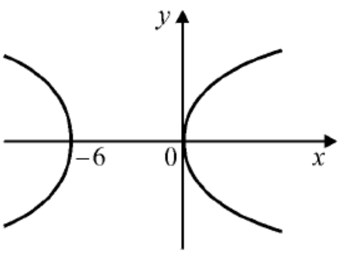
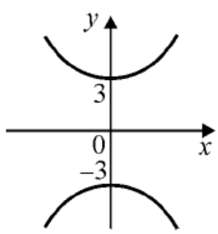
Further Pure 1 Past Paper Questions Pack B: Mark Scheme

Taken from MBP1, MBP3, MBP4, MBP5

Parabolas, Ellipses and Hyperbolas

Pure 3 January 2002

1(a)	G1	B1	1	
(b)(i)		M1 A1√	2	Idea of translation to left (ft their graph) Correct intercepts marked
(ii)		M1 A1	2	√ reflected in $y = x$ Correct with intercepts marked on y - axis
	Total		**5**	

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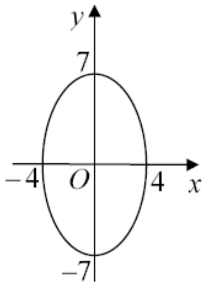
3(a)		M1 A1 B1	 3	Ellipse Symmetrical with major axis in y-direction Intercepts 4 and 7
(b)	One way stretch in x-direction Scale factor $\frac{1}{2}$ Translation in y-direction 3 units	M1 A1 M1 A1	 4	$\begin{bmatrix} 0 \\ 3 \end{bmatrix}$
	Total		**7**	

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2(a)	$\subset$ - shaped parabola Vertex at O, good sketch, symmetry obvious	M1 A1	 2	 *Essentially* all correct
(b)	$x^2 = 8y$ or equivalent	M1 A1	2	M1 for general idea
(c)	Translation; by vector $\begin{bmatrix} 2 \\ 0 \end{bmatrix}$	M1 A1	2	**sc**: B1 for correct description without "translation"
	Total		**6**	

Rational Functions and Asymptotes

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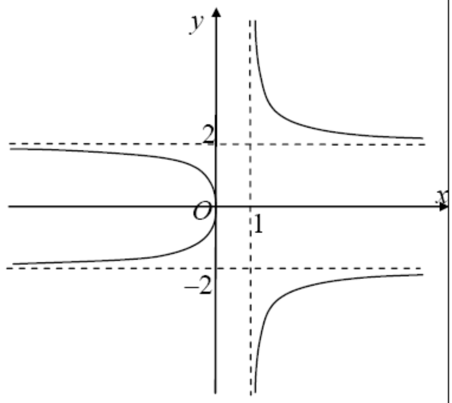
3(a)	$a = 4$ and $b = 1$	B1 B1	2	
(b)	Asymptotes $x = 1$, $y = 2$, $y = -2$ Graph: Correct for $y > 0$ Symmetry in x-axis All correct 	B1 B1 B1 B1 B1	5	One correct; second correct Or B1 for each correct region E.g. 4/5 for all correct graph but with asymptotes $x = 1, y = \pm 4$
	Total		**7**	

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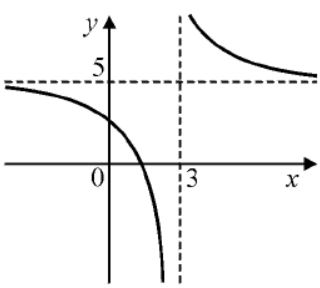
3(a)	 $y = 5$ $x = 3$ $\left(\frac{7}{5}, 0\right)$ and $\left(0, \frac{7}{3}\right)$	M1 A1 B1 B1 B1	5	Rectangular hyperbola, one branch Good sketch Asymptotes equations stated Allow single B1 if values only shown on graph (no equations stated). Condone as values marked on graph
(b)	$x > 3$ $x < \frac{7}{5}$	B1 B1	2	

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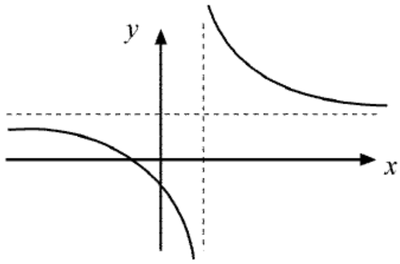
2(a)	$(0,-2)$ accept $x=0$, $y=-2$	B1		
	$\left(-\frac{4}{3},0\right)$ accept $y=0$, $x=-\frac{4}{3}$	B1		
	Asymptotes $x=2$	B1		'x asymptote is 2, y asymptote is 3' - allow B1 only
	$y=3$	B1		$x\to 2, y\to 3$ B1 only
		M1 A1√	6	One branch of hyperbola ft asymptotes
(b)	Appropriate method	M1		Multiply both sides by $(x-2)^2$
	Consideration of graph $y=1 \Rightarrow 3x+4=x-2$ $\Rightarrow x=-3$			$\frac{3x+4}{x-2}-1>0$ Considering $(x–2)>0$ and $(x–2)<0$ $3(x+4)>(x–2) \Rightarrow x>-3$ only M0
	Solution: $x<-3$	A1		
	$x>2$	A1	3	
	Total		**9**	

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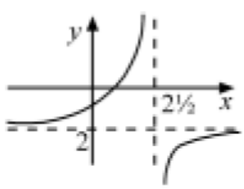
Q	Solution	Marks	Total	Comments
1(a)	$(0,-\frac{3}{5})$ accept $x=0$, $y=-\frac{3}{5}$	B1		
	$\frac{3}{4},0$ accept $y=0$, $x=\frac{3}{4}$	B1		
	Asymptotes $x=2\frac{1}{2}$	B1		
	$y=-2$	B1		
		M1		One branch of hyperbola
		A1√	6	ft asymptotes Condone lack of symmetry to show second branch
(b)	Appropriate method			Multiply both sides by $(2x-5)^2$
	Consideration of graph	M1		Considering $(2x–5)>0$ and $(2x–5)<0$
	$y=0 \Rightarrow 3-4x=0 \Rightarrow x=\frac{3}{4}$			$3–4x<0 \Rightarrow x>\frac{3}{4}$ scores M0
	Solution: $x<\frac{3}{4}$	A1		
	$x>2\frac{1}{2}$	B1	3	
	Total		**9**	

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7(a)	{Vert. Asym….} $x = 2$ $x = 1.5$ {Horiz. Asym….} $y = 1.5$	B1 B1 B1	3	sc If 0/3 give B1 for all three values seen
(b)(i)	$(2x-3)(x-2) = 2x^2 - 7x + 6$	B1		Can be gained in part (a) or (b)(i)
	$(2y-3)x^2 + (9-7y)x + 6y - 7$ {=0}	M1 A1		Attempt to form quadratic in x Correct quadratic in x
	$\Delta = (9-7y)^2 - 4(2y-3)(6y-7)$	m1		Considers $b^2 - 4ac$
	…. $y^2 + 2y - 3$	A1		
	….. $(y+3)(y-1)$	m1		Attempt to factorise or solve
	For real x, $\Delta \geq 0 \Rightarrow y \geq 1$ or $y \leq -3$ $\Rightarrow$ no real values of x for which $-3<y<1$	A1	7	**ag**
(b)(ii)	$y = 1 \Rightarrow -x^2 + 2x - 1 = 0 \Rightarrow x = 1$ $y = -3 \Rightarrow -9x^2 + 30x - 25 = 0 \Rightarrow x = 5/3$	M1 m1		For subst $y = 1$ or $y = -3$ to form a valid quadratic in x For a good attempt to solve a quadratic equation in x
	Turning points are (1,1) and (5/3, −3)	A2,1	4	Allow A1 for one point correct sc If method implied by 'hence' not used then max 2/4 B2 for (1, 1) and (5/3, −3) B1 for any 2 of these 4 coordinates
	Total		**14**	

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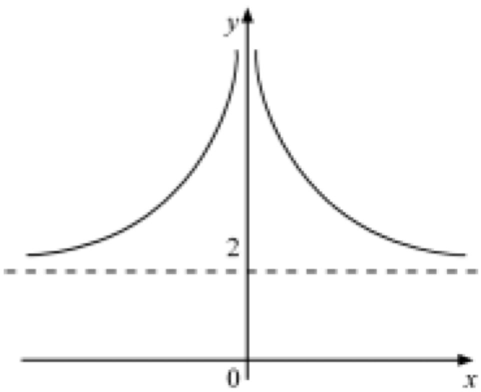
2(a)	Asymptote $x = 0$ Asymptote $y = 2$	B1 B1	2	
(b)		B2	2	Fully correct shape with horizontal asymptote clearly above the x-axis (B1 if either only 1 branch correctly drawn or correct shape with horizontal asymptote the x-axis)
	Total		**4**	

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3	$x^2 - 2yx + 2 - y \ (=0)$	M1 A1		Attempt to form quadratic in x with y involved Condone one sign error.
	$\Delta = (-2y)^2 - 4(1)(2-y)$	m1		Consider b^2-4ac with y involved and no x's.
	.... $4(y^2+y-2)$ ..... $4(y+2)(y-1)$	A1 m1		oe eg '4' can be missing if linking 0 Attempt to factorise or solve a quadratic in y only
	For real x, $\Delta \geq 0 \Rightarrow y \geq 1$ or $y \leq -2$ $\Rightarrow$ no real values of x for which $-2<y<1$	A1	6	cao. Need b^2-4ac linked to an inequality **ag** Only award if no previous errors
	Total		**6**	

