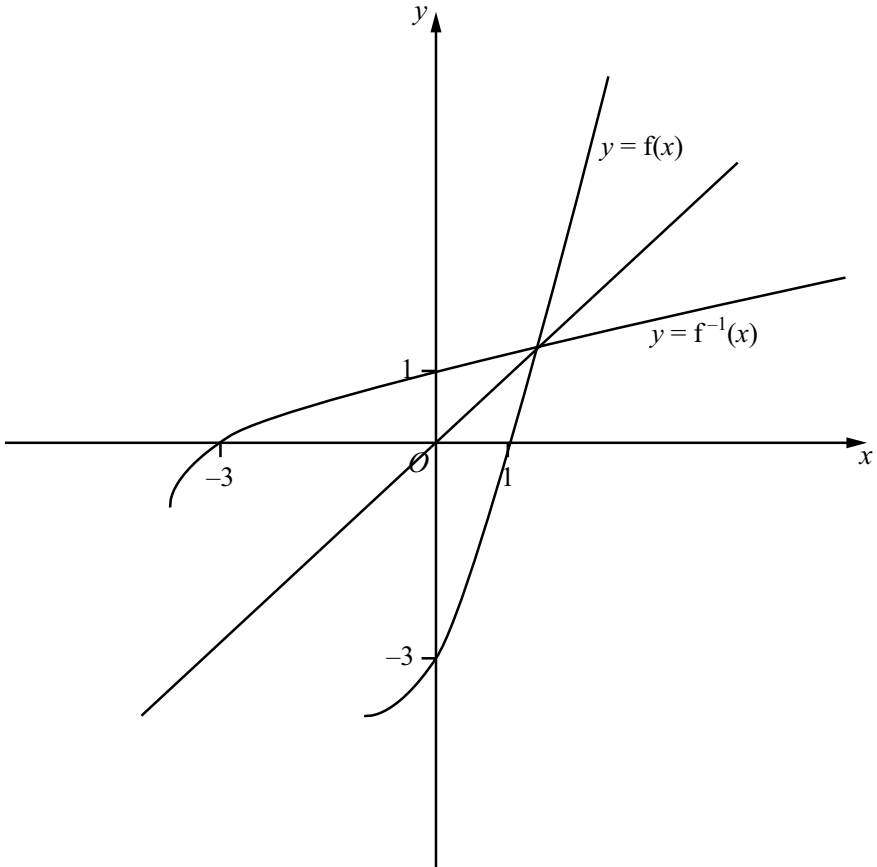


Question	Answer	Marks	Partial Marks
1	$2x^2 - (k + 4)x + (k + 4) (= 0)$ $2x^2 + (-k - 4)x + (k + 4) (= 0)$	<b>B1</b>	
	Discriminant: $(k + 4)^2 - (4 \times 2 \times (k + 4))$	<b>M1</b>	Use of discriminant to obtain 2 critical values using <i>their</i> 3-term quadratic
	$\pm 4$	<b>A1</b>	For critical values
	$k < -4$ $k > 4$	<b>A1</b>	
2(a)	$y = -\frac{1}{2}(x + 5)(x + 1)(x - 2)$	<b>3</b>	<b>B1</b> for negative soi
			<b>B1</b> for $\frac{1}{2}$ soi
			<b>B1</b> for $(x + 5)(x + 1)(x - 2)$ or $x^3 + 4x^2 - 7x - 10$
2(b)	$-5 < x < -1$	<b>B1</b>	
	$x > 2$	<b>B1</b>	
3	$(5x + 4)^2 * (2x - 3)^2$ soi where * is any inequality sign or =	<b>M1</b>	
	$21x^2 + 52x + 7 * 0$	<b>A1</b>	
	Critical values: $-\frac{1}{7}, -\frac{7}{3}$ , soi	<b>A1</b>	
	$-\frac{7}{3} \leq x \leq -\frac{1}{7}$ mark final answer	<b>A1</b>	<b>FT</b> <i>their</i> derived critical values
	<b>Alternative</b>		
	$5x + 4 * 2x - 3$ oe soi and $5x + 4 * 3 - 2x$ oe soi where * is any inequality sign or =	<b>(M1)</b>	
	Critical values: $-\frac{1}{7}, -\frac{7}{3}$ , soi	<b>(A2)</b>	<b>A1</b> for $-\frac{1}{7}$ or $-\frac{7}{3}$
	$-\frac{7}{3} \leq x \leq -\frac{1}{7}$ mark final answer	<b>(A1)</b>	<b>FT</b> <i>their</i> derived critical values

