Pearson

Mark Scheme (Results)

October 2025

International Advanced Level in Pure Mathematics P1

WMA11/01A

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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.

EDEXCEL IAL MATHEMATICS
General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)

   Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN:

   - bod – benefit of doubt
   - ft – follow through
     - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso – correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC – special case
   - oe – or equivalent (and appropriate)
   - d… or dep – dependent
   - indep – independent
   - dp – decimal places
   - sf – significant figures
   - ∗ – The answer is printed on the paper or ag- answer given
   - ⎣ or d… – The second mark is dependent on gaining the first mark

4. All A marks are ‘correct answer only’ (cao), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by ‘MR’ in the body of the script.

6. If a candidate makes more than one attempt at any question:

a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.

b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Pure Mathematics Marking

(NB specific mark schemes may sometimes override these general principles)

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$ leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$ leading to x = ...

2. Formula

Attempt to use correct formula (with values for a, b and c)

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm \frac{b}{2})^2 \pm q \pm c, \quad q \neq 0$ leading to x = ...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1 ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1 ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are small mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done “in your head”, detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Question Number	Scheme	Notes	Marks
1(a)	$\{QR^2=\}(2x)^2+(2x)^2$ Valid attempt at Pythagoras' Theorem. Condone omission of brackets e.g., $\{QR=\}\sqrt{2x^2+2x^2}$ If no sum seen only accept $\{QR^2=\}8x^2$ or $\{QR=\}\sqrt{8x^2}$ or correct answer $\{QR=\}2\sqrt{2}x$ or $\sqrt{8}x$. If trig, must see a correct statement e.g., $\frac{2x}{QR}=\sin 45(^\circ)$		M1
	$\{QR=\}2\sqrt{2}x$ or $\sqrt{8}x$ not e.g., $\sqrt{8x^2}$ Allow e.g., $2x\sqrt{2},\ x\sqrt{8}$. Must be seen in part (a) and do not condone $\pm$ but allow all remaining marks to be scored		A1
			(2)
(b)	Question has: "Solutions relying on calculator technology are not acceptable"		
	$3(x+7)=4x+'2\sqrt{2}x'$ Sets perimeters equal e.g., $x+7+x+7+x+7=2x+2x+'2\sqrt{2}x'$ Allow kx or $kx^{\frac{1}{2}}$ or kx^2 or for $'2\sqrt{2}x'$ Allow the odd slip if the intention is clear e.g. $3(x+7)\to 3x+7$		M1
	$\Rightarrow(1+2\sqrt{2})x=21$ Collects terms in *x* and reaches $Ax=B$ where *A* is a rational number + a surd and *B* is a rational number. Could be implied by $x=$ an intermediate answer Must have had kx for $'2\sqrt{2}x'$		dM1
	Correct **intermediate** answer $x=\frac{21}{(1+2\sqrt{2})}$ or $x=\frac{21}{(1+\sqrt{8})}$ Implied by $-3+6\sqrt{2}$ provided there is some relevant minimal algebra		A1
	$\Rightarrow x=\frac{21}{(2\sqrt{2}+1)}\times\frac{(2\sqrt{2}-1)}{(2\sqrt{2}-1)}$ Any correct method seen to rationalise an expression of form $\frac{D}{C}$ where C is a rational number + a surd and *D* is a rational number. What is shown above is sufficient. Can be implied but not by just a calculator answer.		M1
	$\Rightarrow\{x=\}6\sqrt{2}-3$	$6\sqrt{2}-3$ or $-3+6\sqrt{2}$	A1

	Squaring both sides - example: $3\left(x+7\right)=4x+2\sqrt{2}x$ (M1) $\Rightarrow 2\sqrt{2}\,x=21-x \Rightarrow \left(2\sqrt{2}\,x\right)^2=\left(21-x\right)^2 \Rightarrow 8x^2=441-42x+x^2 \Rightarrow 7x^2+42x-441=0$ Squares and obtains a 3TQ (dM1) Correct 3TQ (A1) $\Rightarrow x^2+6x-63=0 \Rightarrow x=\dfrac{-6\pm\sqrt{6^2-4(1)(-63)}}{2(1)}$ Solves via valid non-calculator method (M1) $\Rightarrow x=\frac{-6\pm\sqrt{288}}{2} \Rightarrow x=-3+6\sqrt{2}$ This answer only (A1)	**(5)**
		Total 7

