Mark Scheme (Results)

Summer 2018

Pearson Edexcel International GCSE
In Mathematics B (4MB0) Paper 02

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.

  Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - cao – correct answer only
  - ft – follow through

- isw – ignore subsequent working
- SC - special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- eeoo – each error or omission

- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If there is a wrong answer indicated always check the working in the body of the script and award any marks appropriate from the mark scheme.

  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.

  Any case of suspected misread loses two A (or B) marks on that part, but can gain the M marks. Mark all work on follow through but enter A0 (or B0) for the first two A or B marks gained.

  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

  If there are multiple attempts shown, then all attempts should be marked and the highest score on a single attempt should be awarded.

- **Follow through marks**

  Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. incorrect cancelling of a fraction that would otherwise be correct.

  It is not appropriate to ignore subsequent work when the additional work essentially shows that the candidate did not understand the demand of the question.

- **Linear equations**

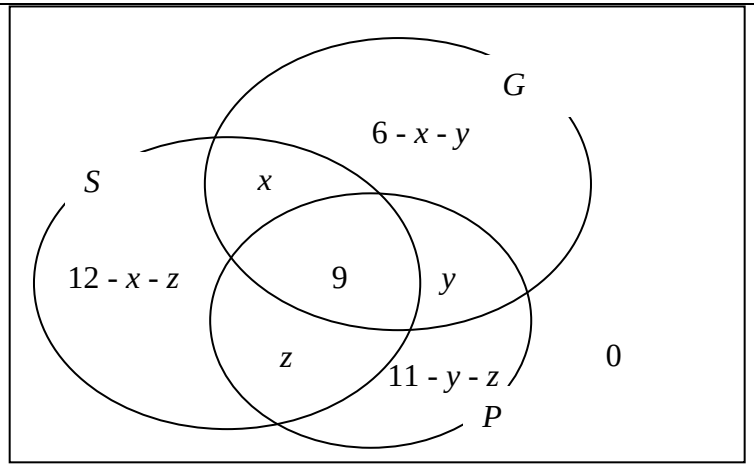
  Full marks can be gained if the solution alone is given, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

- **Parts of questions**

  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another

Question	Working	Answer	Mark	Notes
1(a)	360 ÷ 10 = 36 180 − 36 = 144 OR (2 × 10 − 4)× 90 ÷ 10	144°	2	M1 Any fully correct method to achieve interior angle of decagon. A1
(b)	Let *X* be the foot of the perpendicular from *B* to *AD* (*AX* =)6 cos(180 – "144") (= 4.85) OR (*AX* =) 6 sin ("144" – 90) OR (*AC* or *BD*=) $\frac{6\sin 144}{\sin 18}$ (= 11.4) OR (*AC* or *BD*=) $\sqrt{6^2+6^2-2\times6\times6\times\cos144}$ OR $\frac{AD}{\sin 126}=\frac{6}{\sin 18}$		3	M1 allow "126" and "18" following from their144
	AD = 2 × "4.85" + 6 OR $AD=\frac{"11.4"\sin(180-"144")}{\sin(126)}$ OR $AD=\sqrt{"11.4"^2+6^2-2\times"11.4"\times6\times\cos126}$ OR $AD=\frac{6\sin126}{\sin18}$			M1 dep allow "126" and "18" following from their"144"
		15.7 cm		A1 awrt 15.7 scores M1M1A1
				Total 5 marks

Question	Working	Answer	Mark	Notes
2(a)		Correct diagram	2	B1 for x and y correctly placed B1 ft their "x" and "y" for $12 - $"$x$"$ - z$, $6 - $"$x$"$ - $"$y$", $11 - z - $"$y$" all correct do not need to be simplified NB Mark diagram only
(b)	"x" + "y" + $z = 11$	27	3	M1 ft diagram may be implied by their working or answer
	Adding all the regions gives $38 - x - y - z = 38 - (x + y + z)$ OR $65 - 11 - 2\times9$			M1 ft diagram as long as all sections contain an entry DO NOT ALLOW $65+x+y+z$ oe. For this mark or the A mark.
				A1 ft diagram as long as all sections contain an entry and final answer purely numerical.
				Total 5 marks



