

Summary of changes from Provisional Mark Scheme

Question Number	Summary of change
10b	<p>Alternative methods using intersecting secants for 10(b) leading to awrt 29 (very common). Identical marking structure but slightly different at the end when working out the area of triangle ABF.</p> <p><u>Method 1</u></p> <p>M1 A1 – as per Method I for getting to either $BD = 6.8$ or $FB = 9.8$</p> $\frac{\sin(FAB)}{"9.8"} = \frac{\sin(18+"39")}{4.9+3.5} \Rightarrow FAB = 78.08334293...$ <p>$AFB = 180 - FAB - (18+"39") = 44.91665707...$ M1 for angle AFB.</p> $A = \frac{1}{2}("9.8")(3.5+4.9)\sin("44.9")$ M1 (dependent on both previous M marks) for complete method for finding the required area of triangle ABF. $= 29.062148...$ A1 for 29 or better <p><u>Method 2</u></p> <p>M1 A1 – as per Method I for getting to either $BD = 6.8$ or $FB = 9.8$</p> $\frac{\sin(FAB)}{"9.8"} = \frac{\sin(18+"39")}{4.9+3.5} \Rightarrow FAB = 78.08334293...$ <p>$AFB = 180 - FAB - (18+"39") = 44.91665707...$ M1 for angle AFB.</p> $\frac{AB}{\sin AFB} = \frac{4.9+3.5}{\sin(18+"39")} \Rightarrow AB = 7.071967199...$ $A = \frac{1}{2}(AB)(3.5+4.9)\sin(FAB) \text{ or } A = \frac{1}{2}(AB)("9.8")\sin(18+"39")$ <p>M1 (dependent on both previous M marks) for complete method for finding the required area of triangle ABF.</p> $= 29.062148...$ A1 for 29 or better

<p>Alternative method for finding AB <u>Like Method II Case 2 (finding AB)</u> $\frac{\sin FAD}{3} = \frac{\sin(180 - 51)}{3.5 + 4.9}$ eqn for angle FAD. 16.1141623...)</p> <p>$\frac{AB}{\sin(51 - FAD)} = \frac{3.5 + 4.9}{\sin(180 - 39)}$ up an equation for AB. $AB = 5.7284975...$ better.</p> <p>Area = $\frac{1}{2}(3.5 + 4.9)(AB)\sin((180 - 108) + FAD)$ previous Ms) for a correct method for finding the area of triangle ABF. Area = 24.0466585...</p>	<p>M1 for setting up an ($FAD =$ M1 (dep) for setting A1 for $AB = 5.7$ or M1 (dep on both A1 for 24 or better.</p>
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Question	Working	Answer	Mark	Notes
1(a)		56170	1	B1
(b)	$1.368 \times 10^9 - 2.144 \times 10^7$ or 1346560000			M1 for evidence of the correct subtraction (so M0 for $2.144 \times 10^7 - 1.368 \times 10^9$ unless recovered later) or for a correct answer (to at least 3 significant figures) in non-standard form (e.g., 1346560000, 13.4656×10^8 , 1350000000, etc.). The correct answer implies this mark
		1.34656×10^9	2	A1 allow answers which round to (awrt) 1.35×10^9
(c)	$\frac{5.617 \times 10^4}{2.166 \times 10^6}$ or 0.02593...			M1 for evidence of division of the correct two values (condone for M1 $\frac{2.166 \times 10^6}{5.617 \times 10^4}$) or a correct answer (to at least 3 significant figures) in non-standard form (e.g., 0.0259, 0.259×10^{-1} , 0.0259326, etc.) or for 2.59×10^{-n} where n is a positive integer
		2.59×10^{-2}	2	A1 for awrt 2.59×10^{-2} (e.g., $2.593259464 \times 10^{-2}$ scores both marks, but M1A0 for 2.6×10^{-2} if more accurate answer not seen)
Total 5 marks				

2	$\frac{dy}{dx} = 3x^2 + 2ax + b$			M1 differentiating with at least 1 non-zero term correct.
	$3 \times (2)^2 + 2a \times (2) + b = 9.8$ or $4a + b = -2.2$ oe			M1 dep on 1 st M mark substitute in $x = 2$ into their $\frac{dy}{dx}$ and equating to 9.8 (allow any equivalent, e.g., $12 + 4a + b = 9.8$)
	$6 = 8 + 4a + 2b + 8$ or $2a + b = -5$ oe			M1 substitute in $x = 2$ and $y = 6$ into $y = x^3 + ax^2 + bx + 8$
	$2a = 5 - 2.2$ or $b = -10 + 2.2$			<p>M1 dep on 2nd and 3rd M marks. Correct method (but allow one sign slip) for eliminating a or b from their simultaneous equations</p> <p><u>Elimination method</u> (oe with coefficients of either a or b the same)</p> <p>e.g. $\begin{matrix} 2a + b = -5 \\ 4a + b = -2.2 \end{matrix} \Rightarrow (4a + b) - (2a + b) = -2.2 - (-5)$ (so for this set of equations the candidate must be subtracting the two equations)</p> <p>or e.g. $\begin{matrix} 4a + 2b = -10 \\ 4a + b = -2.2 \end{matrix} \Rightarrow (4a + 2b) - (4a + b) = -10 - (-2.2)$</p> <p><u>Substitution method</u></p> <p>e.g. $b = -5 - 2a \Rightarrow 4a + (-5 - 2a) = -2.2$</p> <p>or e.g. $a = \frac{1}{2}(-5 - b) \Rightarrow 4\left(\frac{-5 - b}{2}\right) + b = -2.2$ (or equivalent)</p> <p>This mark can be implied by either a correct value for a or for b. Allow by use of matrices.</p>
		$a = 1.4$ $b = -7.8$	5	<p>A1(oe e.g. $a = \frac{7}{5}, b = -\frac{39}{5}$) dependent on all four M marks</p> <p>Correct answers with no working scores no marks</p>
				Total 5 marks