Question Number	Scheme	Notes	Marks
2	Question has: "Solutions relying on calculator technology are not acceptable"		
(a)	$\{y=\}x(x+3)(x-2)=x^3+x^2-6x$	Correct expansion. Terms collected. Implied by a correct answer	**B1**
	$\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\}3x^2+2x-6$ M1: For reducing the power of *x* by one for at least one term Indices may not be processed. Allow if $...x^n \to ...x^{n-1}$ seen anywhere in an attempt at the product rule which may be partial A1: Correct expression as shown (terms in any order) Must be seen in part (a).		**M1** **A1**
			(3)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}x}=3x^2+2x-6\geq 2\Rightarrow$ $3x^2+2x-8=0\Rightarrow(3x-4)(x+2)=0\Rightarrow\{x=\}-2,\frac{4}{3}$	M1: Sets their quadratic = 2 (or uses any inequality sign) and attempts to find the critical values by solving a 3TQ (not a 2TQ) via a valid non-calculator method. M0 if 0 is used instead of 2. Roots may be complex. A1: Critical values of $-2,\ \frac{4}{3}$	**M1** **A1**
	$x\leq -2,\quad x\geq\frac{4}{3}$ M1: Selects the outside region appropriately for their real critical values. Do not condone e.g., $-2\geq x\geq\frac{4}{3}$ Can follow previous M0 provided they have solved a 2 or 3 term quadratic with a positive x^2 coefficient, possibly by calculator (if so, must be correct roots for their equation - to 3sf if necessary). Allow if the work shows that they have solved e.g., $3x^2+2x-6=0\ \left\{\Rightarrow x=\frac{-1\pm\sqrt{19}}{3}\right\}$ but do not accept using these roots from $3x^2+2x-8=0$ or e.g., $3x^2+2x-6\geq 2$ May have strict inequalities or one strict, one non-strict. A1: Correct region. Any appropriate notation. Condone "and" but not $\cap$.		**M1** **A1**

	Must be using *x* for both parts of the region not e.g., $x_1 \le -2, \quad x_2 \ge \frac{4}{3}$ ISW once a correct answer is seen even if an incorrectly modified answer follows. Note that 0011 or 0010 are possible. Answer only is no marks but e.g., $3x^2 + 2x - 6 \ge 2, \; x \le -2, \quad x \ge \frac{4}{3}$ is 0011	
		(4)
		Total 7

Question Number	Scheme	Notes	Marks
3	Question has: "Solutions relying on calculator technology are not acceptable" Note that the "= 0" may be implied by solutions		
	$2y^2+1=\dfrac{15}{y^2} \Rightarrow 2y^4+y^2-15=0$	M1: Multiplies through by y^2 and forms a 3TQ equation in y^2 May be written as e.g., $2\left(y^2\right)^2+y^2=15$ A1: Any correct 3 term equation May have replaced y^2 with e.g., x	**M1** **A1**
	$\Rightarrow \left(2y^2-5\right)\left(y^2+3\right)=0 \Rightarrow \{y^2=\}...$	Solves an equation which could be written in the form $ay^4+by^2+c=0$, $a, b, c \neq 0$ by a valid non-calculator method (see guidance) and finds at least one real value for y^2. May have replaced y^2 with e.g., x Do not condone if solutions are wrongly labelled e.g., as $y=...$ instead of $y^2=...$	**dM1**
	$\Rightarrow \{y=\}\pm\dfrac{\sqrt{10}}{2}$ or $\pm\sqrt{\dfrac{5}{2}}$ A1: One correct solution from a correct 3TQ. Note that e.g., $\Rightarrow \left(2y^2-5\right)\left(y^2-3\right)=0 \Rightarrow \{y=\}\dfrac{\sqrt{10}}{2}$ still scores this mark. Accept awrt ± 1.58 A1: Both correct exact solutions from a correct 3TQ. Ignore any of $\pm\sqrt{-3}$ or $\pm\sqrt{3}\,\mathrm{i}$ but A0 if **any (**real or complex) wrong solution is offered. Do not condone if clearly $\dfrac{\sqrt{5}}{2}$ but apply BOD if marginal. May not be labelled but final A0 if e.g., x = ... unless defined earlier		**A1** **A1**

