

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Time 1 hour 30 minutes

Paper
reference

1MA1/2H

Mathematics

PAPER 2 (Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.



Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

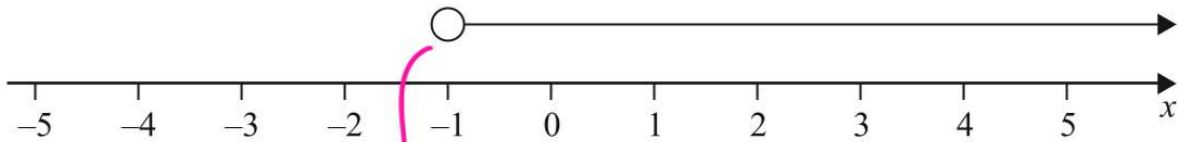
- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►



1

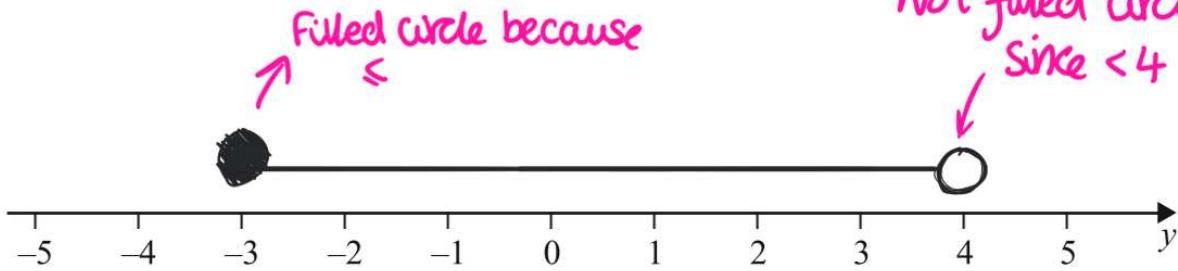
(a) Write down the inequality shown on this number line.



Circle not filled
in means
< or >

① $x > -1$
(1)

(b) On the number line below, show the inequality $-3 \leq y < 4$



Filled circle because
 \leq

Not filled circle
since < 4

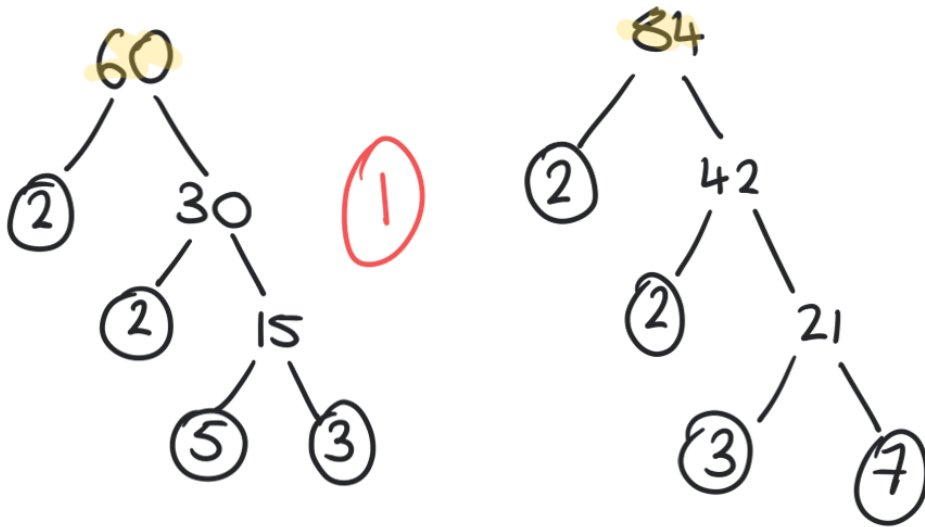
②

(2)

2

(a) Find the Highest Common Factor (HCF) of 60 and 84

Make factor tree for 60 and 84



$$60 = 2 \times 2 \times 3 \times 5$$
$$84 = 2 \times 2 \times 3 \times 7$$

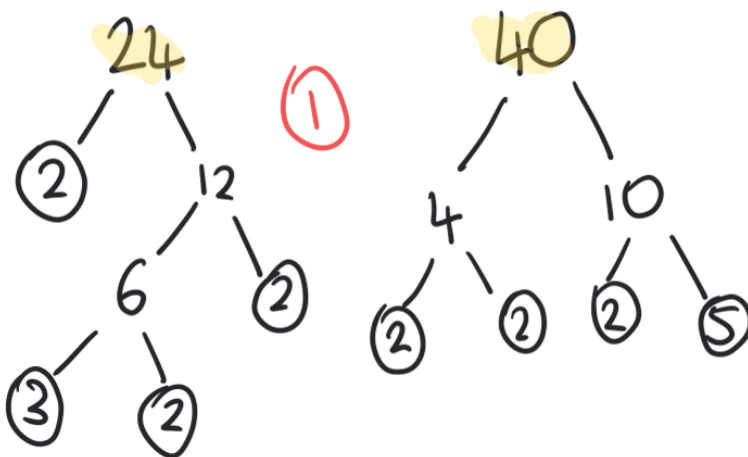
← Look for common numbers between both

$$\text{HCF}(60, 84) = 2 \times 2 \times 3 = 12$$

12 (1)
.....
(2)

