

**Dr Oliver Mathematics**  
**GCSE Mathematics**  
**2012 November Paper 2H: Calculator**  
**1 hour 45 minutes**

The total number of marks available is 100.

You must write down all the stages in your working.

1. Use a calculator to work out

$$\frac{\sqrt{20.4}}{6.2 \times 0.48}$$

(2)

Write down all the figures on your calculator display.

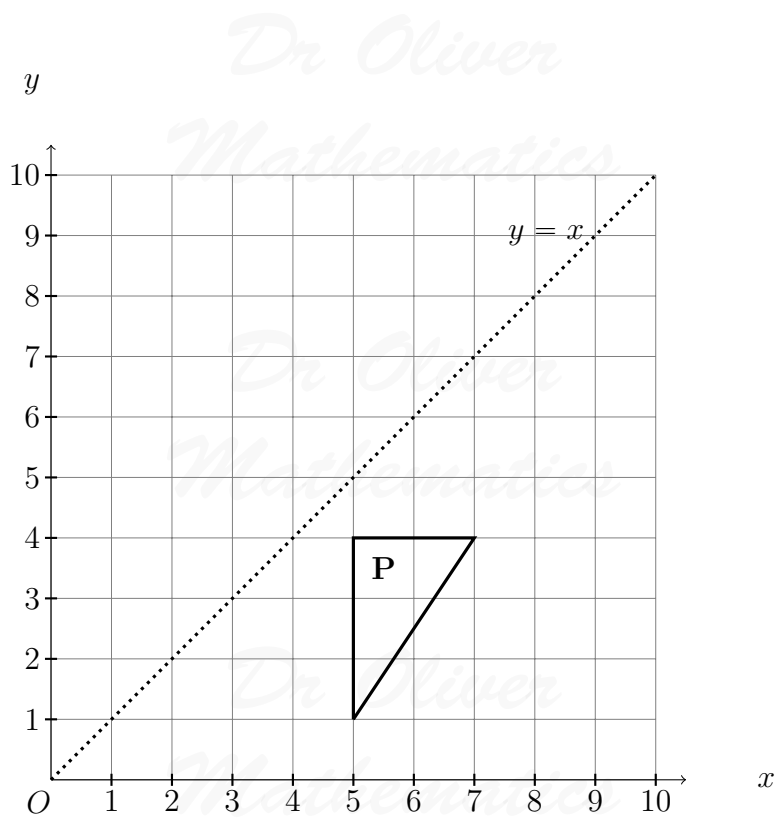
Give your answer as a decimal.

**Solution**

$$\begin{aligned} \frac{\sqrt{20.4}}{6.2 \times 0.48} &= \frac{\sqrt{20.4}}{2.976} \\ &= \underline{\underline{1.517\ 686\ 8}} \text{ (FCD)}. \end{aligned}$$

2. (a) Reflect shape **P** in the line  $y = x$ .

(2)