	Alternative: $$2y^2+1-\frac{15}{y^2}=0 \Rightarrow \left(2y-\frac{5}{y}\right)\left(y+\frac{3}{y}\right)=0$$ M1: Factorises allowing for sign/coefficient errors only A1: Correct factorisation $$2y-\frac{5}{y}=0 \Rightarrow 2y^2-5=0 \Rightarrow y^2=\frac{5}{2}; \qquad y=\pm\sqrt{\frac{5}{2}} \text{ or } \pm\frac{\sqrt{10}}{2}$$ dM1: Proceeds with sign/coefficient errors only to a real value for y^2. Do not condone if this is mis-labelled e.g., as $y=...$ if should be $y^2=...$ A1A1: as above	
		(5)
		Total 5

Question Number	Scheme	Notes	Marks
4	$P(-1, 4),\quad Q(4, 7),\quad R(p, -3)$		
(a)	{Gradient *PQ* =} $\dfrac{y_1-y_2}{x_1-x_2}=\dfrac{7-4}{4-(-1)}\left\{=\dfrac{3}{5}\right\}$ Correct attempt at gradient of *PQ* which may be unsimplified. There must be no evidence of obtaining this fortuitously e.g. by use of an incorrect formula. See below for methods involving simultaneous equations.		**B1**
	$y-4=\frac{3}{5}(x-(-1))$ or $4=\frac{3}{5}(-1)+c,\ \Rightarrow c=...\left\{\frac{23}{5}\right\}\Rightarrow y=...$ $y-7=\frac{3}{5}(x-4)$ or $7=\frac{3}{5}(4)+c,\ \Rightarrow c=...\left\{\frac{23}{5}\right\}\Rightarrow y=...$ Obtains a consistent equation of the line for their gradient using point *P* or Q. Allow this mark with any gradient If $y=mx+c$ must correctly substitute, reach $c=...$ and form equation unless "$y=mx+c$" seen. **Score the first two marks together** for $\frac{y-4}{7-4}=\frac{x-(-1)}{4-(-1)}$ or $\frac{y-7}{7-4}=\frac{x-4}{4-(-1)}$ or $4=-m+c,\ 7=4m+c\Rightarrow m=\frac{3}{5},\ c=\frac{23}{5}\Rightarrow y=\frac{3}{5}x+\frac{23}{5}$ Allow simultaneous equations to be solved by calculator		**M1**
	$\Rightarrow 3x-5y+23=0$ or an integer multiple e.g., $-3x+5y-23=0$ Allow terms in any order but all on one side with = 0 Only allow e.g., $a=-3,\ b=5,\ c=-23$ if $ax+by+c=0$ is seen		**A1**
			(3)
(b)	Question has: "Solutions relying on calculator technology are not acceptable"		
	e.g., Gradient *PR* = "$-\frac{5}{3}$" $\Rightarrow \frac{-7}{p+1}=$ "$-\frac{5}{3}$" Correctly takes negative reciprocal of a positive value $\neq 1$ and forms a correct consistent ft linear equation in *p* (or other variable) by an appropriate method. **OR** e.g., $(p+1)^2+7^2+5^2+3^2=(p-4)^2+10^2$ Alternatively, uses Pythagoras correctly to obtain a correct implied linear equation. Note that it is possible to form an equation using trigonometry. If so it must be consistent and correct and must not have any trig expressions. **OR** e.g, $4=-\frac{5}{3}(-1)+c,\ -3=-\frac{5}{3}p+c\Rightarrow 7=\frac{5}{3}+\frac{5}{3}p$ or $c=\frac{7}{3}\Rightarrow -3=-\frac{5}{3}p+\frac{7}{3}$ Award for appropriate simultaneous equations using *P* and *R* and the correct negative reciprocal of their positive gradient. Must also combine their equations correctly for their gradient which can be implied by $\frac{16}{5}$ with no wrong working, provided there has been some working which might e.g., be just writing down the simultaneous equations		**M1**
	e.g., $5p+5=21\Rightarrow p=\frac{16}{5}$ or $2p+84=116-8p\Rightarrow 10p=32\Rightarrow p=\frac{16}{5}$		**dM1** **A1**

