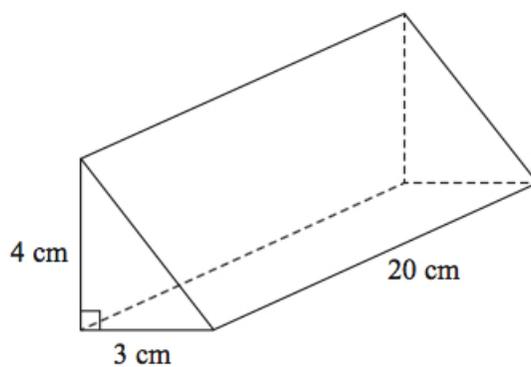
**Solution**

Draw a line of best fit:



3. Here is a triangular prism.

(4)



Work out the volume of this triangular prism.

**Solution**

$$\begin{aligned}\text{Cross-sectional area} &= \frac{1}{2} \times 3 \times 4 \\ &= 6 \text{ cm}^2\end{aligned}$$

and

$$\begin{aligned}\text{volume} &= 6 \times 20 \\ &= \underline{120 \text{ cm}^3}.\end{aligned}$$

4. (a) Simplify

$$4y + 2x - 3 + 3x + 8.$$

(2)

**Solution**

$$4y + 2x - 3 + 3x + 8 = \underline{4y + 5x + 5}.$$

(b) Factorise fully

$$9x^2 - 6xy.$$

(2)

**Solution**

$$9x^2 - 6xy = \underline{3x(3x - 2y)}.$$

(c) Expand

$$4(x + 2).$$

(1)

**Solution**

$$4(x + 2) = \underline{4x + 8}.$$

(d) Expand and simplify

$$(x - 5)(x + 3).$$

(2)

**Solution**

$$\begin{array}{r|rr} \times & x & -5 \\ \hline x & x^2 & -5x \\ +3 & +3x & -15 \\ \hline \end{array}$$

$$(x - 5)(x + 3) = \underline{\underline{x^2 - 2x - 15.}}$$

5. Jane has a packet of seeds.

The probability that a seed will grow is 0.75.

(a) What is the probability that a seed will **not** grow?

(1)

**Solution**

The probability that a seed will **not** grow is

$$1 - 0.75 = \underline{\underline{0.25.}}$$

Jane plants 200 of these seeds.

(b) Estimate the number of the seeds that will grow.

(2)