(b) Find the Lowest Common Multiple (LCM) of 24 and 40

Make factor trees for 24 and 40

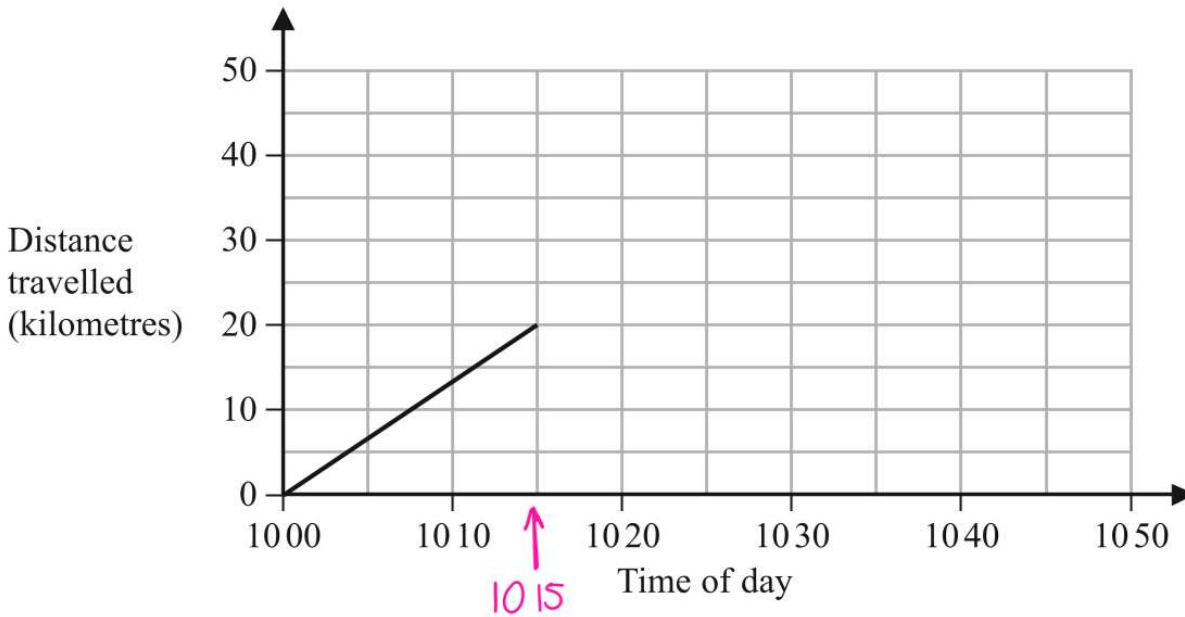


$$24 = 2 \times 2 \times 2 \times 3$$
$$40 = 2 \times 2 \times 2 \times 5$$
$$\text{HCF}(40, 24) = 2 \times 2 \times 2 = 8$$
$$\text{LCM}(40, 24) = 8 \times 3 \times 5 = 120$$

(1) 120
.....
(2)

Sam drives his car on a journey.

Here is the travel graph for the first 15 minutes of his journey.



(a) Work out Sam's speed, in km/h, for the first 15 minutes of his journey.

We have a distance time graph

find gradient of line to work out speed

gradient line = $\frac{\text{change in } y}{\text{change in } x}$

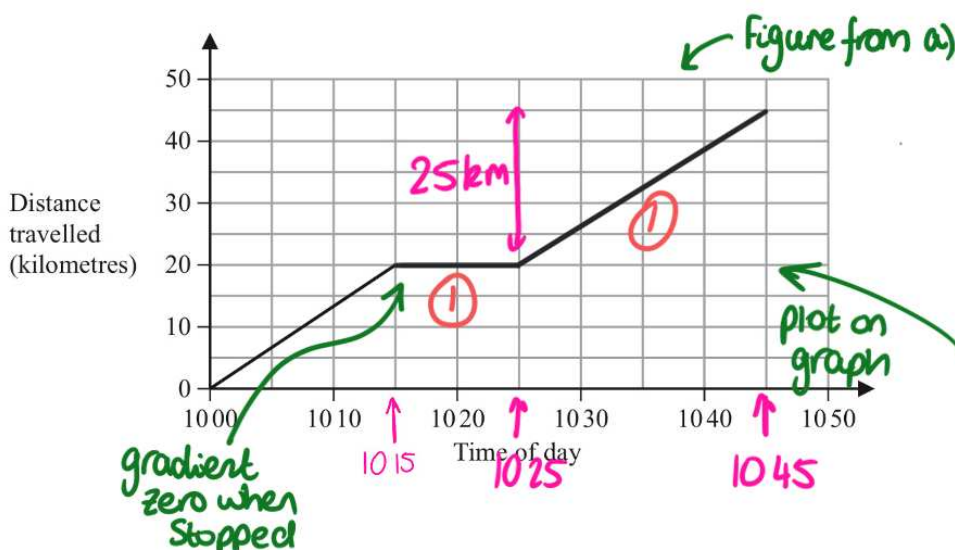
$$\textcircled{1} = \frac{20 - 0 \text{ km}}{15 \text{ minutes}} = \frac{20}{15} \text{ km/minutes}$$

x60 convert to km/h

$$\frac{20}{15} \times 60 = 80 \text{ km/h} \textcircled{1} \textcircled{2}$$

At 10 15 Sam stops for 10 minutes and then drives for 20 minutes at a speed of 75 km/h.

(b) On the grid, complete the travel graph for Sam's journey.



distance = speed x time

convert 20 minutes to hours

$$20 \text{ minutes} = \frac{20}{60} = \frac{1}{3} \text{ hours}$$

$$\text{distance} = 75 \times \frac{1}{3} = 25 \text{ km} \textcircled{1}$$

(3)