	dM1: Solves linear equation in *p*. This is not implied by just $p=\frac{16}{5}$ - must see a previous linear equation or $\dfrac{-7}{p+1}="-\dfrac{5}{3}"$ (Condone using another variable) A1: $p=\dfrac{16}{5},\ 3\dfrac{1}{5}$ or 3.2 Accept just $\frac{16}{5}$ but not if labelled as *x* = ... etc.	
		(3)
		Total 6

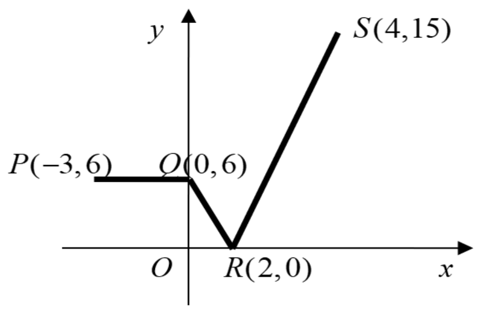
<table>
<tr><th>Question Number</th><th>Scheme</th><th>Notes</th><th>Marks</th></tr>
<tr><td rowspan="2">5</td><td>$$\frac{4\sqrt{x}-3}{2x^2}=\frac{4\sqrt{x}}{2x^2}-\frac{3}{2x^2}=2x^{-\frac{3}{2}}-\frac{3}{2}x^{-2}$$</td><td>M1: Writes as a sum of two terms. Award for $...x^p \pm ...x^q$ with $p \neq q$ and one of p or q correct (indices processed).
Allow if one of p or q = 0
A1: $2x^{-\frac{3}{2}}-\frac{3}{2}x^{-2}$ oe - coefficients could be unsimplified but indices must be processed</td><td>M1
A1</td></tr>
<tr><td colspan="2">$$\int \frac{4\sqrt{x}-3}{2x^2}\,\mathrm{d}x = -4x^{-\frac{1}{2}}+\frac{3}{2}x^{-1}+c$$
dM1: Raises a power of x by one. Allow if this is done on a term individually. Powers may be unprocessed
A1: For one correct term either $-4x^{-\frac{1}{2}}$ or $+\frac{3}{2}x^{-1}$ which may be left unsimplified but powers processed
A1: Fully correct and simplified including an arbitrary constant e.g.
$$-4x^{-\frac{1}{2}}+\frac{3}{2}x^{-1}+c$$
Accept equivalent answers such as $-\frac{4}{\sqrt{x}}+\frac{3}{2x}+c$ but ISW once a correct expression has been seen.
Ignore spurious integral signs, "dx", or if labelled as derivative</td><td>dM1
A1
A1</td></tr>
<tr><td colspan="4" align="right">(5)</td></tr>
<tr><td colspan="4" align="right">Total 5</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Notes</th><th>Marks</th></tr>
<tr><td rowspan="5">6</td><td colspan="2">Question has: "Solutions relying on calculator technology are not acceptable"</td><td></td></tr>
<tr><td>$k\left(3x^2+8x+9\right)=2-6x \Rightarrow$
$3kx^2 + (8k+6)x + 9k - 2 = 0$</td><td>Expresses equation correctly as a three term quadratic or states the correct a, b and c
Accept $3kx^2 + 8kx + 6x + 9k - 2 = 0$ with LHS terms in any order
Could be implied by attempt at discriminant</td><td>B1</td></tr>
<tr><td colspan="2">$(8k+6)^2 - 4(3k)(9k-2)$
$\Rightarrow -44k^2 + 120k + 36$
$\{\Rightarrow 11k^2 - 30k - 9\}$
M1: Uses $b^2 - 4ac$ correctly allowing for $a = \pm 3k$, $b = \pm 8k \pm 6$ and $c = \pm 9k \pm 2$ or $c = \pm 9k$.
No need to expand for the M mark.
If e.g., $a = 3kx^2$ is used then the 'x's must disappear later. Could be seen within use of quadratic formula/CTS. May see e.g. $b^2 ... 4ac$ with = or any inequality sign for ...
A1: Any correct three term quadratic expression for $b^2 - 4ac$ (may be under root sign)</td><td>M1
A1</td></tr>
<tr><td>e.g., $(11k+3)(k-3) = 0 \Rightarrow k = 3, -\frac{3}{11}$</td><td>dM1: For an attempt at finding the critical values via a valid non-calculator method. Must see the precise 3TQ that is then solved (see guidance). May have complex roots. Requires previous M mark.
A1: Correct critical values. Could be labelled with x = ... or unlabelled</td><td>dM1
A1</td></tr>
<tr><td colspan="2">$k < -\frac{3}{11},\ k > 3$
M1: Chooses outside region appropriately for their real critical values. Must not be fortuitous from e.g., two errors that correct themselves. Signs may non-strict or one strict, one non-strict. Requires FIRST M mark. May use e.g., x
Do not condone e.g., $-\frac{3}{11} > k > 3$
A1: Correct region - any suitable notation but must be using k only. Do not condone $k_1 < -\frac{3}{11},\ k_2 > 3$ ISW once a correct answer is seen even if an incorrectly modified answer follows. Condone "and" but not $\cap$
Note that e.g.,1110011 is possible</td><td>M1
A1</td></tr>
<tr><td colspan="4" align="right">(7)</td></tr>
<tr><td colspan="4" align="right">Total 7</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Notes</th><th>Marks</th></tr>
<tr><td>7</td><td colspan="2">Ignore units in parts (b) and (c).
There is no credit for quoting correct formulae and then mis-applying.
Question says "...you must show detailed reasoning"</td><td></td></tr>
<tr><td>(a)</td><td colspan="2">$r\theta = 6\times 3.5 = 21\,\textbf{cm}$

