

MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE ASSESSMENT INTERNATIONAL EDUCATION
General Certificate of Education Ordinary Level

CANDIDATE
NAME

CENTRE
NUMBER

S

INDEX
NUMBER

MATHEMATICS

Paper 2

4052/02

October/November 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO NOT WRITE ON ANY BARCODES.

Answer **all** questions.
The number of marks is given in brackets [] at the end of each question or part question.

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π , use either your calculator value or 3.142.

Answer **all** the questions.

1 (a) Solve $\frac{6}{1-2x} = 5$.

$$\begin{aligned} 6 &= 5(1-2x) \\ 6 &= 5 - 10x \\ 10x &= 5 - 6 \\ 10x &= -1 \\ x &= \frac{-1}{10} \end{aligned}$$

Answer $x = \dots\dots\dots -\frac{1}{10} \dots\dots\dots$ [2]

(b) Factorise completely $12a^2c - 3b^2c$.

$$\begin{aligned} &3c(4a^2 - b^2) \\ &3c(2a - b)(2a + b) \end{aligned}$$

Answer $\dots\dots\dots 3c(2a - b)(2a + b) \dots\dots\dots$ [2]

(c) Solve these simultaneous equations.

$$\begin{aligned} 3x + 4y &= 1 && \text{---} \textcircled{1} \\ 5x - 6y &= 8 && \text{---} \textcircled{2} \end{aligned}$$

You must show your working.

$$\textcircled{1} \times 3 : \quad 9x + 12y = 3 \quad \text{---} \textcircled{3}$$

$$\textcircled{2} \times 2 : \quad 10x - 12y = 16 \quad \text{---} \textcircled{4}$$

$$\begin{aligned} \textcircled{3} + \textcircled{4} : \quad 19x &= 19 \\ x &= 1 \end{aligned}$$

$$\begin{aligned} \text{Sub } x=1 \text{ into } \textcircled{1} : \quad 3(1) + 4y &= 1 \\ 4y &= -2 \\ y &= -\frac{1}{2} \end{aligned}$$

$x = \dots\dots\dots 1 \dots\dots\dots$
 $y = \dots\dots\dots -\frac{1}{2} \dots\dots\dots$ [3]

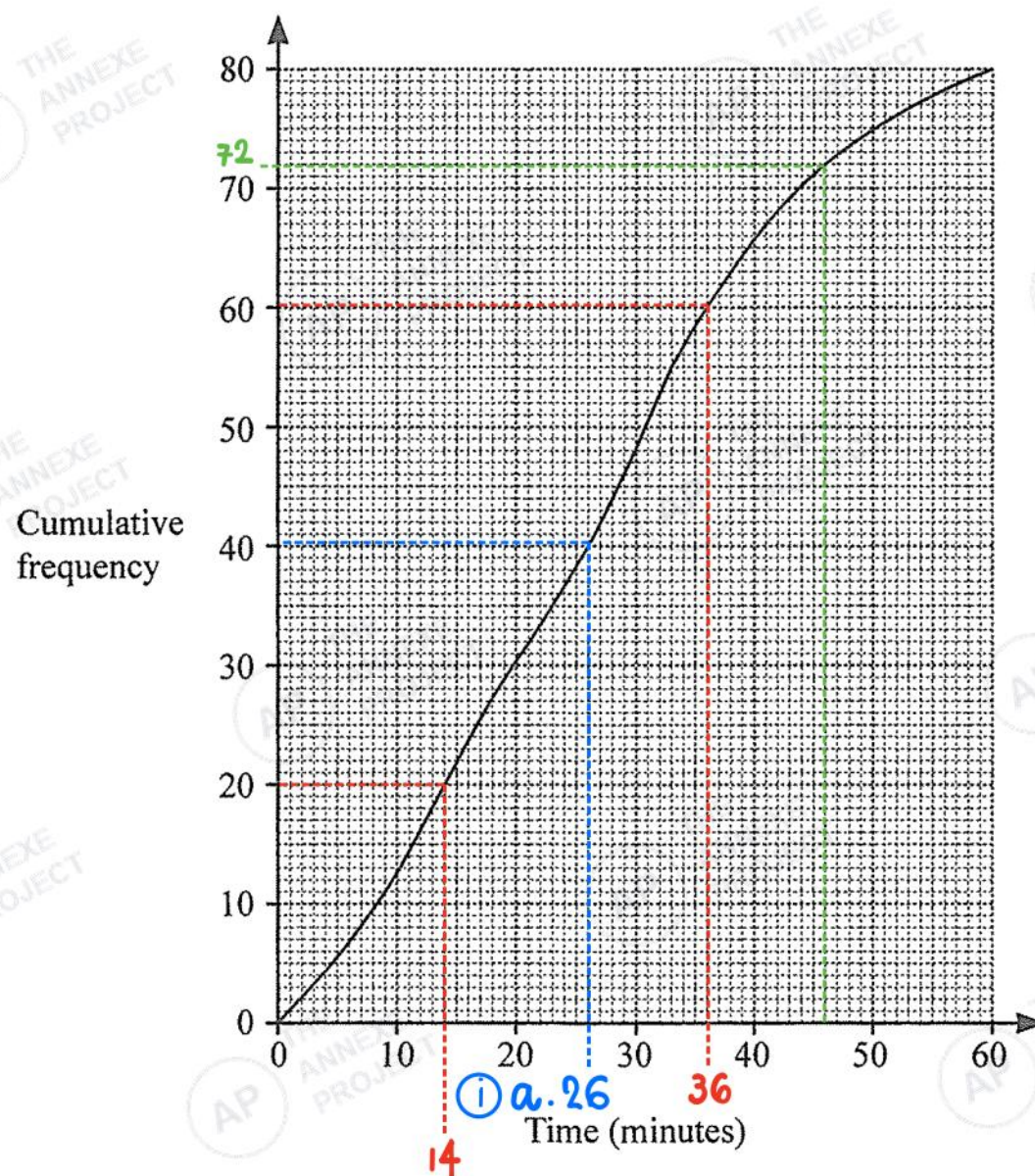
(d) Write $\frac{3x+5}{(x+4)(x-3)} - \frac{2}{x-3}$ as a single fraction in its simplest form.

$$\begin{aligned}\frac{3x+5}{(x+4)(x-3)} - \frac{2}{x-3} &= \frac{3x+5-2(x+4)}{(x+4)(x-3)} \\ &= \frac{3x-2x+5-8}{(x+4)(x-3)} \\ &= \frac{x-3}{(x+4)(x-3)} \\ &= \frac{1}{(x+4)}\end{aligned}$$

$$\frac{1}{(x+4)}$$

Answer [3]

- 2 (a) A website records the times taken for 80 adults to complete a quiz.
The cumulative frequency diagram represents these times.



