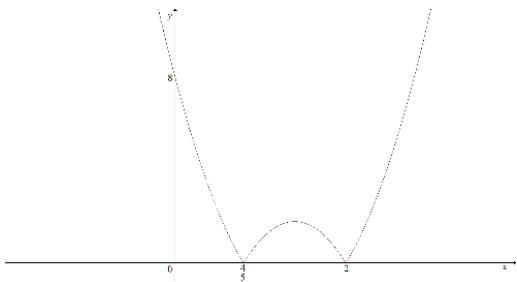


Question	Answer	Marks	Guidance
1(a)	$5\left(x - \frac{7}{5}\right)^2 - \frac{9}{5}$	3	<b>B1</b> for $5(x \pm b)^2$ <b>B1</b> for $\left(x - \frac{7}{5}\right)^2$ <b>B1</b> for $-\frac{9}{5}$
	<b>Alternative</b> By comparing coefficients: $a(x^2 + 2bx + b^2) + c = 5x^2 - 14x + 8$ . $2abx = -14x$ $ab^2 + c = 8$	(3)	<b>B1</b> for $a = 5$ <b>B1</b> for $b = \frac{-14}{10}$ oe <b>B1</b> for $c = \frac{-18}{10}$ oe
1(b)	$\left(\frac{7}{5}, -\frac{9}{5}\right)$	2	<b>FTB1</b> for each, follow through on <i>their</i> $a$ and $b$ from (a) <b>or</b> <b>SC1</b> if differentiation is used in <i>their</i> (a) or restarted in (b) $\frac{dy}{dx} = 10x - 14 = 0$ then $\left(\frac{7}{5}, -\frac{9}{5}\right)$
1(c)		3	<b>B1</b> for the correct shape. Must have the parabola part of the curve with maximum in the first quadrant and cusps on the $x$ -axis. Ignore labelling of their maximum point if incorrect coordinates <b>B1</b> for $\left(\frac{4}{5}, 0\right)$ and $(2, 0)$ , must have a correct shape in the first quadrant. <b>B1</b> for $(0, 8)$ must have a correct shape.
1(d)	$0 < k < \frac{9}{5}$	2	<b>B1FT</b> follow through from 0 and <i>their</i> $-b$ in part (a)
2(a)	$p'(x) = 3ax^2 + 14x + b$ $p''(x) = 6ax + 14$ leading to $3a + 14 = 32$ $a = 6$	2	<b>M1</b> for attempt to differentiate twice and substitute $x = \frac{1}{2}$

Question	Answer	Marks	Guidance
2(b)	$p\left(\frac{4}{3}\right): 80 + 4b + 3c = 0$ oe	<b>M1</b>	Must have 3 terms. For use of $x = \frac{4}{3}$ , at least once <b>and</b> equating to 0 with an attempt at simplification leading to an equation in $b$ and $c$ only Allow one sign error.
	$p(-1): -b + c = 6$ oe	<b>M1</b>	Must have 3 terms. For use of $x = -1$ <b>and</b> equating to 7 with an attempt at simplification leading to an equation in $b$ and $c$ only
	$b = -14, c = -8$	<b>2</b>	<b>M1 dep</b> on both previous <b>M</b> marks and attempt to solve simultaneously to obtain both $b$ and $c$ <b>A1</b> for both
2(c)	$(3x - 4)(2x^2 + 5x + 2)$	<b>2</b>	<b>B1</b> for two terms correct in the quadratic factor. Allow if seen as a quotient in long division. For both marks, need to see both factors together. $\left(x - \frac{4}{3}\right)(6x^2 - 15x + 6)$ from synthetic method gets 0 marks unless recovered.
2(d)	$(3x - 4)(2x + 1)(x + 2)$	<b>B1</b>	Must be all integers
3(a)	Mid-point (6, -5)	<b>B1</b>	
	Gradient of $AB = -\frac{5}{2}$	<b>B1</b>	
	Perpendicular gradient $\frac{2}{5}$	<b>M1</b>	For <i>their</i> perp gradient
	$-9 + 5 = \frac{2}{5}(x - 6)$ oe $x = -4$	<b>2</b>	<b>Dep M1</b> for attempt at the equation of the perpendicular bisector with <i>their</i> mid-point and <i>their</i> perpendicular gradient and use of $y = -9$
3(b)	(16, -1)	<b>2</b>	<b>B1</b> for each, <b>FT</b> on 12 – <i>their a</i> for the $x$ -coordinate.
4(a)	Area under graph = 800 $\frac{1}{2}(10 \times 10) + (10 \times 10) + \frac{1}{2}(10(10 + V)) + \frac{15V}{2} = 800$	<b>M1</b>	For attempt to find the area, allow one error and one omission.
	$V = 48$	<b>A1</b>	