M1: Any correct numerical expression or value for the arc length
A1: 21cm only but allow e.g., 21.0 cm or 210 mm. Not awrt. Units required.</td><td>M1
A1</td></tr>
<tr><td colspan="4" align="right">(2)</td></tr>
<tr><td>(b)</td><td>$AB^2 = 9^2 + 6^2 - 2\times 9\times 6\cos\left(\frac{3}{2}\pi - 3.5\right)$
$\{= 79.115..., \quad AB = 8.89...\}$</td><td>Correct expression for, or equation involving, AB² or AB - but allow with any angle in the cosine rule, even if it is negative or has come from mixed units.
Not implied by a wrong value if there is no work - only accept awrt 78 or 79 (or 8.8 or 8.9) provided no incorrect method seen.
Approaches that do not use the cosine rule must validly reach
$AB^2 = \text{awrt } 78 \text{ or } 79 \text{ OR } AB = \text{awrt } 8.8 \text{ or } 8.9$</td><td>M1</td></tr>
<tr><td></td><td>$P = 6 + 9 + "21" + AB = ...$</td><td>Obtains a value using
6 + 9 + their (a) + their AB</td><td>dM1</td></tr>
<tr><td></td><td>$P = 44.9$</td><td>awrt 44.9</td><td>A1</td></tr>
<tr><td colspan="4" align="right">(3)</td></tr>
<tr><td>(c)</td><td>{Area triangle ABE =}
$\frac{1}{2}\times 6\times 9\sin\left(\frac{3}{2}\pi - 3.5\right)$
or e.g., $\frac{1}{2}\times 9\times 6\cos(3.5-\pi)$
$\{= 25.284...\}$</td><td>Fully correct numerical expression or value for the area of ABE
If angle is a decimal must be awrt 1.2 (1.212...) or if degrees awrt 69° (69.46...)
Implied by awrt 25 (25.28433..) provided no incorrect method seen
Alternative multi-step approaches where the work is not clear must validly reach
Area $ABE = \text{awrt } 25$</td><td>M1</td></tr>
<tr><td></td><td>{Area sector BCDE=}
$\frac{1}{2}\times 6^2\times 3.5\{= 63\}$</td><td>Any correct expression or value for sector area</td><td>B1</td></tr>
<tr><td></td><td>$\frac{1}{2}\times 6\times 9\sin\left(\frac{3}{2}\pi - 3.5\right) + \frac{1}{2}\times 6^2\times 3.5 = 88.3$</td><td>dM1: Obtains a value for sector + triangle. Sector must be
$\frac{1}{2}\times 6^2\times 3.5\{= 63\}$ or $6^2\times 3.5\{= 126\}$ oe</td><td>dM1
A1</td></tr>
</table>