- (i) Use the diagram to estimate

- (a) the median time,

Answer 26 minutes [1]

- (b) the interquartile range of the times.

$$36 - 14 = 22$$

Answer 22 minutes [2]

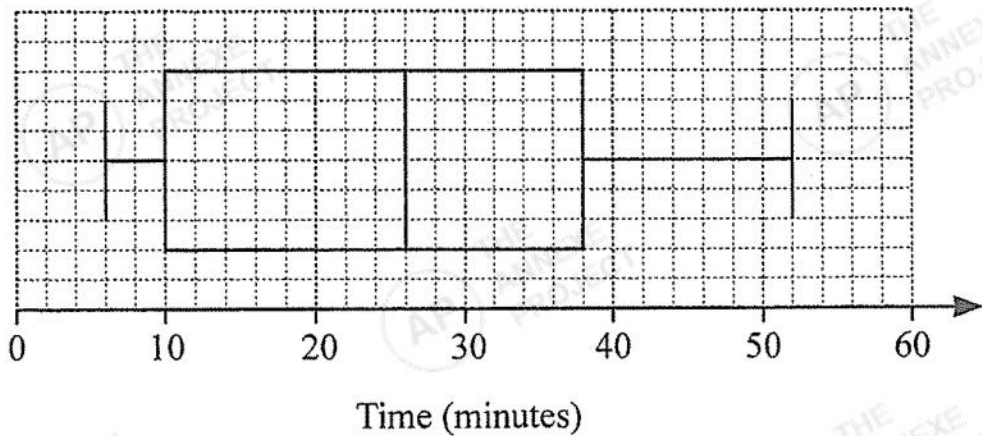
- (ii) One of the 80 adults is chosen at random.

Use the diagram to estimate the probability that the adult took longer than 46 minutes to complete the quiz.

$$\frac{80 - 72}{80} = \frac{8}{80} = \frac{1}{10}$$

Answer $\frac{1}{10}$ [2]

- (b) The website also records the times taken for 80 children to complete the quiz. The box-and-whisker plot represents these times.



Find how many of the 80 children took at most 38 minutes to complete the quiz.

38 mins represents the upper quartile range , i.e. 75%.

$$\frac{75}{100} \times 80 = 60 \text{ children}$$

Answer60 [1]

- (c) The table shows the number of visitors to five different websites in 2022.

Website	A	B	C	D	E
Number of visitors	8.76×10^5	5.43×10^7	1.276×10^5	9.78×10^6	2.84×10^7

- (i) The range of the number of visitors is k million.

Calculate the value of k , correct to the nearest integer.

$$(5.43 \times 10^7) - (1.276 \times 10^5)$$

$$= 54.2 \text{ million}$$

$$\approx 54 \text{ million}$$

Answer $k =$ 54 [1]

- (ii) A pie chart is drawn to represent the data in the table.

Calculate the angle of the sector representing the number of visitors to website D.

$$\frac{9.78 \times 10^6}{(8.76 \times 10^5) + (5.43 \times 10^7) + (1.276 \times 10^5) + (9.78 \times 10^6) + (2.84 \times 10^7)} \times 360^\circ$$

$$= \frac{9.78 \times 10^6}{9.3484 \times 10^7} \times 360^\circ$$

$$= 37.7^\circ$$

Answer37.7 [1]

- 3 (a) Last year, a school raised \$780 for charity.
This year, the school has raised 4.3% more for charity.

Find how much money the school has raised for charity this year.

$$\frac{104.3}{100} \times 780 = \$813.54$$

Answer \$ 813.54 [1]

- (b) The real distance between two schools is 5.6 km.
On a map, the distance between the schools is 35 cm.
On the same map, a field has an area of 0.24 cm².

Work out the real area of the field.
Give your answer in square metres.

Length Ratio

$$35 \text{ cm} : 5.6 \text{ km}$$

$$35 \text{ cm} : 5600 \text{ m}$$

$$1 \text{ cm} : 160 \text{ m}$$

Area Ratio

$$1 \text{ cm}^2 : 160^2 \text{ m}^2$$

$$1 \text{ cm}^2 : 25600 \text{ m}^2$$

$$0.24 \times 25600 = 6144 \text{ m}^2$$

Answer 6144 m² [3]

- (c) Each student at the school is in one of three sports teams.

The ratio of the number of students in Team A to the number of students in Team B is 2 : 3 .

The ratio of the number of students in Team B to the number of students in Team C is 5 : 4 .

$\frac{3}{8}$ of the students in Team C move into Team A.

There are now 87 students in Team A.

Find the number of students at the school.

Team A : B

$$2 : 3$$

$$\times 5 \quad \times 5$$

$$10 : 15$$

Team B : C

$$5 : 4$$

$$\times 3 \quad \times 3$$

$$15 : 12$$

Hence, team A : B : C

$$10 : 15 : 12$$

$$\frac{3}{8} \times 12 \text{ units} = 4.5 \text{ units}$$

If 4.5 units of students move to team A, the distribution of the students will be

$$A : B : C$$

$$14.5 : 15 : 7.5$$

$$14.5 \text{ units} = 87 \text{ students}$$

$$1 \text{ unit} = 6 \text{ students}$$

$$37 \text{ units} = 6 \times 37 = 222 \text{ students}$$

Answer 222 [3]



- (d) A college course has three tests.
Each of the tests is out of 100 marks.

Koh and Min are two students taking this course.

The matrix $\mathbf{R}$ shows information about the marks Koh and Min got on the tests.

$$\mathbf{R} = \begin{matrix} & \begin{matrix} \text{K} & \text{M} \end{matrix} \\ \begin{pmatrix} 86 & 74 \\ 56 & 70 \\ 80 & 24 \end{pmatrix} & \begin{matrix} \text{Test 1} \\ \text{Test 2} \\ \text{Test 3} \end{matrix} \end{matrix}$$

- (i) Test 1 counts for 30% of the final grade for the course.
Test 2 and Test 3 each count for the same proportion of the final grade.