Question	Answer	Marks	Guidance
4(b)	$(-)\frac{\textit{their } V}{15}$	<b>M1</b>	Allow omission of negative sign.
	$-\frac{16}{5} \text{ ms}^{-2}$ oe	<b>A1</b>	<b>FT</b> on <i>their V</i> but must be negative.
5(a)	$(5\sqrt{3} - 6)^2 + (5\sqrt{3} + 6)^2 - 2(5\sqrt{3} - 6)(5\sqrt{3} + 6)\cos 120^\circ$ soi	<b>M1</b>	For the correct use of the cosine rule Condone missing brackets if intention is clear
	$75 + 36 - 60\sqrt{3} + 75 + 36 + 60\sqrt{3} + 75 - 36$	<b>M1</b>	<b>M1 Dep</b> must see sufficient detail to be sure that a calculator is not being used. This is the minimum acceptable $75 + 36 - 60\sqrt{3} + 75 + 36 + 60\sqrt{3} + 39$
	261	<b>A1</b>	Maybe implied by $\sqrt{261}$
	$3\sqrt{29}$	<b>A1</b>	
5(b)	$\frac{2+5\sqrt{5}}{4} = \frac{1}{2}(3+2\sqrt{5}) \times QR \times \sin 30^\circ$ soi	<b>M1</b>	For the correct use of the area of the triangle. Condone missing brackets if intention is clear
	$\frac{2+5\sqrt{5}}{3+2\sqrt{5}} \times \frac{3-2\sqrt{5}}{3-2\sqrt{5}}$ or $\frac{2+5\sqrt{5}}{3+2\sqrt{5}} \times \frac{-3+2\sqrt{5}}{-3+2\sqrt{5}}$	<b>M1</b>	<b>M1 dep</b> for a correct attempt to rationalise <i>their QR</i> . must be the same two terms in the numerator and denominator to rationalise
	$\frac{6+15\sqrt{5}-4\sqrt{5}-50}{9-20}$ $\frac{11\sqrt{5}-44}{-11}$	<b>M1</b>	<b>M1 dep</b> , must see sufficient detail to be sure that a calculator is not being used. This is the minimum acceptable $\frac{6+15\sqrt{5}-4\sqrt{5}-50}{-11}$
	$4 - \sqrt{5}$	<b>A1</b>	

Question	Answer	Marks	Guidance
6(a)	$\frac{\cos \theta + \sin \theta}{\sin \theta + \cos \theta} \text{ soi}$ $\frac{1}{\cos \theta}$	<b>2</b>	<b>B1</b> for $\tan \theta$ and $\cot \theta$ in terms of $\sin$ and $\cos$ . <b>B1</b> for $\sec \theta = \frac{1}{\cos \theta}$
	$\frac{\cos^2 \theta + \sin^2 \theta}{\sin \theta \cos \theta} \times \cos \theta \text{ soi oe}$	<b>M1</b>	For dealing with the fractions in the numerator.
	$\frac{1}{\sin \theta} \times \operatorname{cosec} \theta \text{ cso}$	<b>A1</b>	For correct use of $\cos^2 \theta + \sin^2 \theta = 1$ to obtain the given answer.
	$\frac{1}{\tan \theta} + \tan \theta = \frac{1 + \tan^2 \theta}{\tan \theta} \times \cos \theta \text{ soi oe}$ $\frac{1}{\cos \theta}$	<b>(2)</b>	<b>B1</b> for $\sec \theta = \frac{1}{\cos \theta}$ <b>M1</b> for dealing with the fractions in the numerator.
	$\frac{\sec^2 \theta}{\tan \theta} \times \cos \theta$	<b>(B1)</b>	For correct use of $\tan^2 \theta + 1 = \sec^2 \theta$
	$\frac{1}{\sin \theta} \times \operatorname{cosec} \theta \text{ cso}$	<b>(A1)</b>	For correct use of $\tan \theta$ and $\sec^2 \theta$ to obtain the given answer.
6(b)	$\left(\frac{1}{\sin \frac{\phi}{3}}\right)^2 = 2 \text{ or } \sin \frac{\phi}{3} = \pm \frac{1}{\sqrt{2}} \text{ soi or}$ $\tan \frac{\phi}{3} = \pm 1 \text{ soi}$	<b>B2</b>	<b>B1</b> for $\pm$ missing
	$-405^\circ, -135^\circ, 135^\circ, 405^\circ$	<b>4</b>	<b>M1</b> for one correct positive or negative solution of <i>their</i> $\sin \frac{\phi}{3} = k$ <b>A1</b> for another correct solution <b>M1Dep</b> for one negative or positive solution <b>A1</b> for another correct solution and no extras in the range.
7(a)(i)	6435	<b>B1</b>	Must be evaluated not just ${}^{15}C_8$
7(a)(ii)	With family of 4: 330	<b>B1</b>	Must be evaluated not just ${}^{11}C_4$ or implied by a correct answer
	Without family of 4: 165	<b>B1</b>	Must be evaluated not just ${}^{11}C_8$ or implied by a correct answer
	Total: 495	<b>B1</b>	

