Please check the examination details below before entering your candidate information

Candidate surname	Other names

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

Centre Number | | | | | |

Candidate Number | | | | |

Time 1 hour 30 minutes

Paper reference **1MA1/3H**

Mathematics

PAPER 3 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator, Formulae Sheet (enclosed). 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.
- Good luck with your examination.

Turn over ▶

P66381A

1/1/1/1/1/

P 6 6 3 8 1 A 0 1 2 4

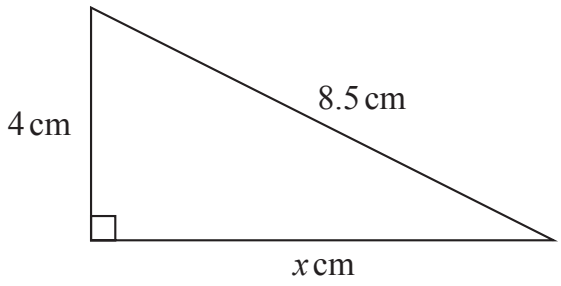
Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Here is a right-angled triangle.



Work out the value of x.

using Pythagoras $a^2+b^2=c^2$:

$4^2+x^2=8.5^2$ (1)

$x^2=8.5^2-4^2$

$x^2=56.25$

$x=7.5$ (1)

take positive root as $x=-7.5$ is not valid

$x =$ 7.5

(Total for Question 1 is 2 marks)

2 $T = 4m^2 - 11$

(a) Work out the value of T when $m = -3$

Substitute $m = -3$

$T = 4(-3)^2 - 11$ (1)

$= 4 \times 9 - 11$

$= 25$

$T =$ 25 (1)

(2)

(b) Make p the subject of the formula $d = 3p + 4$

$d = 3p + 4$

$-4 \quad \downarrow \quad -4$

$d - 4 = 3p$ (1)

$\div 3 \quad \downarrow \quad \div 3$

$\frac{d-4}{3} = p$

$p = \frac{d-4}{3}$ (1)

(2)

(Total for Question 2 is 4 marks)

3 Rick, Selma and Tony are playing a game with counters.

Rick has some counters.
Selma has twice as many counters as Rick.
Tony has 6 counters less than Selma.

In total they have 54 counters.

the number of counters Rick has : the number of counters Tony has = 1 : p

Work out the value of p.

let n be the number of counters Rick has

∴ Selma has $2n$ counters

∴ Tony has $2n-6$ counters (1)

In total they have 54 counters

$n + 2n + 2n-6 = 54$ (1)

$5n-6 = 54$

$5n = 60$

$n = 12$ (1)

so Rick has 12 counters and Tony has $2(12)-6$
$= 18$ counters

Rick : Tony
12 : 18 (1)
1 : $\frac{18}{12}$

we want this in the form 1 : p so divide both sides by 12.

$p = \frac{18}{12} = 1.5$ (1)

$p =$ 1.5

(Total for Question 3 is 5 marks)

4 Jo is going to buy 15 rolls of wallpaper.

Here is some information about the cost of rolls of wallpaper from each of two shops.

Chic Decor
3 rolls for £36

Style Papers
Pack of 5 rolls normal price £70
12% off the normal price

Jo wants to buy the 15 rolls of wallpaper as cheaply as possible.

Should Jo buy the wallpaper from Chic Decor or from Style Papers?
You must show how you get your answer.

From Chic Decor:

3 rolls : £36 (×5)

15 rolls:

£36 × 5 = £180 (1)

From Style Papers:

5 rolls : £70 (×3)

15 rolls:

£70 × 3 = £210

Discount at Style Papers:

12% of £210 = $\frac{12}{100} \times 210 = 25.2$ (1)

£25.20 off:

£210 − £25.20 = £184.80 (1)

