

**Dr Oliver Mathematics**  
**AQA GCSE Mathematics**  
**2017 June Paper 2: Calculator**  
**1 hour 30 minutes**

The total number of marks available is 80.  
You must write down all the stages in your working.

1. Circle the decimal that is closest in value to  $\frac{39}{800}$ . (1)
- 0.04   0.048   0.049   0.05

**Solution**

Well,

$$\frac{39}{800} = 0.04875$$

and so

$$0.04 \quad 0.048 \quad \underline{0.049} \quad 0.05$$

2. Circle the area that is equal to  $36 \text{ mm}^2$ . (1)

**Solution**

Well,

$$\begin{aligned} 36 \text{ mm}^2 &= 36 \times 1 \text{ mm}^2 \\ &= 36 \times 1 \text{ mm} \times 1 \text{ mm} \\ &= 36 \times 0.1 \text{ cm} \times 0.1 \text{ cm} \\ &= 36 \times 0.01 \text{ cm}^2 \\ &= 0.36 \text{ cm}^2 \end{aligned}$$

and so

$$360 \text{ cm}^2 \quad 3600 \text{ cm}^2 \quad 3.6 \text{ cm}^2 \quad \underline{0.36 \text{ cm}^2}$$

3.  $A$  is  $(2, 12)$  and  $B$  is  $(8, 2)$ . (1)  
Circle the midpoint of  $AB$ .

$$(3, 5) \quad (4, 6) \quad (5, 7) \quad (6, 10)$$

**Solution**

Well, the midpoint is

$$\left(\frac{2+8}{2}, \frac{12+2}{2}\right) = (5, 7)$$

and so

$$(3, 5) \quad (4, 6) \quad \underline{(5, 7)} \quad (6, 10)$$

4. Here is a sequence.

$$90 \quad 82 \quad 74 \quad 66 \quad 58$$

(1)

Circle the expression for the  $n$ th term of the sequence.

$$n - 8 \quad 98 - 8n \quad 8n + 82 \quad 8n - 98$$

**Solution**

Well, we go down by 8 every time — and it can't be the expression in 1, 3, or 4! So

$$n - 8 \quad \underline{98 - 8n} \quad 8n + 82 \quad 8n - 98$$

5. A code has 4 digits.  
Each digit is a number from 0 to 9.  
Digits may be repeated.

The code starts

$$5 \quad 4 \quad 1$$

- (a) Amy knows the last digit is odd but not 7.  
She chooses a different odd number at random.  
What is the probability that she chooses the correct number?

(1)

**Solution**

“Amy knows the last digit is odd but not 7”: in that case, she has four numbers to play with (1, 3, 5, or 9). So

$$\text{probability} = \underline{\underline{\frac{1}{4}}}.$$

- (b) The 4-digit code is changed to an even number. (2)  
 The first digit is 3.  
 How many possible codes are there?

**Solution**

$$10 \times 10 \times 5 = \underline{\underline{500 \text{ codes}}}.$$

6. (a) Complete the table of values for (2)

$$y = x^2 - x - 2.$$

$x$	-2	-1	0	1	2	3
$y$			-2	-2		4

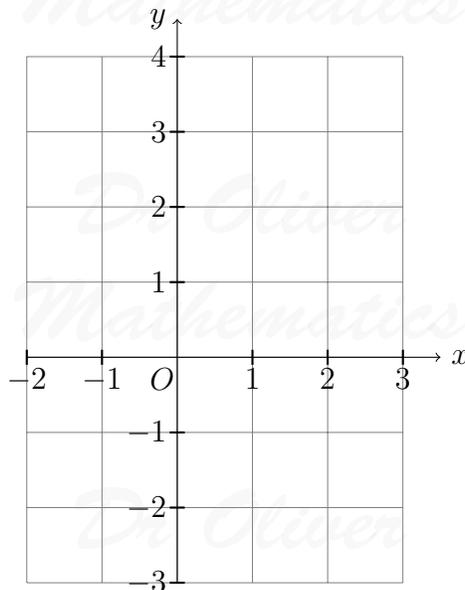
**Solution**

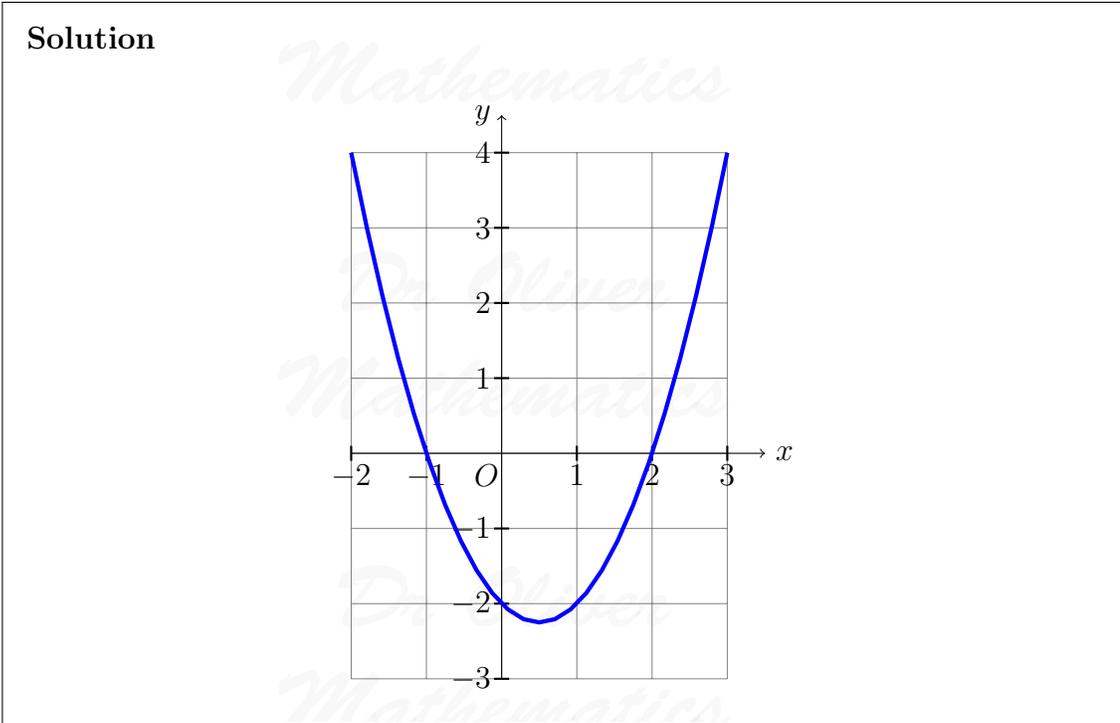
$x$	-2	-1	0	1	2	3
$y$	<u>4</u>	<u>0</u>	-2	-2	<u>0</u>	4