4

(a) Complete the table of values for $y = x^2 - 2x + 2$

$$y = (4)^2 - 2(4) + 2 = 10$$

x	-2	-1	0	1	2	3	4
y	10	5	2	1	2	5	10

$$y = (-2)^2 - 2(-2) + 2 = 10$$

$$y = (-1)^2 - 2(-1) + 2 = 5$$

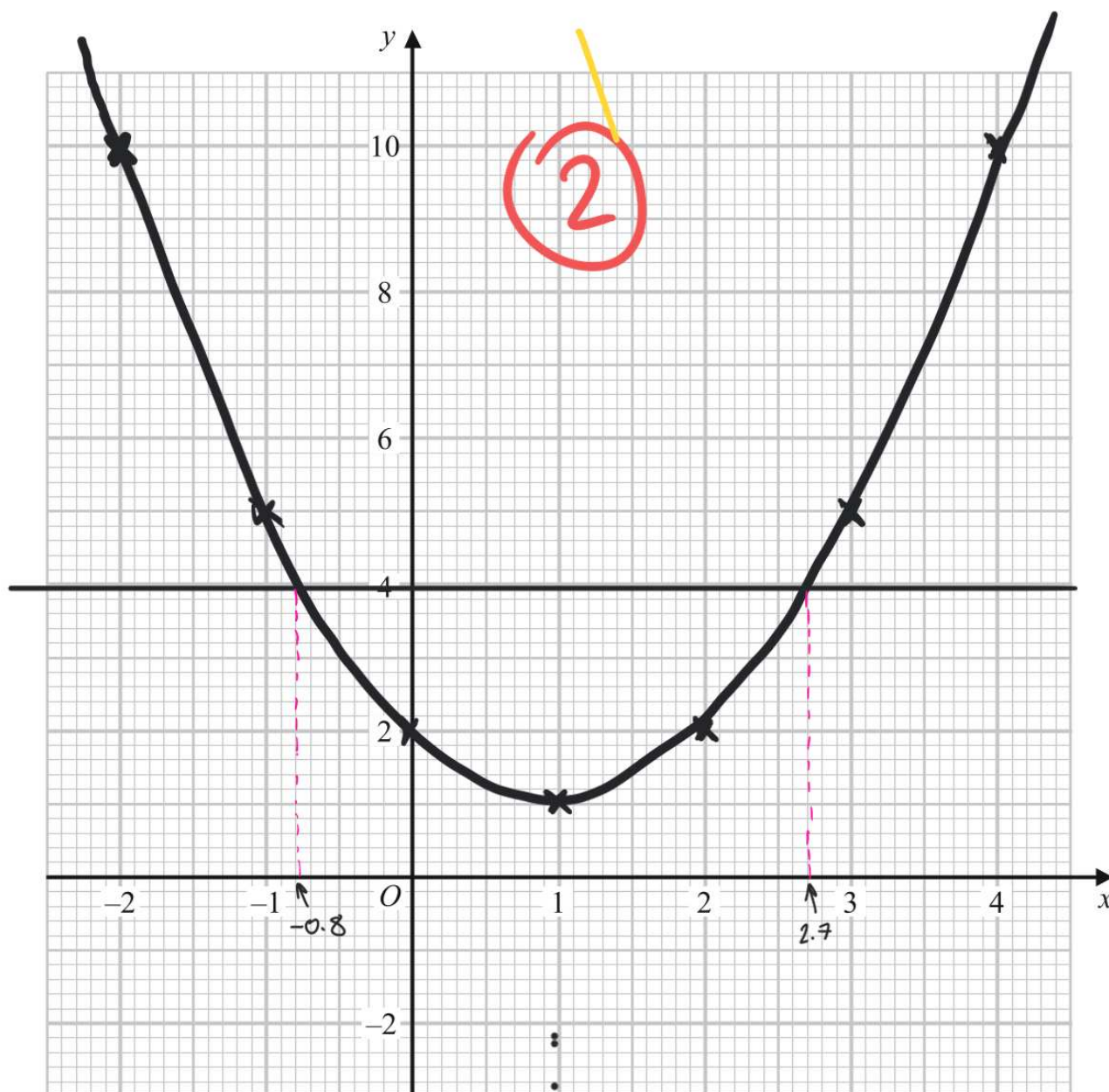
$$y = (1)^2 - 2(1) + 2 = 1$$

$$y = (2)^2 - 2(2) + 2 = 2$$

(2)

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

(2)

(c) Use your graph to find estimates of the solutions of the equation $x^2 - 2x + 2 = 4$

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

$$y = 4$$

Plot $y = 4$ and see where it intersects $y = x^2 - 2x + 2$

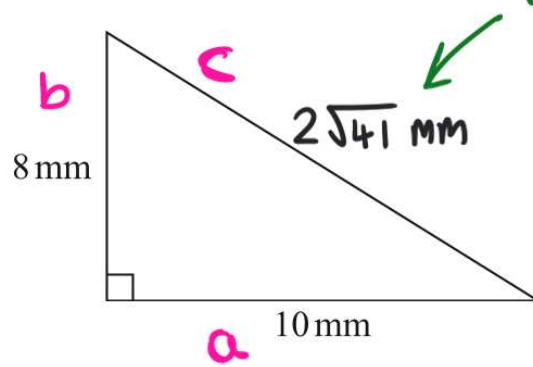
$$x = -0.8 \quad x = 2.7$$

(1)

(1)

(2)

Here is a right-angled triangle.



Using Pythagoras Theorem

$$a^2 + b^2 = c^2$$

$$10^2 + 8^2 = c^2$$

$$c^2 = 164 \quad (1)$$

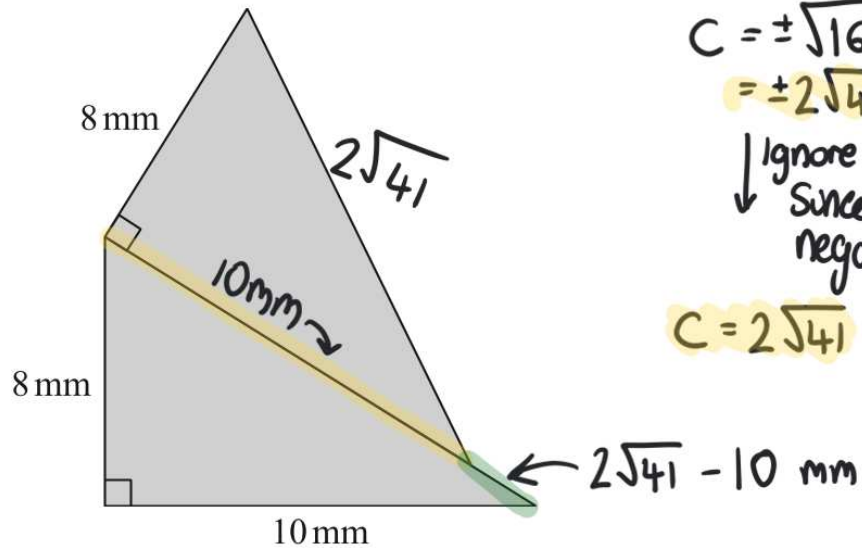
$$c = \pm \sqrt{164}$$

$$= \pm 2\sqrt{41}$$

Ignore negative
Since cannot have
negative length

$$c = 2\sqrt{41} \quad (1)$$

The shaded shape below is made from two of these triangles.



Work out the perimeter of the shaded shape.

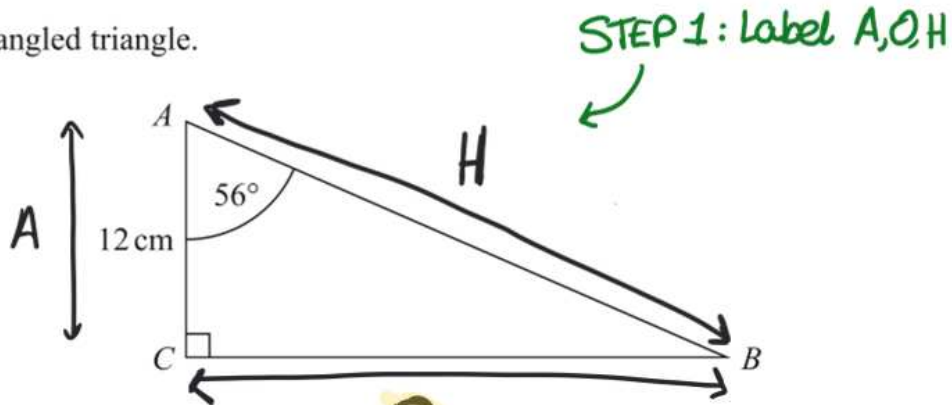
Give your answer correct to 3 significant figures.

$$\text{Perimeter} = 10 + 8 + 8 + 2\sqrt{41} + (2\sqrt{41} - 10) = 41.61249... = 41.6 \text{ mm (3sf)}$$

41.6 mm

6

ABC is a right-angled triangle.



- (a) Work out the length of BC .
Give your answer correct to 1 decimal place.