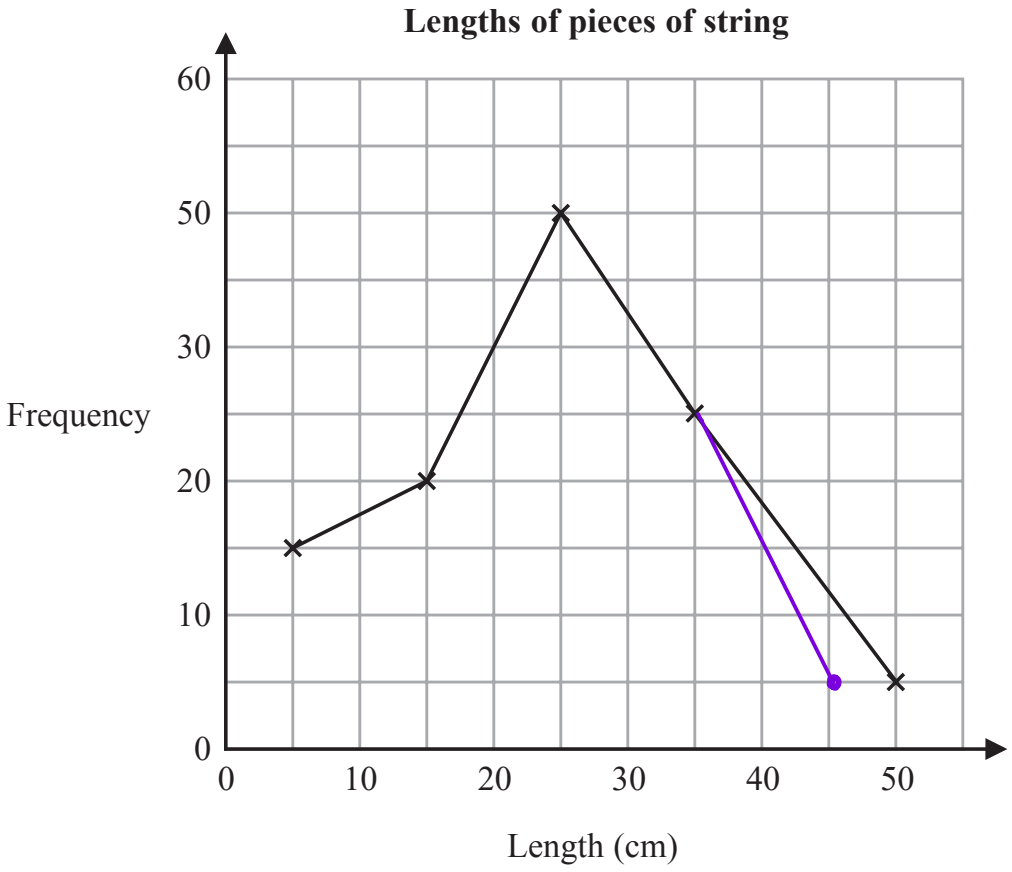
Jo should buy wallpapers from Chic Decor as £180 is cheaper than £184.80 (1)

(Total for Question 4 is 4 marks)

5 The table gives information about the lengths, in cm, of some pieces of string.

Length (t cm)	Frequency
$0 < t \leqslant 10$	15
$10 < t \leqslant 20$	20
$20 < t \leqslant 30$	50
$30 < t \leqslant 40$	25
$40 < t \leqslant 50$	5

Amos draws a frequency polygon for the information in the table.



Write down **two** mistakes that Amos has made.

1 The last point (50,5) is incorrect it should be (45,5) as 45 is the midpoint of the last group

(1)

2 40 is missing from the vertical axis

(1)

(Total for Question 5 is 2 marks)

6 Jessica runs for 15 minutes at an average speed of 6 miles per hour.
She then runs for 40 minutes at an average speed of 9 miles per hour.

It takes Amy 45 minutes to run the same total distance that Jessica runs.

Work out Amy's average speed.
Give your answer in miles per hour.

Find the distance Jessica runs:

15 minutes = 0.25 hours (÷60)

First distance = speed x time
= 6 x 0.25
= 1.5 miles (1)

40 minutes = $\frac{2}{3}$ hours (÷60)

Second distance = speed x time
= 9 x $\frac{2}{3}$
= 6 miles

In total Jessica runs 1.5 + 6 = 7.5 miles (1)
∴ Amy runs 7.5 miles

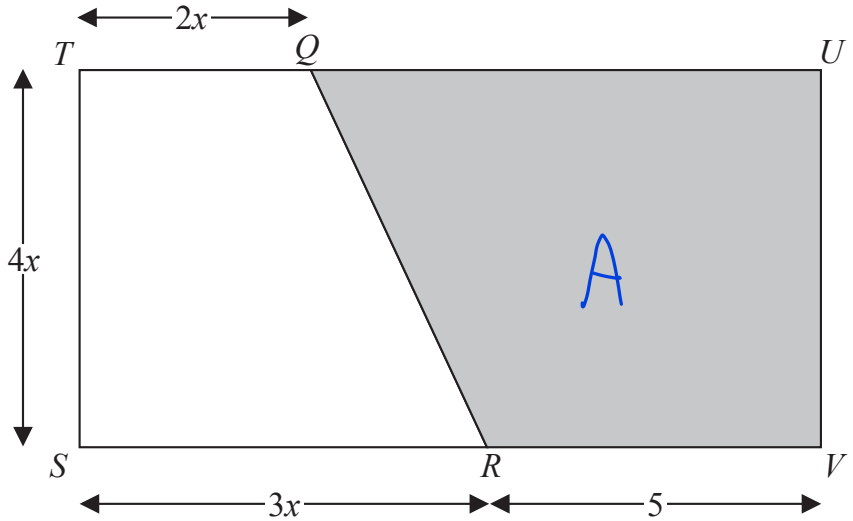
Amy's average speed = $\frac{\text{distance}}{\text{time}} = \frac{7.5}{0.75} = 10$ (1)

45 minutes = 0.75 hours (÷60)

10 (1) miles per hour

(Total for Question 6 is 4 marks)

7 The diagram shows rectangle *STUV*.
TQU and *SRV* are straight lines.
All measurements are in cm.



The area of trapezium *QUVR* is A cm^2

Show that $A = 2x^2 + 20x$

Area of rectangle STUV

= length x width

$= 4x(3x+5)$

$= 12x^2 + 20x$

Area of trapezium STQR

$= \frac{2x + 3x}{2} \times 4x$ (1)