- (b) Draw the graph of (2)

$$y = x^2 - x - 2$$

for values of  $x$  from -2 to 3.

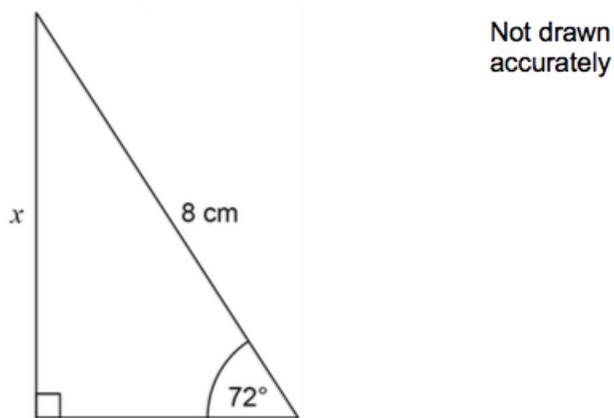




(c) Write down the  $x$ -coordinate of the turning point of the graph. (1)



7. Use trigonometry to work out the length  $x$ . (2)



**Solution**

$$\begin{aligned}\sin &= \frac{\text{opp}}{\text{hyp}} \Rightarrow \sin 72^\circ = \frac{x}{8} \\ &\Rightarrow x = 8 \sin 72^\circ \\ &\Rightarrow x = 7.608\ 452\ 13 \text{ (FCD)} \\ &\Rightarrow \underline{\underline{x = 7.61 \text{ cm (3 sf)}}}.\end{aligned}$$

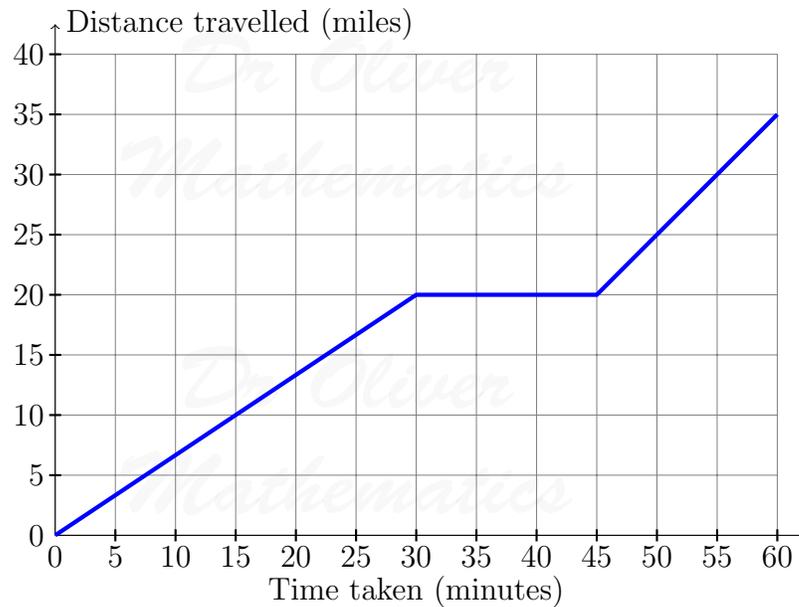
8. Lily goes on a car journey.

- For the first 30 minutes her average speed is 40 miles per hour.
- She then stops for 15 minutes.
- She then completes the journey at an average speed of 60 miles per hour.
- The total journey time is 1 hour.

(a) Draw a distance-time graph for her journey.

(3)

**Solution**



(b) Write down the average speed for the total journey.

(1)

**Solution**

Well,

$$\begin{aligned}\text{average speed} &= \frac{35 \text{ miles}}{1 \text{ hour}} \\ &= \underline{\underline{35 \text{ mph.}}}\end{aligned}$$

9. The table shows information about some CDs.

(4)

Type	Rock	Pop	Jazz
Number of CDs	2	$x$	$2x + 5$

A CD is chosen at random.

The probability it is **rock** is  $\frac{1}{20}$ .

Work out the probability it is jazz.