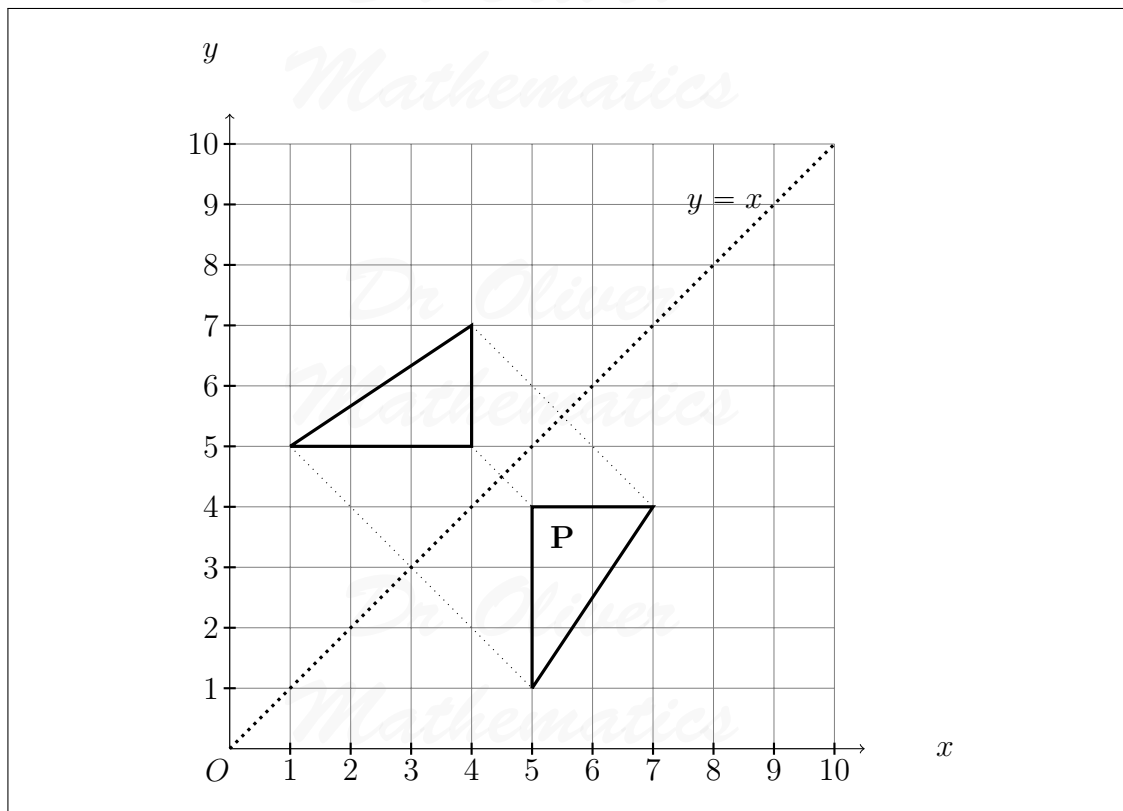


**Solution**

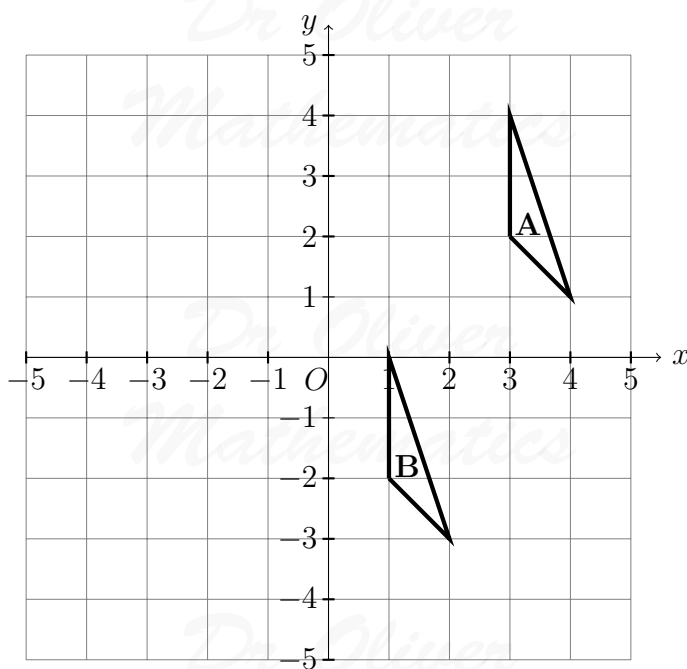
*Dr Oliver Mathematics*

*Dr Oliver Mathematics*

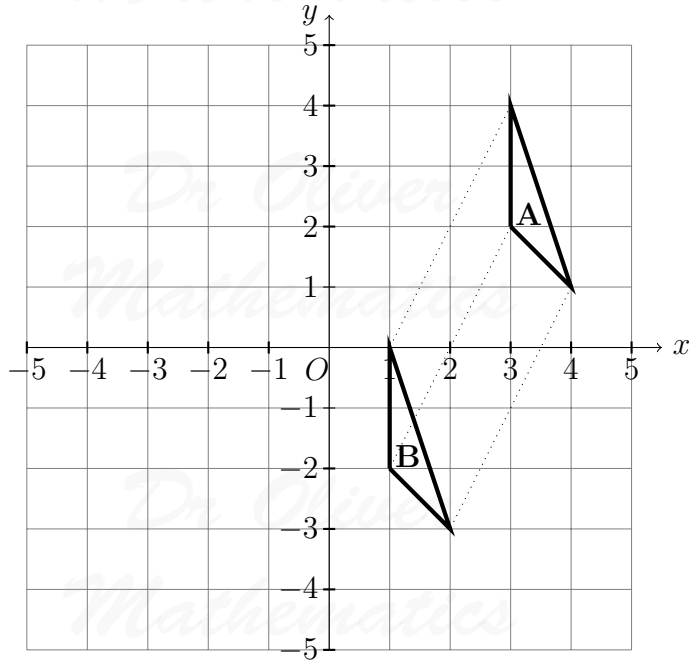
*Dr Oliver Mathematics*



(b) Describe fully the single transformation that maps triangle **A** onto triangle **B**. (2)



**Solution**



It is a translation by  $\underline{\underline{\begin{pmatrix} -2 \\ -4 \end{pmatrix}}}$ .

3. A company sells boxes to factories.

Fred buys boxes.

The boxes are sold in packs of 1 000.

Each pack costs £193.86.

Fred orders 3 packs of boxes.

He gets a discount on his total order.

The table shows the discount he will get.

(5)

Total Order	Discount
£100-£300	5%
£301-£400	10%
£401 and above	15%

Work out the total cost of the order after the discount.

You must show your working.

**Solution**

$$3 \times 193.86 = 581.58$$

and the

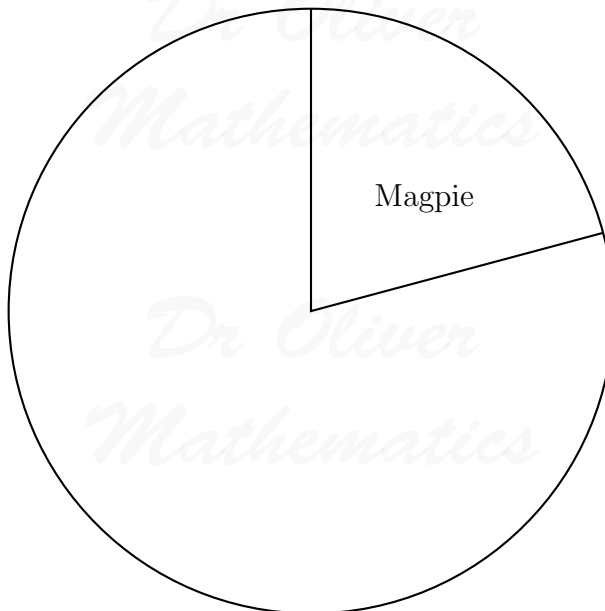
$$\begin{aligned} \text{total cost} &= 581.58 \times (1 - 0.15) \\ &= 581.58 \times 0.85 \\ &= 494.343; \end{aligned}$$

the order will cost Fred £494.34 or £494.35.

4. The table gives some information about the birds Paula sees in her garden one day. (3)

Bird	Frequency
Magpie	15
Thrush	10
Starling	20
Sparrow	27

Complete the accurate pie chart.