Question	Working	Answer	Mark	Notes
3(a)	$\tan x = \frac{110}{600}$	10.4^{o}	2	M1 Fully correct expression involving angle APT
				A1 awrt
(b)	$(AQ^2 =)600^2 + 900^2 - 2 \times 600 \times 900 \cos 65^{o}$	845 m	3	M1 Correct substitution into a correct cosine rule formula.
	$(AQ^2 =)\ 713\,572$			M1 dep correct order of evaluation must see correct final answer or 713 000 to 714 000 inclusive or 456 000 to 457 000 inclusive in working to secure this mark.
				A1 awrt
(c)	$600^2 + "845"^2 - 2 \times 600 \times "845" \cos PAQ$ (cos *PAQ* = 0.260)(*PAQ* = 75) OR $\frac{\sin 65}{"845"} = \frac{\sin PAQ}{900}$ (sin *PAQ* =0.965) OR $\frac{\sin 65}{"845"} = \frac{\sin AQP}{600}$ (sin *AQP* = 0.644) (*AQP* = 40)	285^{o}	3	M1 Correct trig equation leading to PAQ or APQ
	Bearing = 360 –"75" or 180 + 65 + "40"			M1 dep finding a bearing
				A1 awrt
				Total 8 marks

Question	Working	Answer	Mark	Notes
4(a)	$(y = kT^2)$ $1600 = k \times 2.5^2$ OR $\frac{y}{1600} = \left(\frac{4.5}{2.5}\right)^2$	5184	3	M1
	$k = \frac{1600}{2.5^2} (= 256)$ OR $(y =)"\frac{1600}{2.5^2}" \times 4.5^2$			M1 dep A1 Accept 5180 with working seen
(b)	$(y = Kr^3)$ so $K = \frac{12.5}{0.5^3}$ (=100) or $12.5 = K \times 0.5^3$	400	4	M1 can be implied by a fully correct calculation for r
	$("100"r^3 = y =)"256" \times 5000^2$			M1 indep oe.
	$r = \sqrt[3]{\frac{"256" \times 5000^2}{"100"}}$			M1 oe correct calculation for *r* dep on both previous M marks. NB Method for r^3 without clear evidence of cube root taken not sufficient. We must see a $\sqrt[3]{}$ symbol or their *r* must be the cube root ir their r^3.
				A1
				Total 7 marks

Question	Working	Answer	Mark	Notes
5(a)		*Q* correct	1	B1 *Q* drawn correctly Penalise lack of label once only on this question.
(b)		*R* correct	3	
				M1 for $y = x$ drawn and one correct pair of correct coordinates OR 2 correct coordinates
				A1 at least 3 pairs of correct coordinates
				A1 all correct including label.
(c)	$\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}\begin{pmatrix}3 & 3 & 1 & 1\\4 & 6 & 6 & 3\end{pmatrix}$	*S* correct	3	M1 ft Their R Multiply all coordinates as vectors or in a matrix, must be correct order of multiplication.
	$\begin{pmatrix}-4 & -6 & -6 & -3\\3 & 3 & 1 & 1\end{pmatrix}$			A1 ft *R* All points calculated correctly (possibly in matrix or vector form) OR 3 points correctly plotted
				A1 ft *R* All correct including label. Correct answer with no incorrect working scores full marks. ft their *R*. NB A correctly ft rotation of 90° anticlockwise of their *R* score full marks.
(d)	$\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$	$\begin{pmatrix}-1 & 0\\0 & 1\end{pmatrix}$	2	M1 Correct Matrix $\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$ multiplied by $\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}$ (Condone incorrect order) OR 3 elements of final matrix given correctly. Done not award for $\begin{pmatrix}1 & 0\\0 & 1\end{pmatrix}$
				A1 cao isw incorrect subsequent working, checking the matrix transforms Q to S
				Total 9 marks

Question	Working	Answer	Mark	Notes
6(a)	$\frac{800\,000}{200}\times\frac{62}{100}$	2480	2	M1 Full method for 2480
				A1
(b)	Income yr 1 "2480" × 270 (= £669 600)	$ 399 704	6	M1
	Income yr 2 (i) $(4000-"2480")\times\frac{70}{100}\times 220 (=234\ 080)$ Income yr 2 (ii) $\left(4000-"2480"-(4000-"2480")\times\frac{70}{100}\right)\times 150$ (=68 400)			M1 indep Both parts of yr 2
	Total income in £ ("669 600"+"234080"+"68400"=972080)			
	Total income in $ "972 080" × 1.30 = 1 263 704			M1 indep (Any attempt to convert an amount of £ to $)
	Borrowings + interest = $800\,000\times 1.08 = \$864\,000$			M1 indep
	Profit = $"1263704" – "$864 000"			M1 dep all previous M marks
				A1 cao NB Ignore labelling or (a) and (b) in this question. Award marks wherever gained.
				Total 8 marks