**Solution**

Well,

$$2 + x + (2x + 5) = 3x + 7$$

and so

$$P(\text{rock}) = \frac{1}{20} \Rightarrow \frac{2}{3x + 7} = \frac{1}{20}$$

cross-multiply:

$$\Rightarrow 3x + 7 = 40$$

$$\Rightarrow 3x = 33$$

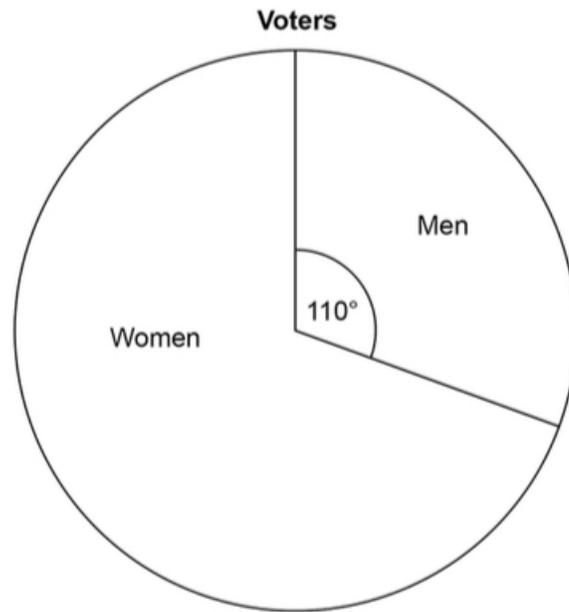
$$\Rightarrow x = 11$$

and that means

$$\begin{aligned}P(\text{jazz}) &= \frac{2(11) + 5}{3(11) + 7} \\ &= \frac{22 + 5}{33 + 7} \\ &= \underline{\underline{\frac{27}{40}}}\end{aligned}$$

10. The pie chart shows information about voters in an election.

(3)



3 360 **more** women voted than men.

Work out the total number of voters.

**Solution**

The women account for

$$360 - 110 = 250^\circ$$

of the pie chart.

Now, let  $x$  and  $y$  be the number of votes cast by men and women respectively. Then

$$\frac{y}{x} = \frac{250}{110} \Rightarrow \frac{3\,360 + x}{x} = \frac{25}{11}$$

cross-multiply:

$$\Rightarrow 11(3\,360 + x) = 25x$$

$$\Rightarrow 36\,960 + 11x = 25x$$

$$\Rightarrow 36\,960 = 14x$$

$$\Rightarrow x = 2\,640$$

$$\Rightarrow y = 3\,360 + 2\,640$$

$$\Rightarrow y = 6\,000.$$

Finally,

$$\begin{aligned}\text{total number of voters} &= 2\,640 + 6\,000 \\ &= \underline{8\,640}.\end{aligned}$$

11. Write these numbers in descending order:

(2)

$$9\,563 \quad 9.56 \times 10^3 \quad 9.56 \times 3^{10}$$

**Solution**

Well,

$$9\,563 = 9.563 \times 10^3$$

$$9.56 \times 10^3$$

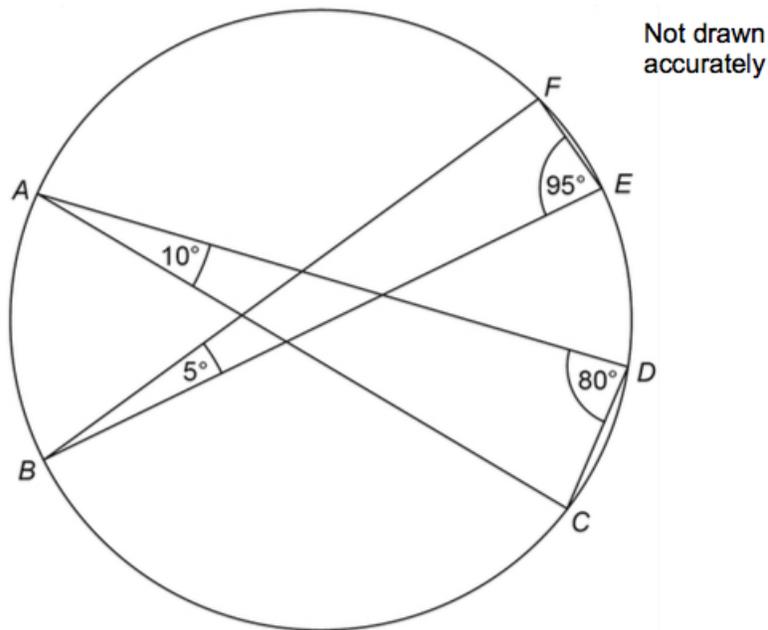
$$9.563^{10} = 5.645\,084\,4 \times 10^5$$

So the answer is

$$\underline{9.56 \times 3^{10} \quad 9\,563 \quad 9.56 \times 10^3}$$

12.  $A$ ,  $B$ ,  $C$ ,  $D$ ,  $E$ , and  $F$  are points on a circle.

(1)



Circle the line that is a diameter of the circle.

*BE AD AC BF*

**Solution**

Well,

$$\angle ACD = 180 - (10 + 80) = 90^\circ$$

and so

*BE AD AC BF*

13. To make one cheese sandwich, Gina uses one bread roll and two cheese slices.

(4)

<b>Pack of 15 bread rolls</b>
<b>£1.88</b>

<b>Pack of 20 cheese slices</b>
<b>£2.15</b>

She is going to buy enough packs to

- have exactly twice as many cheese slices as bread rolls and
- make **more** than 100 cheese sandwiches.

Work out the least amount she can spend.

**Solution**

Well,

$$\begin{aligned} \text{bread rolls : cheese slices} &= 1 : 2 \\ &= 120 : 240. \end{aligned}$$