~~SOHCAHTOA~~

STEP 2

$$\tan \theta = \frac{O}{A} \text{ so } \tan(56^\circ) = \frac{BC}{12}$$

$$12 \tan(56^\circ) = BC \quad (1)$$

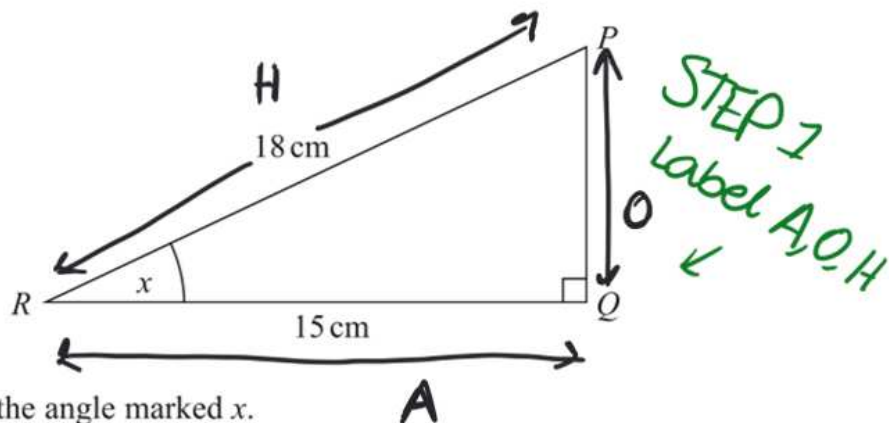
$$BC = 17.79073... \quad (1)$$

$$= 17.8 \text{ (1dp) cm}$$

$$\underline{\hspace{1cm}} \quad (2)$$

17.8 cm

PQR is a right-angled triangle.



- (b) Work out the size of the angle marked x .
Give your answer correct to 1 decimal place.

SOHCAHTOA

STEP 2

$$\cos \theta = \frac{A}{H} \text{ so } \cos(x) = \frac{15}{18}$$

$$x = \cos^{-1}\left(\frac{15}{18}\right) \quad (1)$$

$$= 33.5573... \quad (1)$$

$$= 33.6^\circ \text{ (1dp)}$$

$$\underline{\hspace{1cm}} \quad (2)$$

33.6 °

- 7 Liquid A has a density of 1.8 g/cm^3
Liquid B has a density of 1.2 g/cm^3

80 cm^3 of liquid A is mixed with 40 cm^3 of liquid B to make 120 cm^3 of liquid C.

Work out the density of liquid C.

density = $\frac{\text{mass}}{\text{volume}}$

<p>Liquid A</p> $1.8 = \frac{\text{mass A}}{80}$ $\text{mass A} = 80 \times 1.8$ $= 144 \text{ g}$	<p>Liquid B</p> $1.2 = \frac{\text{mass B}}{40}$ $\text{mass B} = 1.2 \times 40$ $= 48 \text{ g}$
--	---

← liquid C

$$\text{density} = \frac{144 + 48}{80 + 40} = \frac{192}{120} = 1.6 \text{ g/cm}^3$$

①

①

..... 1.6 g/cm^3

(Total for Question 7 is 3 marks)



- 8 The grouped frequency table gives information about the time, in minutes, taken by 50 people to solve a puzzle.

Time (t minutes)	Frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	8
$20 < t \leq 30$	12
$30 < t \leq 40$	15
$40 < t \leq 50$	7
$50 < t \leq 60$	3

Brian was asked to draw a cumulative frequency table for this information.

This is the table that Brian drew.

Time (t minutes)	Cumulative frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	13
$20 < t \leq 30$	25
$30 < t \leq 40$	40
$40 < t \leq 50$	47
$50 < t \leq 60$	50

$0 < t \leq 20$ ←

$0 < t \leq 30$ ←

$0 < t \leq 40$ ←

$0 < t \leq 50$ ←

$0 < t \leq 60$ ←

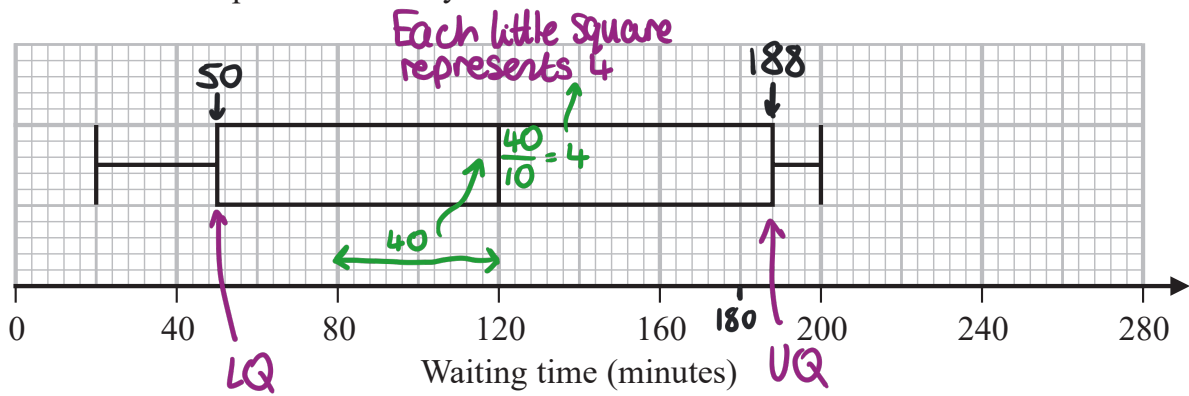
Write down **one** thing that is wrong with this cumulative frequency table.

Error in the inequalities, they should all start $0 < t$
for example $0 < t \leq 20$ instead of $10 < t \leq 20$ (1)

(Total for Question 8 is 1 mark)



- 9 The box plot shows information about the length of time, in minutes, some people waited to see a doctor at a hospital on Monday.



- (a) Work out the interquartile range of the information in the box plot.

$$IQR = UQ - LQ \rightarrow IQR = 188 - 50 = 138 \text{ minutes}$$

(1) (2)

Becky says,

“50% of the people waited for at least 2 hours.”

- (b) Is Becky correct?

Explain why.

Yes because the median is at 2 hours so 50% of the people waited 2 or more hours (1)

(1)



The table gives information about the length of time, in minutes, some people waited to see a doctor at the same hospital on Tuesday.

	Waiting time (minutes)
Shortest time	20
Lower quartile	50
Median	100
Upper quartile	140
Longest time	210

Median for Monday (Part a) is 120

Becky was asked to compare the distribution of the lengths of times people waited on Monday with the distribution of the lengths of times people waited on Tuesday.

She wrote,

“People had to wait longer on Tuesday than on Monday.”

(c) Give **one** reason why Becky may be wrong.

The median is lower on Tuesday (100) compared to Monday (120) ①

(1)

(Total for Question 9 is 4 marks)

- 10 Louise invests £x in Better Investments for 3 years.
Sadiq invests £x in County Bank for 3 years.