Question	Working	Answer	Mark	Notes
7(a)	$A = 2\pi rh + \pi r^2 + \frac{1}{2} \times 4\pi r^2$ OR $A = \pi r(2h + r) + \frac{1}{2} \times 4\pi r^2$	Shown	1	B1 Allow $2\pi r^2$ for $\frac{1}{2} \times 4\pi r^2$ but must see hemisphere and cylinder separately. Do not accept $4\pi r^2 - \pi r^2$
(b)	$(V =) \pi r^2 h - \frac{2}{3}\pi r^3$	shown	4	B1
	$(h =) \frac{1300\pi - 3\pi r^2}{2\pi r}$			M1 Make h the subject allow 1 sign or arithmetic error. NB We must see a clear expression for *h* (may be inferred from substituted expression in *V*) after cancelling
	$V = \pi r^2 \left(\frac{1300\pi - 3\pi r^2}{2\pi r} \right) - \frac{2}{3}\pi r^3$			M1 dep (on B1 and M1) for substitute for *h* in *V*
	$V = 650\pi r - \frac{13}{6}\pi r^2$			A1 Answer Given Must include at least one correct intermediate step following the 2nd M mark eg. $V = \frac{\pi r^2 1300\pi}{2\pi r} - \frac{3}{2}\pi r^3 - \frac{2}{3}\pi r^3$
(c)	$\left(\frac{dV}{dr} = \right) 650\pi - \frac{13}{2}\pi r^2 = 0$	10	2	M1 for attempting to differentiate and setting = 0 must see at least one term correct. =0 can be inferred from their working. A1 cao do not allow ±10
(d)	$V = 650\pi \times 10 - \frac{13}{6}\pi \times 10^3$	$\frac{13\,000\pi}{3}$	2	M1 for substituting for their *r* into *V* or finding *h* from their *r* and using this to find *V* A1 oe (Must be exact) Accept $4333\frac{1}{3}\pi$ or $4333.\dot{3}\pi$
				Total 9 marks

Question	Working	Answer	Mark	Notes
8(a)		-1	1	B1
(b)	$gf(x)=(2x-5)^2$ $4x^2-20x+25=30$ or $4x^2-20x-11=0$ OR $f(x)=(\pm)6$	$x=\frac{11}{2}$ only	3	M1
	$(2x-11)(2x+1)=0$ OR $2x-5=(\pm)6$ OR $(x=)\frac{-(-20)\pm\sqrt{(-20)^2-4\times4\times(-11)}}{2\times4}$			M1 dep
				A1 Award A0 if $x=-\frac{1}{2}$ given as a solution and not rejected.
(c)(i)	$(f^{-1}(x)=)\frac{x+5}{2}$ OR $x=$ f(λ(f(x))	$x=\frac{5+10\lambda}{4\lambda-1}$	5	B1 Inverse function seen or fully correct statement from which x could be found without using inverse seen.
	$"\frac{x+5}{2}"=\lambda(2x-5)$ OR $x=2(2x\lambda-5\lambda)-5$			M1 Fully correct equation. FT their inverse.
	$4\lambda x-x=5+10\lambda$			M1 dep (B and M marks) Terms in x isolated on one side Allow a maximum of 1 sign error
				A1 oe
(ii)		$\frac{1}{4}$		B1 ft Rational expression with λ in denominator from part (i)
				Total 9 marks