**Solution**

The total number of birds is

$$15 + 10 + 20 + 27 = 72.$$

Magpie:

$$\frac{15}{72} \times 360 = 75^\circ.$$

Thrush:

$$\frac{10}{72} \times 360 = 50^\circ.$$

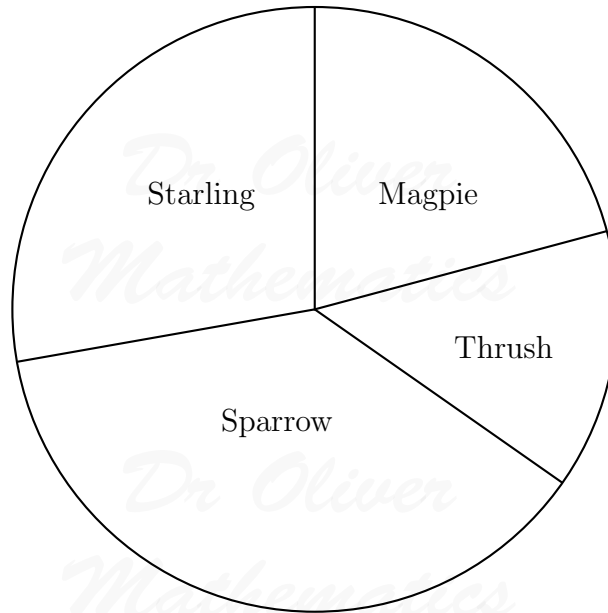
Starling:

$$\frac{20}{72} \times 360 = 100^\circ.$$

Sparrow:

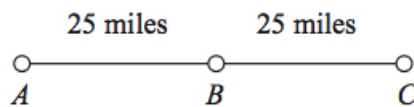
$$\frac{27}{72} \times 360 = 135^\circ.$$

E.g.,



5.  $A$ ,  $B$ , and  $C$  are three service stations on a motorway.

(3)



$AB = 25$  miles.

$BC = 25$  miles.

Aysha drives along the motorway from  $A$  to  $C$ .

Aysha drives at an average speed of 50 mph from  $A$  to  $B$ .

She drives at an average speed of 60 mph from  $B$  to  $C$ .

Work out the difference in the time Aysha takes to drive from  $A$  to  $B$  and the time Aysha takes to drive from  $B$  to  $C$ .

Give your answer in minutes.

**Solution**

From  $A$  to  $B$ , the time is

$$\frac{25}{50} = 0.5 \text{ hours} = 30 \text{ minutes.}$$

From  $B$  to  $C$ , the time is

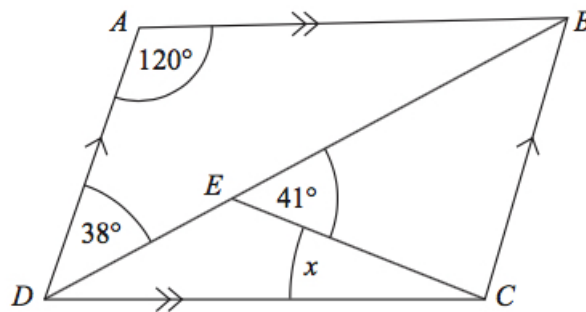
$$\frac{25}{60} = 0.41\bar{6} \text{ hours} = 25 \text{ minutes.}$$

Hence, the difference is

$$30 - 25 = \underline{\underline{5 \text{ minutes.}}}$$

6.  $ABCD$  is a parallelogram.

(4)



Angle  $ADB = 38^\circ$ .

Angle  $BEC = 41^\circ$ .

Angle  $DAB = 120^\circ$ .

Calculate the size of angle  $x$ .

You must give reasons for your answer.

**Solution**

$$\angle CDE = 180 - 120 - 38 = 22^\circ \text{ (interior angles).}$$

$$\angle CED = 180 - 41 = 139^\circ \text{ (supplementary angles).}$$

$$\angle DCE = 180 - 139 - 22 = \underline{\underline{19^\circ}} \text{ (completing the triangle).}$$

7. 160 cm of gold wire has a weight of 17.8 grams. (3)  
Work out the weight of 210 cm of the gold wire.

**Solution**

$$\frac{210}{160} \times 17.8 = \underline{\underline{23.3625 \text{ grams}}}$$

8. (a)  $n$  is an integer. (2)  
 $-1 \leq n < 4$ .  
List the possible values of  $n$ .

**Solution**

$$\underline{\underline{-1, 0, 1, 2, 3.}}$$

- (b) Write down the inequality shown in the diagram. (2)

**Solution**

$$\underline{\underline{-4 < x \leq 3.}}$$

- (c) Solve (2)  
 $3y - 2 > 5$ .



**Solution**

$$3y - 2 > 5 \Rightarrow 3y > 7 \\ \Rightarrow \underline{\underline{y > 2\frac{1}{3}}}.$$

9. The stem and leaf diagram gives information about the numbers of tomatoes on 31 tomato plants.

0	8	8	9				
1	1	1	5	5			
2	1	2	2	6	7	8	8
3	0	2	5	5	7	9	
4	2	2	3	5	8	8	
5	1	1	3	4	7		

Key: 5 | 7 = 57 tomatoes

- (a) Work out the median.

(1)

**Solution**

The median is the

$$\frac{31 + 1}{2} = 16\text{th entry}$$

and the median is 32.

- (b) Work out the interquartile range.

(2)

**Solution**

$$\text{IQR} = 45 - 21 = \underline{\underline{24}}.$$

10. In the UK, petrol cost £1.24 per litre.  
In the USA, petrol cost 3.15 dollars per US gallon.  
1 US gallon = 3.79 litres.  
£1 = 1.47 dollars.  
Was petrol cheaper in the UK or in the USA?

(4)

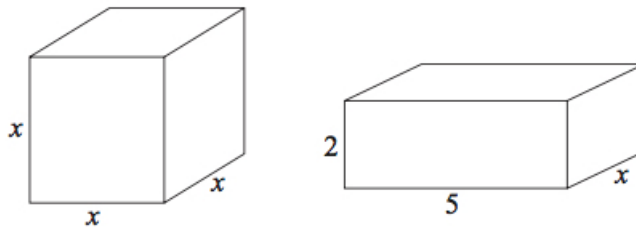
**Solution**

In the USA, petrol costs

$$\frac{3.15}{3.79 \times 1.47} = 0.565\ 397\ 663 \text{ (FCD);}$$

hence, it is cheaper in the USA.

11. The diagram shows a cube and a cuboid.



All the measurements are in cm.

The volume of the cube is  $100 \text{ cm}^3$  more than the volume of the cuboid.