$= \frac{5}{2}x \times 4x$

$= 10x^2$

(1)

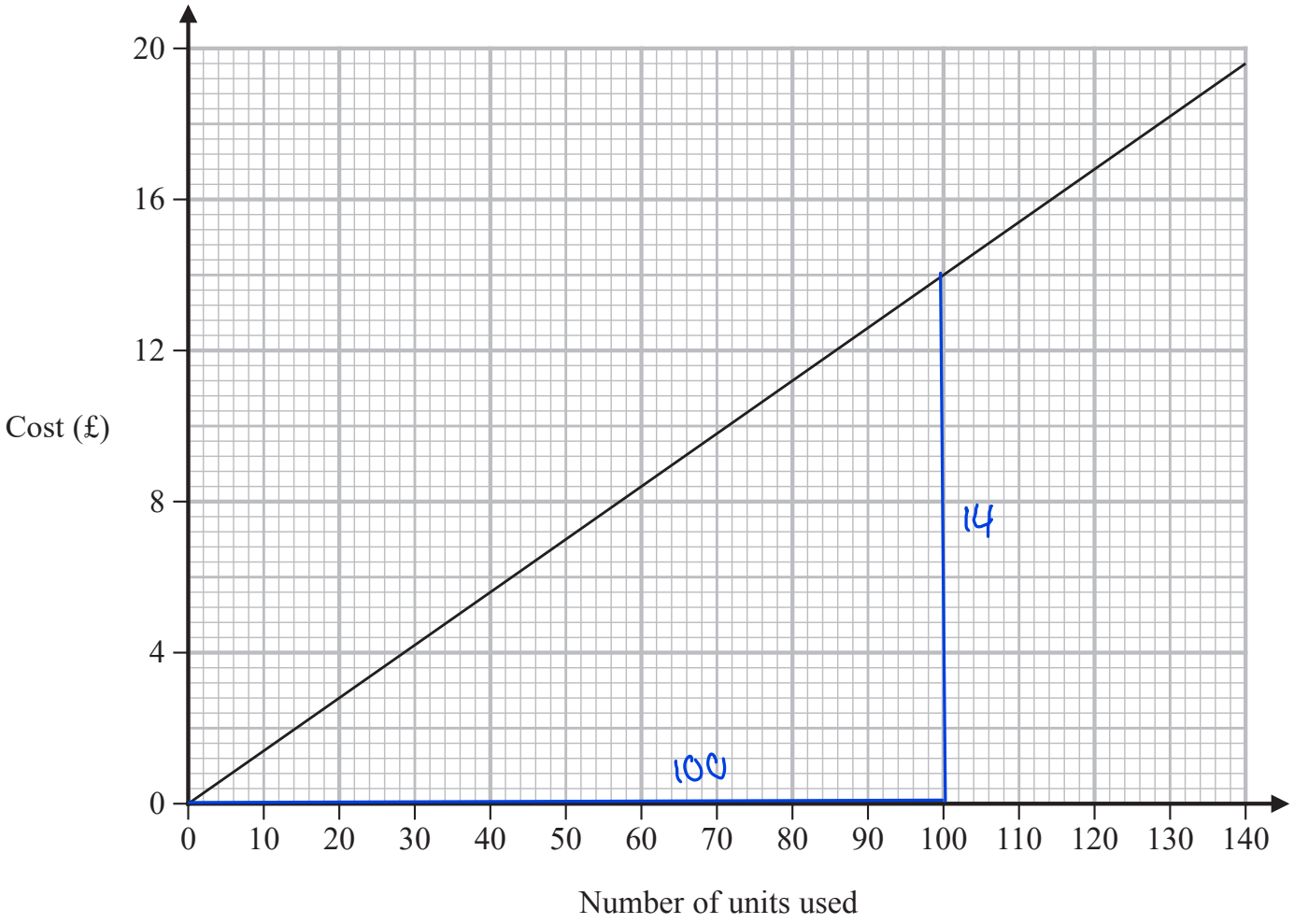
$A = 12x^2 + 20x - 10x^2$ (1)

$A = 2x^2 + 20x$ as required

(Total for Question 7 is 3 marks)

8 An electricity company charges the same fixed amount for each unit of electricity used.

David uses this graph to work out the total cost of the electricity he has used.



(a) Work out the gradient of the straight line.

gradient = $\frac{\Delta y}{\Delta x} = \frac{14}{100} = 0.14$ (1) (1)

0.14

(2)

(b) What does the gradient of this line represent?

the cost per unit of electricity (1)

(1)

(Total for Question 8 is 3 marks)

9 (a) Express $\sqrt{\dfrac{10^{360}}{10^{150} \times 10^{90}}}$ as a power of 10

remember $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

and $\sqrt{a} = a^{1/2}$

$$\sqrt{\frac{10^{360}}{10^{150} \times 10^{90}}} = \frac{(10^{360})^{1/2}}{(10^{150} \times 10^{90})^{1/2}}$$

$$= \frac{10^{360 \times \frac{1}{2}}}{(10^{150+90})^{1/2}} \quad (1)$$

$$= \frac{10^{180}}{(10^{240})^{1/2}}$$

$$= \frac{10^{180}}{10^{120}} = 10^{60} \quad (1)$$

10^{60} (1)

(3)

Liam was asked to express $(12^{50})^2$ as a power of 12

Liam wrote $(12^{50})^2 = 12^{50^2} = 12^{2500}$

Liam's method is wrong.