Question	Working	Answer	Mark	Notes
9(a)(i)		$-6\mathbf{a}$	2	B1 oe
(ii)		$6\mathbf{b}$"$-6\mathbf{a}$"		B1 oe ft (i)
(b)	$\overrightarrow{XC} = 6\mathbf{b} - 15\mathbf{a}$ **OR** $\overrightarrow{CX} = 15\mathbf{a} - 6\mathbf{b}$	Shown	2	M1 ft (a)
	$\overrightarrow{OG} = \overrightarrow{OX} + \overrightarrow{XG} = \overrightarrow{OX} + k\overrightarrow{XC} =$ $\overrightarrow{OX} + k(\overrightarrow{OC} - \overrightarrow{OX}) = 9\mathbf{a} + k(6\mathbf{b} - 6\mathbf{a} - 9\mathbf{a})$ $\overrightarrow{OG} = 6k\mathbf{b} + (9 - 15k)\mathbf{a}$			A1 for a complete method (Answer Given)
(c)	$9-15k = 0$,	$\frac{18}{5}\mathbf{b}$	2	M1
	$\overrightarrow{OG} = 6\times\frac{3}{5}\mathbf{b}$			A1 oe
(d)	$\overrightarrow{OH} = \overrightarrow{OA} + \overrightarrow{AH} = \overrightarrow{OA} + p\overrightarrow{AC} =$ $\overrightarrow{OA} + p(\overrightarrow{OC} - \overrightarrow{OA}) =$ $12\mathbf{a} + p(6\mathbf{b} - 6\mathbf{a} - 12\mathbf{a}) = 6p\mathbf{b} + (12 - 18p)\mathbf{a}$	$m = 9$ $n = 5$	4	M1 Find expression for $\overrightarrow{OH}$ in terms of **a**, **b** and "p" Also award if one of the following seen: OG:OB=3:2 or OG:OB=3:5 or GB:OB = 2:5 Accept any valid ratio.
	$12 - 18p = 0 \quad p = \frac{2}{3}$			M1 dep. Valid method to find "p"
	$OG:GH:HB = \frac{18}{5} : 4 - \frac{18}{5} : 6 - 4$ OR $\frac{2}{5}\ OG = \frac{18}{5}\ GH$ and $2\ OG = \frac{18}{5} GH$			M1 dep Correct ratio given in any form
				A1 accept 9 : 1 : 5
				Total 10 marks

Question	Working	Answer	Mark	Notes
10(a)	Use of at least 3 correct midpoints		4	M1
	$\Sigma fT = 25 \times 70 + 35 \times 130 + 45 \times 210 + 55 \times 160 + 65 \times 130 + 75 \times 100$ (=40500)	50.6 seconds		M1 indep values of T in the interval, including ends and used consistently (EG all minimum values) allow a maximum of one incorrect/missing term.
	"40500" ÷ 800			M1 dep 2nd M marks
				A1 awrt Allow 51 if a fully correct expression seen in working.
(b)	FDs 3, 3.2, 4.8, 7, 3, 0.5	Fully correct histogram	3	M1 for any correct calculation of a FD
				A1 All correct FD or 3 correct bars
				A1 all correct allow ½ small square tolerance on all bars. Bars must touch.
(c)	$\frac{30+\frac{5}{20}\times 64}{n}$ or $\frac{(35-30)\times 3.2+64}{n}$	$\frac{46}{198}$	2	M1 n must be greater than their numerator. ft 3.2 as value of FD of their 2nd bar.
				A1 oe $\frac{23}{99}$,0.232 or better.
				Total 9 marks

Question	Working	Answer	Mark	Notes
11 (a)	$25\times\frac{60\times60}{1000}$	90	2	M1 Fully correct expression A1 cao
(b)	Draw tangent at $t = 4$ Gradient = $\frac{28-4}{8}$	3 m/s^2	3	M1 a clear intention to draw a tangent at the point $t = 4$ M1 dep ft Their drawn tangent, if no tangent drawn do not award mark. A1 2.5 - 3.5 NB. Correct answer within allowed range with no incorrect working seen scores M1M1A1
(c)	SC: Straight line drawn from (2,10) to (4,10) and straight line drawn from (4,10) to (18,10) award B0B1	Correct graph	2	B1 Straight line joining (2,10) to (6, 10) Ignore anything to the left of t=2. Allow 1 small square tolerance. B1 Straight line joining (6,10) to (20, 20) Allow 1 small square tolerance.
(d)	Area under van graph = $10\times4 + \frac{10+20}{2}\times14 = 40 + 210$ $416\frac{2}{3}$ –"250"	$166\frac{2}{3}$	3	M1 ft, correct expression to find area under their "curve" strictly to the right of t=2 allow a maximum of 1 error. NB graph may stop before t=20 M1 (dep) Allow 416.6 to 416.7 for $416\frac{2}{3}$ A1 oe $\frac{500}{3}$ Allow 166.6 to 166.7
				Total 10 marks