Question	Answer	Marks	Partial Marks
4(a)	It is a one to one function because of the given restricted domain or because $x \geq -1$	<b>B1</b>	
4(b)		<b>4</b>	<p><b>B1</b> for <math>y = f(x)</math> for <math>x &gt; -1</math> only</p> <p><b>B1</b> for 1 on <math>x</math>-axis and <math>-3</math> on <math>y</math>-axis for <math>y = f(x)</math></p> <p><b>B1</b> for <math>y = f^{-1}(x)</math> as a reflection of <math>y = f(x)</math> in the line <math>y = x</math>, maybe implied by intercepts with axes</p> <p><b>B1</b> for 1 on <math>y</math>-axis and <math>-3</math> on <math>x</math>-axis for <math>y = f^{-1}(x)</math></p>

Question	Answer	Marks	Partial Marks
5(a)	$\text{LHS} = \frac{\sin x \times \frac{\sin x}{\cos x}}{1 - \cos x}$	<b>M1</b>	Accept other alternative correct methods. Uses $\tan x = \frac{\sin x}{\cos x}$
	$= \frac{1 - \cos^2 x}{\cos x(1 - \cos x)}$	<b>M1</b>	<b>dep</b> for use of $\sin^2 x = 1 - \cos^2 x$ to eliminate $\sin x$
	$\frac{(1 - \cos x)(1 + \cos x)}{\cos x(1 - \cos x)} = \frac{1 + \cos x}{\cos x} = \sec x + 1$	<b>2</b>	<b>M1 dep</b> factorises and cancels correctly. <b>A1</b> for use of $\frac{1}{\cos x} = \sec x$
5(b)	$\sin x(\cos x)^{-2}$	<b>B1</b>	
	$\tan x \sec x$	<b>B1</b>	Must show sufficient detail
6	$x + y = 9$	<b>B1</b>	
	$(x + 1)^2 = y + 2$	<b>B1</b>	
	$x + (x + 1)^2 - 2 = 9$ or $(10 - y)^2 = y + 2$	<b>M1</b>	Eliminate $y$ or $x$ to obtain a quadratic function in one variable Allow unsimplified using <i>their</i> 3-term expressions both containing $x$ and $y$ terms. Condone one sign or arithmetic error.
	$x^2 + 3x - 10 (= 0)$ or $y^2 - 21y + 98 (= 0)$	<b>A1</b>	
	$x = 2, y = 7$	<b>2</b>	<b>M1 dep</b> solution of <i>their</i> 3-term quadratic equation <b>A1</b> for discounting negative $x$ value and stating one solution only.

Question	Answer	Marks	Partial Marks
7(a)	$y^3 = m \ln x + c$	<b>B1</b>	May be implied by subsequent work
	$5 = m + c$ $15 = 6m + c$ $m = 2, c = 3$	<b>2</b>	<b>B1</b> for $m = 2$ <b>B1</b> for $c = 3$
	$y = \sqrt[3]{2 \ln x + 3}$	<b>B1</b>	
	<b>Alternative</b> $y^3 = m \ln x + c$	<b>(B1)</b>	May be implied by subsequent work
	Gradient = 2	<b>(B1)</b>	For finding the gradient and equating to $m$
	$5 = m + c$ $15 = 6m + c$ $c = 3$	<b>(B1)</b>	For at least one correct equation and finding $c$
	$y = \sqrt[3]{2 \ln x + 3}$	<b>(B1)</b>	
7(b)	$x > e^{-2}$	<b>2</b>	<b>M1</b> for a correct method to obtain the critical value of $x$
8(a)	$p(2): 48 + 4a + 2b + 2 = 0$ $2a + b + 25 = 0$	<b>B1</b>	For $2a + b + 25 = 0$ or multiple
	$p(1) = -2p(0)$ $a + b + 12 = 0$	<b>B1</b>	For $a + b + 12 = 0$
	$a = -13, b = 1$	<b>2</b>	<b>M1</b> for attempt to solve <i>their</i> equations in $a$ and $b$ leading to 2 values <b>A1</b> for both
8(b)(i)	$p\left(\frac{1}{2}\right) = \frac{6}{8} - \frac{13}{4} + \frac{1}{2} + 2$	<b>M1</b>	For attempt to find $p\left(\frac{1}{2}\right)$ using <i>their</i> $a$ and $b$
	0	<b>A1</b>	
8(b)(ii)	$(x - 2)(2x - 1)(3x + 1)$	<b>2</b>	<b>M1</b> for realising that 2 factors are known and 3rd factor can be found by observation or algebraic long division, or for making use of $x - 2$ or $2x - 1$ in order to obtain a quadratic factor <b>A1</b> Must see all factors together