(b) Explain why.

because $(a^b)^c = a^{bc}$ NOT a^{b^c} (1)

so $(12^{50})^2 = 12^{100}$

(1)

(Total for Question 9 is 4 marks)

10 Jane bought a new car three years ago.

At the end of the first year the value of the car had decreased by 12.5%
The value of the car then decreased by 10% each year for the next two years.

At the end of the three years, the value of the car was £17 010

Work out the value of the car when Jane bought it three years ago.

Let the valve of the car when Jane bought it 3 years ago be £x.

$100 - 12.5 = 87.5$

After 1 year: $0.875 \times x = 0.875x$ (1)

After 2 years: $0.9 \times 0.875x$

After 3 years: $0.9^2 \times 0.875x$

$0.9^2 \times 0.875x = 17010$ (1)

$$x = \frac{17010}{0.9^2 \times 0.875}$$

$x = 24000$ (1)

£ 24,000

(Total for Question 10 is 3 marks)

11 Rayheem has

16 shirts
5 pairs of jeans
3 jackets

Rayheem chooses an outfit to wear.
An outfit is 1 shirt, 1 pair of jeans and 1 jacket.

Work out how many different outfits Rayheem can choose.

# of outfits = # of shirts x # of jeans x # of jackets

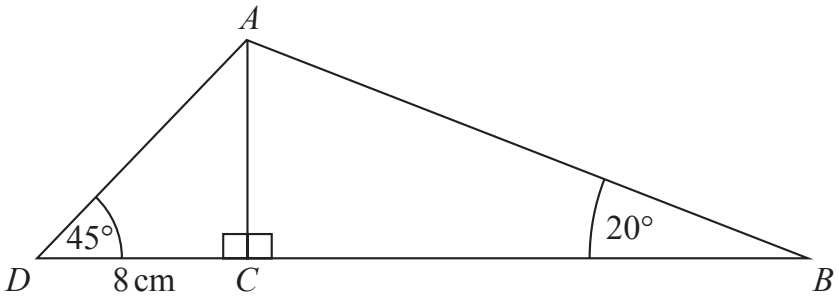
= 16 x 5 x 3 (1)

= 240 (1)

240

(Total for Question 11 is 2 marks)

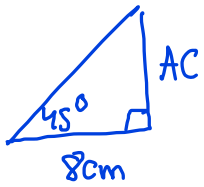
12 *ABC* and *ACD* are right-angled triangles.



DC = 8 cm
Angle *ADC* = 45°
Angle *ABC* = 20°

Work out the length of *AB*.
Give your answer correct to 3 significant figures.

considering △ADC

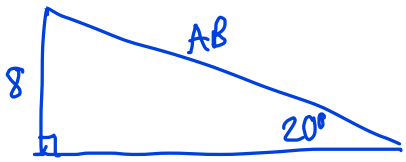


$\tan 45° = \frac{AC}{8}$

$\Rightarrow AC = 8\tan 45°$

$= 8$ (1)

considering △ABC



$\sin 20° = \frac{8}{AB}$ (1)

$\Rightarrow AB = \frac{8}{\sin 20°}$

$= 23.390...$

$= 23.4$ (3sf) (1)

23.4 cm

(Total for Question 12 is 3 marks)

13 **a** and **b** are vectors such that

$$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} \quad \text{and} \quad 3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$$

Find **b** as a column vector.

$3\underline{a} - 2\underline{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ ↓ substitute $\underline{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

$3\begin{pmatrix} 2 \\ -3 \end{pmatrix} - 2\underline{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ (1)

$2\underline{b} = 3\begin{pmatrix} 2 \\ -3 \end{pmatrix} - \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ (1)

$2\underline{b} = \begin{pmatrix} -2 \\ 8 \end{pmatrix}$

$\underline{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ (1)

$\begin{pmatrix} -1 \\ 4 \end{pmatrix}$

(Total for Question 13 is 3 marks)

14 (a) Factorise fully $4p^2 - 36$

both terms have a factor 4

$4[p^2 - 9]$ (1) ↓ difference of 2 squares

$4(p+3)(p-3)$ (1)

$a^2 - b^2 = (a+b)(a-b)$

$4(p+3)(p-3)$

(2)

(b) Show that $(m + 4)(2m - 5)(3m + 1)$ can be written in the form $am^3 + bm^2 + cm + d$ where a, b, c and d are integers.