So she needs

$$\frac{120}{8} = 15$$

packs of bread rolls and

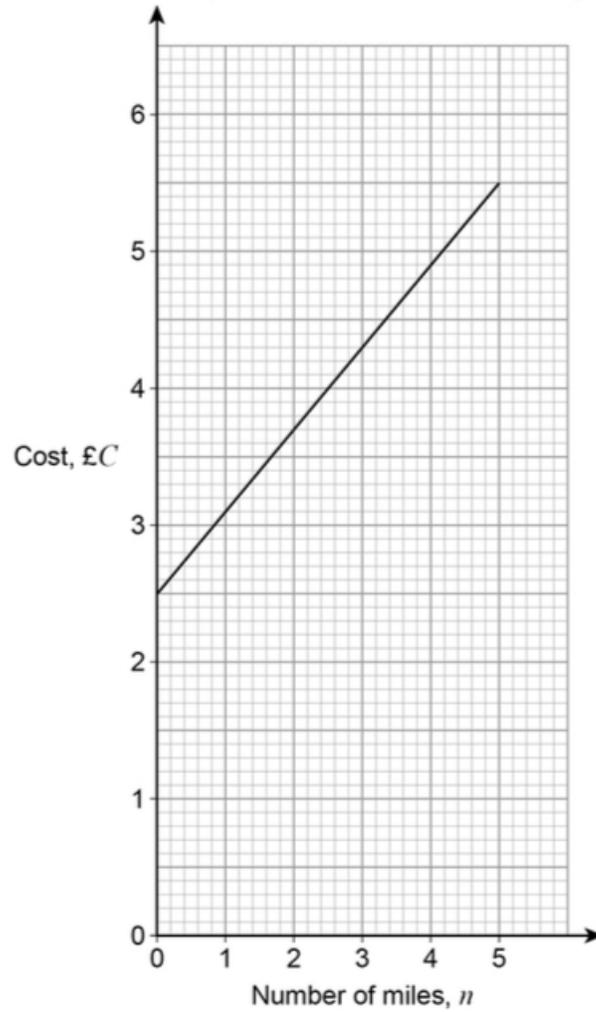
$$\frac{240}{2} = 12$$

packs of cheese slices. Finally,

$$\begin{aligned} \text{least amount} &= (8 \times 1.88) + (12 \times 2.15) \\ &= 15.04 + 25.80 \\ &= \underline{\underline{\pounds 40.84}}. \end{aligned}$$

14. The graph shows the cost of some taxi journeys.

(3)



Work out a formula for  $C$  in terms of  $n$ .

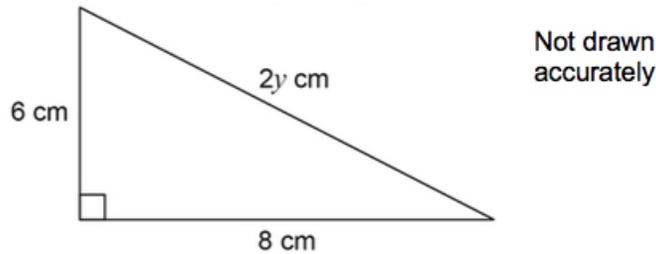
**Solution**

$$\begin{aligned}\text{Gradient} &= \frac{5.5 - 2.5}{5 - 0} \\ &= 0.6\end{aligned}$$

and, clearly, the  $C$ -intercept is 2.5. Hence,

$$\underline{C = 0.6n + 2.5.}$$

15. Sami is trying to work out the exact value of  $y$  using Pythagoras' theorem.



Here is her working.

$$(2y)^2 = 6^2 + 8^2$$

$$2y^2 = 36 + 64$$

$$2y^2 = 100$$

$$y^2 = 100 \div 2$$

$$y^2 = 50$$

$$y = \sqrt{50}.$$

(a) What error has she made in her working?

(1)

**Solution**

She has not squared the 2: she should have written  $4y^2$  instead of  $2y^2$ .

(b) Kai works out that  $y = 5$ .

(1)

Mel says, “ $y$  cannot be 5 because the hypotenuse should be the longest side and the other sides are longer than 5 cm.”

Is Mel correct?

Tick a box.

Yes

No

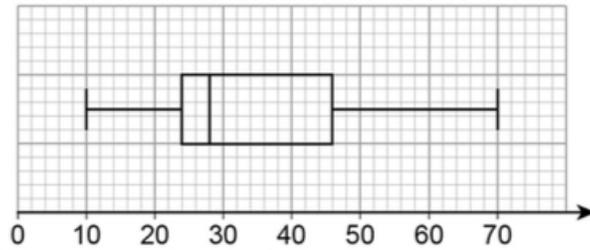
Give a reason for your answer.

**Solution**

No: Mel did not double it to get 10.

16. Here is a box plot.

(1)



Circle the median value.

28 35 24 22

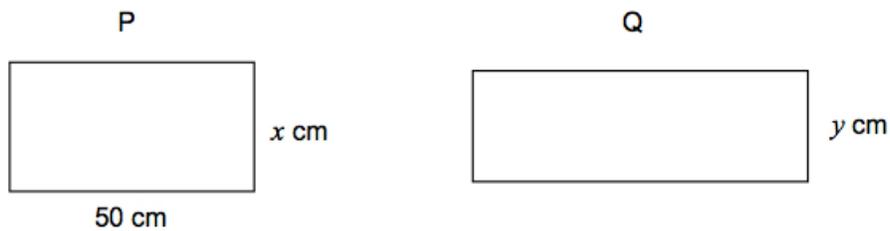
**Solution**

28 35 24 22

17.  $P$  is a rectangle with length 50 cm and width  $x$  cm.

(4)

$Q$  is a rectangle with width  $y$  cm.



- The length of  $Q$  is 20% more than the length of  $P$ .
- The area of  $Q$  is 10% less than the area of  $P$ .

Work out the ratio  $x : y$ .

Give your answer in its simplest form.