Question	Working	Answer	Mark	Notes	
12(a)		−2, −1.5, 5.7	3	B1, B1, B1 cao	
(b)			3	Treat as B3 ft (-1EEOO) -1 mark for straight line segments (penalise ONCE only on segments between x=1 and x=2) each point missed each missed segment each point not plotted each point incorrectly plotted tramlines (penalise ONCE only) very poor curve (penalise ONCE only) Allow ½ a small square tolerance on all points.	
(c)		−2.5	1	B1 Accept –2.4 - –2.6 or ft as long as the value is from a turning point on the curve.	
(d)	$x^3 - 2x^2 - 6x + 5 = 0 \Rightarrow$ $x^2 - 2x - 6 + \frac{5}{x} = 0$	0.7, 3.3	4	M1 oe dividing by x	NB Allow a total of one sign error across both of these two marks
	$\Rightarrow x^2 - 8 + \frac{5}{x} = 2x - 2$			M1 dep Isolating $x^2 - 8 + \frac{5}{x}$	
	Draw $y = 2x - 2$ and find at least one intersection			M1 Draw their line as long as is in the form $y = \pm 2x + c$ (allow c=0)	
				A1 Allow 0.6-0.8 and 3.2-3.4 NB must have evidence of correct working, a minimum of a non-horizontal straight line drawn.	
					Total 11 marks

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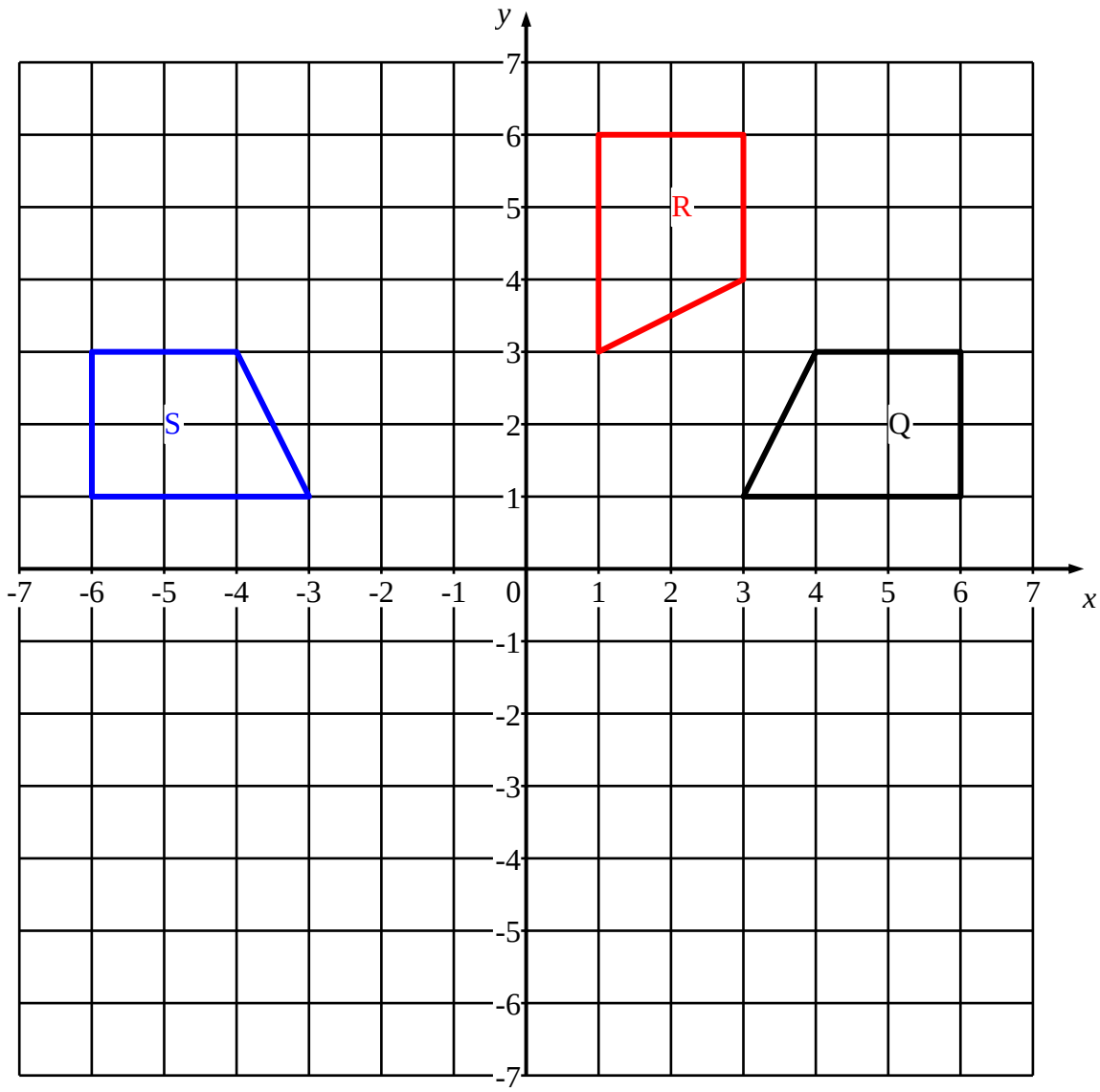