$(m+4)(2m-5)(3m+1)$

consider $(2m-5)(3m+1)$

$= 6m^2 + 2m - 15m - 5$

$= 6m^2 - 13m - 5$ (1)

$(m+4)(6m^2 - 13m - 5)$

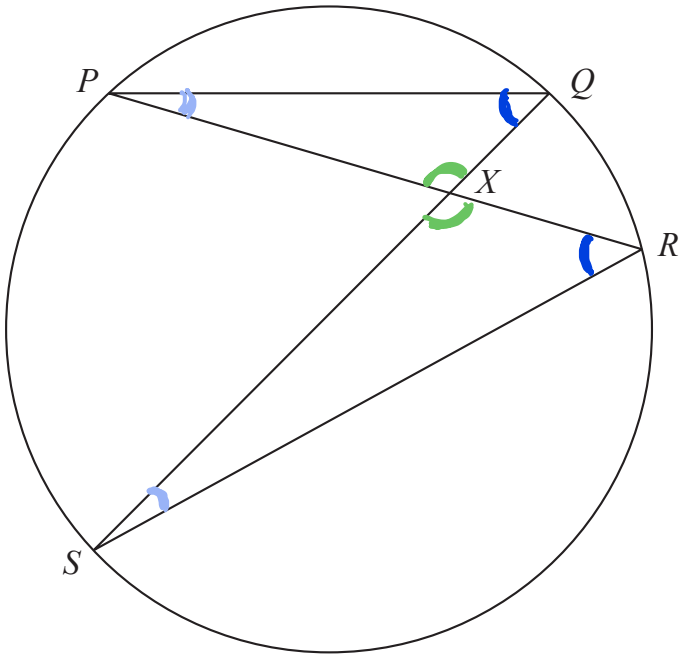
$= 6m^3 - 13m^2 - 5m + 24m^2 - 52m - 20$ (1)

$= 6m^3 + 11m^2 - 57m - 20$ (1)

(3)

(Total for Question 14 is 5 marks)

15 P, Q, R and S are four points on a circle.



PXR and SXQ are straight lines.

Prove that triangle PQX and triangle SRX are similar.

$\angle PQX = \angle SRX$ angles in the same segment are equal (1)

$\angle QPX = \angle RSX$ angles in the same segment are equal

$\angle PXQ = \angle SXR$ vertically opposite angles are equal (1)

All three angles are equal so the triangles are similar. (1)

(Total for Question 15 is 3 marks)

16 $p = \sqrt{\frac{2e}{f}}$

e = 6.8 correct to 1 decimal place.

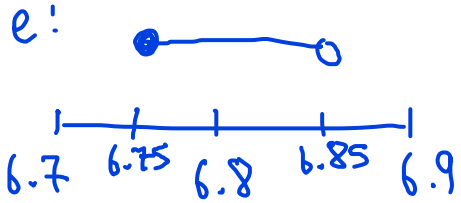
f = 0.05 correct to 1 significant figure.

Work out the upper bound for the value of p.
Give your answer correct to 3 significant figures.
You must show all your working.

$p = \sqrt{\frac{2e}{f}}$

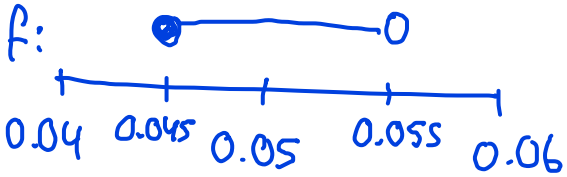
to find UB of p, use UB of e (as it is on the numerator) and the LB of f (as it is in the denominator)

e:



UB of e = 6.85 (1)

f:



LB of f = 0.045

$\therefore$ UB of $p = \sqrt{\frac{2 \times 6.85}{0.045}}$ (1)

$= 17.448...$

$= 17.4$ (3sf) (1)

17.4

(Total for Question 16 is 3 marks)

