Summary of changes from Provisional Mark Scheme

Question Number	Summary of change
10b	**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*.** **<u>Method 1</u>** **M1 A1 – as per Method I for getting to either *BD* = 6.8 or *FB* = 9.8** $\frac{\sin(FAB)}{"9.8"} = \frac{\sin(18+"39")}{4.9+3.5} \Rightarrow FAB = 78.08334293...$ $AFB = 180 - FAB - (18+"39") = 44.91665707...$ **M1 for angle *AFB*.** $A = \frac{1}{2}("9.8")(3.5+4.9)\sin("44.9")$ **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** **<u>Method 2</u>** **M1 A1 – as per Method I for getting to either *BD* = 6.8 or *FB* = 9.8** $\frac{\sin(FAB)}{"9.8"} = \frac{\sin(18+"39")}{4.9+3.5} \Rightarrow FAB = 78.08334293...$ $AFB = 180 - FAB - (18+"39") = 44.91665707...$ **M1 for angle *AFB*.** $\frac{AB}{\sin AFB} = \frac{4.9+3.5}{\sin(18+"39")} \Rightarrow AB = 7.071967199...$ $A = \frac{1}{2}(AB)(3.5+4.9)\sin(FAB)$ or $A = \frac{1}{2}(AB)("9.8")\sin(18+"39")$ **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**

	Alternative method for finding *AB* <u>Like Method II Case 2 (finding *AB*)</u> $\frac{\sin FAD}{3}=\frac{\sin(180-51)}{3.5+4.9}$ **M1** for setting up an eqn for angle *FAD*. ($FAD =$ 16.1141623…) $\frac{AB}{\sin(51-FAD)}=\frac{3.5+4.9}{\sin(18+"39")}$ **M1** (dep) for setting up an equation for *AB*. $AB = 5.7284975…$ **A1** for $AB = 5.7$ or better. Area = $\frac{1}{2}(3.5+4.9)(AB)\sin((180-108)+FAD)$ **M1** (dep on both previous Ms) for a correct method for finding the area of triangle *ABF*. Area = 24.0466585… **A1** for 24 or better.

Question	Working	Answer	Mark	Notes
1(a)		56170	1	B1
(b)	$1.368\times10^9 - 2.144\times10^7$ or 1346560000			M1 for evidence of the correct subtraction (so M0 for $2.144\times10^7 - 1.368\times10^9$ 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)	$\frac{5.617\times10^4}{2.166\times10^6}$ or 0.02593…			M1 for evidence of division of the correct two values (condone for M1 $\frac{2.166\times10^6}{5.617\times10^4}$) 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., 2.593259464×10^{-2} scores both marks, but M1A0 for 2.6×10^{-2} if more accurate answer not seen)
				Total 5 marks

2	$\frac{\mathrm{d}y}{\mathrm{d}x}=3x^2+2ax+b$			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 1st M mark substitute in $x = 2$ into their $\frac{\mathrm{d}y}{\mathrm{d}x}$ 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 $b=-10+2.2$			M1 dep on 2nd and 3rd M marks. Correct method (but allow one sign slip) for eliminating *a* or *b* from their simultaneous equations <u>Elimination method</u> (oe with coefficients of either *a* or *b* the same) 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) or e.g. $\begin{matrix}4a+2b=-10\\4a+b=-2.2\end{matrix}\Rightarrow(4a+2b)-(4a+b)=-10-(-2.2)$ <u>Substitution method</u> e.g. $b=-5-2a\Rightarrow 4a+(-5-2a)=-2.2$ or e.g. $a=\frac{1}{2}(-5-b)\Rightarrow 4\left(\frac{-5-b}{2}\right)+b=-2.2$ (or equivalent) This mark can be implied by either a correct value for *a* or for *b*. Allow by use of matrices.
		$a = 1.4$ $b = -7.8$	5	A1(oe e.g. $a=\frac{7}{5},b=-\frac{39}{5}$) dependent on all four M marks **Correct answers with no working scores no marks**
				Total 5 marks

3 (a) (i)	$4x^2+18x+24=160$ oe			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 $4x^2+18x+24=160$). Must see the 160 e.g. $4x^2+18x+24-160=0$ For reference (if fully un-simplified): $8x+(\frac{5}{2}x+7)+(x^2+9)+(4x-1)+(\frac{3}{2}x+8)+(2x^2+4)$ $+(x^2+2x-3)=160$
		$2x^2+9x-68=0$		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
(ii)	$(2x+17)(x-4)[=0]$ oe			M1 correct method for solving the **given** 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 $2\left(x+\frac{9}{4}\right)^2 \pm ...[=0]$ Either correct value of x $\left(x=-\frac{17}{2} \text{ or } x=4\right)$ can imply this mark **NB anything appearing in square brackets [..] is not required**
		$x=4$	4	A1 (A0 if $x=-\frac{17}{2}$ given as a final answer too)
(b)	$\dfrac{\frac{3\times"4"}{2}+8}{3\times"4"^2+7.5\times"4"+8}$ oe			M1 for either $\dfrac{\frac{3}{2}x+8}{(\frac{3}{2}x+8)+(4x-1)+(2x^2+4)+(x^2+2x-3)}$ 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
		$\frac{7}{43}$	2	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)
				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 $\overrightarrow{AC}=-2\mathbf{a}+5\mathbf{b}+6\mathbf{a}+5\mathbf{b}(=4\mathbf{a}+10\mathbf{b})$
	$\overrightarrow{AP}=-2\mathbf{a}+\frac{1}{5}(\text{"}6\mathbf{a}+10\mathbf{b}\text{"})$ or $\overrightarrow{PB}=-\frac{1}{5}(\text{"}6\mathbf{a}+10\mathbf{b}\text{"})+5\mathbf{b}$ 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 $\overrightarrow{AP}=\left(\frac{1}{5}\overrightarrow{AC}+\frac{4}{5}\overrightarrow{AO}\right)=\frac{1}{5}(\text{"}4\mathbf{a}+10\mathbf{b}\text{"})+\frac{4}{5}(-2\mathbf{a})$
	$\overrightarrow{AP}=-\frac{4}{5}\mathbf{a}+2\mathbf{b}=\frac{2}{5}\overrightarrow{AB}$ 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			A1cso 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., $25\left(x-\frac{6}{5}\right)^2\pm...[=0]$
	$4\times"0.8"-y=5$ or $4\times1.6-y=5$ or $4x-(-1.8)=5$ or $4x-1.4=5$ oe			M1indep 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**
				Total 6 marks

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