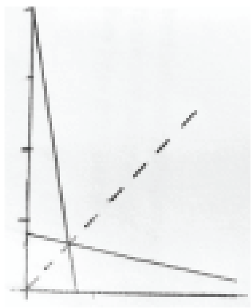
Question	Answer	Marks	Guidance
1	*EITHER:* Term is $^9C_3 \times 2^6 \times (-\tfrac{1}{4})^3$	**(B1, B1, B1)**	OE
	OR1: $\left(\frac{8x^3-1}{4x^2}\right)^9 = \left(\frac{1}{4x^2}\right)^9 \left(8x^3-1\right)^9 \; or \; -\left(\frac{1}{4x^2}\right)^9 \left(1-8x^3\right)^9$		
	Term is $-\frac{1}{4^9} \times {}^9C_3 \times 8^6$	**(B1, B1, B1)**	OE
	OR2: $\left(2x\right)^9 \left(1-\frac{1}{8x^3}\right)^9$		
	Term is $2^9 \times {}^9C_3 \times \left(-\frac{1}{8}\right)^3$	**(B1, B1, B1)**	OE
	Selected term, which must be independent of x $= -84$	**B1**	
		4	

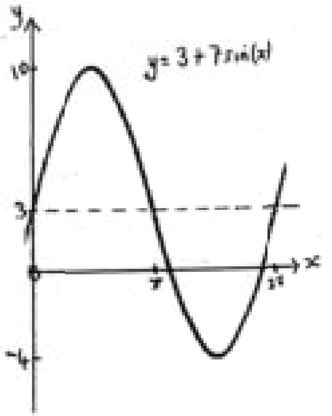
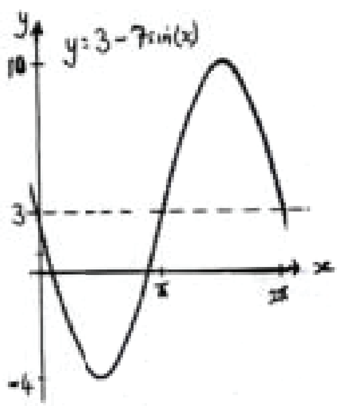
Question	Answer	Marks	Guidance
2(i)	$\frac{4-x}{5}$	**B1**	OE
	Equate a valid attempt at f^{-1} with f, or with x, or f with x $\rightarrow \left(\frac{2}{3}, \frac{2}{3}\right)$ **or** (0.667, 0.667)	**M1, A1**	Equating and an attempt to solve as far $x =$. Both coordinates.
		3	
2(ii)		**B1**	Line $y = 4 - 5x$ – must be straight, through approximately (0,4) and intersecting the positive x axis near (1,0) as shown.
		B1	Line $y = \frac{4-x}{5}$ – must be straight and through approximately (0, 0.8). No need to see intersection with x axis.
		B1	A line through (0,0) and the point of intersection of a pair of straight lines with negative gradients. This line must be at 45° unless scales are different in which case the line must be labelled $y=x$.
		3	

Question	Answer	Marks	Guidance
3(a)	Uses $r = (1.05 \text{ or } 105\%)^{9,\ 10 \text{ or } 11}$	**B1**	Used to multiply repeatedly or in any GP formula.
	New value = 10000×1.05^{10} = ($)16 300	**B1**	
		2	

Question	Answer	Marks	Guidance
3(b)	*EITHER:* $n = 1 \rightarrow 5 \qquad a = 5$	**(B1**	Uses $n = 1$ to find a
	$n = 2 \rightarrow 13$	**B1**	Correct S_n for any other value of n (e.g. $n = 2$)
	$a + (a + d) = 13 \quad \rightarrow d = 3$	**M1 A1)**	Correct method leading to $d =$
	OR: $\left(\frac{n}{2}\right)\left(2a+(n-1)d\right)=\left(\frac{n}{2}\right)(3n+7)$		$\left(\frac{n}{2}\right)$ maybe be ignored
	$\therefore dn + 2a - d = 3n + 7 \rightarrow dn = 3n \rightarrow d = 3$	**(*M1A1**	Method mark awarded for equating terms in n from correct S_n formula.
	$2a - (their\ 3) = 7, \qquad a = 5$	**DM1 A1)**	
		4	

Question	Answer	Marks	Guidance
4(i)	Pythagoras → $r = \sqrt{72}$ OE or $\cos 45 = \frac{6}{r} \to r = \frac{6}{\cos 45} = 6\sqrt{2}$	**M1**	Correct method leading to $r =$
	Arc $DC = \sqrt{72} \times \frac{1}{4}\pi = \frac{3\sqrt{2}}{2}\pi$, 2.12π, 6.66	**M1 A1**	Use of $s=r\theta$ with their r (NOT 6) and $\frac{1}{4}\pi$
		3	
4(ii)	Area of sector-*BDC* is $\frac{1}{2} \times 72 \times \frac{1}{4}\pi$ (= 9π or 28.274…)	***M1**	Use of $\frac{1}{2}r^2\theta$ with their r (NOT 6) and $\frac{1}{4}\pi$
	Area $Q = 9\pi - 18$ (10.274…)	**DM1**	Subtracts their $\frac{1}{2} \times 6 \times 6$ from their $\frac{1}{2}r^2\theta$
	Area P is ($\frac{1}{4}\pi 6^2$ – area Q) = 18	**M1**	Uses {$\frac{1}{4}\pi 6^2$ – (their area Q using $\sqrt{72}$)}
	Ratio is $\frac{18}{9\pi - 18}$ $\left(\frac{18}{10.274}\right) \to 1.75$	**A1**	
		4	

Question	Answer	Marks	Guidance
5(i)	*EITHER:* Uses $\tan^2 2x = \frac{\sin^2 2x}{\cos^2 2x}$	**(M1**	Replaces $\tan^2 2x$ by $\frac{\sin^2 2x}{\cos^2 2x}$ not $\frac{\sin^2}{\cos^2}2x$
	Uses $\sin^2 2x = (1 - \cos^2 2x)$	**M1**	Replaces $\sin^2 2x$ by $(1 - \cos^2 2x)$
	$\rightarrow 2\cos^2 2x + 3\cos 2x + 1 = 0$	**A1)**	AG. All correct
	OR: $\tan^2 2x = \sec^2 2x - 1$	**(M1**	Replaces $\tan^2 2x$ by $\sec^2 2x - 1$
	$\sec^2 2x = \frac{1}{\cos^2 2x}$ Multiply through by $\cos^2 2x$ and rearrange	**M1**	Replaces $\sec^2 2x$ by $\frac{1}{\cos^2 2x}$
	$\rightarrow 2\cos^2 2x + 3\cos 2x + 1 = 0$	**A1)**	AG. All correct
		3	
5(ii)	$\cos 2x = -½, -1$	**M1**	Uses **(i)** to get values for $\cos 2x$. Allow incorrect sign(s).
	$2x = 120°, 240°$ or $2x = 180°1$ $x = 60°$ or $120°$	**A1 A1 FT**	**A1** for 60° or 120° FT for 180−1st answer
	or $x = 90°$	**A1**	Any extra answer(s) in given range only penalise fourth mark so max 3/4.
		4	

Question	Answer	Marks	Guidance
6(a)(i)	$4 = a + ½b$ $3 = a + b$	**M1**	Forming simultaneous equations and eliminating one of the variables – probably a. May still include $\sin\frac{\pi}{2}$ and / or $\sin\frac{\pi}{6}$
	$\rightarrow a = 5,\ b = -2$	**A1 A1**	
		3	
6(a)(ii)	$\text{ff}(x) = a + b\sin(a + b\sin x)$	**M1**	Valid method for ff. Could be f(0) = N followed by f(N) = M.
	$\text{ff}(0) = 5 – 2\sin 5 = 6.92$	**A1**	
6(b)	*EITHER:* $10 = c + d$ *and* $-4 = c – d$ $10 = c – d$ *and* $-4 = c + d$	**(M1**	Either pair of equations stated.
	$c = 3$, $d = 7$, -7 or ±7	**A1 A1)**	Either pair solved ISW **Alternately** c=3 **B1**, range = 14 **M1**→ d = 7, –7 or ±7 **A1**
	OR: 	**(M1 A1 A1)**	Either of these diagrams can be awarded M1.Correct values of c and/or d can be awarded the A1, A1
		3	

Question	Answer	Marks	Guidance
7(i)	$\frac{dy}{dx} = 2x - 4 = 0$		Can use completing the square.
	$\rightarrow x = 2,\ y = 3$	**B1 B1**	
	Midpoint of *AB* is (3, 5)	**B1 FT**	**FT** on (*their* 2, *their* 3) with (4,7)
	$\rightarrow m = \frac{7}{3}$ (or 2.33)	**B1**	
		4	
7(ii)	Simultaneous equations $\rightarrow x^2 - 4x - mx + 9 (= 0)$	***M1**	Equates and sets to 0 must contain *m*
	Use of $b^2 - 4ac \rightarrow (m + 4)^2 - 36$	**DM1**	Any use of $b^2 - 4ac$ on equation set to 0 must contain *m*
	Solves = 0 → −10 or 2	**A1**	Correct end-points.
	$-10 < m < 2$	**A1**	Don't condone $\leqslant$ at either or both end(s). Accept $-10 < m$, $m < 2$.
		4	

Question	Answer	Marks	Guidance
8(i)	$\frac{dy}{dx} = 0$	**M1**	Sets $\frac{dy}{dx}$ to 0 and attempts to solve leading to two values for *x*.
	$x = 1, x = 4$	**A1**	Both values needed
		2	

Question	Answer	Marks	Guidance
8(ii)	$\frac{d^2y}{dx^2} = -2x + 5$	**B1**	
	Using both of their x values in their $\frac{d^2y}{dx^2}$	**M1**	Evidence of any valid method for both points.
	$x = 1 \rightarrow (3) \rightarrow$ Minimum, $x = 4 \rightarrow (-3) \rightarrow$ Maximum	**A1**	
		3	
8(iii)	$y = -\frac{x^3}{3} + \frac{5x^2}{2} - 4x \quad (+c)$	**B2, 1, 0**	$+c$ not needed. –1 each error or omission.
	Uses $x = 6$, $y = 2$ in an integrand to find c $\rightarrow c = 8$	**M1 A1**	Statement of the final equation not required.
		4	

Question	Answer	Marks	Guidance
9(i)	$\overrightarrow{AB} = \begin{pmatrix} 4 \\ 3 \\ 2 \end{pmatrix}$ or $\overrightarrow{BA} = \begin{pmatrix} -4 \\ -3 \\ -2 \end{pmatrix}$	**M1**	Use of **b** – **a** or **a** – **b**
	e.g. $\overrightarrow{AO} . \overrightarrow{AB} = -8 + 6 + 2 = 0 \rightarrow O\hat{A}B = 90°$ AG **OR** $\left\lvert\overrightarrow{OA}\right\rvert = 3, \left\lvert\overrightarrow{OB}\right\rvert = \sqrt{38}, \left\lvert\overrightarrow{AB}\right\rvert = \sqrt{29}$ $OA^2 + AB^2 = OB^2 \rightarrow O\hat{A}B = 90°$ AG	**M1 A1**	Use of dot product with either $\overrightarrow{AO}$ *or* $\overrightarrow{OA}$ *&either* $\overrightarrow{AB}$ *or* $\overrightarrow{BA}$. Must see 3 component products OR Correct use of Pythagoras. In both methods must state angle or $\Theta = 90^{\circ}$ or similar for **A1**
		3	
9(ii)	$\overrightarrow{CB} = \begin{pmatrix} 6 \\ -6 \\ -3 \end{pmatrix}$ or $\overrightarrow{BC} = \begin{pmatrix} -6 \\ 6 \\ 3 \end{pmatrix}$	**B1**	Must correctly identify the vector.
	$\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC}$ (or $-\overrightarrow{CB}$) $= \begin{pmatrix} 0 \\ 7 \\ 4 \end{pmatrix}$	**M1 A1**	Correct link leading to $\overrightarrow{OC}$
		3	

Question	Answer	Marks	Guidance
9(iii)	$\left\|\overrightarrow{OA}\right\| = 3, \left\|\overrightarrow{BC}\right\| = 9, \left\|\overrightarrow{AB}\right\| = \sqrt{29}$ (5.39)	**B1**	For any one of these
	Area = ½(3 + 9) $\sqrt{29}$ or 3 $\sqrt{29}$ + 3 $\sqrt{29}$	**M1**	Correct formula(e) used for trapezium or (rectangle + triangle) or two triangles using their lengths.
	= 6 $\sqrt{29}$ $(1\sqrt{1044}, 2\sqrt{261}$ ***or*** $3\sqrt{116})$	**A1**	Exact answer in correct form.
		3	

Question	Answer	Marks	Guidance
10(i)	$\frac{dy}{dx} = \frac{1}{2} \times (5x-1)^{-\frac{1}{2}} \times 5 \quad (= \frac{5}{6})$	**B1 B1**	**B1** Without × 5 **B1** × 5 of an attempt at differentiation
	m of normal = $-\frac{6}{5}$	**M1**	Uses $m_1m_2 = -1$ with their numeric value from their dy/dx
	Equation of normal $\boldsymbol{y} - 3 = -\frac{6}{5}(\boldsymbol{x} - 2)$ OE or 5y + 6x = 27 or $\boldsymbol{y} = \frac{-6}{5}\boldsymbol{x} + \frac{27}{5}$	**A1**	Unsimplified. Can use $y = mx + c$ to get $c = 5.4$ ISW

Question	Answer	Marks	Guidance
10(ii)	*EITHER:*	**(B1**	Correct expression without ÷5
	For the curve $\left(\int\right)\sqrt{5x-1}\,dx = \dfrac{(5x-1)^{\frac{3}{2}}}{\frac{3}{2}} \div 5$	**B1**	For dividing an attempt at integration of y by 5
	Limits from $\frac{1}{5}$ to 2 used → 3.6 or $\frac{18}{5}$ OE	**M1 A1**	Using $\frac{1}{5}$ and 2 to evaluate an integrand $\left(\text{may be } \int y^2\right)$
	Normal crosses x-axis when $y = 0$, → x= (4½)	**M1**	Uses their equation of normal, NOT tangent
	Area of triangle = 3.75 or $\frac{15}{4}$ OE	**A1**	This can be obtained by integration
	Total area=3.6 + 3.75 = 7.35, $\frac{147}{20}$ OE	**A1)**	
	OR: For the curve: $\left(\int\right)\frac{1}{5}\left(y^2+1\right)dy = \frac{1}{5}\left(\frac{y^3}{3}+y\right)$	**(B2, 1, 0**	–1 each error or omission.
	Limits from 0 to 3 used → 2.4 or $\frac{12}{5}$ OE	**M1 A1**	Using 0 and 3 to evaluate an integrand
	Uses their equation of normal, NOT tangent.	**M1**	Either to find side length for trapezium or attempt at integrating between 0 and 3
	Area of trapezium = $\frac{1}{2}(2+4½)\times 3 = \frac{39}{4} \text{ or } 9\frac{3}{4}$	**A1**	This can be obtained by integration
	Shaded area = $\frac{39}{4}-\frac{12}{5} = 7.35, \frac{147}{20}$ OE	**A1)**	

Question	Answer	Marks	Guidance
		7	