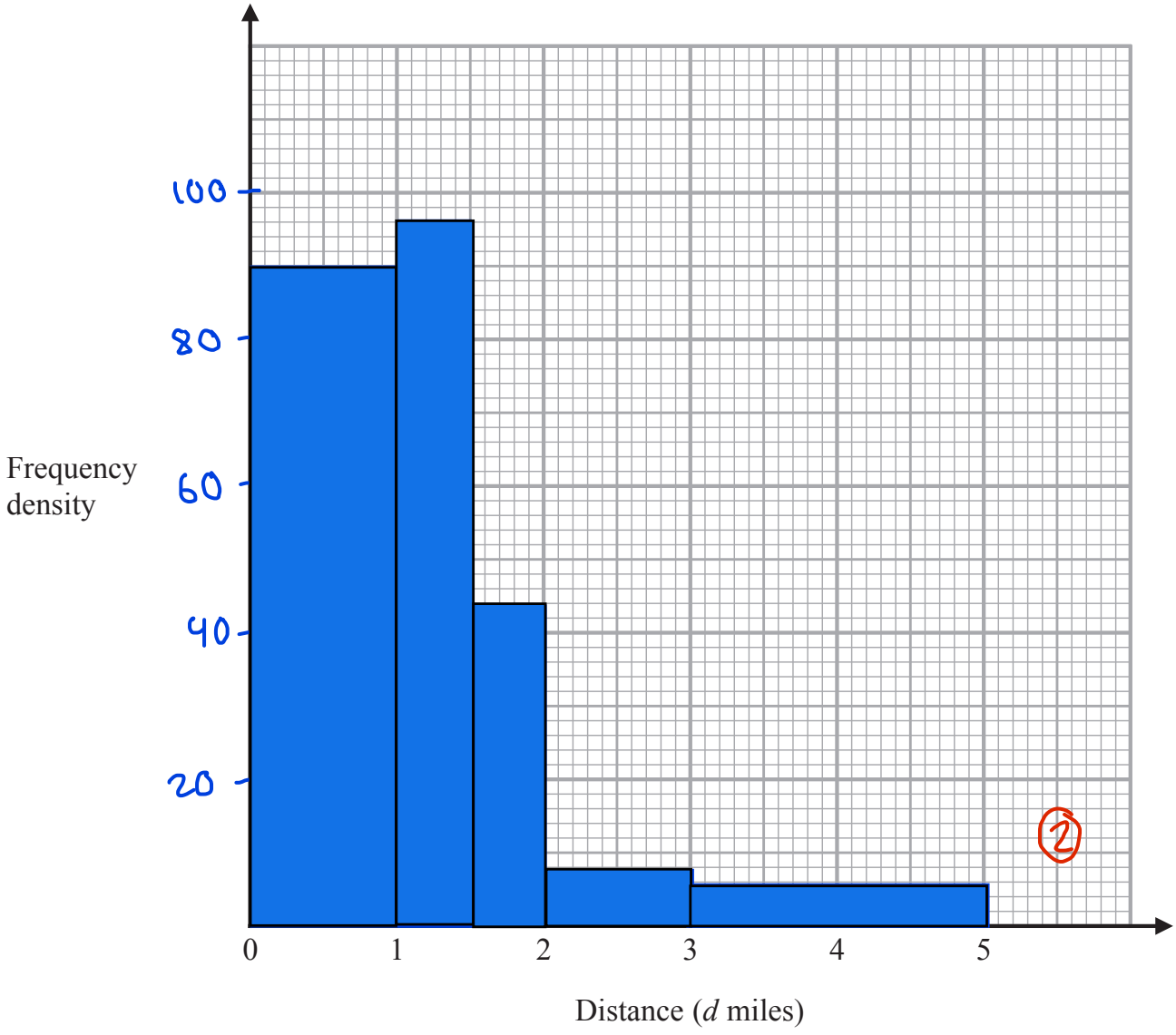
17 The table gives information about the distances, in miles, that some Year 10 students live from school.

Distance (d miles)	Frequency
$0 < d \leqslant 1.0$	90
$1.0 < d \leqslant 1.5$	48
$1.5 < d \leqslant 2.0$	22
$2.0 < d \leqslant 3.0$	8
$3.0 < d \leqslant 5.0$	12

Frequency = f.d. × c.w.
⇒ f.d. = frequency / c.w.