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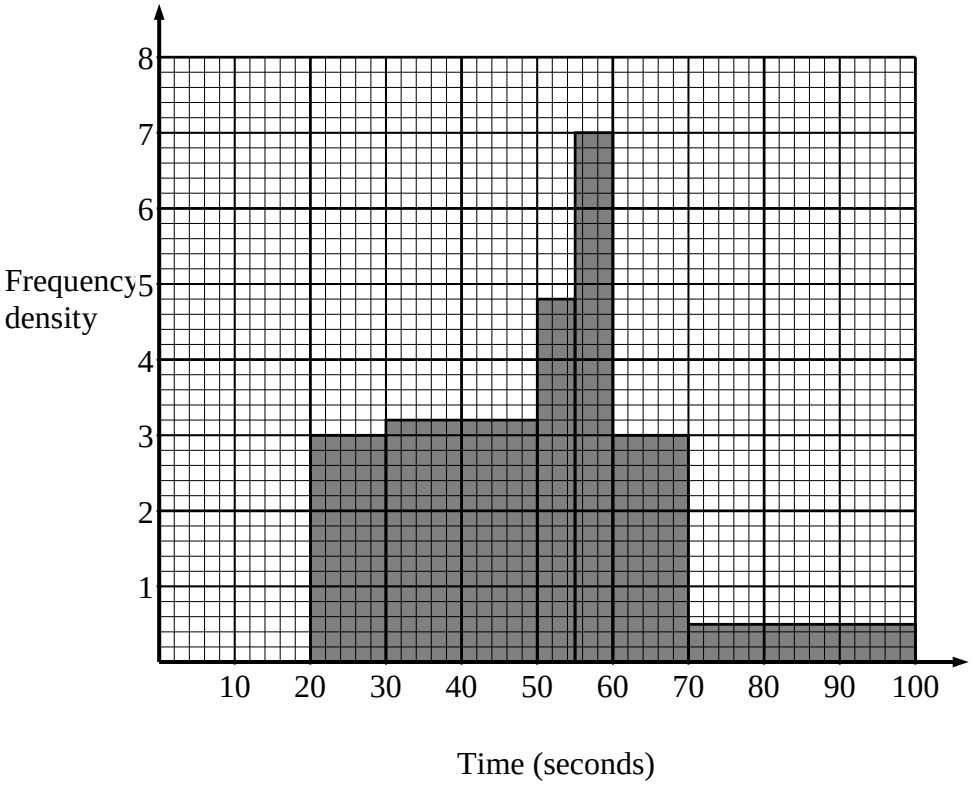
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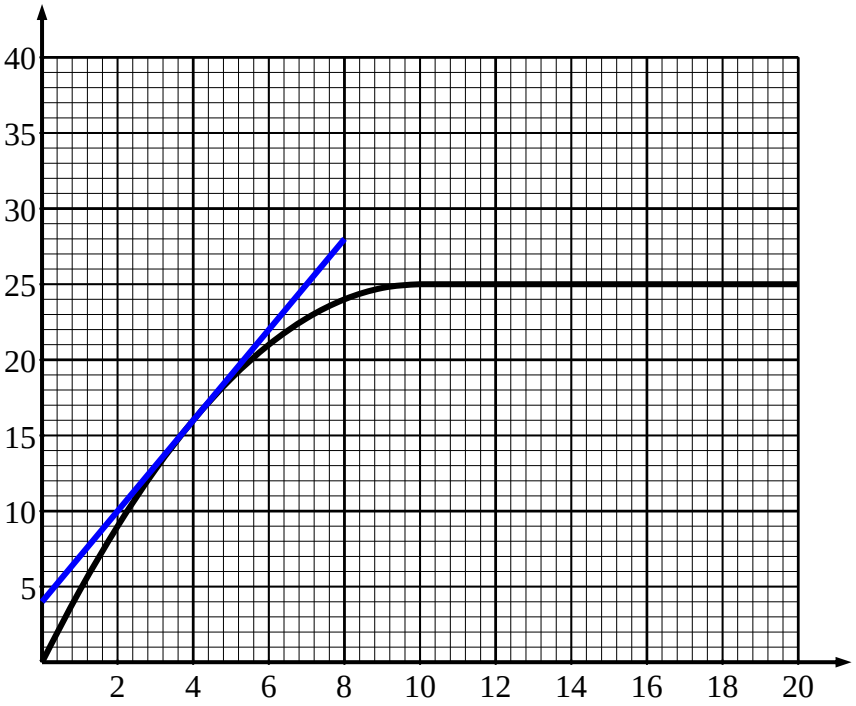