Question	Answer	Marks	Partial Marks
9(a)	When $x = 1, y = 8$	<b>B1</b>	
	$\frac{dy}{dx} = 3x^2 - 12x + 3$	<b>M1</b>	For obtaining the form $ax^2 + bx + c$
	When $x = 1, \frac{dy}{dx} = -6$	<b>A1</b>	
	Equation of tangent $y = -6x + 14$	<b>A1</b>	
9(b)	$x^3 - 6x^2 + 9x - 4 (= 0)$ Leading to either $(x - 1)(x^2 - 5x + 4) (= 0)$ or $(x - 4)(x^2 - 2x + 1) (= 0)$	<b>2</b>	<b>M1</b> for equating <i>their</i> tangent to curve and simplifying to 4-term cubic. <b>M1 dep</b> for either finding a factor or stating that $(x - 1)$ is a factor or for making at least 3 attempts to find a factor.
	$(x - 1)(x - 1)(x - 4) (= 0)$	<b>2</b>	<b>A1</b> for $(x - 1)$ or $x = 1$ nfw <b>A1</b> for $x - 4$ or $x = 4$ not repeated nfw
	$(4, -10)$	<b>A1</b>	Must have shown sufficient correct detail
10	$1 + \frac{2}{x} + \frac{1}{x^2}$	<b>2</b>	<b>B1</b> for 2 correct terms
	$x + 2 \ln x - \frac{1}{x}$	<b>2</b>	<b>B1</b> for 2 correct terms
	$\left[4 + 2 \ln 4 - \frac{1}{4}\right] - \left[2 + 2 \ln 2 - \frac{1}{2}\right]$	<b>M1</b>	For correct substitution of limits into <i>their</i> integral, must have at least one <b>B1</b> from each of the two sets of <b>B</b> marks
	$\frac{9}{4} + 2 \ln 2$ oe	<b>A1</b>	
11(a)	$2\mathbf{b} + \mathbf{a}$	<b>B1</b>	
11(b)	$2\mathbf{a} - 2\mathbf{b}$	<b>B1</b>	
11(c)	$2\mathbf{b} + \mathbf{a} + \mu(2\mathbf{a} - 2\mathbf{b})$	<b>B1</b>	<b>FT</b> on <i>their</i> part (a) and (b)
11(d)	$\lambda(3\mathbf{a} + \mathbf{b})$	<b>B1</b>	
11(e)	$3\lambda = 1 + 2\mu$ $\lambda = 2 - 2\mu$ leading to $\lambda = \frac{3}{4}, \mu = \frac{5}{8}$	<b>3</b>	<b>M1</b> for equating like vectors using parts (c) and (d) and forming two 3-term simultaneous equations <b>M1 dep</b> for solution to obtain both values

Question	Answer	Marks	Partial Marks
12(a)	Centre (1, -3)	2	<b>B1</b> for each
	Gradient of radius = 3 so gradient of the tangent is $-\frac{1}{3}$	<b>M1</b>	<b>FT</b> on <i>their</i> radius gradient
	$y = -\frac{1}{3}(x - 2)$	2	<b>M1 dep</b> for attempt at gradient using <i>their</i> perp gradient
12(b)	Radius = $\sqrt{10}$	2	<b>M1</b> for attempting to find the radius of $C_1$ , may be seen in part (a), but must be used in part (b)
	Centre (3, 3)	2	<b>B1</b> for each
	$(x - 3)^2 + (y - 3)^2 = 10$	<b>A1</b>	
13	$\cos \theta = x - 2$ and $\sin \theta = \frac{2}{y}$ soi	<b>B1</b>	
	$(x - 2)^2 + \frac{4}{y^2} = 1$	<b>M1</b>	For a correct attempt to use $\cos^2 \theta + \sin^2 \theta = 1$ or other relevant identity
	$y^2 = \frac{4}{1 - (x - 2)^2}$ oe	<b>M1</b>	<b>dep</b> attempt to rearrange to obtain $y^2$
	$y = \frac{2}{\sqrt{1 - (x - 2)^2}}$ or $\frac{2}{\sqrt{4x - x^2 - 3}}$ oe	<b>A1</b>	Must be positive