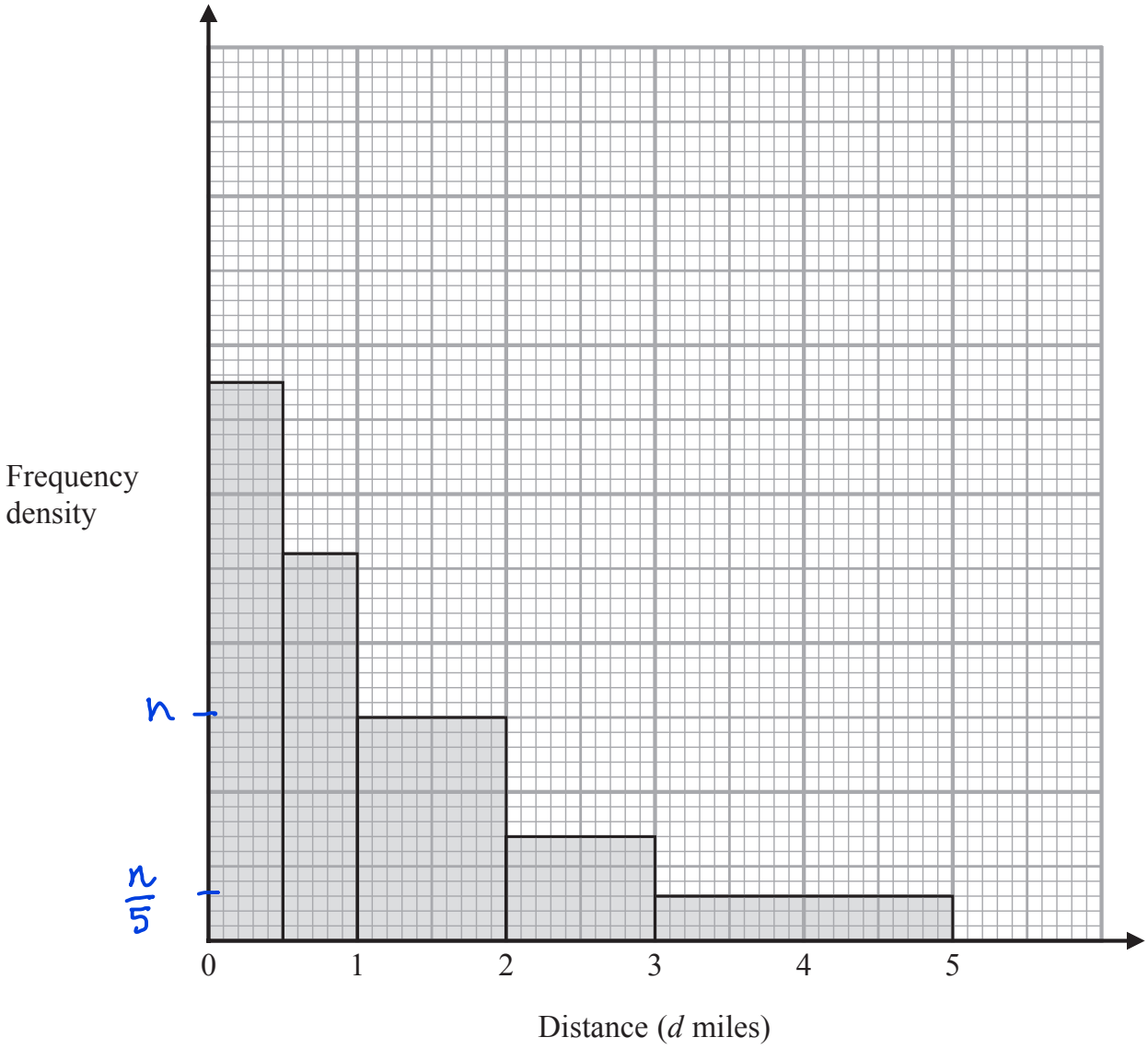
c.w.	f.d. ①
1	90
0.5	96
0.5	44
1	8
2	6

(a) On the grid, draw a histogram for this information.



(3)

The histogram below shows information about the distances, in miles, that some Year 11 students live from school.



The number of Year 11 students who live between 1 and 2 miles from school is n.

(b) Find an expression, in terms of n, for the number of Year 11 students who live between 3 and 5 miles from school.

1 - 2 mile group:
has class width 1
has frequency n
$\Rightarrow$ freq. density $= \frac{n}{1} = n$

3 - 5 mile group:
has class width 2

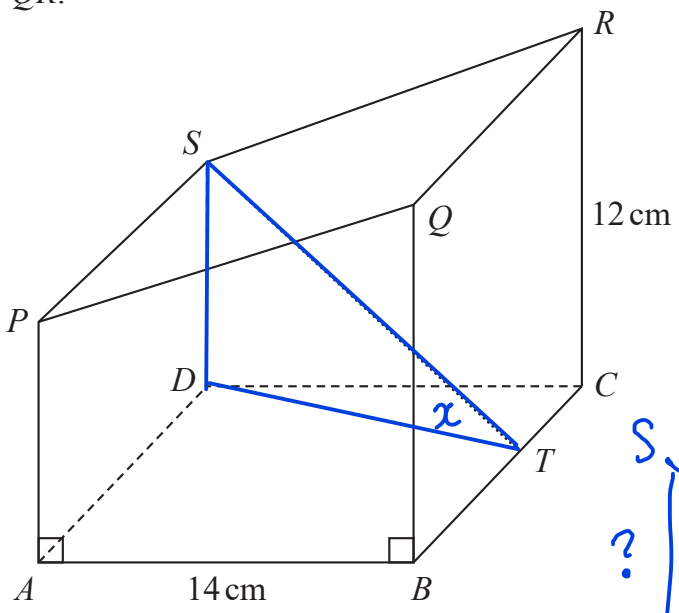
Find freq. density of 3-5 group:
n : 15 squares $\downarrow \div 5$
$n/5$: 3 squares (1)
$\therefore$ freq. density $= \frac{n}{5}$
Frequency $= \frac{n}{5} \times 2 = 0.4n$ (1)

$0.4n$

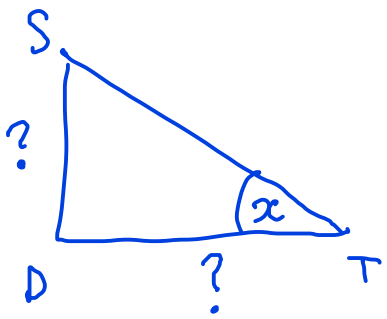
(2)

(Total for Question 17 is 5 marks)

18 Here is a prism *ABCDSPQR*.

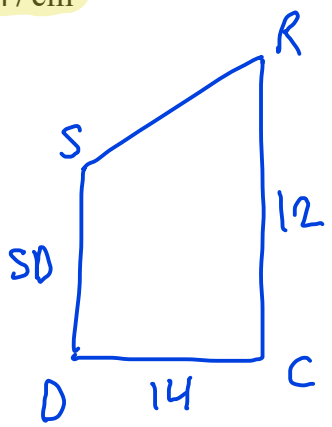


Method: find the lengths SD and DT, then use trig



The base *ABCD* of the prism is a square of side 14 cm
T is the point on *BC* such that $BT : TC = 4 : 3$

The cross section of the prism is in the shape of a trapezium of area 147 cm^2
$CR = 12$ cm



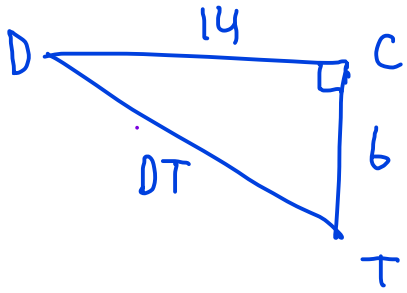
Find the size of the angle between the line *ST* and the base *ABCD*.
Give your answer correct to 1 decimal place.