**Solution**

$Q$ 's length is

$$\frac{120}{100} \times 50 = 60 \text{ cm}$$

and  $Q$ 's area is

$$(1 - 0.1) \times 50x = 0.9 \times 50x \\ = 45x.$$

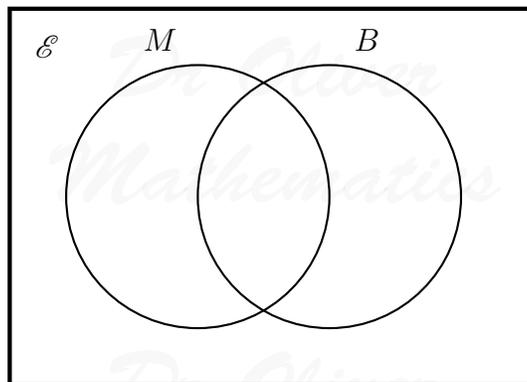
Now,

$$\frac{x}{y} = \frac{60}{45} \Rightarrow x : y = 60 : 45 \\ \Rightarrow \underline{\underline{x : y = 4 : 3.}}$$

18. A school has 86 teachers.

- 42 are male and 44 are female.
  - $\frac{1}{3}$  of the male teachers have blue eyes.
  - $\frac{1}{4}$  of the female teachers have blue eyes.
- (a)  $\mathcal{E} = \{\text{teachers in the school}\}$ .  
 $M = \{\text{male teachers}\}$ .  
 $B = \{\text{teachers who have blue eyes}\}$ .

(3)



Complete the Venn diagram.

**Solution**

Well, the number of teachers who are male and have blue eyes is

$$\frac{1}{3} \times 42 = 14$$

which means there are

$$42 - 14 = 28$$

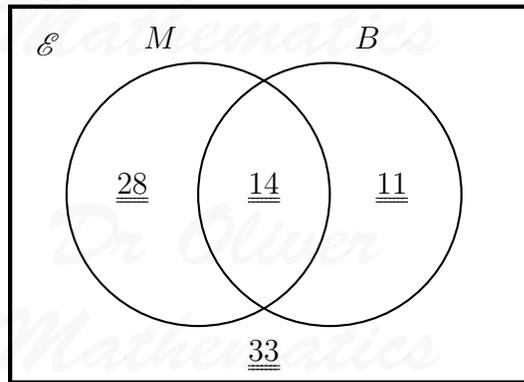
male teachers who have different coloured eyes. Next, the number of teachers who are female and have blue eyes is

$$\frac{1}{4} \times 44 = 11$$

which means there are

$$44 - 11 = 33$$

female teachers who have different coloured eyes.



- (b) One teacher who has blue eyes is chosen at random.

(1)

Work out the probability that the teacher is male.

**Solution**

$$\begin{aligned} P(\text{male given blue eyes}) &= \frac{14}{14 + 11} \\ &= \frac{14}{25} \end{aligned}$$

19. Rana sells 192 cakes in the ratio

(5)

$$\text{small} : \text{medium} : \text{large} = 7 : 6 : 11.$$

- The profit for one medium cake is twice the profit for one small cake.
- The profit for one large cake is three times the profit for one small cake.

Her total profit is £532.48.

Work out the profit for one small cake.

**Solution**

Well,

$$7 + (2 \times 6) + (3 \times 11) = 7 + 12 + 33 = 52$$

and the profit for one small cake is

$$\frac{7}{52} \times 532.48 = \pounds 71.68.$$

Now,

$$7 + 6 + 11 = 24$$

and

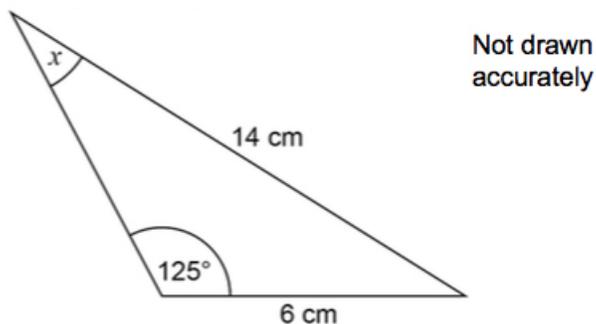
$$\frac{7}{24} \times 192 = 56 \text{ cakes.}$$

Finally, the profit for one small cake is

$$\frac{71.68}{56} = \underline{\underline{\pounds 1.28.}}$$

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

(3)

**Solution**

Sine rule:

$$\begin{aligned} \frac{\sin x^\circ}{6} &= \frac{\sin 125^\circ}{14} \Rightarrow \sin x^\circ = \frac{6 \sin 125^\circ}{14} \\ &\Rightarrow x = 20.55247901 \text{ (FCD)} \\ &\Rightarrow \underline{\underline{x = 20.6 \text{ (3 sf)}}}. \end{aligned}$$

21. Solve

$$5x^2 = 10x + 4.$$

(4)

Give your answers to 2 decimal places.

**Solution**

$$5x^2 = 10x + 4 \Rightarrow 5x^2 - 10x - 4 = 0$$

quadratic formula:  $a = 5$ ,  $b = -10$ , and  $c = -4$

$$\begin{aligned} x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ &= \frac{10 \pm \sqrt{(-10)^2 - 4 \times 5 \times (-4)}}{2 \times 5} \\ &= \frac{10 \pm \sqrt{180}}{10} \\ &= -0.341\,640\,786\,5, 2.341\,640\,786 \text{ (FCD)} \\ &= \underline{\underline{-0.34, 2.34}} \text{ (2 dp)}. \end{aligned}$$

22. A ball, dropped vertically, falls  $d$  metres in  $t$  seconds.

(4)

- $d$  is directly proportional to the square of  $t$ .
- The ball drops 45 metres in the first 3 seconds.

How far does the ball drop in the **next** 7 seconds?