Represent this information in a 1×3 matrix $\mathbf{T}$.
Give each element as a decimal.

Answer $\mathbf{T} = (0.3 \ 0.35 \ 0.35)$ [1]

- (ii) Evaluate the matrix $\mathbf{P} = \mathbf{TR}$.

$$\mathbf{P} = (0.3 \ 0.35 \ 0.35) \begin{pmatrix} 86 & 74 \\ 56 & 70 \\ 80 & 24 \end{pmatrix}$$

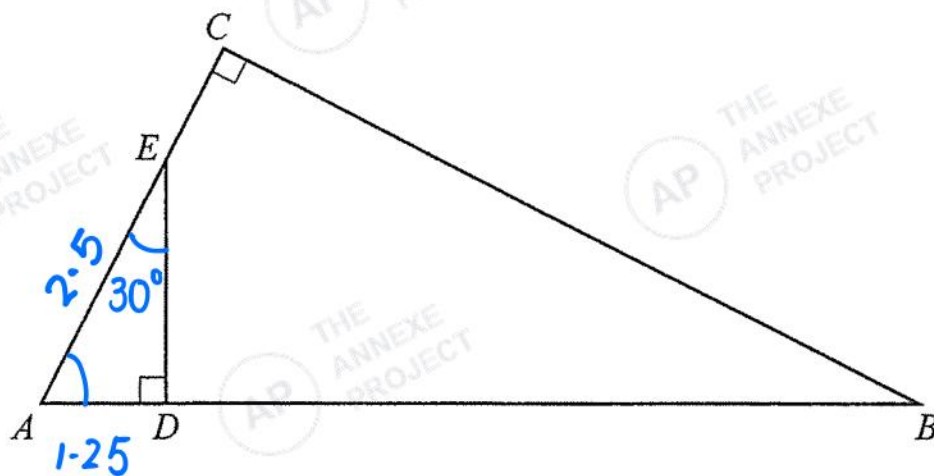
$$= (73.4 \ 55.1)$$

Answer $\mathbf{P} = (73.4 \ 55.1)$ [1]

- (iii) State what the elements of $\mathbf{P}$ represent.

It represents the final grade of Koh and Min
respectively. [1]

4 (a)



In the diagram, ACB and ADE are right-angled triangles.

(i) Show that the two triangles are geometrically similar.

Answer

$A \longleftrightarrow A$
 $C \longleftrightarrow D$
 $B \longleftrightarrow E$

$\angle ACB = \angle ADE$ (right-angled)
 $\angle CAB = \angle DAE$ (common $\angle$)
 By A-A test,
 $\triangle ACB$ and $\triangle ADE$ are similar.

[2]

(ii) $AD = 1.25$ cm, $AB = 8$ cm and angle $AED = 30^\circ$.

Find the perimeter of $BCED$.

$$\tan 30^\circ = \frac{1.25}{ED}$$

$$ED = 2.1651 \text{ cm}$$

$$\sin 30^\circ = \frac{1.25}{AE}$$

$$AE = 2.5 \text{ cm}$$

$$\frac{AC}{AD} = \frac{AB}{AE}$$

$$\frac{AC}{1.25} = \frac{8}{2.5}$$

$$AC = 4 \text{ cm}$$

$$\frac{AC}{AD} = \frac{CB}{DE}$$

$$\frac{4}{1.25} = \frac{CB}{2.1651}$$

$$CB = 6.9283 \text{ cm}$$

Perimeter

$$= ED + DB + BC + CE$$

$$= 2.1651 + 6.75 + 6.9283 + 1.5$$

$$= 17.3 \text{ cm}$$

17.3

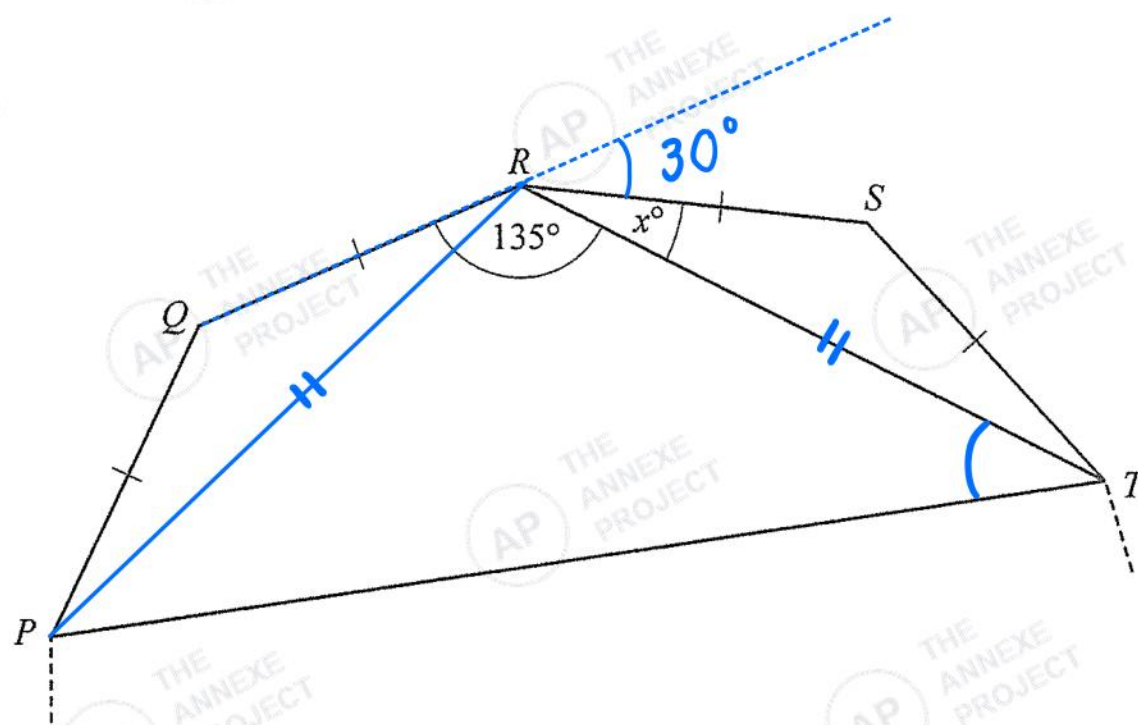
Answer cm [4]

$$\text{Hence, } EC = 4 - 2.5 = 1.5 \text{ cm}$$

$$DB = AB - AD$$

$$= 8 - 1.25 = 6.75 \text{ cm}$$

(b)



PQ, QR, RS and ST are four sides of a regular polygon.
Angle $QRT = 135^\circ$ and angle $SRT = x^\circ$.