<p>Better Investments</p> <p>Compound Interest</p> <p>2.5% per annum</p>

<p>County Bank</p> <p>Compound Interest</p> <p>2% per annum for the first two years 3.5% per annum for each extra year</p>

At the end of the 3 years, the value of Louise's investment is £344 605

Work out the value of Sadiq's investment at the end of the 3 years.

$$\text{£}x \times 1.025 \times 1.025 \times 1.025 = \text{£}344\,605$$

(1) Increase by 2.5%
Same as $\times 1.025$

$$\frac{1.025^3 x = 344\,605}{\cancel{1.025^3} \quad 1.025^3}$$

(1) $x = 320\,000$

Sadiq's initial investment was
 $\text{£}320\,000$

$$320\,000 \times 1.02 \times 1.02 \times 1.035 = \text{£}344\,580.48$$

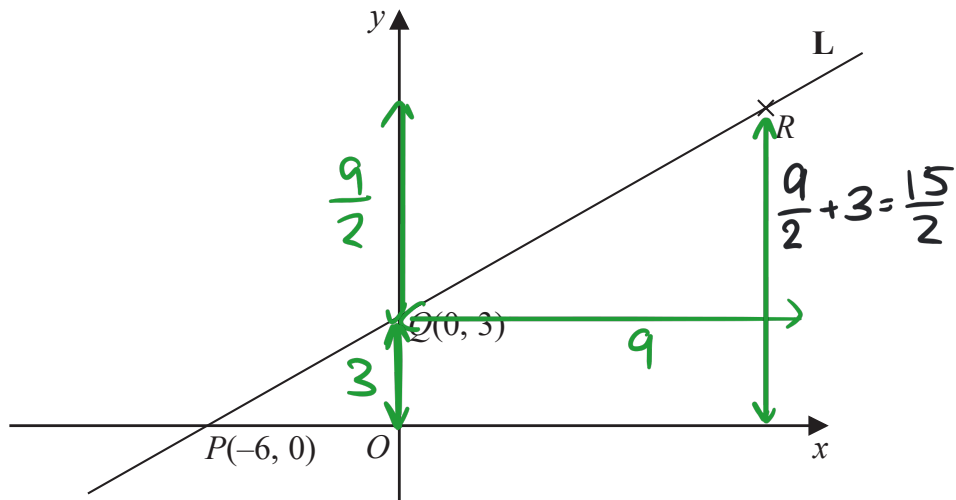
(1)

£ 344 580.48

(Total for Question 10 is 4 marks)



11 Here is a sketch of the line L.



The points $P(-6, 0)$ and $Q(0, 3)$ are points on the line L.

The point R is such that PQR is a straight line and $PQ:QR = 2:3$

(a) Find the coordinates of R.

x coordinates $0 - (-6) = 6$ $\begin{matrix} \times 3 \\ \downarrow \\ 2:3 \\ \downarrow \times 3 \\ 6:9 \end{matrix}$ \leftarrow distance Q to R in x direction is 9
 y coordinates $3 - 0 = 3$ $\begin{matrix} \times \frac{3}{2} \\ \downarrow \\ 2:3 \\ \downarrow \times \frac{3}{2} \\ 3:\frac{9}{2} \end{matrix}$ \leftarrow distance Q to R in y direction is $\frac{9}{2}$
 $\left(\dots \overset{\textcircled{1}}{9} \dots, \overset{\textcircled{1}}{\frac{15}{2}} \dots \right)$ (2)

(b) Find an equation of the line that is perpendicular to L and passes through Q.

$\left. \begin{matrix} Q(0, 3) \\ P(-6, 0) \end{matrix} \right\} \begin{matrix} m = \frac{\text{change in } y}{\text{change in } x} = \frac{3-0}{0-(-6)} = \frac{3}{6} \leftarrow \text{gradient L } \textcircled{1} \\ \text{gradient} \end{matrix}$

\downarrow To get gradient of perpendicular line we take the negative reciprocal of m
 $M = \frac{-6}{3} \leftarrow$ gradient line perpendicular to L $\textcircled{1}$

Equation of line is $y - y_1 = m(x - x_1)$ \leftarrow using $Q(0, 3)$
 $y - 3 = \frac{-6}{3}(x - 0) \Rightarrow y - 3 = -2x$
 $\Rightarrow y = -2x + 3$ $\textcircled{1}$ (3)

(Total for Question 11 is 5 marks)

12 Expand and simplify $(x - 2)(3x + 2)(2x + 3)$

Multiply pair of brackets first

$$\begin{aligned}(x-2)(3x+2) \\ = 3x^2 + 2x - 6x - 4 \\ = 3x^2 - 4x - 4 \quad (1)\end{aligned}$$

$$\begin{aligned}(3x^2 - 4x - 4)(2x + 3) \\ = 6x^3 + 9x^2 - 8x^2 - 12x - 8x - 12 \\ = 6x^3 + x^2 - 20x - 12 \quad (1)\end{aligned}$$

$$6x^3 + x^2 - 20x - 12 \quad (1)$$

(Total for Question 12 is 3 marks)

13 In a school there are 16 teachers and 220 students.

Of these students 120 are girls and 100 are boys.

One teacher, one girl and one boy are going to be chosen to represent the school.

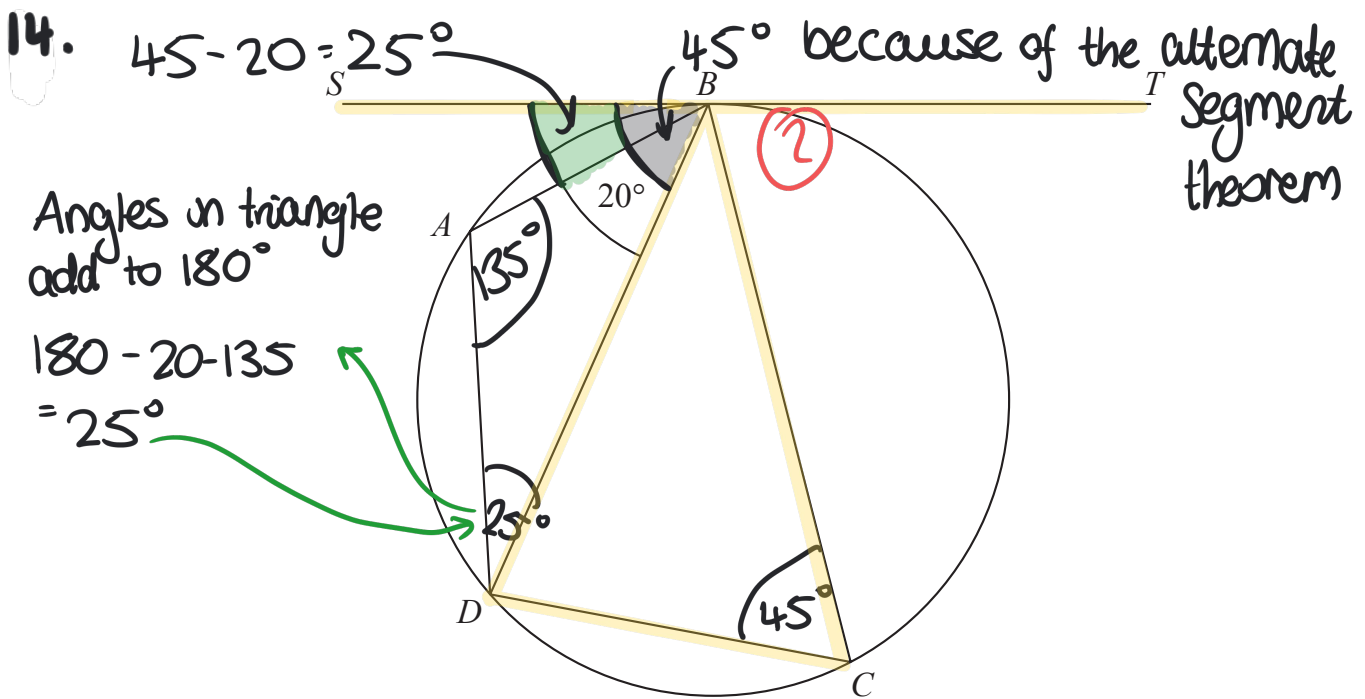
Work out the number of different ways there are to choose one teacher, one girl and one boy.