3 (a) (i)	$4x^2 + 18x + 24 = 160$ oe			<p>M1 adding all the subsets together and equating to 160. Need not be simplified (but if all 7 terms not shown explicitly then need to see at least $4x^2 + 18x + 24 = 160$).</p> <p>Must see the 160 e.g. $4x^2 + 18x + 24 - 160 = 0$</p> <p>For reference (if fully un-simplified):</p> $8x + \left(\frac{5}{2}x + 7\right) + (x^2 + 9) + (4x - 1) + \left(\frac{3}{2}x + 8\right) + (2x^2 + 4) + (x^2 + 2x - 3) = 160$
		$2x^2 + 9x - 68 = 0$		<p>A1 simplifying to the given 3 term quadratic (at least one intermediate line from initial line of working to given answer) – must include $= 0$ (allow $0 = 2x^2 + 9x - 68$) so all terms on one side equal to zero</p>
(ii)	$(2x + 17)(x - 4) [= 0]$ oe			<p>M1 correct method for solving the given 3 term quadratic – either by formula, completing the square or factorising.</p> <p>By factorising: brackets must expand to give 2 out of 3 correct terms</p> <p>By formula: correct substitution into fully correct formula (allow 1 sign error)</p> <p>By completing the square: must see $2\left(x + \frac{9}{4}\right)^2 \pm \dots [= 0]$</p> <p>Either correct value of $x \left(x = -\frac{17}{2} \text{ or } x = 4\right)$ can imply this mark</p> <p>NB anything appearing in square brackets [...] is not required</p>
		$x = 4$	4	<p>A1 (A0 if $x = -\frac{17}{2}$ given as a final answer too)</p>
(b)	$\frac{\frac{3 \times "4"}{2} + 8}{3 \times "4" + 7.5 \times "4" + 8}$ oe			<p>M1 for either $\frac{\frac{3}{2}x + 8}{\left(\frac{3}{2}x + 8\right) + (4x - 1) + (2x^2 + 4) + (x^2 + 2x - 3)}$ oe or for an equivalent expression with their value of x (which must be a positive integer) – if value for x substituted then numerator must be less than 160</p>
		$\frac{7}{43}$	2	<p>A1 oe exact value (A0 if non-exact answer e.g., 0.163 given and exact answer not seen) – award M1A0 if $7/43$ seen in working (but not given as final answer)</p>
Total 6 marks				