(i) Show that $x = 15$.

Answer

$$\begin{aligned}\angle STR &= x^\circ \text{ (base } \angle\text{s of isos. } \triangle) \\ \angle RST &= 180^\circ - 2x \\ \angle RST &= \angle QRS \\ 180 - 2x &= 135 + x \\ 3x &= 45 \\ x &= 15\end{aligned}$$

[2]

(ii) Find the number of sides of the regular polygon.

$$\begin{aligned}\text{ext. } \angle QRS &= 180^\circ - 135^\circ - 15^\circ = 30^\circ \\ \text{number of sides} &= \frac{360^\circ}{30^\circ} = 12\end{aligned}$$

Answer 12 [1]

(iii) Find the size of angle RTP .

$$\begin{aligned}\triangle PQR &\text{ is congruent to } \triangle RST \\ \angle QRP &= x^\circ = 15^\circ \\ \text{Hence, } \angle PRT &= 135^\circ - 15^\circ = 120^\circ \\ PR &= RT \\ \text{Hence } \angle RTP &= \frac{180^\circ - 120^\circ}{2} = 30^\circ \text{ (base } \angle\text{s of isos. } \triangle)\end{aligned}$$

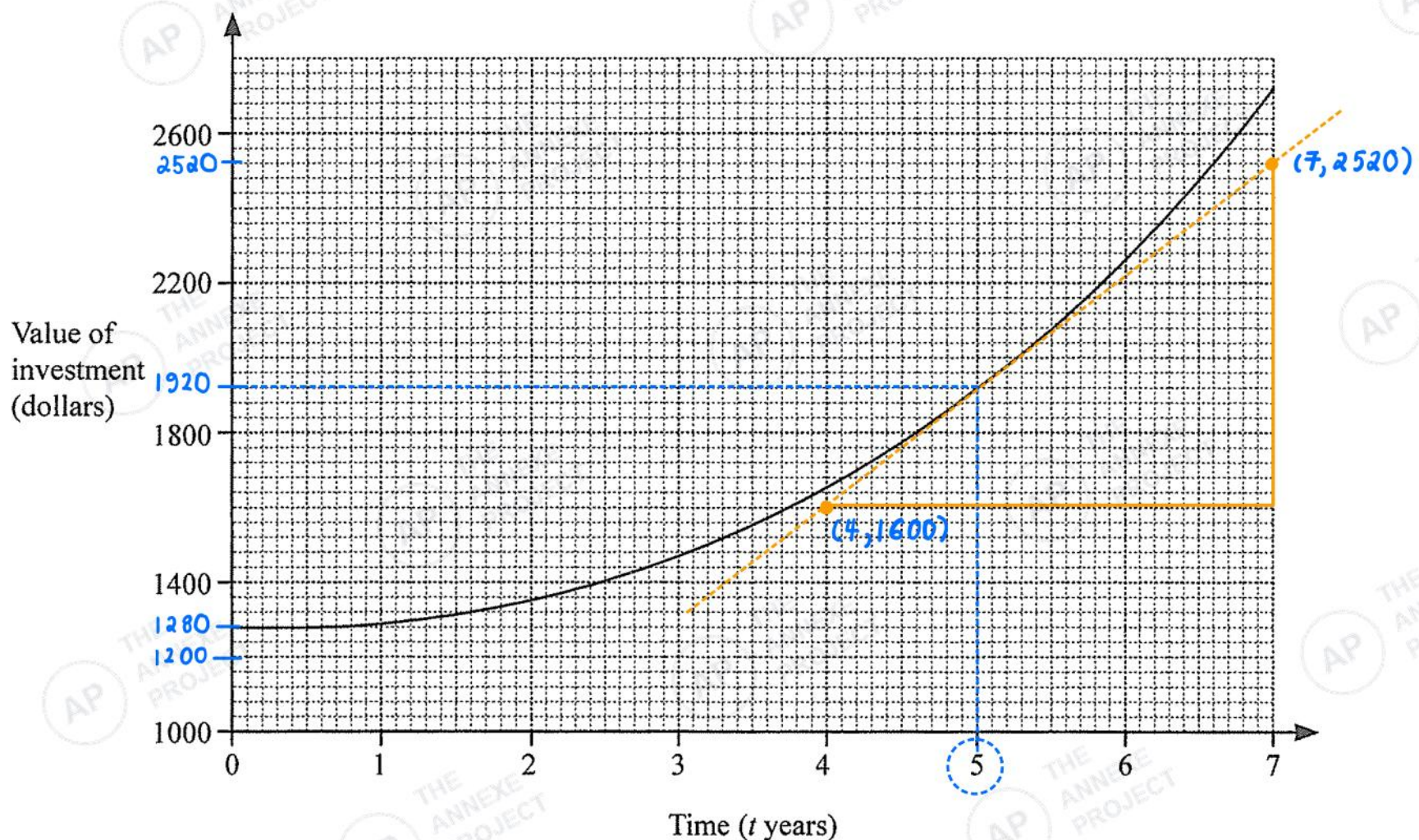
Answer Angle $RTP = 30^\circ$ [3]

5 (a) Write $\frac{2^{189} \times 2^{482}}{2^{100} + 2^{100}}$ as a single power of 2.

$$\begin{aligned}
 &= \frac{2^{189+482}}{2^{100}(1+1)} \\
 &= \frac{2^{671}}{2^{100}(2)} = \frac{2^{671}}{2^{101}} = 2^{671-101} = 2^{570}
 \end{aligned}$$

Answer [2]

(b) Luke invests some money into an account.
The graph shows the value of Luke's investment, in dollars, t years after he invests.