$$16 \times 120 \times 100 = 192000$$

(1)

$$192000 \quad (1)$$

(Total for Question 13 is 2 marks)



A, B, C and D are four points on a circle.
 SBT is a tangent to the circle.
 Angle $ABD = 20^\circ$

the size of angle BAD : the size of angle $BCD = 3 : 1$

Find the size of angle SBA .
 Give a reason for each stage of your working.

Opposite angles in a cyclic quadrilateral add to 180° ①

180° ← share in ratio 3:1

$\frac{180}{3+1} = \frac{180}{4} = 45^\circ$ ← one 'part' of the ratio

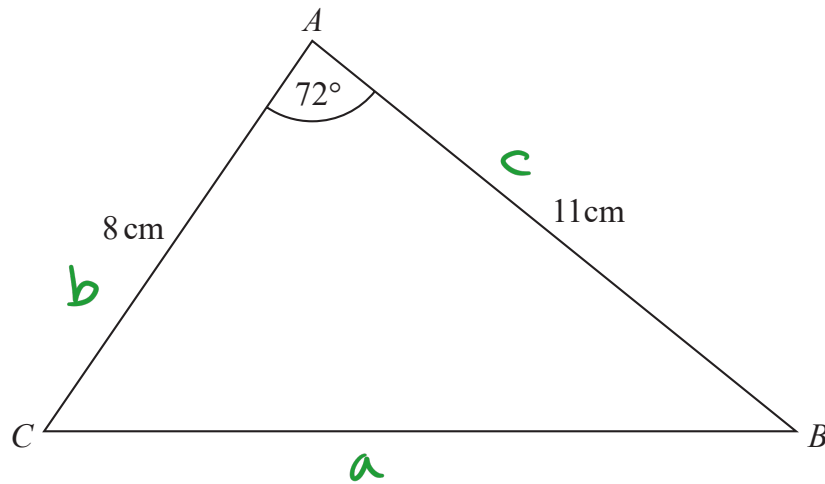
angle $BAD = 3 \times 45 = 135^\circ$
 angle $BCD = 1 \times 45 = 45^\circ$

25 ①

(Total for Question 14 is 4 marks)



15 Here is triangle ABC .



- (a) Find the length of BC .
Give your answer correct to 3 significant figures.

$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

$$a^2 = 8^2 + 11^2 - 2(8)(11) \cos(72^\circ) \text{ (1)}$$

$$a^2 = 130.61... \text{ (1)}$$

$$a = \sqrt{130.61...} = 11.4286... = 11.4 \text{ (3sf)}$$

..... 11.4 cm
(3)

- (b) Find the area of triangle ABC .
Give your answer correct to 3 significant figures.

$$\text{Area triangle} = \frac{1}{2} ab \sin C$$

$$= \frac{1}{2} cb \sin A \text{ (1)}$$

$$= \frac{1}{2} (11)(8) \sin(72^\circ)$$

$$= 41.846... = 41.8 \text{ cm}^2 \text{ (3sf)}$$

..... 41.8 cm²
(2)

(Total for Question 15 is 5 marks)



- 16 (a) Use the iteration formula $x_{n+1} = \sqrt[3]{10 - 2x_n}$ to find the values of x_1 , x_2 and x_3 .
Start with $x_0 = 2$

$$x_0 = 2$$

$$x_1 = \sqrt[3]{10 - 2(2)} = \sqrt[3]{10 - 4} = \sqrt[3]{6} = 1.8171... \text{ (1)}$$

$$x_2 = \sqrt[3]{10 - 2(1.8171...)} = 1.8533... \text{ (1)}$$

← DON'T ROUND
use all decimal points
by using calculator ANS
button

$$x_3 = \sqrt[3]{10 - 2(1.8533...)} = 1.8462... \text{ (1)}$$

$$x_1 = 1.8171... \\ x_2 = 1.8533... \\ x_3 = 1.8462... \\ \text{(3)}$$

The values of x_1 , x_2 and x_3 found in part (a) are estimates of the solution of an equation of the form $x^3 + ax + b = 0$ where a and b are integers.

- (b) Find the value of a and the value of b .

$$x_{n+1} = \sqrt[3]{10 - 2x_n} \leftarrow \text{from a)}$$

$$\begin{aligned} x &= \sqrt[3]{10 - 2x} \Rightarrow x^3 = 10 - 2x \\ &\Rightarrow x^3 + 2x + (-10) = 0 \end{aligned}$$