**Solution**

Now,

$$d \propto t^2 \Rightarrow d = kt^2,$$

for some constant  $k$ . Next,

$$45 = k \times 3^2 \Rightarrow k = 5$$

and so

$$d = 5t^2.$$

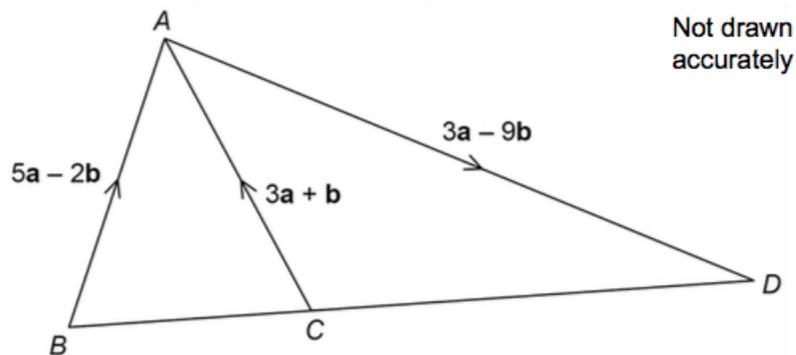
Finally, the ball drops

$$\begin{aligned}d_{10} - d_3 &= (5 \times 10^2) - 45 \\ &= 500 - 45 \\ &= \underline{\underline{455 \text{ m}}}\end{aligned}$$

in the next 7 seconds

23. Is  $BCD$  a straight line?

(3)



Show working to support your answer.

**Solution**

Well,

$$\begin{aligned}\vec{BC} &= \vec{BA} + \vec{AC} \\ &= \vec{BA} - \vec{CA} \\ &= (5\mathbf{a} - 2\mathbf{b}) - (3\mathbf{a} + \mathbf{b}) \\ &= 2\mathbf{a} - 3\mathbf{b}\end{aligned}$$

and

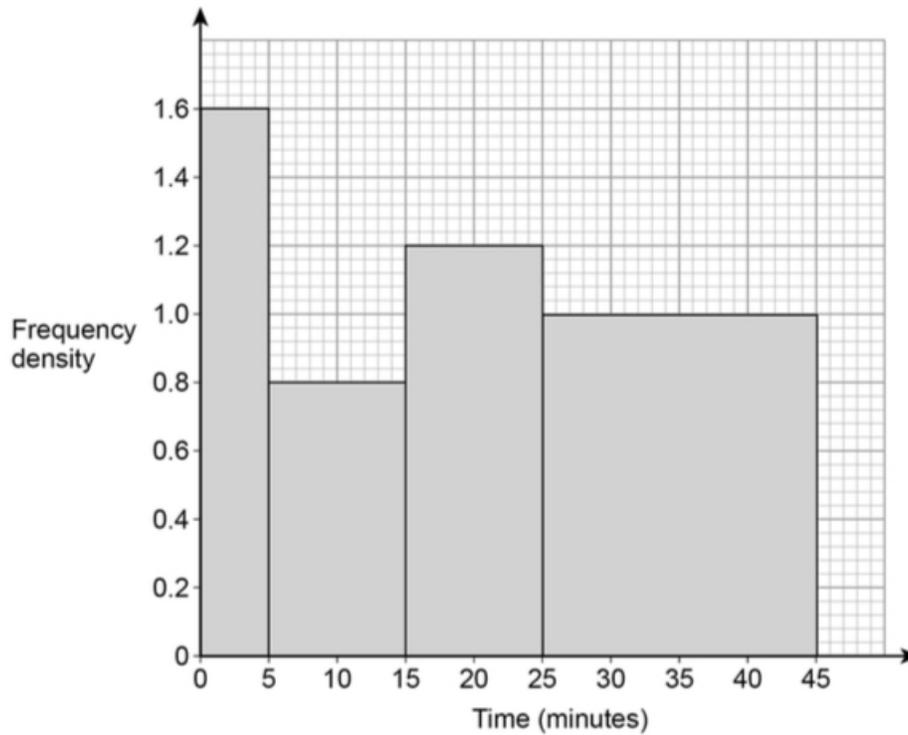
$$\begin{aligned}\vec{BD} &= \vec{BA} + \vec{AD} \\ &= (5\mathbf{a} - 2\mathbf{b}) + (3\mathbf{a} - 9\mathbf{b}) \\ &= 8\mathbf{a} - 11\mathbf{b} \\ &= 4\left(2\mathbf{a} - \frac{11}{4}\mathbf{b}\right);\end{aligned}$$

$\vec{BC}$  is not parallel to  $\vec{BD}$  and so  $BCD$  a not straight line.

24. 48 students completed some homework.

(4)

This histogram shows information about the times taken.



Work out an estimate of the interquartile range.

You **must** show your working.

### Solution

Interval	Frequency Density	Width	Frequency	Cum. Freq.
0 - 5	1.6	5	$1.6 \times 5 = 8$	8
5 - 15	0.8	10	$0.8 \times 10 = 8$	$8 + 8 = 16$
15 - 25	1.2	10	$1.2 \times 10 = 12$	$16 + 12 = 28$
25 - 45	1	20	$1 \times 20 = 20$	$28 + 20 = 48$
Total			48 ✓	

Now, the LQ at the 12th position and it is

$$\begin{aligned} \text{LQ} &= 5 + \left(\frac{4}{8} \times 10\right) \\ &= 5 + 5 \\ &= 10. \end{aligned}$$

The UQ at the 36th position and it is

$$\begin{aligned} \text{UQ} &= 28 + \left(\frac{8}{20} \times 20\right) \\ &= 28 + 8 \\ &= 36. \end{aligned}$$

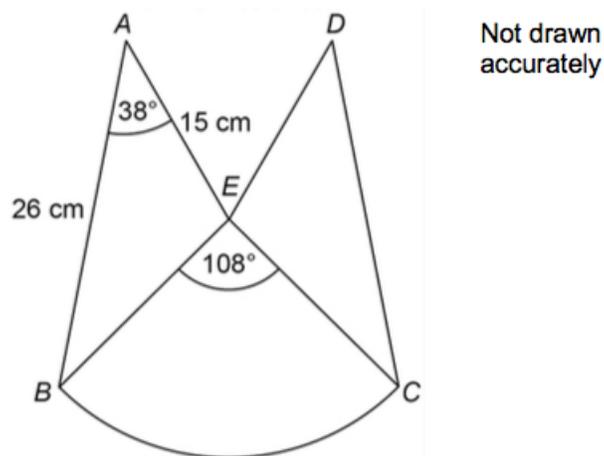
Finally,

$$\begin{aligned} \text{IQR} &= \text{UQ} - \text{LQ} \\ &= 36 - 10 \\ &= \underline{\underline{26}}. \end{aligned}$$

25. The diagram shows a logo.

(5)

- $ABE$  and  $DCE$  are congruent triangles.
- $BCE$  is a sector of a circle, centre  $E$ .