- (a) Show that

$$x^3 - 10x = 100.$$

(2)

**Solution**

The volume of the cube is

$$x \times x \times x = x^3$$

and the volume of the cuboid is

$$2 \times 5 \times x = 10x.$$

Finally, the is a difference of 100:

$$\underline{\underline{x^3 - 10x = 100.}}$$

- (b) Use a trial and improvement method to find the value of  $x$ .

Give your answer correct to 1 decimal place.

You must show **all** your working.

(4)

**Solution**

$x$	$x^3 - 10x$	Comment
3	-3	too low
4	24	too low
5	75	too low
6	156	too high

So, the answer is between 5 and 6.

You must be in TABLE mode; on my calculator (Casio fx-991) it is Mode 3.

**F(X)=** and you type in  $X^3 - 10X$ ; then you press  $\boxed{=}$ .

**Start?** and you enter 5; then you press  $\boxed{=}$ .

**End?** and you enter 6; then you press  $\boxed{=}$ .

**Step?** and enter 0.05 – 1 decimal place divided by 2; then you press  $\boxed{=}$ .

$x$	$f(x)$	Comment
5.35	99.63	too low
5.4	103.46	too high

Clearly,

$$5.35 < x < 5.4$$

and the answer is

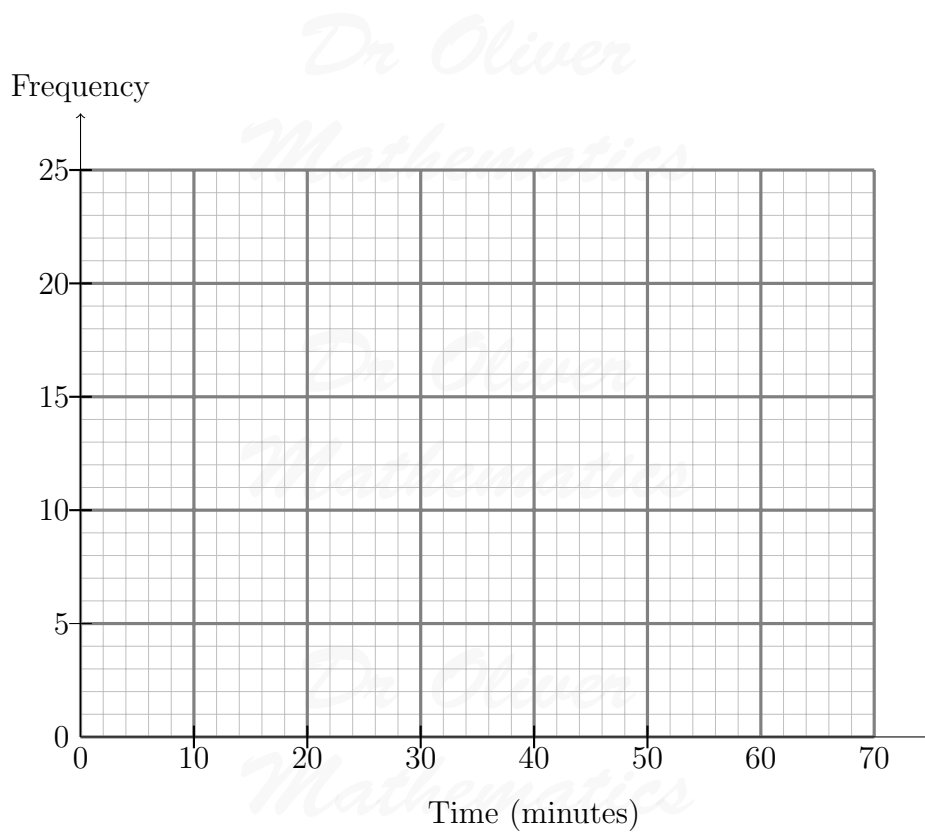
$$\underline{\underline{x = 5.4 \text{ (1 dp)}}}.$$

12. The frequency table gives information about the times it took some office workers to get to the office one day.

Time ( $t$ minutes)	Frequency
$0 < t \leq 10$	4
$10 < t \leq 20$	8
$20 < t \leq 30$	14
$30 < t \leq 40$	16
$40 < t \leq 50$	6
$50 < t \leq 60$	2

- (a) Draw a frequency polygon for this information.

(2)