ABCD square so BC = 14

BT : TC
4 : 3
×2 ↓ ×2
8 : 6

4 + 3 = 7
14 ÷ 7 = 2

so TC = 6cm (1)



Area of Trapezium SDCR
$= \frac{SD + 12}{2} \times 14$

$147 = 7SD + 84$

$\Rightarrow SD = \frac{147 - 84}{7} = 9$ (1)

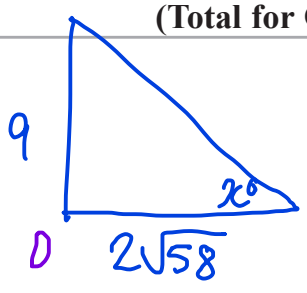
(1)

30.6 °

$DT = \sqrt{14^2 + 6^2}$

$= 2\sqrt{58}$ (1)

(Total for Question 18 is 5 marks)



$x = \tan^{-1}\left(\frac{9}{2\sqrt{58}}\right)$ (1)

$= 30.577...$

19 Show that $\frac{3x}{x+2} - \frac{2x+1}{x-2} - 1$ can be written in the form $\frac{ax+b}{x^2-4}$ where a and b are integers.

make all terms have a common denominator of $(x+2)(x-2)$

$$\frac{3x(x-2)}{(x+2)(x-2)} - \frac{(2x+1)(x+2)}{(x+2)(x-2)} - \frac{(x+2)(x-2)}{(x+2)(x-2)}$$ (1) (1)

expand brackets along numerator ↓

$$= \frac{3x^2-6x}{(x+2)(x-2)} - \frac{2x^2+4x+x+2}{(x+2)(x-2)} - \frac{x^2-4}{(x+2)(x-2)}$$

combine onto single fraction ↓

$$= \frac{3x^2-6x-(2x^2+5x+2)-(x^2-4)}{(x+2)(x-2)}$$

simplify terms ↓

$$= \frac{3x^2-6x-2x^2-5x-2-x^2+4}{x^2-4}$$ (1)

$$= \frac{-11x+2}{x^2-4}$$ (1)

(Total for Question 19 is 4 marks)

20 The profit made by a shop increases each year.

The profit made by the shop in year n is £P_n

Given that the profit made by the shop in the next year is £P_{n+1} then

$$P_{n+1} = aP_n + 800 \text{ where } a \text{ is a constant.}$$

The table shows the profit made by the shop in 2018 and in 2019

Year	2018	2019
Profit	£24 000	£29 600

Work out the profit predicted to be made by the shop in 2021

$P_{n+1} = aP_n + 800$

$29,600 = 24,000a + 800$

$a = \dfrac{29,600 - 800}{24,000}$ (1)

$a = 1.2$

$P_{2020} = 1.2P_{2019} + 800$ (1)

$= 1.2(29600) + 800$

$= 36320$

$P_{2021} = 1.2P_{2020} + 800$ (1)

$= 1.2(36320) + 800$

$= 44384$ (1)

£ 44384

(Total for Question 20 is 4 marks)

21 Ray has nine cards numbered 1 to 9

1	2	3	4	5	6	7	8	9

4 even
5 odd

Ray takes at random three of these cards.

He works out the sum of the numbers on the three cards and records the result.

Work out the probability that the result is an even number.

the sum of three numbers is even if and only if:

- all numbers are even
- two numbers are odd and one is even

E = even picked
O = odd picked

Probability of EEE = $\frac{4}{9} \times \frac{3}{8} \times \frac{2}{7} = \frac{1}{21}$ (1)

Probability of OOE = $\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7} = \frac{10}{63}$ (1)

Probability of OEO = $\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7} = \frac{10}{63}$

Probability of EOO = $\frac{4}{9} \times \frac{5}{8} \times \frac{4}{7} = \frac{10}{63}$

Sum of all four probabilities is the probability that Ray's total is even.

$\frac{1}{21} + 3 \times \frac{10}{63} = \frac{11}{21}$ (1) (1)

$\frac{11}{21}$

(Total for Question 21 is 4 marks)

22 **L** is the straight line with equation $y = 2x - 5$

C is a graph with equation $y^2 = 6x^2 - 25x - 8$

Using algebra, find the coordinates of the points of intersection of **L** and **C**.
You must show all your working.

eliminate y by substituting $y = 2x - 5$ into C.

$(2x-5)^2 = 6x^2 - 25x - 8$ (1)

$4x^2 - 20x + 25 = 6x^2 - 25x - 8$ (1)

$0 = 2x^2 - 5x - 33$

$0 = (2x - 11)(x + 3)$ (1)

so $x = \frac{11}{2}$ or $x = -3$

If $x = \frac{11}{2}$, $y = 2(\frac{11}{2}) - 5$

$= 11 - 5$

$= 6$

$(\frac{11}{2}, 6)$ (1)

If $x = -3$, $y = 2(-3) - 5$

$= -6 - 5$

$= -11$

$(-3, -11)$ (1)

(-3 , -11)

(11/2 , 6)

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS