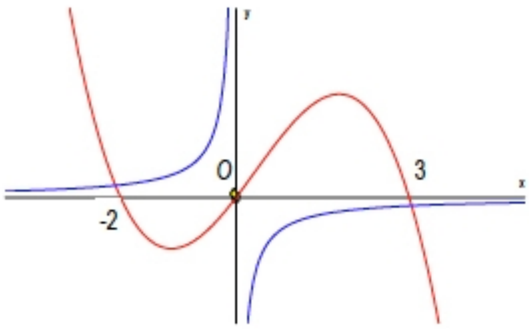
Pure Mathematics 1 Practice Paper J11 MARK SCHEME

Question 1

Question Number	Scheme	Marks
(a)	 (i) correct shape (-ve cubic) Crossing at (-2, 0) Through the origin Crossing at (3,0) (ii) 2 branches in correct quadrants not crossing axes One intersection with cubic on each branch	B1 B1 B1 B1 B1
(b)	"2" solutions Since only "2" intersections	B1ft dB1ft (2) **8**
	Notes	
(b)	B1ft for a value that is compatible with their sketch dB1ft This mark is dependent on the value being compatible with their sketch. For a comment relating the number of solutions to the number of intersections. [Only allow 0, 2 or 4]	

Question 2

Question Number	Scheme	Marks
(a)	$(8-3-k=0)$ so $\underline{k=5}$	B1 (1)
(b)	$2y=3x+k$ $y=\frac{3}{2}x+\ldots$ and so $m=\frac{3}{2}$ o.e.	M1 A1 (2)
(c)	Perpendicular gradient $=-\frac{2}{3}$ Equation of line is: $y-4=-\frac{2}{3}(x-1)$ $\underline{3y+2x-14=0}$ o.e.	B1ft M1A1ft A1 (4)
(d)	$y=0, \Rightarrow B(7,0)$ or $\underline{x=7}$ $\quad x=7$ or $-\frac{c}{a}$	M1A1ft (2)
(e)	$AB^2=(7-1)^2+(4-0)^2$ $AB=\sqrt{52}$ or $2\sqrt{13}$	M1 A1 (2) 11
	Notes	
(b)	M1 for an attempt to rearrange to $y=\ldots$ A1 for clear statement that gradient is 1.5, can be $m=1.5$ o.e.	
(c)	B1ft for using the perpendicular gradient rule correctly on their "1.5" M1 for an attempt at finding the equation of the line through A using their gradient. Allow a sign slip 1^{st} A1ft for a correct equation of the line follow through their changed gradient 2^{nd} A1 as printed or equivalent with integer coefficients – allow $\underline{3y+2x=14}$ or $\underline{3y=14-2x}$	
(d)	M1 for use of $y=0$ to find $x=\ldots$ in their equation A1ft for $x=7$ or $-\frac{c}{a}$	
(e)	M1 for an attempt to find AB or AB^2 A1 for any correct surd form- need not be simplified	

Question 3

Question Number	Scheme		Marks
(a)	$C\left(\frac{-2+8}{2}, \frac{11+1}{2}\right) = C(3, 6)$ **AG**	Correct method (no errors) for finding the mid-point of AB giving $(3, 6)$	B1*
			(1)
(b)	$(8-3)^2+(1-6)^2$ or $\sqrt{(8-3)^2+(1-6)^2}$ or	Applies distance formula in order to find the radius.	M1
	$(-2-3)^2+(11-6)^2$ or $\sqrt{(-2-3)^2+(11-6)^2}$	Correct application of formula.	A1
	$(x-3)^2+(y-6)^2 = 50\left(\text{or } \left(\sqrt{50}\right)^2 \text{ or } \left(5\sqrt{2}\right)^2\right)$	$(x \pm 3)^2 + (y \pm 6)^2 = k$, k is a positive value.	M1
		$(x-3)^2+(y-6)^2 = 50$ (Not 7.07^2)	A1
			(4)
(c)	{For $(10, 7)$, } $\underline{(10-3)^2+(7-6)^2 = 50}$, {so the point lies on C.}		B1
			(1)
(d)	{Gradient of radius} $= \frac{7-6}{10-3}$ or $\frac{1}{7}$	This must be seen in part (d).	B1
	Gradient of tangent $= \frac{-7}{1}$	Using a perpendicular gradient method.	M1
	$y-7 = -7(x-10)$	$y-7 = (\text{their gradient})(x-10)$	M1
	$y = -7x+77$	$y = -7x+77$ or $y = 77-7x$	A1 cao
			(4)
			[10]
	Notes		
(a)	Alternative method: $C\left(-2+\frac{8--2}{2}, 11+\frac{1-11}{2}\right)$ or $C\left(8+\frac{-2-8}{2}, 1+\frac{11-1}{2}\right)$		
(b)	You need to be convinced that the candidate is attempting to work out the radius and not the diameter of the circle to award the first M1. Therefore allow 1st M1 generously for $\frac{(-2-8)^2+(11-1)^2}{2}$ Award 1st M1A1 for $\frac{(-2-8)^2+(11-1)^2}{4}$ or $\frac{\sqrt{(-2-8)^2+(11-1)^2}}{2}$. Correct answer in (b) with no working scores full marks.		
(c)	B1 awarded for correct verification of $\underline{(10-3)^2+(7-6)^2 = 50}$ with no errors. Also to gain this mark candidates need to have the correct equation of the circle either from part (b) or re-attempted in part (c). They cannot verify $(10, 7)$ lies on C without a correct C. Also a candidate could either substitute $x = 10$ in C to find $y = 7$ or substitute $y = 7$ in C to find $x = 10$.		

Question Number	Scheme	Marks
(d)	2nd M1 mark also for the complete method of applying $7 = (\text{their gradient})(10) + c$, finding c. **Note**: Award 2nd M0 in (d) if their numerical gradient is either 0 or ∞. **Alternative:** For first two marks (differentiation): $2(x-3)+2(y-6)\frac{dy}{dx} = 0$ (or equivalent) scores B1. 1st M1 for substituting **both** $x = 10$ and $y = 7$ to find a value for $\frac{dy}{dx}$, which must contain both x and y. (This M mark can be awarded generously, even if the attempted "differentiation" is not "implicit".) **Alternative:** $(10-3)(x-3)+(7-6)(y-6) = 50$ scores B1M1M1 which leads to $y = -7x+77$.	

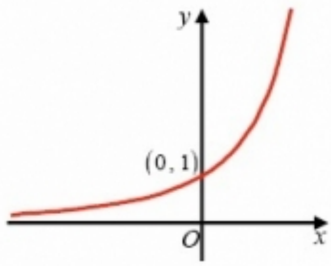
Question 4

(a)	$\left(\dfrac{dy}{dx}=\right)\dfrac{3}{2}x^{2}-\dfrac{27}{2}x^{\frac{1}{2}}-8x^{-2}$	M1A1A1A1 (4)
(b)	$x=4 \ \Rightarrow\ y=\dfrac{1}{2}\times 64-9\times 2^{3}+\dfrac{8}{4}+30$ $= 32 - 72 + 2 + 30 \qquad = \underline{-8}$ *	M1 A1cso (2)
(c)	$x=4 \ \Rightarrow\ y'=\dfrac{3}{2}\times 4^{2}-\dfrac{27}{2}\times 2-\dfrac{8}{16}$ $= 24-27-\dfrac{1}{2}= \qquad -\dfrac{7}{2}$ Gradient of the normal = $-1\div"\frac{7}{2}"$ Equation of normal: $y--8=\dfrac{2}{7}(x-4)$ $\underline{7y-2x+64=0}$	M1 A1 M1 M1A1ft A1 (6) **12**
Question Number	Scheme	Marks
	Notes	
(a)	1^{st} M1 for an attempt to differentiate $x^{n}\rightarrow x^{n-1}$ 1^{st} A1 for one correct term in x 2^{nd} A1 for 2 terms in x correct 3^{rd} A1 for all correct x terms. No 30 term and no $+c$.	
(b)	M1 for substituting $x = 4$ into $y =$ and attempting $4^{\frac{3}{2}}$ A1 note this is a printed answer	
(c)	1^{st} M1 Substitute x = 4 into y' (allow slips) A1 Obtains -3.5 or equivalent 2^{nd} M1 for correct use of the perpendicular gradient rule using their gradient. (May be slip doing the division) Their gradient must have come from y' 3^{rd} M1 for an attempt at equation of tangent or normal at P 2^{nd} A1ft for correct use of their changed gradient to find **normal** at P. Depends on 1^{st}, 2^{nd} and 3^{rd} Ms 3^{rd} A1 for any equivalent form with integer coefficients	

Question 5

Question Number	Scheme		Marks
(a)	$V = 4x(5-x)^2 = 4x(25-10x+x^2)$		
	So, $V = 100x - 40x^2 + 4x^3$	$\pm\alpha x \pm \beta x^2 \pm \gamma x^3$, where $\alpha, \beta, \gamma \neq 0$	M1
		$V = 100x - 40x^2 + 4x^3$	A1
	$\frac{dV}{dx} = 100 - 80x + 12x^2$	At least two of their expanded terms differentiated correctly.	M1
		$100 - 80x + 12x^2$	A1 cao
			(4)
(b)	$100 - 80x + 12x^2 = 0$	Sets their $\frac{dV}{dx}$ from part (a) $= 0$	M1
	$\{\Rightarrow 4(3x^2 - 20x + 25) = 0 \Rightarrow 4(3x-5)(x-5) = 0\}$		
	$\{\text{As } 0 < x < 5\}\ x = \frac{5}{3}$	$x = \frac{5}{3}$ or $x =$ awrt 1.67	A1
	$x = \frac{5}{3},\ V = 4(\frac{5}{3})(5 - \frac{5}{3})^2$	Substitute candidate's value of x **where** $0 < x < 5$ into a formula for V.	dM1
	So, $V = \frac{2000}{27} = 74\frac{2}{27} = 74.074...$	Either $\frac{2000}{27}$ or $74\frac{2}{27}$ or awrt 74.1	A1
			(4)
(c)	$\frac{d^2V}{dx^2} = -80 + 24x$	Differentiates their $\frac{dV}{dx}$ **correctly** to give $\frac{d^2V}{dx^2}$.	M1
	When $x = \frac{5}{3}$, $\frac{d^2V}{dx^2} = -80 + 24\left(\frac{5}{3}\right)$		
	$\frac{d^2V}{dx^2} = -40 < 0 \Rightarrow V$ is a maximum	$\underline{\frac{d^2V}{dx^2} = -40}$ and $\underline{< 0 \text{ or negative}}$ and $\underline{\text{maximum}}$.	A1 cso
			(2) [10]
	Notes		
(a)	1st M1 for a three term cubic in the form $\pm\alpha x \pm \beta x^2 \pm \gamma x^3$. Note that an un-combined $\pm\alpha x \pm \lambda x^2 \pm \mu x^2 \pm \gamma x^3$, $\alpha, \lambda, \mu, \gamma \neq 0$ is fine for the 1st M1. 1st A1 for either $100x - 40x^2 + 4x^3$ or $100x - 20x^2 - 20x^2 + 4x^3$. 2nd M1 for any two of their expanded terms differentiated correctly. NB: If expanded expression is divided by a constant, then the 2nd M1 can be awarded for at least two terms are correct. Note for un-combined $\pm\lambda x^2 \pm \mu x^2$, $\pm 2\lambda x \pm 2\mu x$ counts as one term differentiated correctly. 2nd A1 for $100 - 80x + 12x^2$, **cao**. **Note:** See appendix for those candidates who apply the product rule of differentiation.		

Question 6

Question Number	Scheme	Marks
(a)	Graph of $y = 7^x,\ x \in \mathbb{R}$ and solving $7^{2x} - 4(7^x) + 3 = 0$	
	 At least two of the three criteria correct. **(See notes below.)**	B1
	All three criteria correct. **(See notes below.)**	B1
		(2)
(b)	$y^2 - 4y + 3\{=0\}$ — Forming a quadratic {using $"y" = 7^x$}.	M1
	$y^2 - 4y + 3\{=0\}$	A1
	$\{(y-3)(y-1) = 0$ or $(7^x - 3)(7^x - 1) = 0\}$	
	$y = 3,\ y = 1$ or $7^x = 3,\ 7^x = 1$ — Both $y = 3$ and $y = 1$.	A1
	$\{7^x = 3 \Rightarrow\}\ x\log 7 = \log 3$ or $x = \dfrac{\log 3}{\log 7}$ or $x = \log_7 3$ — A valid method for solving $7^x = k$ where $k > 0,\ k \neq 1$	dM1
	$x = 0.5645....$ — 0.565 or awrt 0.56	A1
	$x = 0$ — $x = 0$ stated as a solution.	B1
		(6)
		[8]

	Notes
(a)	B1B0: Any two of the following three criteria below correct. B1B1: All three criteria correct. Criteria number 1: Correct shape of curve for $x \geq 0$. Criteria number 2: Correct shape of curve for $x < 0$. Criteria number 3: $(0, 1)$ stated or 1 marked on the y-axis. Allow $(1, 0)$ rather than $(0, 1)$ if marked in the "correct" place on the y-axis.

Question Number	Scheme	Marks
(b)	1st M1 is an attempt to form a quadratic equation {using $"y" = 7^x$.} 1st A1 mark is for the correct quadratic equation of $y^2 - 4y + 3\{=0\}$. Can use any variable here, eg: y, x or 7^x. Allow M1A1 for $x^2 - 4x + 3\{=0\}$. Writing $(7^x)^2 - 4(7^x) + 3 = 0$ is also sufficient for M1A1. Award M0A0 for seeing $7^{x^2} - 4(7^x) + 3 = 0$ by itself without seeing $y^2 - 4y + 3\{=0\}$ or $(7^x)^2 - 4(7^x) + 3 = 0$. 1st A1 mark for both $y = 3$ and $y = 1$ or both $7^x = 3$ and $7^x = 1$. Do not give this accuracy mark for both $x = 3$ and $x = 1$, unless these are recovered in later working by candidate applying logarithms on these. Award M1A1A1 for $7^x = 3$ and $7^x = 1$ written down with no earlier working. 3rd dM1 for solving $7^x = k,\ k > 0,\ k \neq 1$ to give either $x\ln 7 = \ln k$ or $x = \dfrac{\ln k}{\ln 7}$ or $x = \log_7 k$. dM1 is dependent upon the award of M1. 2nd A1 for 0.565 or awrt 0.56. B1 is for the solution of $x = 0$, from *any* working.	

Question 7

Question Number	Scheme		Marks
(a)	$\theta = 20 + Ae^{-kt}$ (eqn *)		
	$\{t = 0,\ \theta = 90 \Rightarrow\}$ $90 = 20 + Ae^{-k(0)}$	Substitutes $t = 0$ and $\theta = 90$ into eqn *	M1
	$90 = 20 + A \Rightarrow \underline{A = 70}$	$\underline{A = 70}$	A1
			(2)
(b)	$\theta = 20 + 70e^{-kt}$		
	$\{t = 5,\ \theta = 55 \Rightarrow\}$ $55 = 20 + 70e^{-k(5)}$ $\frac{35}{70} = e^{-5k}$	Substitutes $t = 5$ and $\theta = 55$ into eqn * and rearranges eqn * to make $e^{\pm 5k}$ the subject.	M1
	$\ln\left(\frac{35}{70}\right) = -5k$	Takes 'lns' and proceeds to make '$\pm 5k$' the subject.	dM1
	$-5k = \ln\left(\frac{1}{2}\right)$		
	$-5k = \ln 1 - \ln 2 \Rightarrow -5k = -\ln 2 \Rightarrow \underline{k = \frac{1}{5}\ln 2}$	Convincing proof that $k = \frac{1}{5}\ln 2$	A1 *
			(3)
(c)	$\theta = 20 + 70e^{-\frac{1}{5}t\ln 2}$		
	$\frac{d\theta}{dt} = -\frac{1}{5}\ln 2.(70)e^{-\frac{1}{5}t\ln 2}$	$\pm\alpha e^{-kt}$ where $k = \frac{1}{5}\ln 2$ $-14\ln 2e^{-\frac{1}{5}t\ln 2}$	M1 A1 oe
	When $t = 10$, $\frac{d\theta}{dt} = -14\ln 2e^{-2\ln 2}$		
	$\frac{d\theta}{dt} = -\frac{7}{2}\ln 2 = -2.426015132...$		
	Rate of decrease of $\theta = 2.426\ ^{\circ}C/\text{min}$ (3 dp.)	awrt ± 2.426	A1
			(3) [8]

Question 8

Question Number	Scheme		Marks
(a)	Seeing -1 and 5. (See note below.)		B1 (1)
(b)	$(x+1)(x-5) = \underline{x^2-4x-5}$ or $\underline{x^2-5x+x-5}$		B1
	$\int (x^2-4x-5)\,dx = \frac{x^3}{3} - \frac{4x^2}{2} - 5x\ \{+c\}$	M: $x^n \to x^{n+1}$ for any one term. 1st A1 at least two out of three terms correctly ft.	M1A1ft A1
	$\left[\frac{x^3}{3} - \frac{4x^2}{2} - 5x\right]_{-1}^{5} = (......) - (......)$	Substitutes 5 and -1 (or limits from part(a)) into an "integrated function" and subtracts, either way round.	dM1
	$\left\{\begin{array}{l}\left(\frac{125}{3} - \frac{100}{2} - 25\right) - \left(-\frac{1}{3} - 2 + 5\right)\\ = \left(-\frac{100}{3}\right) - \left(\frac{8}{3}\right) = -36\end{array}\right\}$		
	Hence, Area $= 36$	Final answer must be 36, not -36	A1 (6) [7]
	Notes		
(a)	B1: for -1 and 5. Note that $(-1, 0)$ and $(5, 0)$ are acceptable for B1. Also allow $(0, -1)$ and $(0, 5)$ generously for B1. Note that if a candidate writes down that $A: (5,0)$, $B: (-1,0)$, (ie A and B interchanged,) then B0. Also allow values inserted in the correct position on the x-axis of the graph.		
(b)	B1 for x^2-4x-5 or $x^2-5x+x-5$. If you believe that the candidate is applying the Way 2 method then $-x^2+4x+5$ or $-x^2+5x-x+5$ would then be fine for B1. 1st M1 for an attempt to integrate meaning that $x^n \to x^{n+1}$ for at least one of the terms. Note that $-5 \to 5x$ is sufficient for M1. 1st A1 at least two out of three terms correctly ft from their multiplied out brackets. 2nd A1 for correct integration only and no follow through. Ignore the use of a '$+c$'. Allow 2nd A1 also for $\frac{x^3}{3} - \frac{5x^2}{2} + \frac{x^2}{2} - 5x$. Note that $-\frac{5x^2}{2} + \frac{x^2}{2}$ only counts as one integrated term for the 1st A1 mark. Do not allow any extra terms for the 2nd A1 mark. 2nd M1: Note that this method mark is dependent upon the award of the first M1 mark in part (b). Substitutes 5 and -1 (and not 1 if the candidate has stated $x = -1$ in part (a).) (or the limits the candidate has found from part(a)) into an "integrated function" and subtracts, either way round. 3rd A1: For a final answer of 36, not -36. **Note:** An alternative method exists where the candidate states from the outset that Area $(R) = -\int_{-1}^{5}(x^2-4x+5)\,dx$ is detailed in the Appendix.		

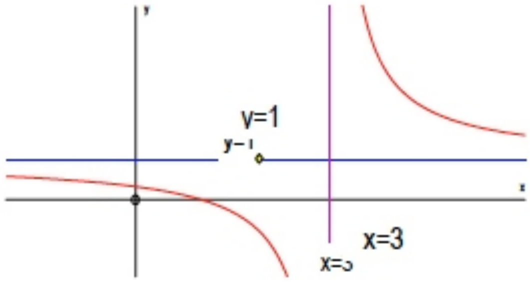
Question Number	Scheme		Marks
Aliter (b) Way 2	$(x+1)(x-5) = \underline{x^2-4x-5}$ or $\underline{x^2-5x+x-5}$	Can be implied by later working.	B1
	$-\int (x^2-4x-5)\,dx = -\frac{x^3}{3} + \frac{4x^2}{2} + 5x\ \{+c\}$	M: $x^n \to x^{n+1}$ for any one term. 1st A1 any two out of three terms correctly ft.	M1A1ft A1
	$\left[-\frac{x^3}{3} + \frac{4x^2}{2} + 5x\right]_{-1}^{5} = (......) - (......)$	Substitutes 5 and -1 (or limits from part(a)) into an "integrated function" and subtracts, either way round.	dM1
	$\left\{\begin{array}{l}\left(-\frac{125}{3} + \frac{100}{2} + 25\right) - \left(\frac{1}{3} + 2 - 5\right)\\ = \left(\frac{100}{3}\right) - \left(-\frac{8}{3}\right)\end{array}\right\}$		
	Hence, Area $= 36$		A1 (6)

Question 9

Question Number	Scheme		Marks
(a)	$3\sin^2 x + 7\sin x = \cos^2 x - 4;\ \ 0 \le x < 360^\circ$		
	$3\sin^2 x + 7\sin x = (1 - \sin^2 x) - 4$		M1
	$4\sin^2 x + 7\sin x + 3 = 0$ **AG**		A1 * cso
			(2)
(b)	$(4\sin x + 3)(\sin x + 1)\ \{= 0\}$	Valid attempt at factorisation and $\sin x = ...$	M1
	$\sin x = -\frac{3}{4},\quad \sin x = -1$	Both $\sin x = -\frac{3}{4}$ and $\sin x = -1$.	A1
	$(\lvert\alpha\rvert = 48.59...)$		
	$x = 180 + 48.59$ or $x = 360 - 48.59$	Either $(180 + \lvert\alpha\rvert)$ or $(360 - \lvert\alpha\rvert)$	dM1
	$x = 228.59...,\ x = 311.41...$	Both awrt 228.6 and awrt 311.4	A1
	$\{\sin x = -1\} \Rightarrow x = 270$	270	B1
			(5)
			[7]

	Notes
(a)	M1 for a correct method to change $\cos^2 x$ into $\sin^2 x$ (must use $\cos^2 x = 1 - \sin^2 x$). Note that applying $\cos^2 x = \sin^2 x - 1$, scores M0. A1 for obtaining the printed answer without error (except for implied use of zero.), although the equation at the end of the proof **must be = 0.** Solution **just** written only as above would score M1A1.
(b)	1st M1 for a valid attempt at factorisation, can use any variable here, s, y, x or $\sin x$, and an attempt to find at least one of the solutions. *Alternatively*, using a correct formula for solving the quadratic. Either the formula must be stated correctly or the correct form must be implied by the substitution. 1st A1 for the two correct values of $\sin x$. If they have used a substitution, a correct value of their s or their y or their x. 2nd M1 for solving $\sin x = -k$, $0 < k < 1$ and realising a solution is either of the form $(180 + \lvert\alpha\rvert)$ or $(360 - \lvert\alpha\rvert)$ where $\alpha = \sin^{-1}(k)$. Note that you **cannot** access this mark from $\sin x = -1 \Rightarrow x = 270$. Note that this mark is dependent upon the 1st M1 mark awarded. 2nd A1 for both awrt 228.6 and awrt 311.4 B1 for 270. If there are any EXTRA solutions inside the range $0 \le x < 360^\circ$ and the candidate would otherwise score FULL MARKS then withhold the final bA2 mark (the fourth mark in this part of the question). Also ignore EXTRA solutions outside the range $0 \le x < 360^\circ$. **Working in Radians:** Note the answers in radians are $x = 3.9896...,\ 5.4351...,\ 4.7123...$ If a candidate works in radians then mark part (b) as above awarding the 2nd A1 for both awrt 4.0 and awrt 5.4 and the B1 for awrt 4.7 or $\frac{3\pi}{2}$. If the candidate would then score FULL MARKS then withhold the final bA2 mark (the fourth mark in this part of the question.) **No working:** Award B1 for 270 seen without any working. Award M0A0M1A1 for awrt 228.6 and awrt 311.4 seen without any working. Award M0A0M1A0 for any one of awrt 228.6 or awrt 311.4 seen without any working.

Question 10

Question Number	Scheme	Marks
(a)	 Correct shape with a single crossing of each axis $y = 1$ labelled or stated $x = 3$ labelled or stated	B1 B1 B1 (3)
(b)	Horizontal translation so crosses the x-axis at $(1, 0)$ New equation is $(y=)\dfrac{x\pm1}{(x\pm1)-2}$ When $x = 0$ $y =$ $=\dfrac{1}{3}$	B1 M1 M1 A1 (4) **7**
	Notes	
(b)	B1 for point (1,0) identified - this may be marked on the sketch as 1 on x axis. Accept $x = 1$. 1st M1 for attempt at new equation and either numerator or denominator correct 2nd M1 for setting $x = 0$ in their new equation and solving as far as $y = \ldots$ A1 for $\frac{1}{3}$ or exact equivalent. Must see $y = \frac{1}{3}$ or $(0, \frac{1}{3})$ or point marked on y-axis. **Alternative** $f(-1) = \dfrac{-1}{-1-2} = \dfrac{1}{3}$ scores M1M1A0 unless $x = 0$ is seen or they write the point as $(0, \frac{1}{3})$ or give $y = 1/3$ Answers only: $x = 1$, $y = 1/3$ is full marks as is $(1,0)$ $(0, 1/3)$ Just 1 and 1/3 is B0 M1 M1 A0 Special case : Translates 1 unit to left (a) B0, B1, B0 (b) Mark (b) as before May score B0 M1 M1 A0 so 3/7 or may ignore sketch and start again scoring full marks for this part.	

Question 11

(i) 50% of 25 000 is 12 500 and the population [in 2005] is 12 000 [so consistent]	**B1**	or 12 000 is 48% of 25 000 so less than 50%[so consistent]	
(ii) $\log_{10} P = \log_{10} a - kt$ or $\log_{10} \frac{P}{a} = -kt$ o.e. www	**B2**	condone omission of base; **M1** for $\log_{10} P = \log_{10} a + \log_{10} 10^{-kt}$ or better www	
(iii) 4.27, 4.21, 4.13, 4.08 plots ruled line of best fit drawn	**B1** **B1** **B1**	accept 4.273…, 4.2108…, 4.130…, 4.079… rounded to 2 or more dp 1 mm tolerance ft their values if at least 4 correct values are correctly plotted	f.t. if at least two calculated values correct must have at least one point on or above and at least one point on or below the line and must cover $0 \le t \le 25$
(iv) $a = 25000$ to 25400 $0.01 \le k \le 0.014$ $P = a \times 10^{-kt}$ or $P = 10^{\log a - kt}$ with values in acceptable ranges	**B1** **B2** **B1**	allow $10^{4.4..}$ **M1** for $-k = \frac{\Delta y}{\Delta x}$ using values from table or graph; condone $+k$ **B0** if left in logarithmic form	**M1** for a correct first step in solving a pair of valid equations in either form **A1** for k **A1** for a **A1** for $P = a \times 10^{-kt}$
(v) $P = a \times 10^{-35k}$ 8600 to 9000 comparing their value with 9375 o.e. and reaching the correct conclusion for their value	**M1** **A1** **A1**	T heir a and k f.t.	allow $\log P = \log a - 35k$