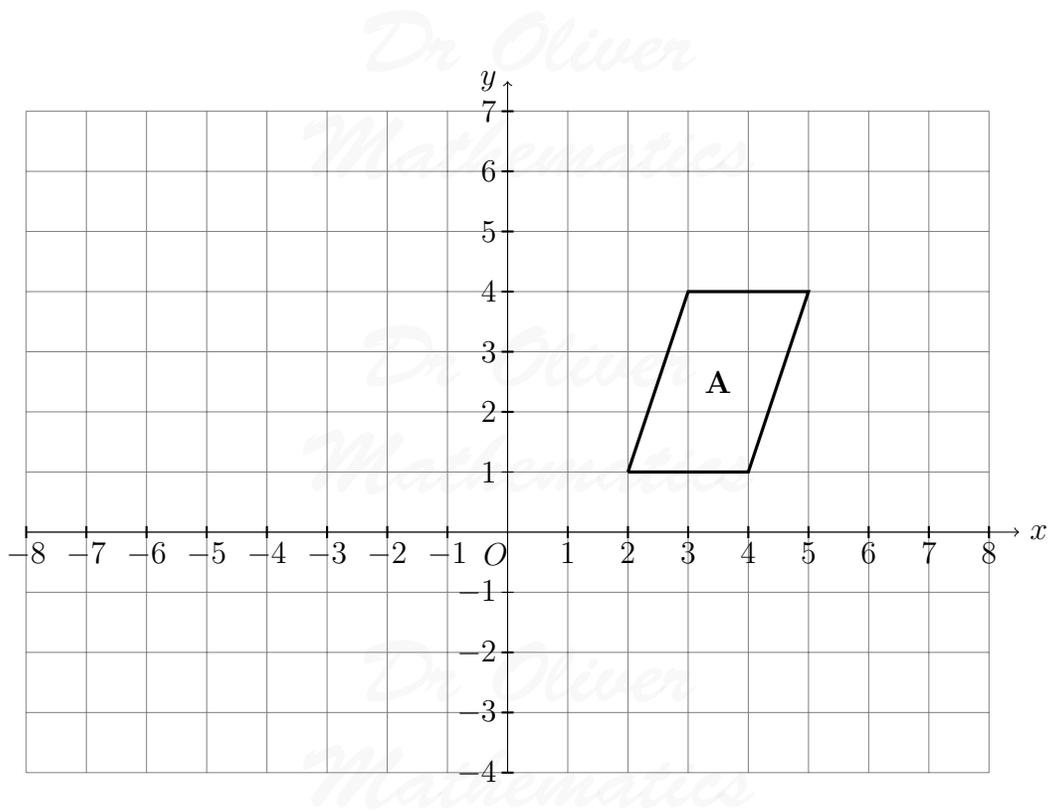
**Solution**

The number of the seeds that will grow is

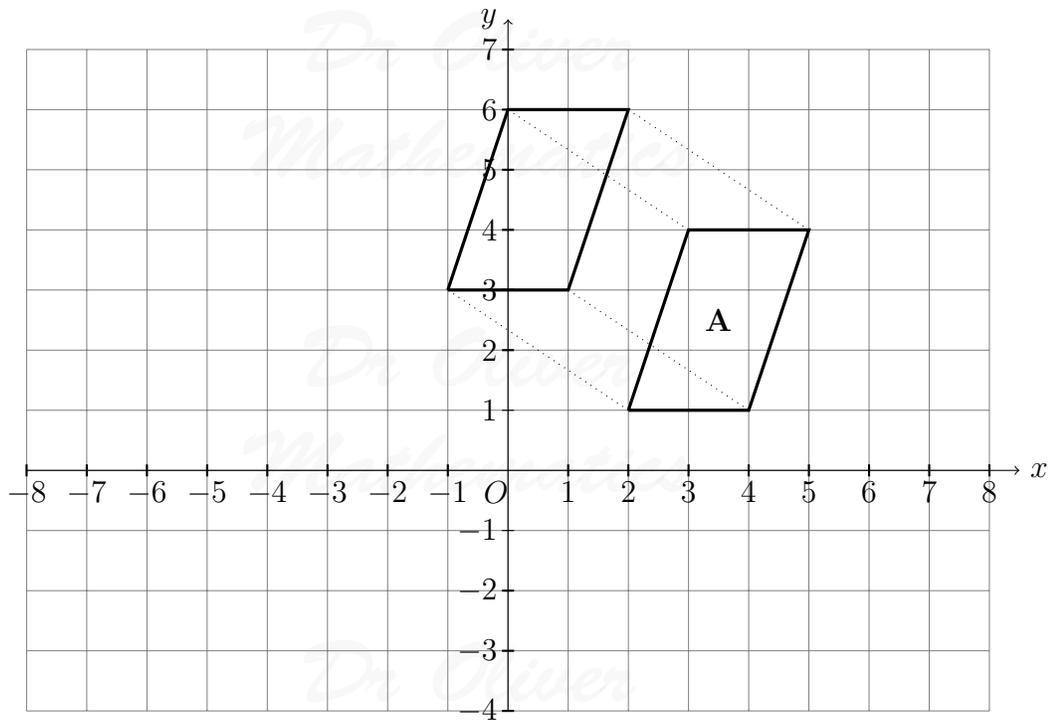
$$200 \times 0.75 = \underline{\underline{150.}}$$

6. (a) Translate shape **A** by the vector  $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$ .

(1)