Show that the area of the logo is  $510 \text{ cm}^2$ , to 2 significant figures.

**Solution**

Area of a triangle:

$$\begin{aligned} \text{Area of } ABE &= \frac{1}{2} \times 26 \times 15 \times \sin 38^\circ \\ &= 120.053\,987\,7 \text{ (FCD)}. \end{aligned}$$

Cosine rule:

$$\begin{aligned} BE^2 &= AB^2 + AE^2 - 2 \times AB \times AE \times \cos BAE \\ \Rightarrow BE^2 &= 26^2 + 15^2 - 2 \times 26 \times 15 \times \cos 38^\circ \\ \Rightarrow BE &= 16.921\,926\,96 \text{ (FCD)} \end{aligned}$$

and

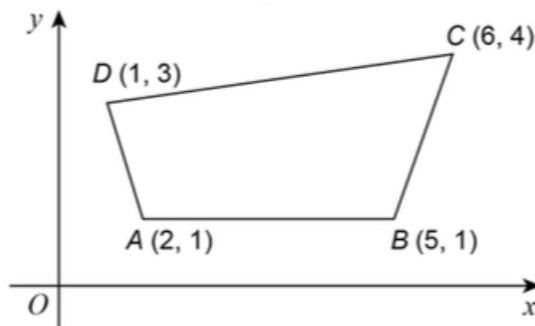
$$\begin{aligned} \text{the area of the sector } BCE &= \frac{108}{360} \times \pi \times 16.921\dots^2 \\ &= 269.880\,036\,4 \text{ (FCD)}. \end{aligned}$$

Finally,

$$\begin{aligned} \text{the area of the logo} &= (2 \times 120.053\dots) + 269.880\dots \\ &= 509.988\,011\,7 \text{ (FCD)} \\ &= \underline{\underline{510 \text{ cm}^2}} \text{ (2 sf)}. \end{aligned}$$

26. (a) A sketch of a quadrilateral  $ABCD$  is shown.

(1)



Not drawn accurately

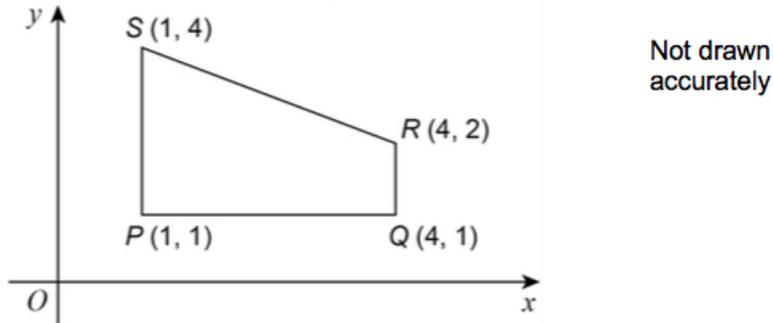
$ABCD$  is enlarged, centre  $B$ , scale factor  $\frac{1}{3}$ .  
Circle the vertex that is invariant.

A B C D

**Solution**

A B C D

(b) A sketch of a quadrilateral  $PQRS$  is shown. (1)



$PQRS$  is reflected in the line  $y = x$ .  
Circle the vertex that is invariant.

P Q R S

**Solution**

P Q R S

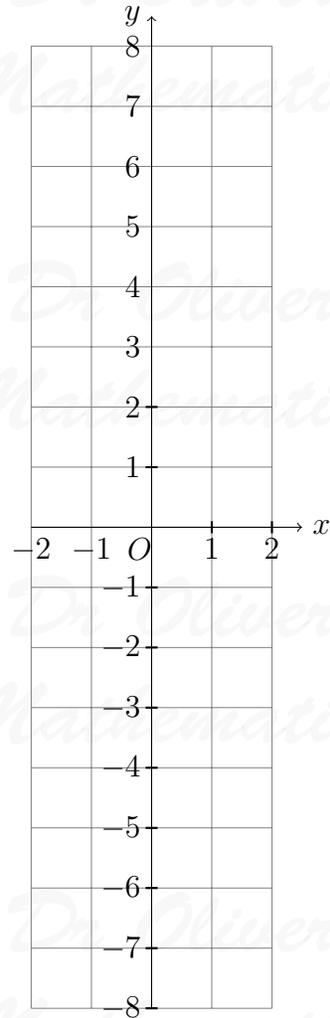
27. (a) (2)

$$h(x) = \sqrt[3]{x} \text{ for all values of } x.$$

On the grid, draw the graph of the inverse function  $y = h^{-1}(x)$  for  $-2 \leq x \leq 2$ .