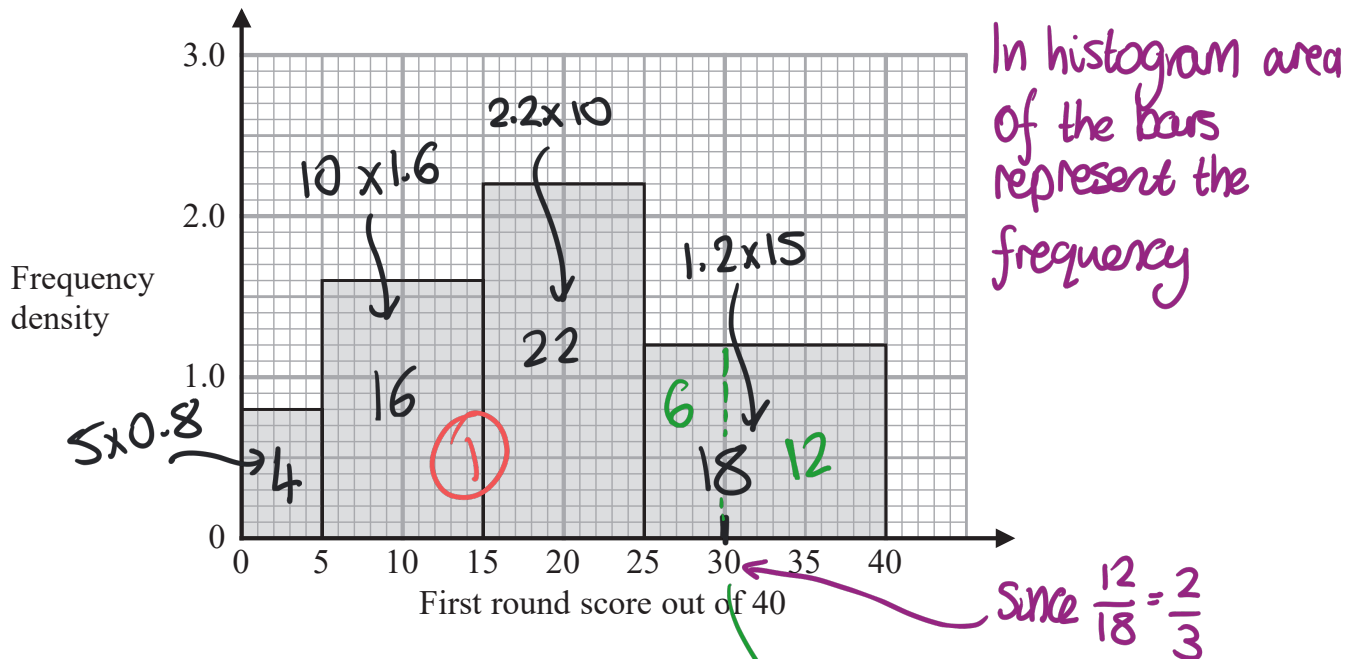
$$\begin{aligned} a &= 2 \\ b &= -10 \end{aligned} \text{ (1)}$$

(Total for Question 16 is 4 marks)



17 Some people took part in the first round of a competition.

The histogram gives information about the scores of these people in the first round.



20% of the people got a score high enough for them to qualify for the second round.

Work out an estimate for the score needed to qualify for the second round.

You must show all your working.

$$4 + 16 + 22 + 18 = 60 \text{ people in total}$$

$$60 \times 0.2 = 12 \text{ 20\% of 60}$$

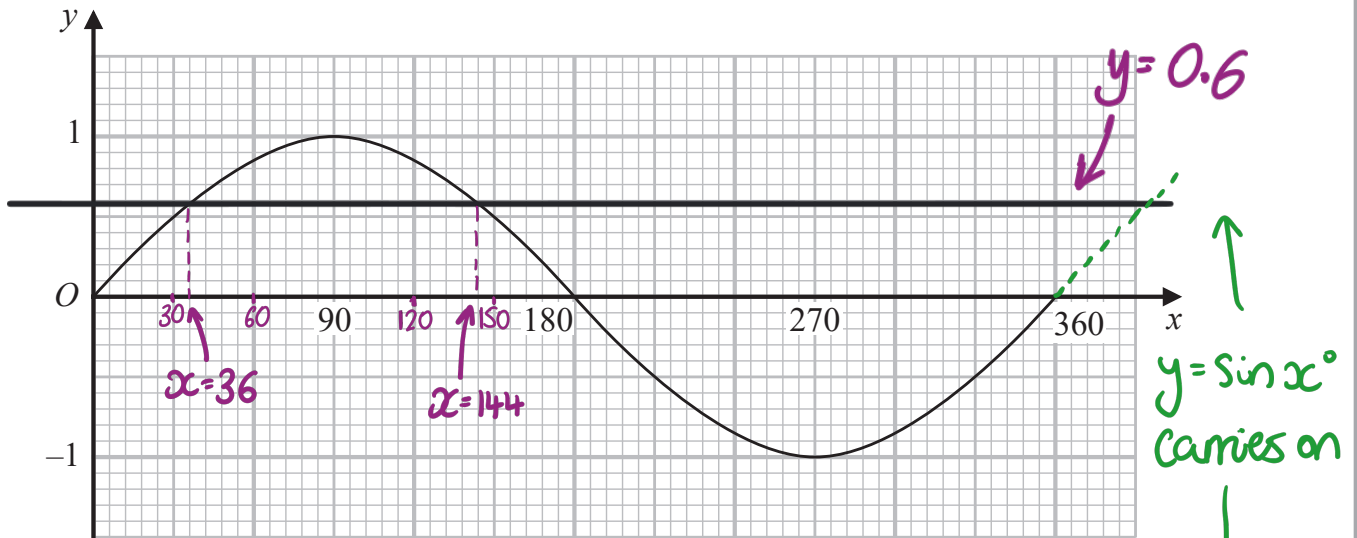
Estimate of qualifying score is 30 since 12 people got 30 or more

30

(Total for Question 17 is 4 marks)



18 Here is a graph of $y = \sin x^\circ$ for $0 \leq x \leq 360$



(a) Using this graph, find estimates of all **four** solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 720$$

So next two solutions are at
 $x = 360 + 36 = 396^\circ$
 $x = 360 + 144 = 504^\circ$

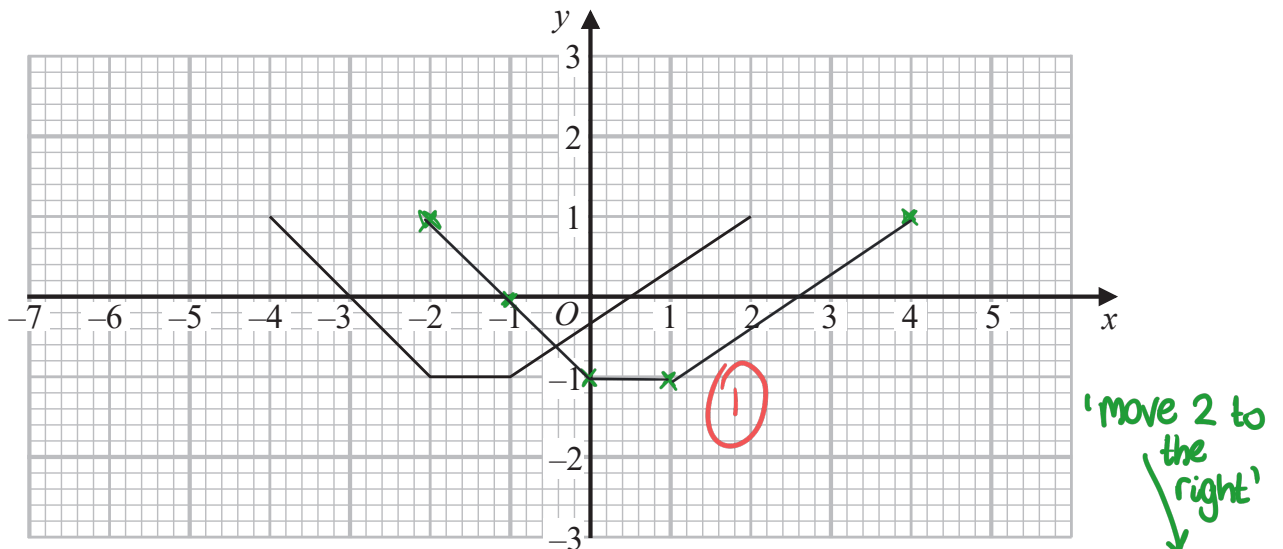
$x = 36, x = 144, x = 396, x = 504$

The graph of $y = \sin x^\circ$ is reflected in the x -axis.

(b) Write down an equation of the reflected graph.

$$y = -\sin x^\circ \quad (1)$$

Here is a graph of $y = f(x)$



(c) On the grid, draw the graph of $y = f(x - 2)$

→ translation by vector $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ (1)

(Total for Question 18 is 4 marks)

20 In a village,

if it rains on one day, the probability that it will rain on the next day is 0.8

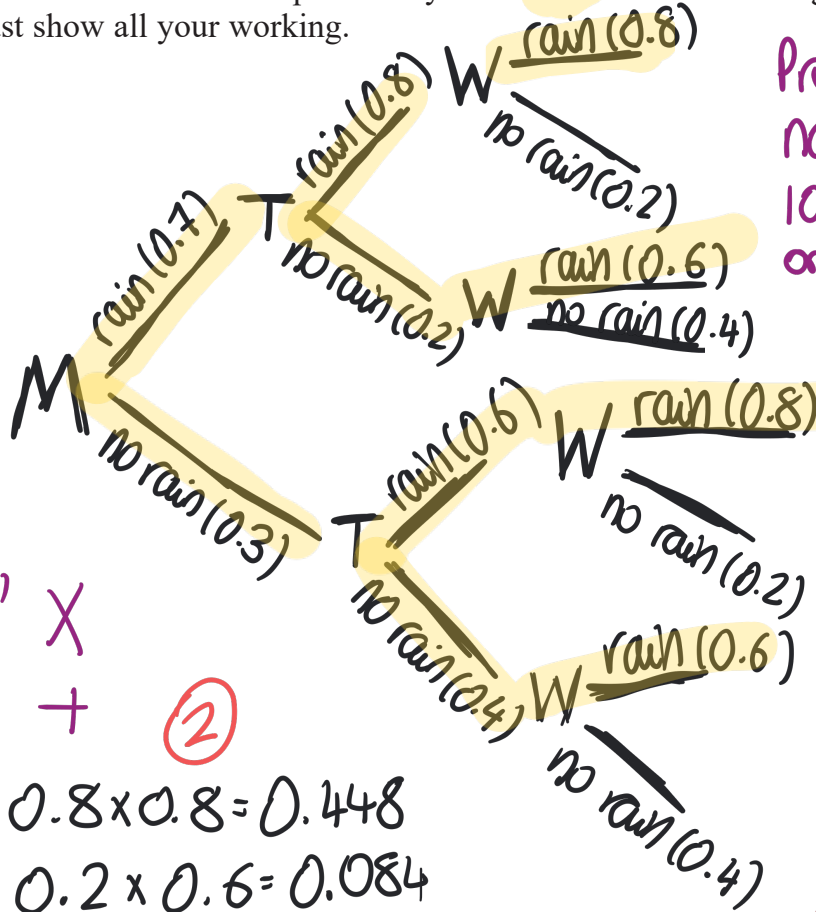
if it does **not** rain on one day, the probability that it will rain on the next day is 0.6

A weather forecaster says,

“There is a 70% chance that it will rain in the village on Monday.”

Work out an estimate for the probability that it will rain in the village on Wednesday.

You must show all your working.



Probability of raining or not raining is 1 (because 100% chance of either raining or not raining)

This allows you to work out missing probabilities

'And' X

'Or' +

②

$$0.7 \times 0.8 \times 0.8 = 0.448$$

$$0.7 \times 0.2 \times 0.6 = 0.084$$

$$0.3 \times 0.6 \times 0.8 = 0.144$$

$$0.3 \times 0.4 \times 0.6 = 0.072$$

Probability will rain Wednesday

$$0.448 + 0.084 + 0.144 + 0.072 = 0.748$$

①

①
0.748

(Total for Question 20 is 4 marks)

21 The time period, T seconds, of a simple pendulum of length l cm is given by the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$

Katie uses a simple pendulum in an experiment to find an estimate for the value of g .

Here are her results.

$l = 52.0$ correct to 3 significant figures.

$T = 1.45$ correct to 3 significant figures.

Work out the upper bound and the lower bound for the value of g .

Use $\pi = 3.142$

You must show all your working.

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$\frac{T}{2\pi} = \sqrt{\frac{l}{g}}$$

square

$$\frac{T^2}{(2\pi)^2} = \frac{l}{g}$$

$\times (2\pi)^2$

$$T^2 = \frac{l(2\pi)^2}{g}$$

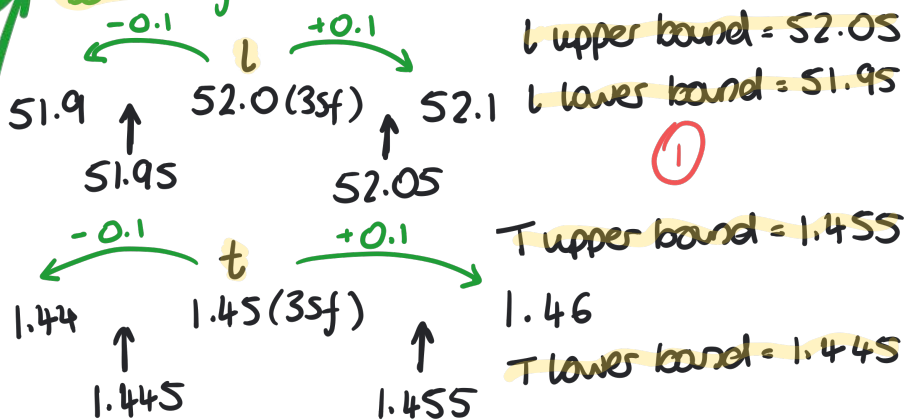
$\times g$

$$\frac{gT^2}{T^2} = \frac{l(2\pi)^2}{T^2}$$

$$g = \frac{l(2\pi)^2}{T^2}$$

①

Work out upper and lower bounds of T and l



Big number
Small number = Big number

Small number
Big number = Small number

We are working out upper and lower bounds of...

$$g = \frac{l(2\pi)^2}{T^2}$$

lower bound \rightarrow $\frac{l \text{ lower bound}}{T \text{ upper bound}}$

upper bound \rightarrow $\frac{l \text{ upper bound}}{T \text{ lower bound}}$

① $\frac{51.95(2 \times 3.142)^2}{1.455^2} = 969.0181643$

① $\frac{52.05(2 \times 3.142)^2}{1.445^2} = 984.3677853$