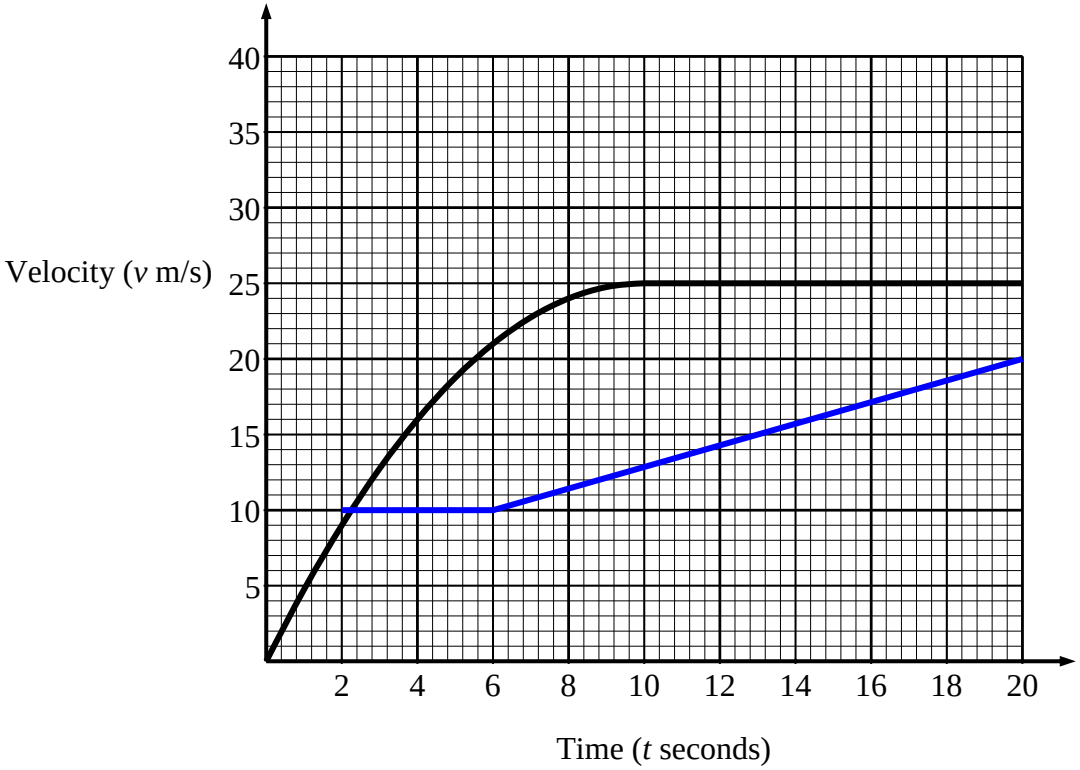
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