At time $t = T$, the value of Luke's investment is 1.5 times its initial value.

By drawing a tangent, work out an estimate for the gradient of the graph at time $t = T$.
State the units of your answer.

initial investment = 1280
at $t = T$, $1280 \times 1.5 = 1920$
From graph, $T = 5$ years.

$$\$ \frac{920}{3} \text{ / year}$$

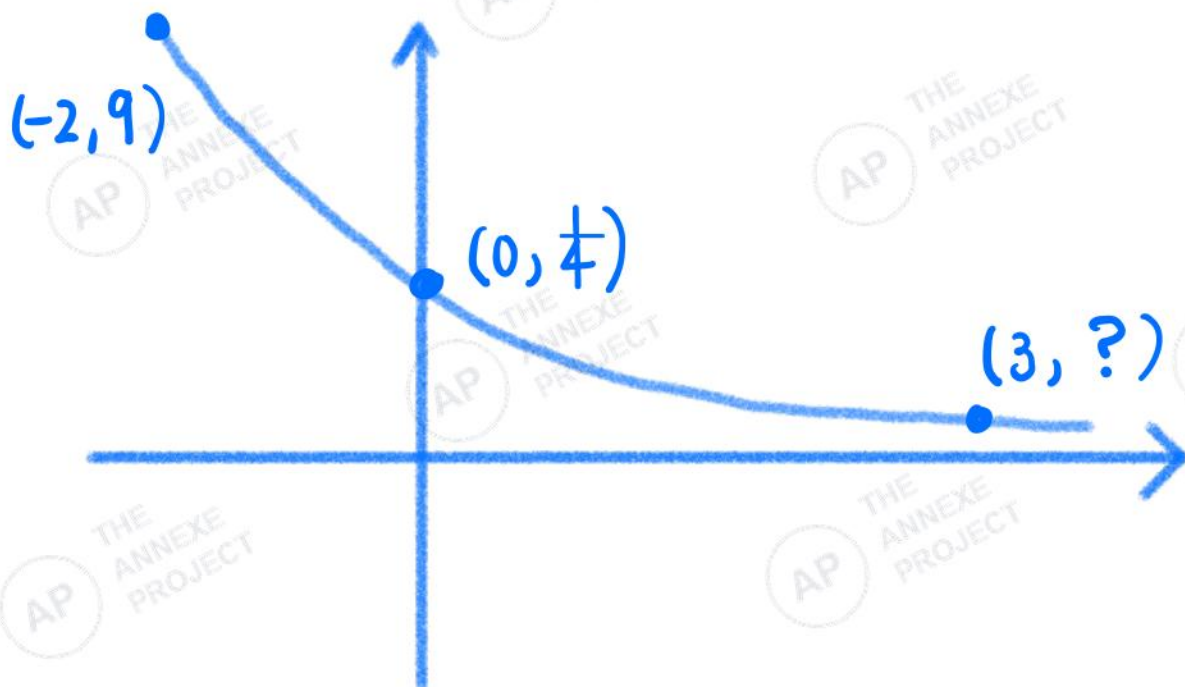
Answer [4]

$$\begin{aligned}
 \text{at } T=5, \\
 \text{gradient} &= \frac{2520 - 1600}{7 - 4} \\
 &= \frac{920}{3}
 \end{aligned}$$

(c) The graph of $y = ka^x$, where $a > 0$, passes through the points $(0, \frac{1}{4})$ and $(-2, 9)$.

The point P has x -coordinate 3 and lies on the graph.

Find the exact y -coordinate of P .



When $x = 0$, $y = \frac{1}{4}$:

$$\frac{1}{4} = ka^0$$

$$\therefore k = \frac{1}{4}$$

When $x = -2$, $y = 9$:

$$9 = \frac{1}{4}a^{-2}$$

$$36 = a^{-2}$$

$$36 = \frac{1}{a^2}$$

$$a^2 = \frac{1}{36}$$

$$a = \pm \frac{1}{6}$$

$$a = \frac{1}{6} \text{ (given } a > 0 \text{)}$$

$$\text{Hence, } y = \frac{1}{4} \left(\frac{1}{6} \right)^x$$

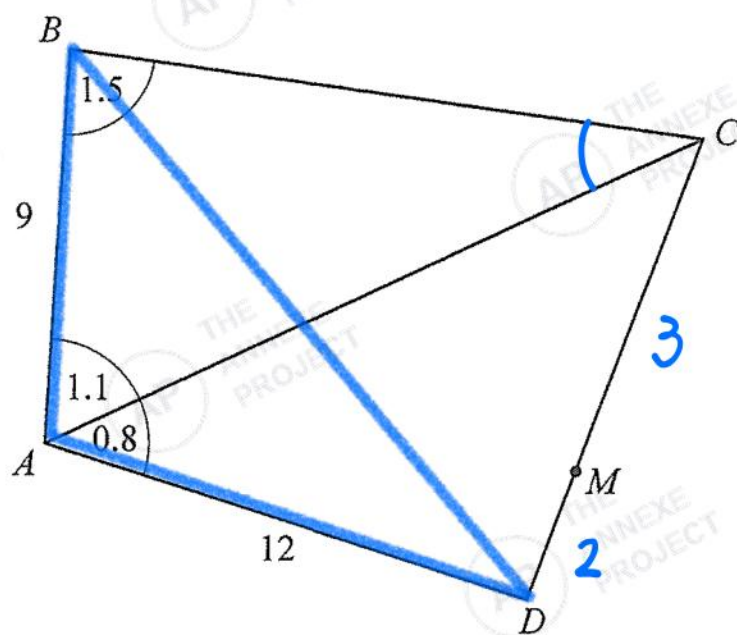
$$\text{When } x = 3, \quad y = \frac{1}{4} \left(\frac{1}{6} \right)^3$$

$$= \frac{1}{4} \left(\frac{1}{216} \right)$$

$$= \frac{1}{864}$$

Answer $\frac{1}{864}$ [3]

6 (a)



The diagram shows a quadrilateral, $ABCD$.

$AB = 9$ cm and $AD = 12$ cm.

Angle $ABC = 1.5$ radians, angle $BAC = 1.1$ radians and angle $DAC = 0.8$ radians.

The point M lies on CD such that $CM : CD = 3 : 5$.

(i) Work out the area of triangle ABD .

$$\frac{1}{2}(9)(12) \sin 1.9$$

$$= 51.1 \text{ cm}^2$$

Answer 51.1 cm^2 [2]

(ii) Calculate the length CM .

$$\angle BCA = 0.54159 \text{ rad.}$$

By Sine Rule :

$$\frac{9}{\sin 0.54159} = \frac{AC}{\sin 1.5}$$

$$AC = 17.415 \text{ cm}$$

By Cosine Rule :

$$CD^2 = 17.415^2 + 12^2 - 2(17.415)(12) \cos 0.8$$

$$CD = 12.493$$

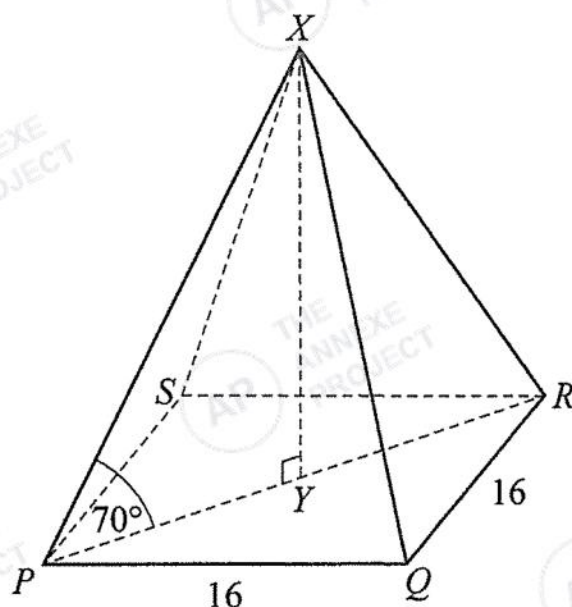
$$CM = \frac{3}{5} CD$$

$$= \frac{3}{5} \times 12.493$$

$$= 7.50 \text{ cm}$$

Answer 7.50 cm [5]

(b)



The diagram shows a solid metal square-based pyramid, $XPQRS$.
The square $PQRS$ has side length 16 cm.
The vertex, X , is directly above the centre of the square, Y .
Angle $XPY = 70^\circ$.

The pyramid is melted down and made into as many solid cubes as possible.
The side length of each of these cubes is 3.5 cm.

The remaining metal is used to make a sphere with radius r cm.

Find the value of r .

Step 1: Find PR

$$PR^2 = 16^2 + 16^2$$

$$PR = \sqrt{512}$$

$$\therefore PY = \frac{1}{2}\sqrt{512}$$

Step 2: Find XY

$$\tan 70^\circ = \frac{XY}{\frac{1}{2}\sqrt{512}}$$

$$XY = 31.084 \text{ cm}$$

Step 3: Volume of pyramid

$$V = \frac{1}{3} \times 16^2 \times 31.084$$

$$= 2652.51 \text{ cm}^3$$

Step 4: Max. number of cubes

$$2652.51 \div (3.5)^3$$
$$= 61.866236$$

i.e. 61 cubes

$$0.866236 \times 3.5^3$$
$$= 37.13987 \text{ cm}^3 \text{ of metal left.}$$

Step 5:

$$\frac{4}{3}\pi r^3 = 37.13987$$

$$r = 2.0697$$

$$2.07 \text{ cm}$$

Answer $r = \dots\dots\dots$ [6]

- 7 (a) $\mathcal{U} = \{\text{integers } x : 5 \leq x \leq 24\}$
 $A = \{\text{factors of } 24\}$
 $B = \{\text{multiples of } 5\}$

Below are two statements.

For each statement, write whether you agree or disagree and give a reason for each answer.

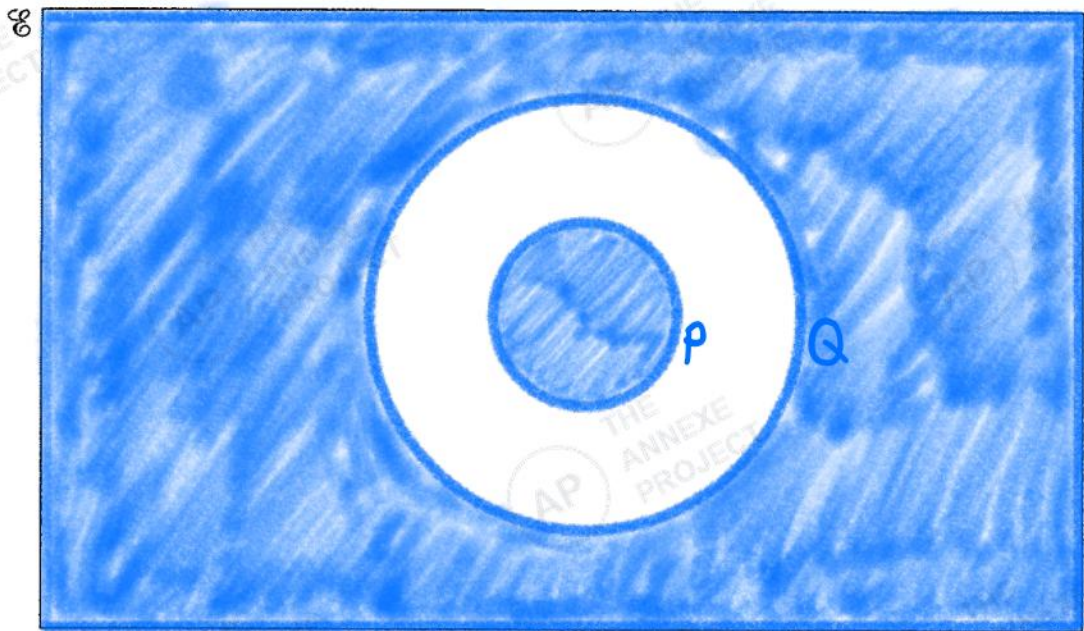
Statement	Agree/disagree	Reason
$A = \{1, 2, 3, 4, 6, 8, 12, 24\}$	Disagree	$\mathcal{U}$ only contains integers from 5 to 24 inclusive. Hence A should be $\{6, 8, 12, 24\}$
$A \cap B = \emptyset$	Agree	There are no common elements for set A and B.