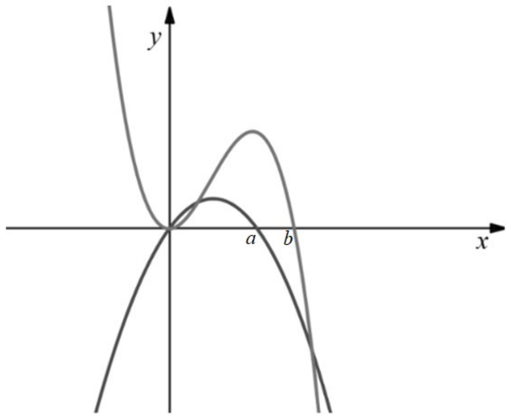
		A1: Awrt 88.3	
			(4)
			Total 9

Question Number	Scheme	Notes	Marks
8(a)	Ignore any *y* coordinates given and any labelling of points Note that coordinate pairs are $A\left(\frac{8}{5}, \frac{4}{5}\right)$ & $B\left(\frac{20}{9}, \frac{10}{9}\right)$		
	$\frac{1}{2}x = -2x + 4$	Sets $\frac{1}{2}x = ax + 4$ where $a < 0$	**1st M1**
	$\frac{1}{2}x = -2x + 4 \left\{\Rightarrow \frac{5}{2}x = 4 \Rightarrow\right\} \{x =\} \frac{8}{5}$ oe	dM1: Sets $\frac{1}{2}x = -2x + 4$ and obtains a value for *x* (which could be decimal) A1: Correct value. Must be a fraction	**dM1** **A1**
	$\frac{1}{2}x = 5x - 10$	Sets $\frac{1}{2}x = 5x + b$ where $b < 0$	**3rd M1**
	$\frac{1}{2}x = 5x - 10 \left\{\Rightarrow \frac{9}{2}x = 10 \Rightarrow\right\} \{x =\} \frac{20}{9}$ oe	dM1: Sets $\frac{1}{2}x = 5x - 10$ and obtains a value for *x* (which could be decimal) A1: Correct value. Must be a fraction	**dM1** **A1**
	There is no credit for answers only - some algebraic working must be seen.		
			(6)
(b)	 Do not be concerned with scaling e.g., if *P* is closer to the origin than *R* etc. There is no credit for the correct points but no sketch. May use P', Q', R' & S' or other letters - ignore any labels used for the points. Ignore any intersections with $y = \frac{1}{2}x$ or e.g., $y = \frac{3}{4}x$ shown	A sketch graph going from L to R made up of 3 straight line segments with two points positioned and labelled appropriately (*P* scores if it is in Q2, Q on positive *y*-axis, *R* on positive *x*-axis, *S* in Q1 but graph might not be the correct shape) May use numbers on axes rather than coordinates. Letters are not required. Coordinates may be indicated separately (e.g., following just having the letters on the sketch) but anything marked on sketch take precedence.	**B1**
		Fully valid sketch: same shape (horizontal line in Q2 to *y*-axis, then V with its vertex on the *x*-axis in Q1 but condone *S* being below *P* & *Q* and ignore the relative gradients of *QR* and *RS*) with all 4 points correct. May use numbers on axes rather than coordinates. Letters are not required. Coordinates may be	**dB1**

		indicated separately but any marked on sketch take precedence.	
			(2)
			Total 8