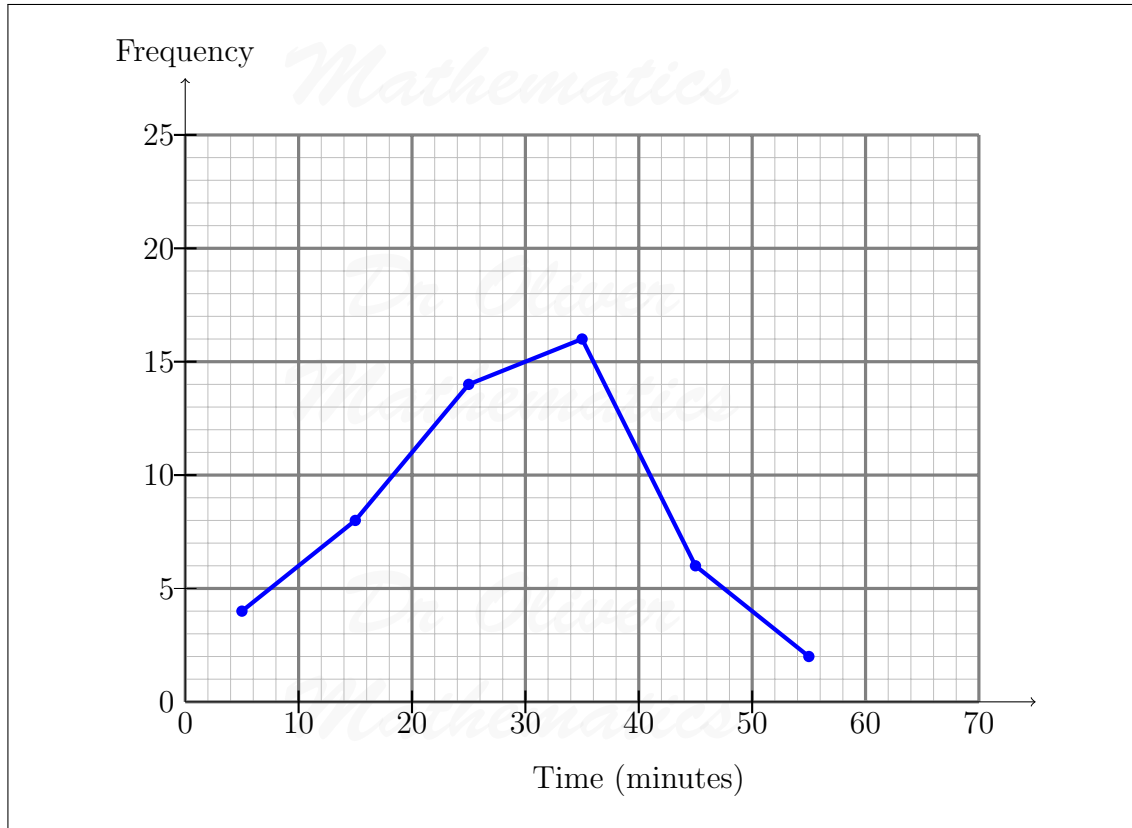


**Solution**

Dr Oliver  
Mathematics

Dr Oliver  
Mathematics

Dr Oliver  
Mathematics



- (b) Write down the modal class interval. (1)

**Solution**

$$\underline{\underline{30 < t \leq 40.}}$$

One of the office workers is chosen at random.

- (c) Work out the probability that this office worker took more than 40 minutes to get to the office. (2)

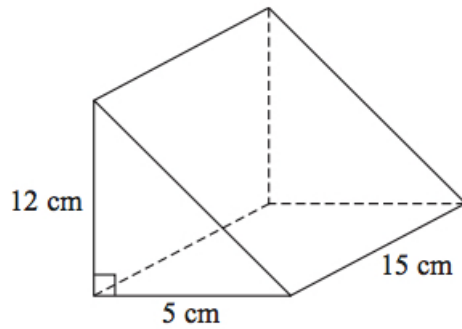
**Solution**

$$4 + 8 + 14 + 16 + 6 + 2 = 50$$

and the probability that this office worker took more than 40 minutes to get to the office is

$$\frac{8}{50} = \underline{\underline{\frac{4}{25}}}$$

13. The diagram shows a solid triangular prism. (3)



The prism is made from metal.  
 The density of the metal is 6.6 grams per  $\text{cm}^3$ .  
 Calculate the mass of the prism.

**Solution**

$$\begin{aligned} \text{Cross-sectional area} &= \frac{1}{2} \times 5 \times 12 \\ &= 30 \text{ cm}^2 \end{aligned}$$

and the

$$\begin{aligned} \text{volume} &= 30 \times 15 \\ &= 450 \text{ cm}^3. \end{aligned}$$

Finally,

$$\begin{aligned} \text{mass} &= 450 \times 6.6 \\ &= \underline{\underline{2970 \text{ g}}}. \end{aligned}$$

14. (a) Factorise

$$x^2 + 7x.$$

(1)

**Solution**

$$x^2 + 7x = \underline{\underline{x(x + 7)}}.$$

(b) Factorise

$$y^2 - 10y + 16.$$

(2)

**Solution**

$$\left. \begin{array}{l} \text{add to:} \quad -10 \\ \text{multiply to:} \quad +16 \end{array} \right\} -2, -8$$

$$y^2 - 10y + 16 = \underline{\underline{(y - 2)(y - 8)}}.$$

(c) (i) Factorise

(3)

$$2t^2 + 5t + 2.$$

**Solution**

$$\left. \begin{array}{l} \text{add to:} \quad +5 \\ \text{multiply to:} \quad (+2) \times (+2) = +4 \end{array} \right\} +1, +4$$

E.g.,

$$\begin{aligned} 2t^2 + 5t + 2 &= 2t^2 + 4t + t + 2 \\ &= 2t(t + 2) + 1(t + 2) \\ &= \underline{\underline{(2t + 1)(t + 2)}}. \end{aligned}$$

(ii)  $t$  is a positive whole number.

The expression

$$2t^2 + 5t + 2$$

can never have a value that is a prime number.

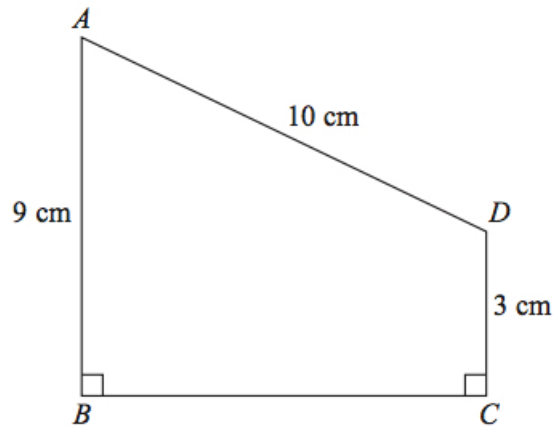
Explain why.

**Solution**

E.g., this is always a product of two whole numbers each of which is greater than 1.

15.  $ABCD$  is a trapezium.

(5)



$AD = 10$  cm.

$AB = 9$  cm.

$DC = 3$  cm.

Angle  $ABC =$  angle  $BCD = 90^\circ$ .

Calculate the length of  $AC$ .

Give your answer correct to 3 significant figures.

**Solution**

$$9 - 3 = 6 \text{ cm}$$

and

$$\begin{aligned} BC &= \sqrt{10^2 - 6^2} \\ &= \sqrt{64} \\ &= 8. \end{aligned}$$

Hence,

$$\begin{aligned} AC &= \sqrt{9^2 + 8^2} \\ &= \sqrt{145} \\ &= 12.041\ 594\ 58 \text{ (FCD)} \\ &= \underline{\underline{12.0 \text{ cm (3 sf)}}}. \end{aligned}$$

16. Bill's weight decreases from 64.8 kg to 59.3 kg.  
Calculate the percentage decrease in Bill's weight.  
Give your answer correct to 3 significant figures.