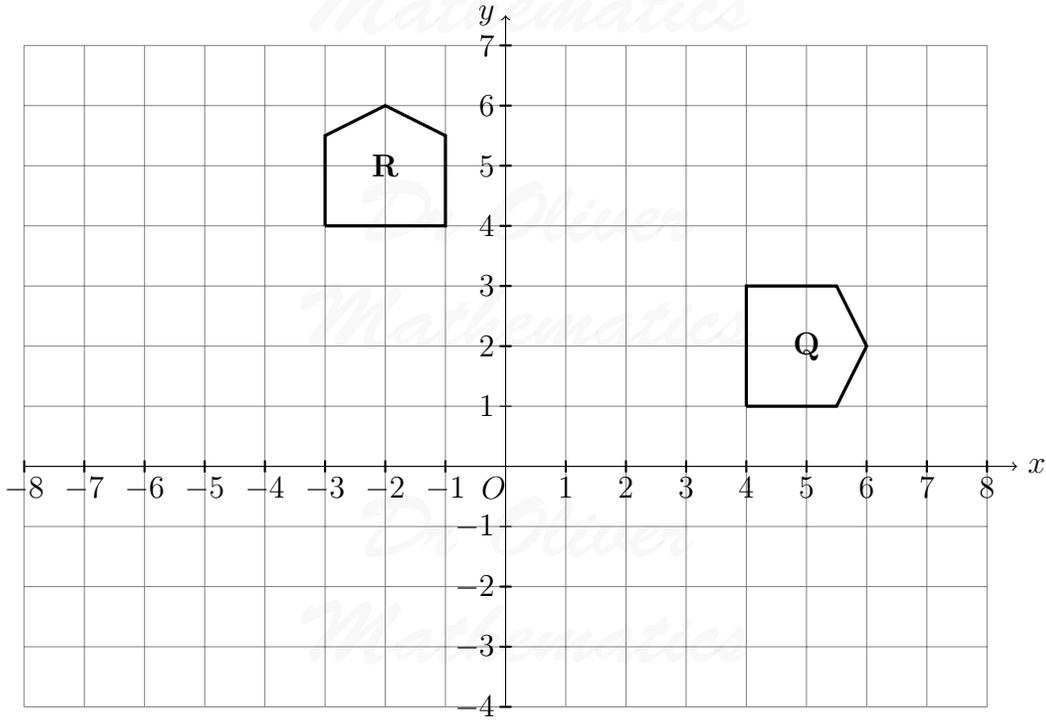


**Solution**

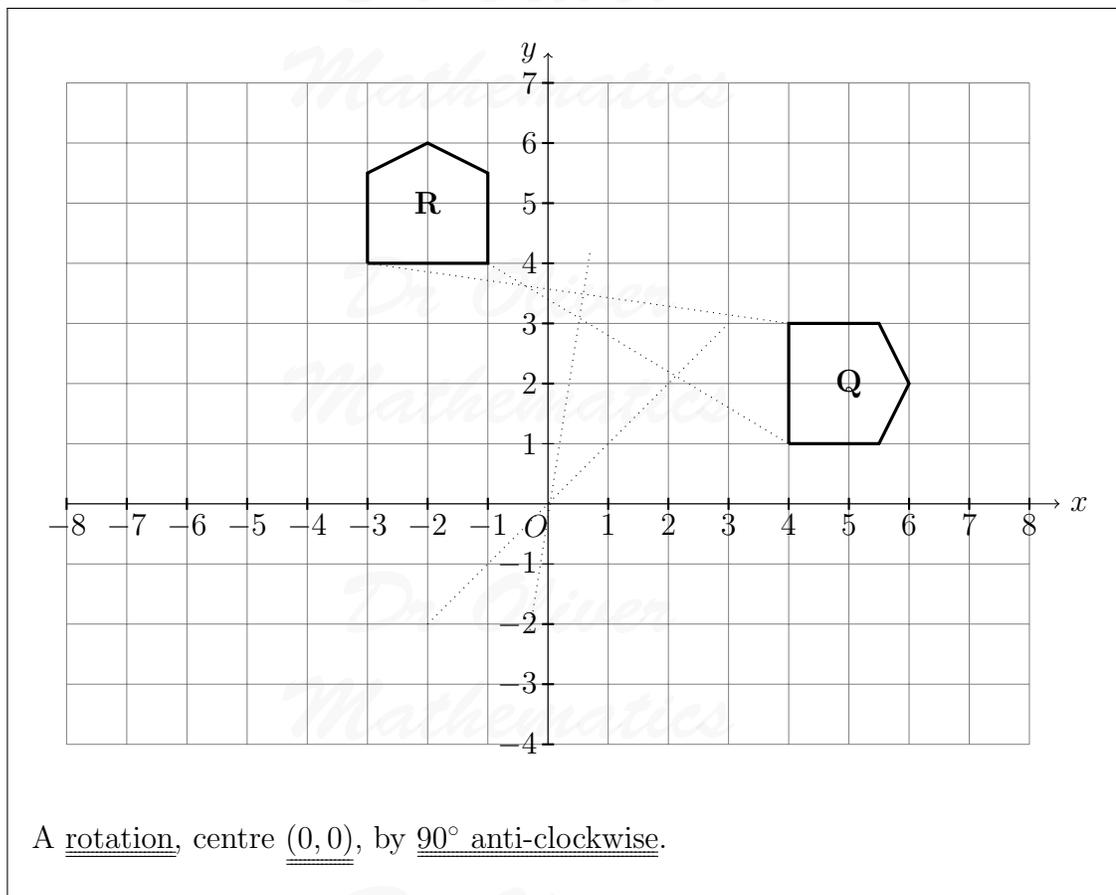


(b) Describe fully the single transformation that maps shape **Q** onto shape **R**.

(3)



**Solution**



7. Rita is going to make some cheeseburgers for a party. (4)
- She buys some packets of cheese slices and some boxes of burgers.
- There are 20 cheese slices in each packet.
- There are 12 burgers in each box.
- Rita buys exactly the same number of cheese slices and burgers.
- (a) How many packets of cheese slices and how many boxes of burgers does she buy?

**Solution**

$$\begin{array}{r|l} & 20 \\ 2 & \underline{10} \\ 2 & \underline{5} \\ 5 & \underline{1} \end{array}$$

and so

$$20 = 2 \times 2 \times 5 = 2^2 \times 5.$$

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$$\begin{array}{r|l} & 12 \\ 2 & \underline{6} \\ 2 & \underline{3} \\ 3 & \underline{1} \end{array}$$

and so

$$12 = 2 \times 2 \times 3 = 2^2 \times 3.$$

Hence,

$$\text{LCM}(20, 12) = 2^2 \times 3 \times 5 = 60.$$

Rita will buy

$$\frac{60}{20} = \underline{\underline{3 \text{ packets of cheese slices}}}$$

and

$$\frac{60}{12} = \underline{\underline{5 \text{ boxes of burgers.}}}$$

Rita wants to put one cheese slice and one burger into each bread roll.  
She wants to use all the cheese slices and all the burgers.

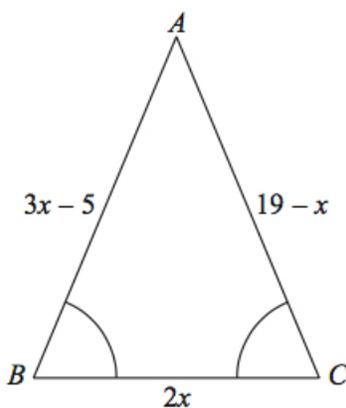
(b) How many bread rolls does Rita need?

**Solution**

60.

8.  $ABC$  is a triangle.

(5)



Angle  $ABC =$  angle  $BCA$ .

The length of side  $AB$  is  $(3x - 5)$  cm.

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The length of side  $AC$  is  $(19 - x)$  cm.

The length of side  $BC$  is  $2x$  cm.

Work out the perimeter of the triangle.

Give your answer as a number of centimetres.

**Solution**

$$3x - 5 = 19 - x \Rightarrow 4x = 24$$

$$\Rightarrow x = 6$$

and, therefore, the sides of the triangle are 12 cm, 13 cm, and 13 cm and so the perimeter of the triangle is

$$12 + 13 + 13 = \underline{\underline{38 \text{ cm}}}.$$

9. Julia is investigating how much exercise people do in a week. She uses these two questions in a questionnaire.

**Question 1**

**What is your age?**

Under 15

15 to 25

25 to 40

over 40

**Question 2**

**How much exercise do you do?**

A bit

Some

A lot

- (a) Write down **one** thing wrong with each of these questions. (2)

**Solution**

Question 1: E.g., '25' is a repeated option, no units.

Question 2: E.g., no time frame, non-specific responses, no number quantities, open to interpretation, no option for those who do not exercise.

Julia wants to know how much time people spend exercising.