Question Number	Scheme	Notes	Marks
9	Question parts are marked separately throughout this paper (except for Q10) e.g., there are no marks in (b) for integration that is clearly an answer to (a).		
(a)	$\mathrm{f}'(x)=30+\dfrac{6-5x^2}{\sqrt{x}}$ $\{\mathrm{f}'(4)=\}30+\dfrac{6-5\times4^2}{\sqrt{4}}=-7$	M1: Attempts $\mathrm{f}'(4)$ and achieves a value. Allow slips in substitution but if only a value is given it must be -7 A1: Correct value. May be implied later if uncalculated	**M1** **A1**
	$y+8=\dfrac{1}{7}(x-4)$ or $y=mx+c:-8=\dfrac{1}{7}(4)+c\Rightarrow c=...\left\{-\dfrac{60}{7}\right\}\Rightarrow y=...$	Uses the correct negative reciprocal of their $\mathrm{f}'(4)\neq 0\text{ or }1$ correctly with (4, –8) to obtain a straight line equation. If $y=mx+c$ must correctly substitute, reach $c=...$ and form equation unless "$y=mx+c$" seen Allow this mark if they use their $\mathrm{f}''(4)$	**M1**
	$\Rightarrow y=\dfrac{1}{7}x-\dfrac{60}{7}$	$y=\dfrac{1}{7}x-\dfrac{60}{7}$. This form only with exact values. Allow if *y* on one side and the two other terms on the other side.	**A1**
			(4)
(b)	$\mathrm{f}'(x)=30+\dfrac{6-5x^2}{\sqrt{x}}=30+6x^{-\frac{1}{2}}-5x^{\frac{3}{2}}\Rightarrow$ $\{\mathrm{f}(x)=\}30x+12x^{\frac{1}{2}}-2x^{\frac{5}{2}}(+c)$	M1: For $30\rightarrow30x$ or raises the power of $...x^{-\frac{1}{2}}$ or $...x^{\frac{3}{2}}$ by 1 A1: Two correct terms A1: Correct expression. $\{\mathrm{f}(x)=\}30x+12x^{\frac{1}{2}}-2x^{\frac{5}{2}}(+c)$ No constant required. May be unsimplified but indices must be processed	**M1** **A1** **A1**
	If parts/substitution are used then award the M for $30\rightarrow30x$ otherwise integration must be completed and a correct form achieved to score any marks.		
	$-8=30(4)+12(4)^{\frac{1}{2}}-2(4)^{\frac{5}{2}}+c\Rightarrow c=...$ Substitutes (4, –8) correctly into their f(*x*) and finds value of c Allow slips after substitution but must not e.g., mix up *x* and *y* You make have to check for consistency if there is minimal working		**dM1**

	$\{\mathrm{f}(x) \text{ or } y =\}\quad 30x + 12x^{\frac{1}{2}} - 2x^{\frac{5}{2}} - 88$	Correct and simplified four term expression. A0 if stops at $c = -88$. Do not need to see $\mathrm{f}(x) = \ldots$ Condone if e.g., a spurious integration sign remains	**A1**
			(5)
			Total 9

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Notes</th><th>Marks</th></tr>
<tr><td>10</td><td colspan="2">For this question, mark the parts together so e.g., marks for (b) and (c) may be scored for appropriate work in (a).</td><td></td></tr>
<tr><td rowspan="5">(a)</td><td rowspan="5">$y = x(a-x), \quad y = x^2(b-x), \quad b > a > 0$


Ignore any labelling of the graphs with the equations. Work on the sketch takes precedence. If coordinates are given separately they must be identified e.g., labelled P, Q on the sketch and given in the answer space. Give BOD as a "slip of the pen" if curvature poor at the ends of the graphs. Allow asymmetry of the quadratic. Note that the vertex of the parabola could be above the maximum of the cubic.</td><td>For any negative quadratic curve
(i.e., not an inverted V shape)</td><td>1st B1</td></tr>
<tr><td>For any quadratic curve that intersects the x-axis at the origin and a, with a indicated on the positive x-axis. If coordinates, must be the right way round unless axis labelled</td><td>2nd B1</td></tr>
<tr><td>For any negative cubic shaped curve (min then max - not point of inflection)</td><td>3rd B1</td></tr>
<tr><td>For a negative cubic shaped curve with a minimum turning point at the origin</td><td>4th B1</td></tr>
<tr><td>A completely correct diagram. Cubic crossing the positive x-axis at b to the right of a.
If coordinates, must be the right way round unless axis labelled.
The curves do not need to intersect in Q4 and do not be concerned about the relative gradients. Ignore any coords for intersections if given.</td><td>5th B1</td></tr>
<tr><td colspan="4" align="right">(5)</td></tr>
</table>