4(a)		$-2\mathbf{a} + 5\mathbf{b}$	1	B1 oe (e.g., $5\mathbf{b} - 2\mathbf{a}$) allow vectors not underlined throughout the question
(b) (i)	$\overrightarrow{OC} = 5\mathbf{b} + 6\mathbf{a} + 5\mathbf{b}$ or $\overrightarrow{OC} = 6\mathbf{a} + 10\mathbf{b}$			M1 for finding either \overrightarrow{OC} , possibly seen as part of another vector e.g., \overrightarrow{OP} where for reference: $\overrightarrow{OP} = \frac{1}{5}(5\mathbf{b} + 6\mathbf{a} + 5\mathbf{b})$ or for $\overrightarrow{AC} = -2\mathbf{a} + 5\mathbf{b} + 6\mathbf{a} + 5\mathbf{b} (= 4\mathbf{a} + 10\mathbf{b})$
	$\overrightarrow{AP} = -2\mathbf{a} + \frac{1}{5}("6\mathbf{a} + 10\mathbf{b}")$ or $\overrightarrow{PB} = -\frac{1}{5}("6\mathbf{a} + 10\mathbf{b}") + 5\mathbf{b}$ oe			M1 for finding either \overrightarrow{AP} or \overrightarrow{PB} (need not be simplified) oe (e.g., \overrightarrow{PA} or \overrightarrow{BP}) e.g., $\overrightarrow{AP} = \overrightarrow{AC} + \overrightarrow{CP} = -2\mathbf{a} + 5\mathbf{b} + 6\mathbf{a} + 5\mathbf{b} - 4\left(\frac{6}{5}\mathbf{a} + 2\mathbf{b}\right) \left[= -\frac{4}{5}\mathbf{a} + 2\mathbf{b} \right]$ $\overrightarrow{PB} = \overrightarrow{PO} + \overrightarrow{OA} + \overrightarrow{AC} + \overrightarrow{CB} = -\left(\frac{6}{5}\mathbf{a} + 2\mathbf{b}\right) + 2\mathbf{a} + 4\mathbf{a} + 10\mathbf{b} - 6\mathbf{a} - 5\mathbf{b}$ $\left[= -\frac{6}{5}\mathbf{a} + 3\mathbf{b} \right]$ or for $\overrightarrow{AP} = \left(\frac{1}{5}\overrightarrow{AC} + \frac{4}{5}\overrightarrow{AO}\right) = \frac{1}{5}("4\mathbf{a} + 10\mathbf{b}") + \frac{4}{5}(-2\mathbf{a})$
	$\overrightarrow{AP} = -\frac{4}{5}\mathbf{a} + 2\mathbf{b} = \frac{2}{5}\overrightarrow{AB}$ or $\overrightarrow{PB} = -\frac{6}{5}\mathbf{a} + 3\mathbf{b} = \frac{3}{5}\overrightarrow{AB}$ or $\overrightarrow{AP} = -\frac{4}{5}\mathbf{a} + 2\mathbf{b} = \frac{2}{3}\overrightarrow{PB}$ oe			Also showing multiple using any two of AP, BP, AB (or PA, PB, BA or a mixture of the two e.g., AP with BA) oe, e.g., $\overrightarrow{AB} = \frac{5}{2}\overrightarrow{AP}$ or $\overrightarrow{AP} = \frac{2}{3}\overrightarrow{PB}$ or $\overrightarrow{AB} = \frac{5}{3}\overrightarrow{BP}$ or $\overrightarrow{AB} = -\frac{5}{3}\overrightarrow{PB}$ or $\overrightarrow{AP} = -\frac{2}{3}\overrightarrow{BP}$ or $\overrightarrow{AB} = -\frac{5}{2}\overrightarrow{PA}$ etc.
		AP and AB are parallel with the point A in common on each line \therefore collinear		A1 for a comment that one is a multiple of the other (oe e.g. that they are parallel) and that there is a common point on each of the two lines (so if $\overrightarrow{AB}, \overrightarrow{AP}$ used then must mention that A is the common point, if $\overrightarrow{PB}, \overrightarrow{AB}$ used then must mention that B is the common point, etc.)
(b) (ii)		$2 : 3$	5	B1 oe Accept $m = 2$ and $n = 3$ oe (provided that m and n are in the ratio $2 : 3$ e.g., $1 : 1.5, 4 : 6$, or stating $m = 1, n = 1.5$, etc.)
Total 6 marks				

5	$2x^2 = 11 - 3(4x - 5)^2$ or $2\left(\frac{5+y}{4}\right)^2 = 11 - 3y^2$			M1 for correct substitution of the linear equation $4x - y = 5$ into the quadratic equation $2x^2 = 11 - 3y^2$ to form an (unsimplified) quadratic equation in either x or y . This mark can be implied by the second M mark.
	$2x^2 = 11 - 3(16x^2 - 40x + 25)$ or $2\left(\frac{25 + 10y + y^2}{16}\right) = 11 - 3y^2$			M1 for correct expansion of either their $(4x - 5)^2$ or $\left(\frac{5+y}{4}\right)^2$ in correct equation (not dependent on previous M mark)
	$25x^2 - 60x + 32 [= 0]$ or $25y^2 + 10y - 63 [= 0]$			A1 for a correct 3 term quadratic in either x or y dep on both previous M marks (oe e.g., $50x^2 - 120x + 64 [= 0]$, $50y^2 + 20y - 126 [= 0]$, etc. look out for all signs reversed)
	$(5x - 4)(5x - 8) [= 0]$ or $(5y - 7)(5y - 9) [= 0]$			M1 correct method for solving their 3-term quadratic – either by formula, completing the square or factorising. By factorising: brackets must expand to give 2 out of 3 correct terms By formula: correct substitution into fully correct formula (allow 1 sign error). By completing the square: must see e.g., $25\left(x - \frac{6}{5}\right)^2 \pm \dots [= 0]$
	$4 \times "0.8" - y = 5$ or $4 \times 1.6 - y = 5$ or $4x - (-1.8) = 5$ or $4x - 1.4 = 5$ oe			M1 indep substituting their two x values into either equation leading to values for y or vice versa (not dependent on any previous M marks) – this mark can be implied by correct values (if no working seen). This mark can be implied by both correct pairs of values.
		(0.8, -1.8) (1.6, 1.4)	6	A1 for both correct pairs of x and y values (oe e.g., $x = \frac{4}{5}, y = -\frac{9}{5}$ and $x = \frac{8}{5}, y = \frac{7}{5}$) This mark is dependent on all previous marks. Correct answer(s) with no working scores no marks
<div>Total 6 marks</div>				

Question 6

For reference: $y = x^2 + 2x + \frac{4}{x}$ and

x	-4	-2	-1	-0.5	0.5	1	2	4
y	7	-2	-5	-8.75	9.25	7	10	25