[2]

- (b) Set P and set Q are such that $P \subset Q$.

In the space below,

- (i) complete the Venn diagram to represent set P and set Q ,
(ii) shade the region on your diagram which represents $P \cup Q'$.



[2]

- (c) A company has 220 employees that are either full-time workers, part-time workers or contractors. The table below shows information about the employees at the company.

	Right-handed	Left-handed
Full-time worker	18	12
Part-time worker	65	45
Contractor	60	20

- (i) One of the employees is chosen at random.

Work out the probability that this employee is not a contractor and not left-handed.

$$\frac{18 + 65}{220} = \frac{83}{220}$$

Answer $\frac{83}{220}$ [1]

- (ii) Three of the full-time workers are chosen at random.

Work out the probability that they are either all right-handed or all left-handed.

$$\left(\frac{18}{30} \times \frac{17}{29} \times \frac{16}{28}\right) + \left(\frac{12}{30} \times \frac{11}{29} \times \frac{10}{28}\right)$$

$$= \frac{37}{145}$$

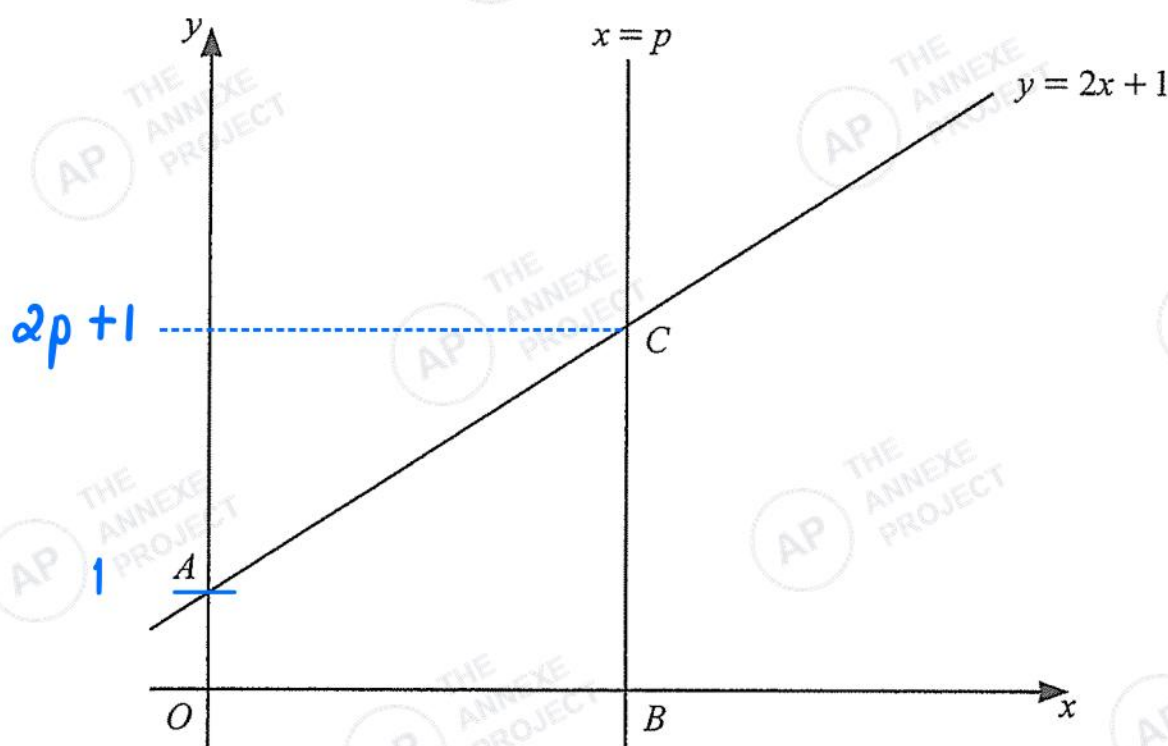
Answer $\frac{37}{145}$ [3]



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- 8 (a) The diagram shows a sketch of the line $y = 2x + 1$ and the line $x = p$, where $p > 0$.



Point A is the y -intercept of the line $y = 2x + 1$ and point B is the x -intercept of the line $x = p$. The lines intersect at point C .

The area of trapezium $OACB$ is $\frac{15}{4}$ units².

- (i) Show that $4p^2 + 4p - 15 = 0$.

Answer

$$\text{Area of trapezium} = \frac{h}{2} \times (\text{sum of parallel lengths})$$

$$\frac{15}{4} = \frac{p}{2} \times (1 + 2p + 1)$$

$$\frac{15}{4} = p(p + 1)$$

$$15 = 4p^2 + 4p$$

$$\therefore 4p^2 + 4p - 15 = 0$$

[2]

- (ii) By factorising $4p^2 + 4p - 15 = 0$, find the value of p .

$$(2p - 3)(2p + 5) = 0$$

$$p = \frac{3}{2} \quad \text{or} \quad p = -\frac{5}{2} \text{ (rej.)}$$

$$\frac{3}{2}$$

Answer $p = \dots\dots\dots$ [3]

- (iii) Find the length of the line segment AC .

$$A = (0, 1) \quad , \quad C = \left(\frac{3}{2}, 4\right)$$

$$\begin{aligned} AC &= \sqrt{\left(\frac{3}{2} - 0\right)^2 + (4 - 1)^2} \\ &= \sqrt{\frac{45}{4}} \\ &= 3.35 \end{aligned}$$

Answer 3.35 [2]

- (b) Point P and point Q have coordinates $(1, -5)$ and $(-4, -2)$ respectively.
Line l has equation $x - y = 2$.
Point R lies on the line l and has coordinates $(x, 0)$.

- (i) Find the value of x .

$$\begin{aligned} x - 0 &= 2 \\ x &= 2 \end{aligned}$$

Answer $x =$ 2 [1]

- (ii) Find an equation for the line parallel to PQ which passes through the point R .
Give your answer in the form $ax + by = c$, where a , b and c are integers.

$$\begin{aligned} \text{gradient of } PQ &= \frac{-2 - (-5)}{-4 - 1} \\ &= \frac{3}{-5} \end{aligned}$$

$$y - 0 = -\frac{3}{5}(x - 2)$$

$$y = -\frac{3}{5}x + \frac{6}{5}$$

$$5y = -3x + 6$$

$$3x + 5y = 6$$

Answer $3x + 5y = 6$ [3]

- 9 Erin is planning a road trip in the UK with an electric car. She finds the following information to help plan her trip.