Question Number	Scheme	Notes	Marks
10(b)	$\{x(4-x)=x^2(7-x)\Rightarrow\}\,4x-x^2=7x^2-x^3$ $\{x(4-x)=x^2(7-x)\Rightarrow\}\,x(4-x)=x(7x-x^2)$	Sets $x(4-x)=x^2(7-x)$ and multiplies out both brackets to achieve a correct form or factorises RHS to correct form	M1
	$\{\Rightarrow x^3-8x^2+4x=0\}\Rightarrow x\left(x^2-8x+4\right)=0$ Proceeds to the given answer with no errors seen. No intermediate step is required. Accept e.g., $0=\left(4+x^2-8x\right)x$ but must have 0 = or = 0 and be fully factorised		A1*
			(2)
(c)	Question has: "Solutions relying on calculator technology are not acceptable"		
	$x^2-8x+4=0\Rightarrow x=\dfrac{-(-8)\pm\sqrt{8^2-4(1)(4)}}{2(1)}\Rightarrow x=4\pm2\sqrt{3}$ M1: Attempts to solve $x^2-8x+4=0$ by valid non-calculator means (not factorisation). May be complex if using CTS but see guidance. A1: $\{x=\}\,4\pm2\sqrt{3}$ but allow $\{x=\}\,4\pm\sqrt{12}$ and may just give one solution. Fraction must have been dealt with.		M1 A1
	$x=4-2\sqrt{3}$ $y=x(4-x)=2\sqrt{3}\left(4-2\sqrt{3}\right)=-12+8\sqrt{3}$		
	M1: Chooses either of their $x=4\pm2\sqrt{3}$ (rational number + surd) and uses $y=x(4-x)$ or $y=x^2(7-x)$ to obtain a value (rational number + surd). Method may not be shown - if so value must be correct for their *x*. If working is shown allow slips such as $\left(4-2\sqrt{3}\right)\left(4-4-2\sqrt{3}\right)=\ldots$ or $\left(4-2\sqrt{3}\right)\left(-2\sqrt{3}\right)=\ldots$ May be seen on the graph in (a). Note also that $x=4+2\sqrt{3}\Rightarrow y=-12-8\sqrt{3}$		M1
	dM1: **Shows a method** of finding *y* (achieving rational number + surd) from the **correct** $x=4-2\sqrt{3}$ (may use both) E.g. $\left(4-2\sqrt{3}\right)\left(2\sqrt{3}\right)=\ldots$ or $\left(4-2\sqrt{3}\right)\left(4-\left(4-2\sqrt{3}\right)\right)=\ldots$ Must start with a correct expression so do not condone starting with $\left(4-2\sqrt{3}\right)\left(4-4-2\sqrt{3}\right)$ or $\left(4-2\sqrt{3}\right)\left(-2\sqrt{3}\right)$ However, $\left(4-2\sqrt{3}\right)^2\left(3+2\sqrt{3}\right)$ requires the correct $\left(28-16\sqrt{3}\right)\left(3+2\sqrt{3}\right)$ or $2\sqrt{3}\left(4-2\sqrt{3}\right)$ seen Requires previous M mark		dM1
	$\left(4-2\sqrt{3},-12+8\sqrt{3}\right)$ Correct coordinates in this form. Accept $x=-2\sqrt{3}+4,\ y=8\sqrt{3}-12$		A1

	If both are given then the correct solution must be identified e.g., $A\left(4-2\sqrt{3},-12+8\sqrt{3}\right)$ and note that the other intersection is $\left(4+2\sqrt{3},-12-8\sqrt{3}\right)$ which can be ignored if the correct point is identified. $p=4,\ q=-2,\ r=-12,\ s=8$ is A0 without sight of $\left(p+q\sqrt{3},\ r+s\sqrt{3}\right)$ Note that 00111, 00110 and 00100 are possible.	
		(5)
		Total 12