- (b) Design a question Julia could use in her questionnaire. (2)

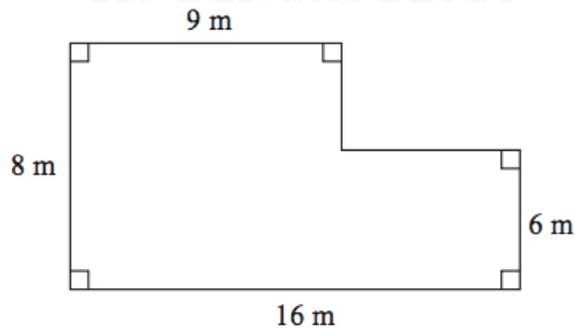
**Solution**

A suitable question with a time frame, e.g., “Did you exercise today/last week/last month? Tick the appropriate box.”

At least three exhaustive and non-overlapping tick boxes (best defined using inequality notation): for example, Did Not Exercise,  $0 \text{ mins} < x \leq 30 \text{ mins}$ ,  $30 \text{ mins} < x \leq 60 \text{ mins}$ ,  $x > 60 \text{ mins}$ .

10. The diagram shows the floor of a village hall.

(5)



The caretaker needs to polish the floor.

One tin of polish normally costs £19.

One tin of polish covers  $12 \text{ m}^2$  of floor.

There is a discount of 30% off the cost of the polish.

The caretaker has £130.

Has the caretaker got enough money to buy the polish for the floor?

You must show all your working.

**Solution**

$$\begin{aligned} \text{Area} &= (8 \times 16) - (2 \times 7) \\ &= 128 - 14 \\ &= 114 \text{ m}^2. \end{aligned}$$

He need 10 tins of polish and this costs him £190. However, he gets 30% off the cost of the polish:

$$\begin{array}{r|l} \times & 100 \quad 90 \\ \hline 0.7 & 70 \quad 63 \\ \hline \end{array}$$

$$190 \times 0.7 = 70 + 63 = 133;$$

hence, the caretaker does not have enough money.

11. Each day a company posts some small letters and some large letters. (5)

The company posts all the letters by first class post.

The tables show information about the cost of sending a small letter by first class post and the cost of sending a large letter by first class post.

Small Letter		Large Letter	
Weight	First Class Post	Weight	First Class Post
0–100 g	60p	0–100 g	£1.00
		101–250 g	£1.50
		251–500 g	£1.70
		501–750 g	£2.50

One day the company wants to post 200 letters.

The ratio of the number of small letters to the number of large letters is 3 : 2.

70% of the large letters weigh 0-100 g.

The rest of the large letters weigh 101-250 g.

Work out the total cost of posting the 200 letters by first class post.

### Solution

$$3 + 2 = 5$$

and so the number of small letters is

$$\frac{3}{5} \times 200 = 120$$

and the number of large letters is

$$\frac{2}{5} \times 200 = 80.$$

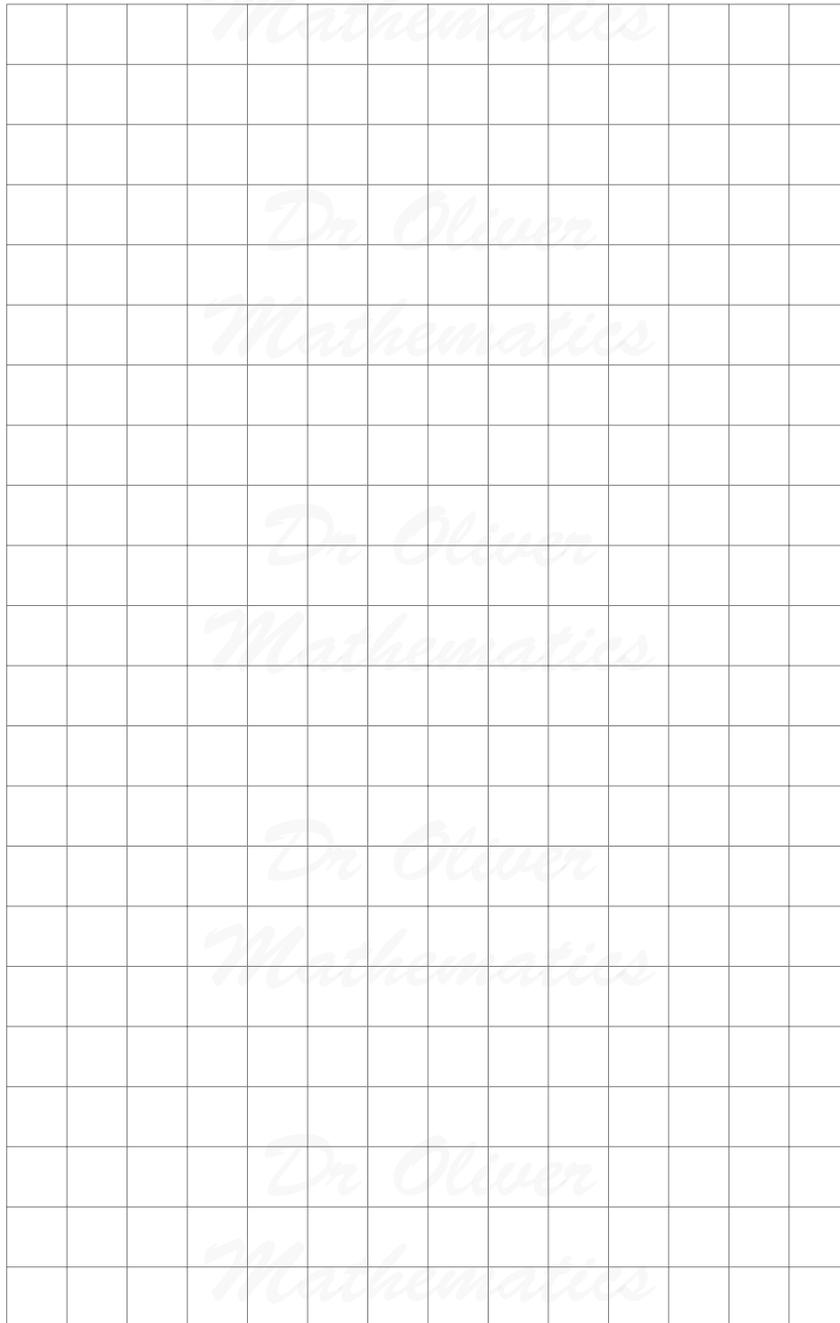
Now, 70% of the large letters weigh 0-100 g:

$$0.7 \times 80 = 56.$$

Hence, the total cost of posting is

$$\begin{aligned} (120 \times 0.6) + (56 \times 1) + (24 \times 1.5) &= 72 + 56 + 36 \\ &= 128 + 36 \\ &= \underline{\underline{£164}}. \end{aligned}$$

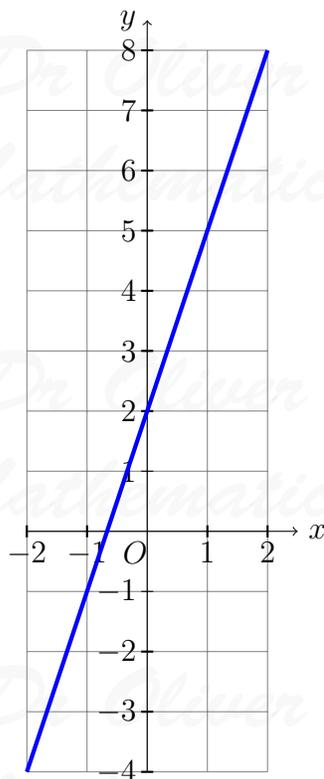
12. On the grid, draw the graph of  $y = 3x + 2$  for values of  $x$  from  $-2$  to  $2$ . (4)



**Solution**

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$x$	-2	-1	0	1	2
$y$	-4	-1	2	5	8



13. Hertford Juniors is a basketball team.

(3)

At the end of 10 games, their mean score is 35 points per game.

At the end of 11 games, their mean score has gone down to 33 points per game.

How many points did the team score in the 11th game?

**Solution**

At the end of 10 games, their total score is

$$10 \times 35 = 350.$$

At the end of 11 games, their total score is

$$11 \times 33 = 363.$$

Hence, they scored

$$363 - 350 = \underline{\underline{13 \text{ points}}}.$$

14. (a) Write down the reciprocal of 5. (1)

**Solution**

$$\underline{\underline{\frac{1}{5}}}.$$

- (b) Evaluate  $3^{-2}$ . (1)

**Solution**

$$3^{-2} = \frac{1}{3^2} = \underline{\underline{\frac{1}{9}}}.$$

- (c) Calculate  $9 \times 10^4 \times 3 \times 10^3$ . (2)  
Give your answer in standard form.

**Solution**

$$\begin{aligned} 9 \times 10^4 \times 3 \times 10^3 &= (9 \times 3) \times (10^4 \times 10^3) \\ &= 27 \times 10^7 \\ &= \underline{\underline{2.7 \times 10^8}}. \end{aligned}$$

15. Solve the simultaneous equations (4)

$$3x + 4y = 5$$

$$2x - 3y = 9.$$

**Solution**

$$3x + 4y = 5 \quad (1)$$

$$2x - 3y = 9 \quad (2)$$

$$2 \times (1) : 6x + 8y = 10 \quad (3)$$

$$3 \times (2) : 6x - 9y = 27 \quad (4)$$

Now, (3) - (4):

$$17y = -17 \Rightarrow \underline{y = -1}$$

$$\Rightarrow 3x - 4 = 5$$

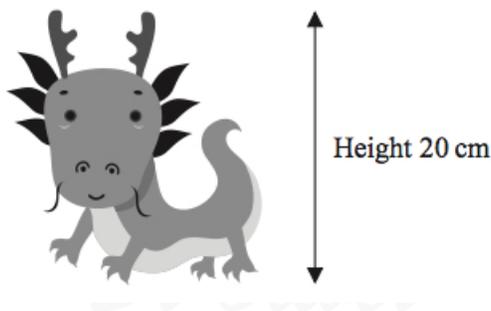
$$\Rightarrow 3x = 9$$

$$\Rightarrow \underline{x = 3.}$$

16. A company makes monsters.

(3)

The company makes small monsters with a height of 20 cm.



A small monster has a surface area of  $300 \text{ cm}^2$ .

The company also makes large monsters with a height of 120 cm.

A small monster and a large monster are mathematically similar.

Work out the surface area of a large monster.

### Solution

The length scale factor (LSF) is

$$\frac{120}{20} = 6$$

and the area scale factor (ASF) is

$$6^2 = 36.$$

Hence, the surface area of a large monster is

$$300 \times 36 = \underline{\underline{10\,800 \text{ cm}^2}}.$$

17.  $AB$  is a line segment.

$A$  is the point with coordinates  $(3, 6, 7)$ .

The midpoint of  $AB$  has coordinates  $(-2, 2, 5)$ .

Find the coordinates of  $B$ .