(3)

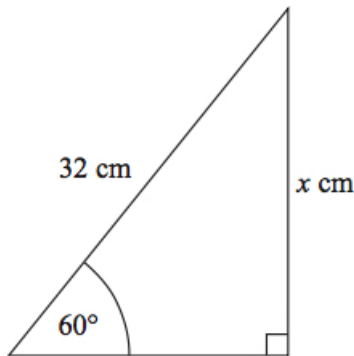


**Solution**

$$\begin{aligned}\text{Percentage decrease} &= \left( \frac{64.8 - 59.3}{64.8} \right) \times 100\% \\ &= \frac{5.5}{64.8} \times 100\% \\ &= 8.487\,654\,321 \text{ (FCD)} \\ &= \underline{\underline{8.49\% (3 sf)}}.\end{aligned}$$

17. Here is a diagram.

(3)



Calculate the value of  $x$ .  
Give your answer correct to 3 significant figures.

**Solution**

$$\begin{aligned}\text{opp} &= \text{hyp} \times \sin \Rightarrow x = 32 \sin 60^\circ \\ &\Rightarrow x = 27.712\,812\,92 \text{ (FCD)} \\ &= \underline{\underline{27.7 \text{ cm (3 sf)}}}.\end{aligned}$$

18. (a) Complete the table of values for

(2)

$$y = \frac{6}{x}.$$

$x$	0.5	1	2	3	4	5	6
$y$		6	3		1.5		1

**Solution**

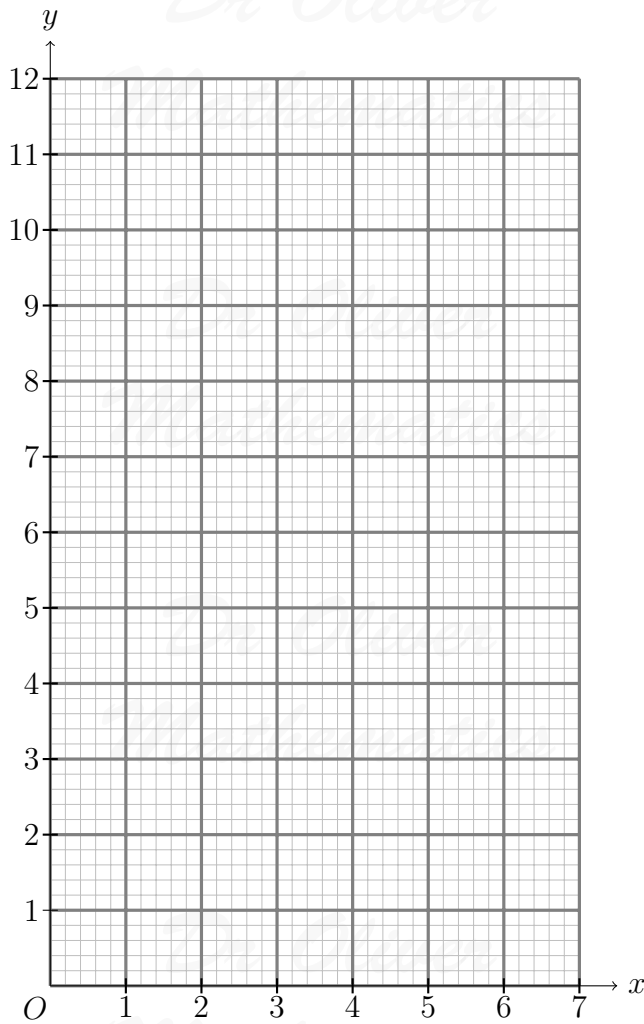
$x$	0.5	1	2	3	4	5	6
$y$	<u>12</u>	6	3	<u>2</u>	1.5	<u>1.2</u>	1

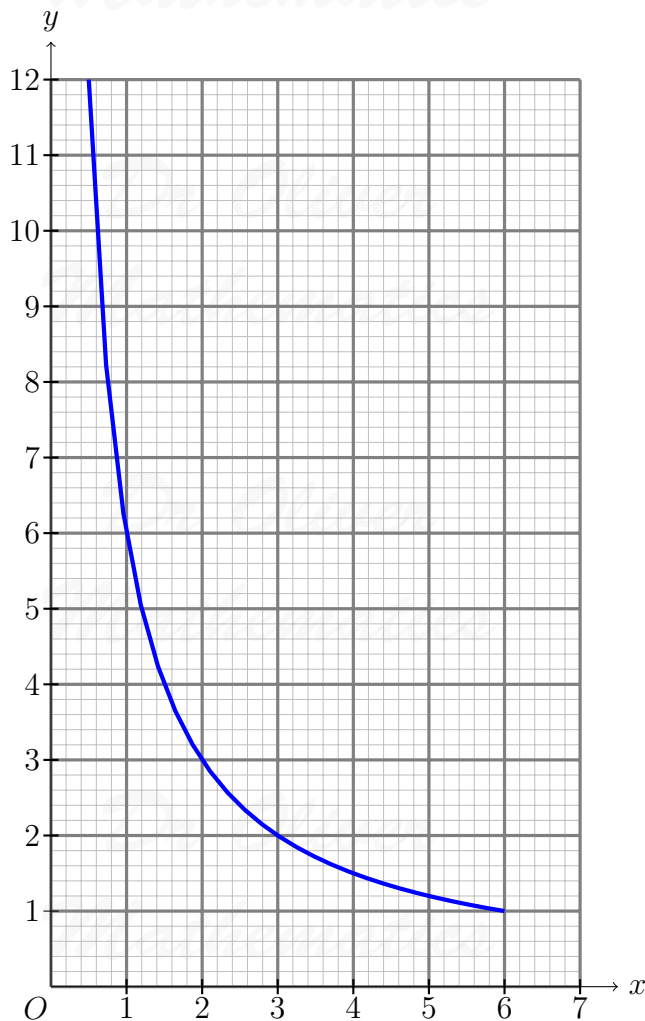
(b) On the grid, draw the graph of

$$y = \frac{6}{x}$$

(2)

for  $0.5 \leq x \leq 6$ .



**Solution**

19. Rob is learning about the planets.

Rob makes a model of the Sun.

He also makes a model of the planet Jupiter.

Rob is going to hang the two models in the school hall.

Rob wants a distance of 16 m between the two models.

The real distance between the planet Jupiter and the Sun is  $8 \times 10^8$  km.

Work out the scale Rob should use.

Give your answer in the form  $1 : n$ .

(3)

**Solution**

$$\begin{aligned}
 16 \text{ m} : 8 \times 10^8 \text{ km} &\Rightarrow 16 \text{ m} : 8000 \times 10^8 \text{ m} \\
 &\Rightarrow 1 : 500 \times 10^8 \\
 &\Rightarrow \underline{\underline{1 : 5 \times 10^{10}}}.
 \end{aligned}$$

20. Simplify

$$\frac{x+1}{2} + \frac{x+3}{3}.$$

(3)

**Solution**

$$\begin{aligned}
 \frac{x+1}{2} + \frac{x+3}{3} &= \frac{3(x+1)}{6} + \frac{2(x+3)}{6} \\
 &= \frac{3(x+1) + 2(x+3)}{6} \\
 &= \frac{3x+3+2x+6}{6} \\
 &= \frac{5x+9}{6}.
 \end{aligned}$$

21. Here are seven tiles.



Jim takes at random a tile.

He does **not** replace the tile.

Jim then takes at random a second tile.

(a) Calculate the probability that both the tiles Jim takes have the number 1 on them.

(2)

**Solution**

$$\begin{aligned}
 P(1, 1) &= \frac{2}{7} \times \frac{1}{6} \\
 &= \frac{2}{42} \\
 &= \underline{\underline{\frac{1}{21}}}.
 \end{aligned}$$

- (b) Calculate the probability that the number on the second tile Jim takes is greater than the number on the first tile he takes. (3)

**Solution**

$$\begin{aligned}
 P(\text{greater}) &= \left(\frac{2}{7} \times \frac{5}{6}\right) + \left(\frac{3}{7} \times \frac{2}{6}\right) \\
 &= \frac{10}{42} + \frac{6}{42} \\
 &= \frac{16}{42} \\
 &= \underline{\underline{\frac{4}{21}}}.
 \end{aligned}$$

22. (a) Solve

$$2x^2 + 9x - 7 = 0.$$

(3)

Give your solutions correct to 3 significant figures.

**Solution**

$a = 2$ ,  $b = 9$ , and  $c = -7$ :

$$\begin{aligned}
 x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-9 \pm \sqrt{9^2 - 4 \times 2 \times (-7)}}{2 \times 2} \\
 &= \frac{-9 \pm \sqrt{137}}{4} \\
 &= -5.176\ 174\ 978 \text{ or } 0.676\ 174\ 977\ 7 \text{ (FCD)} \\
 &= \underline{\underline{-5.18 \text{ or } 0.676 \text{ (3 sf)}}}.
 \end{aligned}$$

- (b) Solve

$$\frac{2}{y^2} + \frac{9}{y} - 7 = 0.$$

(2)

Give your solutions correct to 3 significant figures.

**Solution**

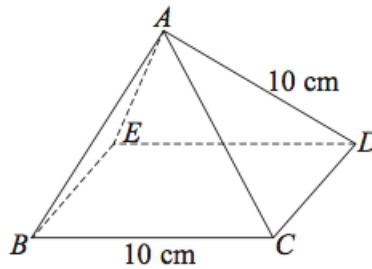
Let

$$y = \frac{1}{x} :$$

then

$$\begin{aligned} y &= -0.193\ 192\ 850\ 8 \text{ or } 1.478\ 907\ 136 \text{ (FCD)} \\ &= \underline{\underline{-0.193 \text{ or } 1.48 \text{ (3 sf)}}}. \end{aligned}$$

23. The diagram shows a pyramid.



$BCDE$  is a square with sides of length 10 cm.

The other faces of the pyramid are equilateral triangles with sides of length 10 cm.

(a) Calculate the volume of the pyramid.

(4)

Give your answer correct to 3 significant figures.

**Solution**

Let  $F$  be the midpoint of the square. Now,

$$\begin{aligned} BD &= \sqrt{10^2 + 10^2} \\ &= \sqrt{200} \\ &= 10\sqrt{2} \end{aligned}$$

and

$$FD = 5\sqrt{2}.$$

Next,

$$\begin{aligned} AF &= \sqrt{10^2 - (5\sqrt{2})^2} \\ &= \sqrt{50} \\ &= 5\sqrt{2}. \end{aligned}$$

Finally,

$$\begin{aligned}\text{volume} &= \frac{1}{3} \times 10 \times 10 \times 5\sqrt{2} \\ &= 235.702\,260\,4 \text{ (FCD)} \\ &= \underline{\underline{236 \text{ cm}^3}} \text{ (3 sf).}\end{aligned}$$

(b) Find the size of angle  $DAB$ .