Distance between UK cities by road in kilometres

London				
95	Oxford			
322	260	Manchester		
340	299	135	York	
650	589	352	317	Edinburgh

For example, the distance between Oxford and York is 299 km.

Electric car charging information

There are three main types of electric car chargers that can be used.

	Slow chargers	Fast chargers	Rapid chargers
Approximate cost (cents per km)	3.6	25.1	45.0
Approximate charging rate	up to 11 km of range in 30 minutes	up to 64 km of range in 30 minutes	up to 193 km of range in 30 minutes

Erin plans to drive at an average speed of 90 kilometres per hour on her trip.

- (a) How long would it take Erin to drive from York to Edinburgh?
Give your answer in hours and minutes, correct to the nearest minute.

$$\frac{317}{90} = 3 \text{ h } 31 \text{ min}$$

Answer3..... hours31..... minutes [1]

The range of Erin’s car is 420 km when the battery is fully charged.
Electric cars are often charged to 80% of the battery’s capacity.

- (b) Calculate the range of Erin’s car when the battery is charged to 80% capacity.

$$0.8 \times 420 = 336 \text{ km}$$

Answer336..... km [1]



- (c) Erin plans to start her trip in London with a fully charged car battery. She will drive to Oxford, then to Manchester, then to York and finally to Edinburgh.

Erin will charge the battery in Manchester and in York.
She will use a rapid charger in Manchester and a fast charger in York.
Each time, Erin will charge the battery to 80% capacity.

Erin calculates the total journey time for her trip and the total cost of charging the battery.
The total journey time includes the time that Erin will spend waiting for the battery to charge.
Erin assumes that each charger charges at a constant maximum rate.

Erin says:

My total journey time will be less than 12 hours.
The total cost of charging the battery in Manchester and York will be less than \$165.

Using Erin's assumption, justify with calculations whether she is correct.

$$\text{Total distance travelled} = 95 + 260 + 135 + 317 \\ = 807 \text{ km.}$$

$$\text{Total time on road} = \frac{807}{90} = 8.9667 \text{ h} = 8 \text{ h } 58 \text{ mins}$$

$$\text{At Manchester, the range of her car is } 420 - 95 - 260 \\ = 65 \text{ km}$$

She needs to charge it to 336 km.

$$\text{Amt. of range to charge} = 336 - 65 = 271 \text{ km.}$$

$$\text{time to charge} = \frac{271}{193} \times 30 = 42.124 \text{ mins.}$$

$$\text{Cost of charging} = 0.45 \times 271 = \$121.95$$

$$\text{At York, the range of her car is } 336 - 135 = 201 \text{ km}$$

She needs to charge it to 336 km.

$$\text{Amt. of range to charge} = 336 - 201 = 135 \text{ km.}$$

$$\text{time to charge} = \frac{135}{64} \times 30 = 63.28125 \text{ mins.}$$

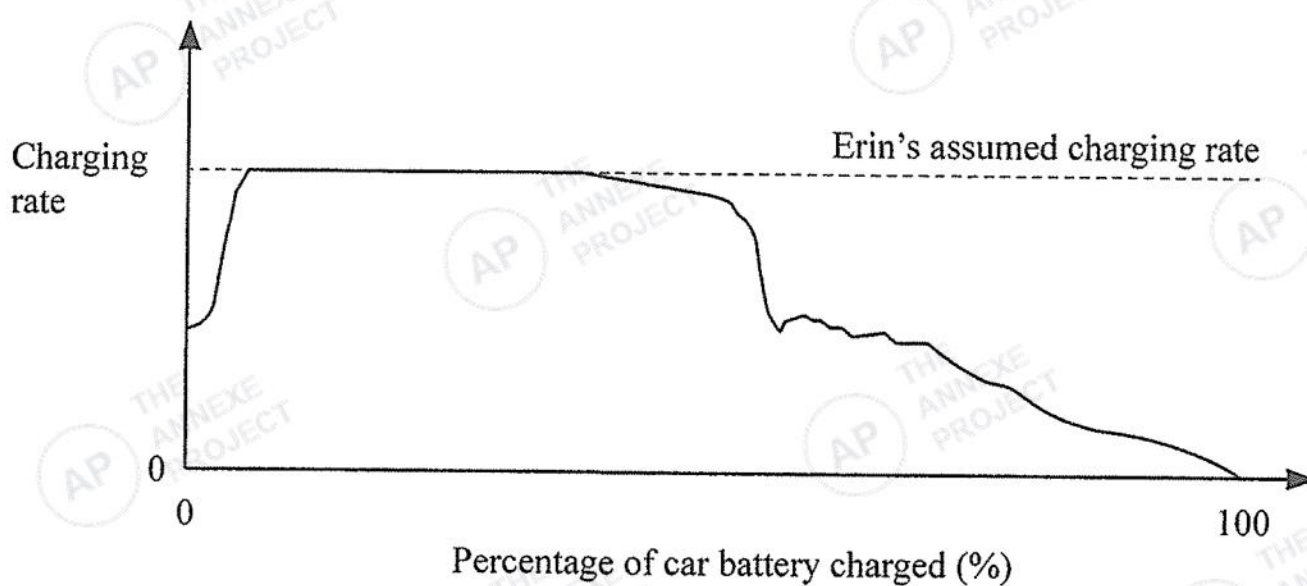
$$\text{Cost of charging} = 0.251 \times 135 = \$33.885 \quad [6]$$

$$\text{Total journey time} = 8 \text{ h } 58 \text{ mins} + 42.1 \text{ mins} + 63.3 \text{ mins} \\ = 10 \text{ h } 43 \text{ mins (Erin is right)}$$

$$\text{Total cost} = 121.95 + 33.89 = \$155.84 \text{ (Erin is right)}$$

- (d) Erin's assumption is wrong.
The chargers do **not** charge at a constant maximum rate.

The graph shows how the charging rate of each of the chargers varies as the battery is charged.



Explain what effect this will have on Erin's total journey time.

Her total journey time will increase since it will take a longer time to charge the car.

[1]

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