(2)

**Solution**

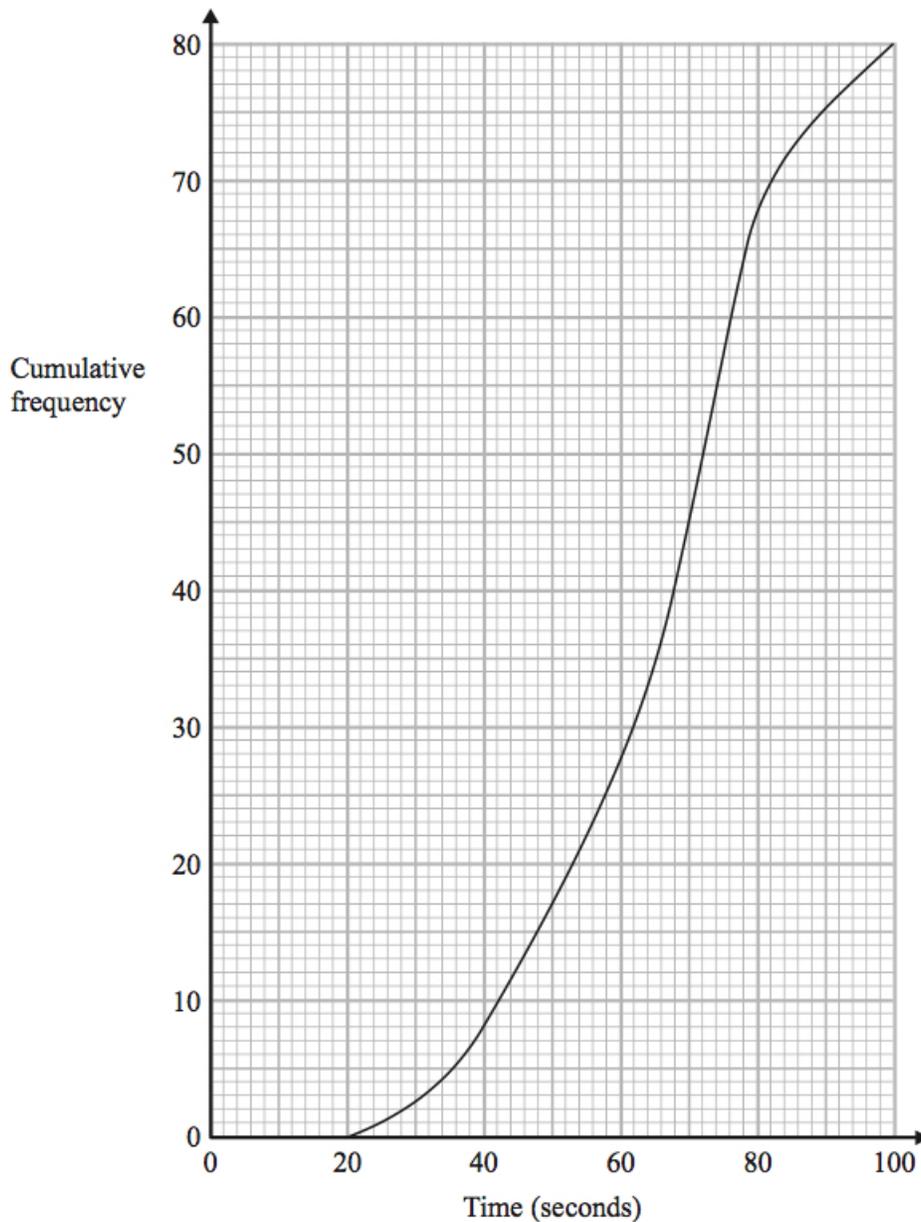
$$x_B = -2 + (-2 - 3) = -7$$

$$y_B = 2 + (2 - 6) = -2$$

$$z_B = 5 + (5 - 7) = 3;$$

hence, the coordinates of  $B$  are  $(-7, -2, 3)$ .

18. The cumulative frequency graph shows information about the times 80 swimmers take to swim 50 metres.



(a) Use the graph to find an estimate for the median time.

(1)

**Solution**

Correct read-off: approximately 68 seconds.

A swimmer has to swim 50 metres in 60 seconds or less to qualify for the swimming team.

The team captain says, “More than 25% of swimmers have qualified for the swimming team.”

- (b) Is the team captain right? (3)  
 You must show how you got your answer.

**Solution**

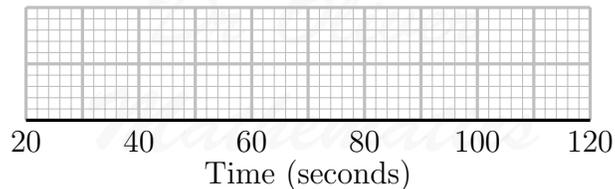
Correct read-off: approximately 28 swimmers and the percentage is

$$\frac{28}{80} \times 100\% = \frac{28}{4} \times 5\% = 7 \times 5\% = 35\%;$$

hence, the team captain is right.

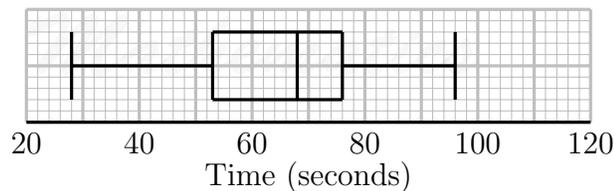
For these 80 swimmers, the least time taken was 28 seconds and the greatest time taken was 96 seconds.

- (c) Use the cumulative frequency graph and the information above to draw a box plot for the times taken by the swimmers. (3)



**Solution**

The lower quartile is 53 and the upper quartile is 78.



19. In a supermarket, the probability that John buys fruit is 0.7. (3)  
 In the same supermarket, the probability that John independently buys vegetables is 0.4.  
 Work out the probability that John buys fruit or buys vegetables or buys both.