(2)

**Solution**

Let the size of the angle be  $x^\circ$ . Then,

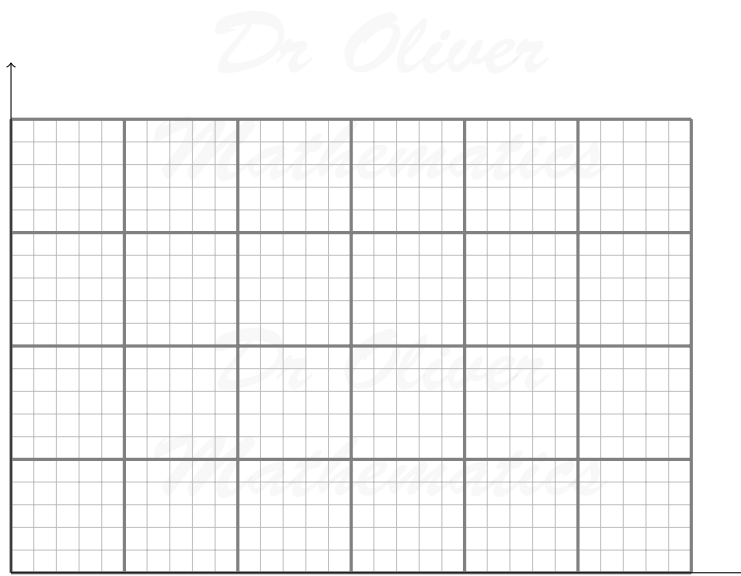
$$\begin{aligned}\cos x^\circ &= \frac{AB^2 + AD^2 - BD^2}{2 \times AB \times AD} \\ \Rightarrow \cos x^\circ &= \frac{10^2 + 10^2 - (10\sqrt{2})^2}{2 \times 10 \times 10} \\ \Rightarrow \cos x^\circ &= 0 \\ \Rightarrow \underline{\underline{x^\circ = 90^\circ}}.\end{aligned}$$

24. The table gives information about the heights,  $h$  metres, of trees in a wood.

(3)

Height ( $h$ metres)	Frequency
$0 < h \leq 2$	7
$2 < h \leq 4$	14
$4 < h \leq 8$	18
$8 < h \leq 16$	24
$16 < h \leq 20$	10

Draw a histogram to show this information.



**Solution**

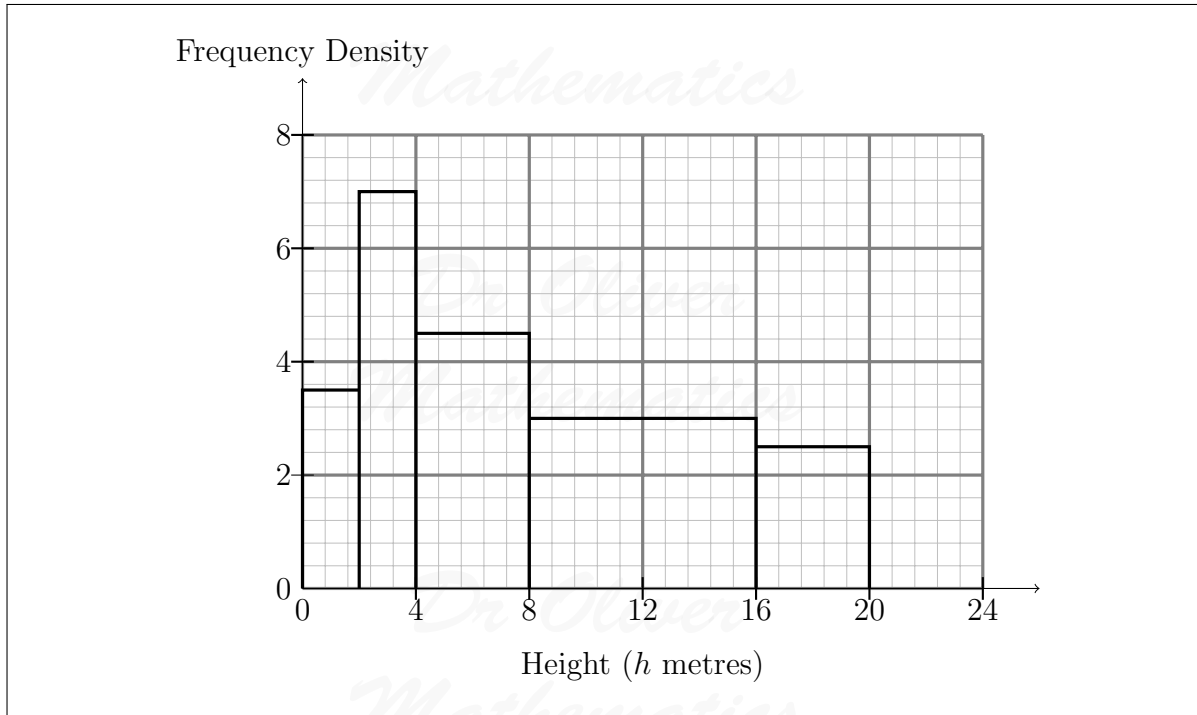
Height ( $h$ metres)	Frequency	Width	Frequency Density
$0 < h \leq 2$	7	2	$\frac{7}{2} = 3.5$
$2 < h \leq 4$	14	2	$\frac{14}{2} = 7$
$4 < h \leq 8$	18	4	$\frac{18}{4} = 4.5$
$8 < h \leq 16$	24	8	$\frac{24}{8} = 3$
$16 < h \leq 20$	10	4	$\frac{10}{4} = 2.5$

*Mathematics*

*Dr Oliver*  
*Mathematics*

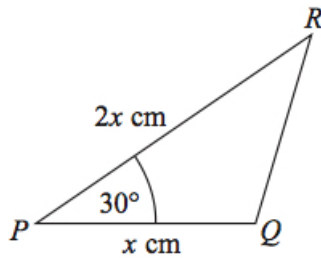
*Dr Oliver*  
*Mathematics*





25. The diagram shows the triangle PQR.

(3)



$PQ = x \text{ cm.}$

$PR = 2x \text{ cm.}$

Angle  $QPR = 30^\circ.$

The area of triangle  $PQR = A \text{ cm}^2.$

Show that  $x = \sqrt{2A}.$

**Solution**

*Dr Oliver*  
*Mathematics*

$$\begin{aligned} A &= \frac{1}{2} \times x \times 2x \times \sin 30^\circ \\ \Rightarrow A &= \frac{1}{2}x^2 \\ \Rightarrow x^2 &= 2A \\ \Rightarrow \underline{\underline{x = \sqrt{2A}}}, \end{aligned}$$

as required.

*Dr Oliver*  
*Mathematics*

*Dr Oliver*  
*Mathematics*

*Dr Oliver*  
*Mathematics*

*Dr Oliver*  
*Mathematics*

*Dr Oliver*  
*Mathematics*