Dr Oliver

Mathematics



**Solution**

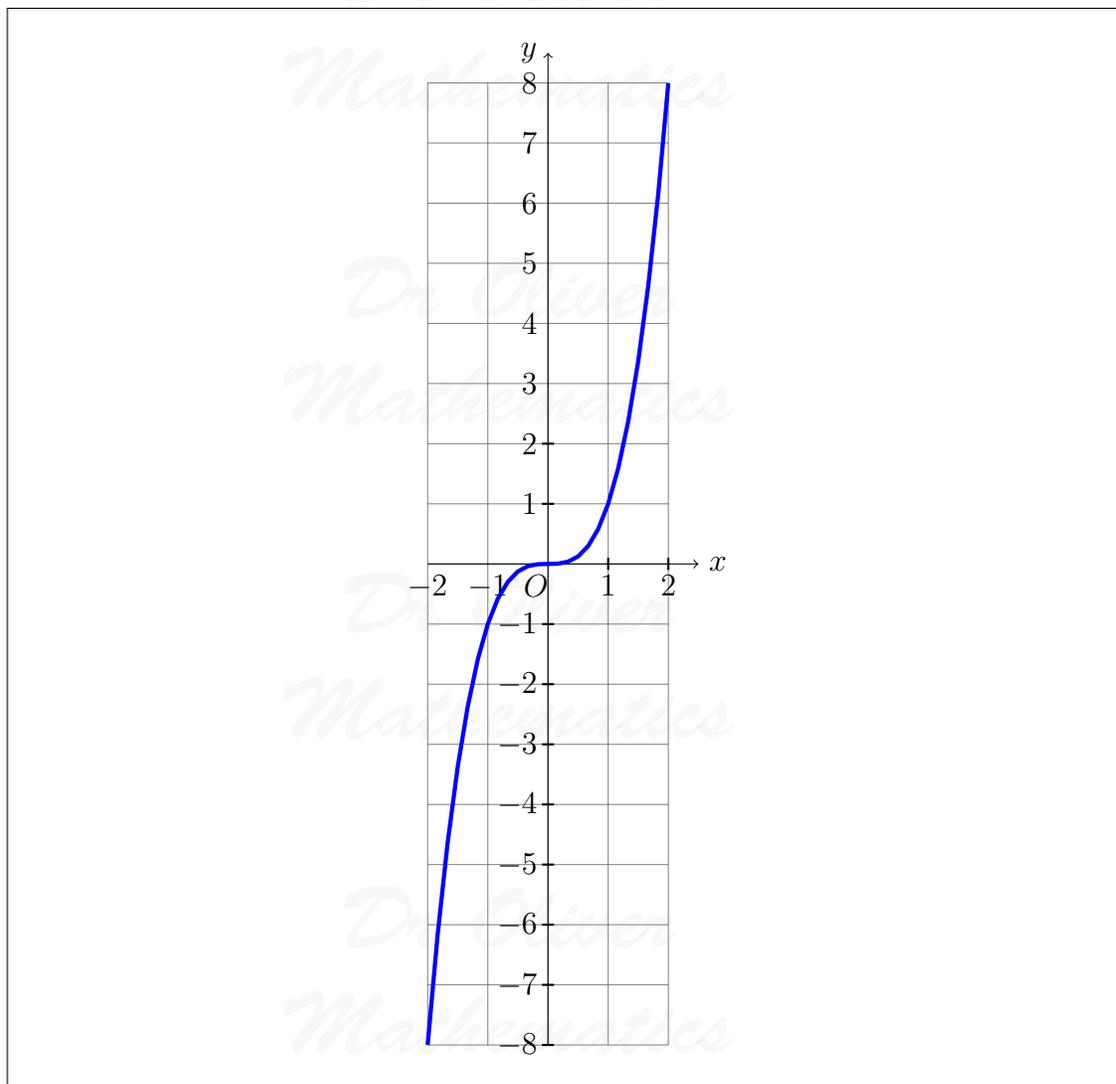
Well,

$$y = \sqrt[3]{x} \Rightarrow y^3 = x$$

and, so,

$$h^{-1}(x) = x^3.$$

Mathematics

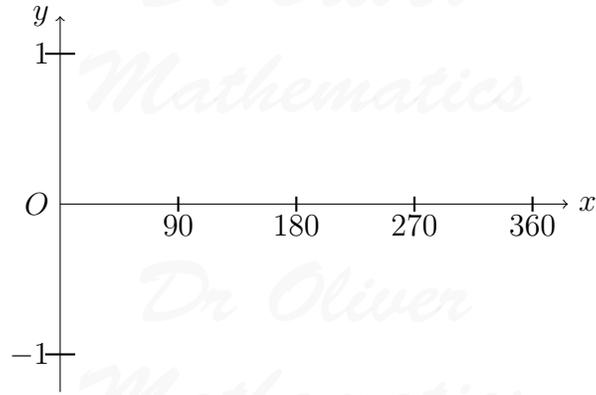


(b) For all values of  $x$ ,

- $f(x) = \sin x^\circ$  and
- $g(x) = (x + 90)^\circ$ .

On the grid, draw the graph of the composite function  $y = f g(x)$  for  $0 \leq x \leq 360$ .

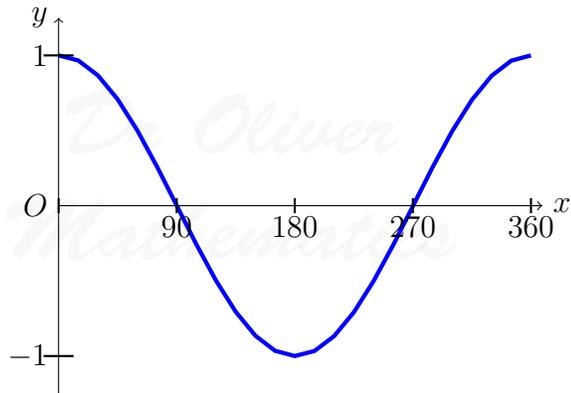
(2)



**Solution**

Now,

$$\begin{aligned} f \circ g(x) &= f(g(x)) \\ &= f(x + 90)^\circ \\ &= \sin(x + 90)^\circ. \end{aligned}$$



$(f \circ g(x) = \cos x^\circ!)$