**Solution**

Now, the probability that John does not buy fruit is

$$1 - 0.7 = 0.3$$

and the probability that John does not buy vegetables is

$$1 - 0.4 = 0.6.$$

Hence, the probability that John buys fruit or buys vegetables or buys both is

$$\begin{aligned} 1 - P(\text{neither}) &= 1 - (0.3 \times 0.6) \\ &= 1 - 0.18 \\ &= \underline{0.82}. \end{aligned}$$

20. (a) Solve

$$\frac{4(8x - 2)}{3x} = 10. \quad (3)$$

**Solution**

$$\begin{aligned} \frac{4(8x - 2)}{3x} = 10 &\Rightarrow 32x - 8 = 30x \\ &\Rightarrow 2x = 8 \\ &\Rightarrow \underline{x = 4}. \end{aligned}$$

(b) Write as a single fraction in its simplest form

$$\frac{2}{y + 3} - \frac{1}{y - 6}. \quad (3)$$

**Solution**

$$\begin{aligned} \frac{2}{y + 3} + \frac{1}{y - 6} &= \frac{2(y - 6)}{(y + 3)(y - 6)} - \frac{(y + 3)}{(y + 3)(y - 6)} \\ &= \frac{2y - 12 - y - 3}{(y + 3)(y - 6)} \\ &= \frac{y - 15}{\underline{(y + 3)(y - 6)}}. \end{aligned}$$

21.  $y$  is directly proportional to the square of  $x$ . (4)  
 When  $x = 3$ ,  $y = 36$ .  
 Find the value of  $y$  when  $x = 5$ .

**Solution**

$$y \propto x^2 \Rightarrow y = kx^2$$

for some  $k$ . Now,

$$36 = k \times 3^2 \Rightarrow k = 4$$

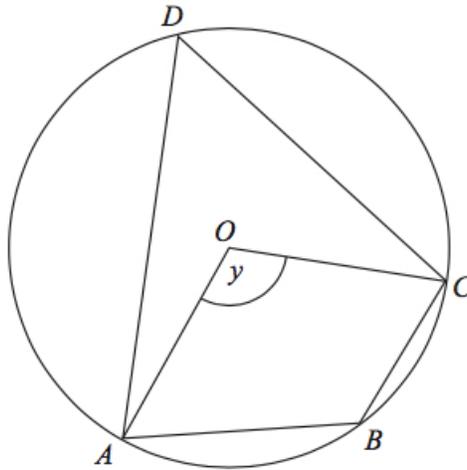
and

$$y = 4x^2.$$

Finally,

$$y = 4 \times 5^2 = \underline{\underline{100}}.$$

22.  $A$ ,  $B$ ,  $C$ , and  $D$  are points on the circumference of a circle, centre  $O$ . (4)



Angle  $AOC = y$ .

Find the size of angle  $ABC$  in terms of  $y$ .

Give a reason for each stage of your working.

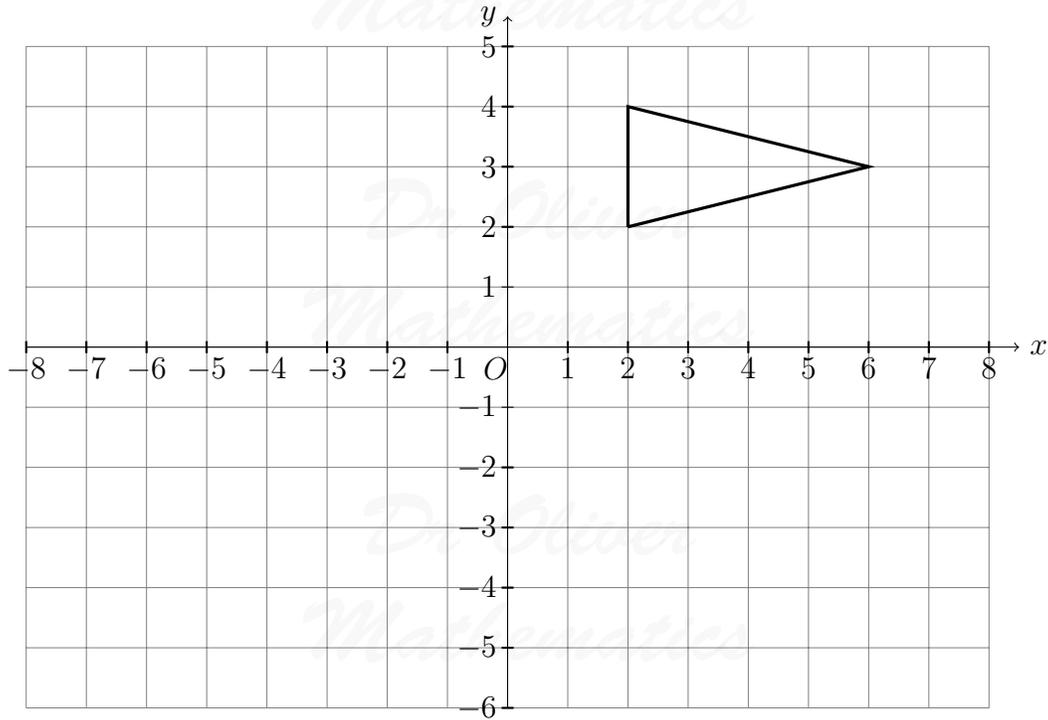
**Solution**

Angle  $ADC = \frac{1}{2}y$  (angle at the centre is twice the angle at the circumference)