Question	Answer	Marks	Guidance
7(b)	$\frac{(n+9) \times n!}{(n-10)!} = \frac{(n^2 + 243)(n-1)!}{(n-1-9)!}$ $n(n+9) = n^2 + 243 \quad \text{oe}$	<b>2</b>	<b>B1</b> for either ${}^n P_{10} = \frac{n!}{(n-10)!}$ or ${}^n P_{10} = \frac{(n-1)!}{(n-1-9)!}$ <b>B1 dep</b> for $n(n+9) = n^2 + 243$
	$n = 27$	<b>B1</b>	
8(a)	$\frac{(2x+1) \times \frac{1}{3} \times 3(3x-4)^{-\frac{2}{3}} - 2(3x-4)^{\frac{1}{3}}}{(2x+1)^2} \quad \text{oe}$ <p>or by using the product rule</p> $\frac{1}{3} \times 3 \times (3x-4)^{-\frac{2}{3}} \times (2x+1)^{-1} + -2 \times (2x+1)^{-2} (3x-4)^{\frac{1}{3}}$	<b>3</b>	<b>B1</b> for $\frac{1}{3} \times 3 \times (3x-4)^{-\frac{2}{3}}$ oe <b>M1</b> for an attempt to differentiate a quotient. <b>A1</b> for all terms other than $\frac{1}{3} \times 3 \times (3x-4)^{-\frac{2}{3}}$ correct. Allow unsimplified.
	$\frac{(3x-4)^{-\frac{2}{3}}}{(2x+1)^2} ((2x+1) - 2(3x-4))$	<b>M1</b>	<b>M1 dep</b> for attempt to factorise, must be in the form $\frac{(3x-4)^{-\frac{2}{3}}}{(2x+1)^2} [(ax+1) - b(3x-4)]$
	$\frac{9-4x}{(2x+1)^2 (3x-4)^{\frac{2}{3}}}$	<b>A1</b>	
8(b)	(2.25, 0.255)	<b>2</b>	<b>B1 FT</b> for <i>their</i> x-coordinate only. Do not allow <b>FT</b> if they score <b>M0</b> in part (a)
9(a)	$n = 57$ cso	<b>3</b>	<b>B1</b> for $\frac{n}{2} (2 \ln q + 3(n-1) \ln q)$ oe soi Allow if in indices form i.e.: $\frac{n}{2} (\ln q^2 + (n-1) \ln q^3)$ <b>B1</b> for $3n^2 - n - 9690 = 0$ oe soi
9(b)	Common ratio = $p^{-2x}$	<b>B1</b>	Allow unsimplified
	nth term = $p^{3x}(p^{-2x})^{n-1}$ soi	<b>B1</b>	Allow unsimplified
	$p^{(5-2n)x}$	<b>B1</b>	

Question	Answer	Marks	Guidance
9(c)	Common ratio = $\frac{4}{3}\cos^2 3\theta$	<b>B1</b>	Allow unsimplified. Must be convinced it is the common ratio not just writing the first term e.g. $r =$ or seeing $\frac{16}{9}\cos^4 3\theta$ $\frac{4}{3}\cos^2 3\theta$
	$\frac{4}{3}\cos^2 3\theta(*) - 1$ or $\frac{4}{3}\cos^2 3\theta(*) 1$ or oe soi $\frac{4}{3}\cos^2 3\theta(*) 0$	<b>B1</b>	
	$\cos 3\theta(*) \frac{\sqrt{3}}{2}$ or $\cos 3\theta(*) - \frac{\sqrt{3}}{2}$ or soi $\cos 3\theta(*) 0$	<b>B1</b>	
	$3\theta(*) \frac{5\pi}{6}$ and $3\theta(*) \frac{\pi}{6}$ soi	<b>B1</b>	Seeing $\frac{5\pi}{18}$ or $\frac{\pi}{18}$ implied the first 3 marks
	$\frac{\pi}{18} < \theta < \frac{5\pi}{18}$	<b>B1</b>	
10(a)	$\frac{dy}{dx} = 2 \times 3(3x+1)\ln(3x+1) + \frac{3(3x+1)^2}{3x+1}$ Simplified to: $\frac{dy}{dx} = 3(3x+1)(1 + 2\ln(3x+1))$	<b>3</b>	<b>B1</b> for $\frac{3}{3x+1}$ <b>M1</b> for attempt to differentiate a product <b>A1</b> for all terms other than $\frac{3}{3x+1}$ correct. Allow unsimplified.
10(b)	$k(3x+1)^2 \ln(3x+1)$ soi	<b>B1</b>	
	$\int (3x+1)dx = \frac{3x^2}{2} + x + c$	<b>B1</b>	May be a multiple May be seen as $\frac{1}{3} \times \frac{1}{2} \times (3x+1)^2$
	$\frac{1}{6}(3x+1)^2 \ln(3x+1) - \frac{3x^2}{4} - \frac{x}{2} + c$	<b>B2</b>	<b>B1</b> for two correct algebraic terms For <b>B2</b> must have $(+c)$