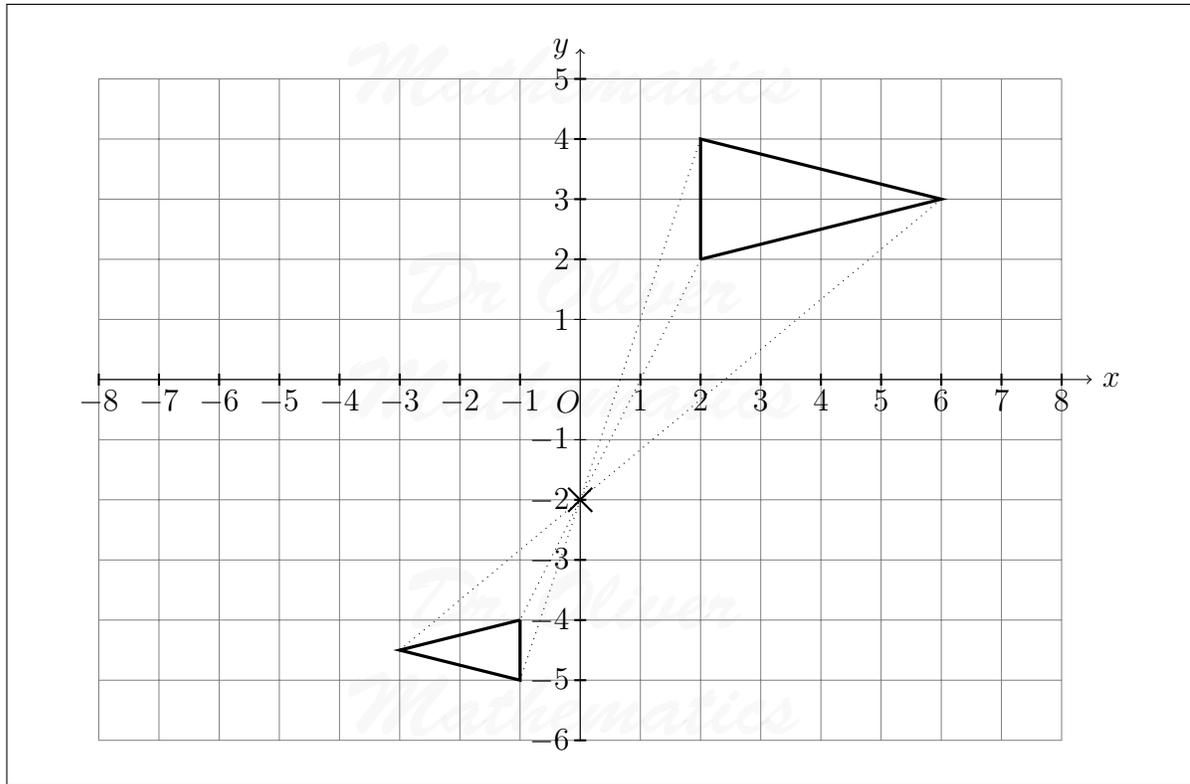
Angle  $ABC = \underline{\underline{180 - \frac{1}{2}y}}$  (opposite angles in cyclic quadrilateral add to  $180^\circ$ .)

23. On the grid, enlarge the triangle by scale factor  $-\frac{1}{2}$ , centre  $(0, -2)$ .

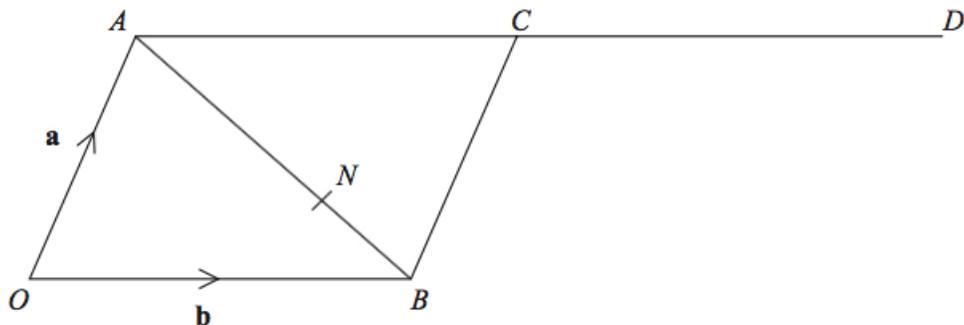
(2)



**Solution**



24.  $OACB$  is a parallelogram.



$\vec{OA} = \mathbf{a}$  and  $\vec{OB} = \mathbf{b}$ .

$D$  is the point such that  $\vec{AC} = \vec{CD}$ .

The point  $N$  divides  $AB$  in the ratio  $2 : 1$ .

(a) Write an expression for  $\vec{ON}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(3)

**Solution**

$$\begin{aligned}
\overrightarrow{ON} &= \overrightarrow{OA} + \overrightarrow{AN} \\
&= \overrightarrow{OA} + \frac{2}{3}\overrightarrow{AB} \\
&= \overrightarrow{OA} + \frac{2}{3}(\overrightarrow{AO} + \overrightarrow{OB}) \\
&= \mathbf{a} + \frac{2}{3}(\mathbf{b} - \mathbf{a}) \\
&= \mathbf{a} + \frac{2}{3}\mathbf{b} - \frac{2}{3}\mathbf{a} \\
&= \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b} \\
&= \frac{1}{3}(\mathbf{a} + 2\mathbf{b}).
\end{aligned}$$

(b) Prove that  $OND$  is a straight line.

(3)

**Solution**

$$\begin{aligned}
\overrightarrow{OD} &= \overrightarrow{OA} + \overrightarrow{AD} \\
&= \overrightarrow{OA} + 2\overrightarrow{AC} \\
&= \mathbf{a} + 2\mathbf{b} \\
&= 3\overrightarrow{ON};
\end{aligned}$$

hence,  $OND$  is a straight line.