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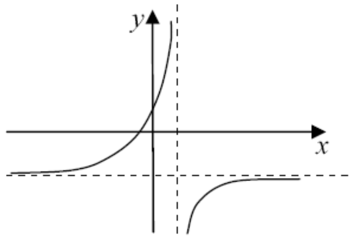
2(a)(i)	(0,4) and $\left(-\frac{4}{3}, 0\right)$	B1 B1	2	
(ii)	Asymptote at $x = \frac{1}{2}$ and at $y = -1\frac{1}{2}$	B1 B1	2	
(iii)		M1 A1	2	One branch roughly correct Good graph
(b)	$3x + 4 = 1 - 2x \quad \Rightarrow 5x = -3$ $\Rightarrow x = -\frac{3}{5}$	M1 A1	2	
(c)	Use of value from (b) $\Rightarrow x \leq -\frac{3}{5}$ Also $x > \frac{1}{2}$	M1 A1 B1	3	If algebraic method – must be sound eg simply multiplying up to give $3x + 4 \leq 1 - 2x \Rightarrow$ M0
	Total		**11**	

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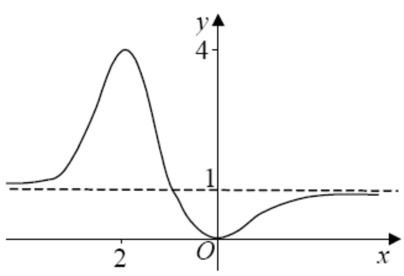
5(a)	$y = 1$	B1	1	Must be the equation
(b)(i)	$(y-1)x^2 + 3yx + 3y \quad \{=0\}$	M1 A1		Attempt to form quadratic in x Correct quadratic in x
	$\Delta = (3y)^2 - 4(y-1)(3y)$	m1		Considers b^2–$4ac$
	…. $-3y^2+12y$	A1		
	….. $-3y\ (y-4)$	m1		Attempt to factorise or solve
	For real x, $\Delta \geq 0 \Rightarrow 0 \leq y \leq 4$	A1	6	**ag** cso
(ii)	$y = 4 \Rightarrow 3x^2 + 12x + 12 = 0$	M1		Substitute $y = 4$ to form a 'valid' quadratic in x. (PI)
	$\Rightarrow x = -2$, turning point (-2, 4)	A1		If not using 'hence' then (-2, 4) is B1 max.
	$\{y = 0 \Rightarrow -x^2 = 0 \Rightarrow x = 0\}$			
	Turning point (0,0)	B1	3	
(c)		B3,2,1	3	B1 for shape B1 for origin as only point where graph meets the axes B1 for correct behaviour at the 'end-points'
	Total		**13**	

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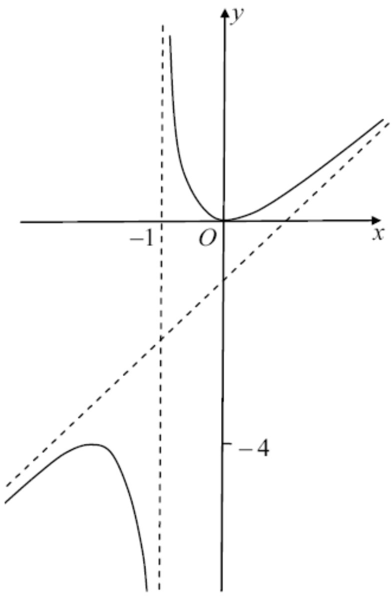
5(a)	Asymptote $x = -1$	B1		
	$y = x - 1 + \frac{1}{x+1}$	M1		Full attempt to divide out
	Asymptote $y = x - 1$	A1	3	
(b)	Turning point (0,0)	B1		**Alternative** Valid method to find $y'(x)$
	When $y = -4$, $x^2 + 4x + 4 = 0$	M1		and then puts $y'(x) = 0$ [M1]
	Turning point (–2, –4)	A1	3	$x^2 + 2x = 0 \Rightarrow$ TPs (0,0) [A1] and (–2, –4) [A1]
(c)		B1		Single upper branch; shape and y not < 0
		B1		Single lower branch; shape and y not > – 4
		B1	3	Dependent on previous two Bs. Asymptotic behaviour on both branches; through the origin
	Total		**9**	

Complex Numbers

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4(a)	$z^2 = 4 - 12 - 8\sqrt{3}\mathrm{i}$	M1		3 terms or $-8 + k\mathrm{i}$
	$= -8 - 8\sqrt{3}\mathrm{i}$	A1		
	$4z = -8 + 8\sqrt{3}\mathrm{i}$			
	$\Rightarrow z^2 + 4z = -16$ oe	A1√	3	Answer is real **or** imaginary part shown to be zero ft provided it is real number

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6(a)(i)	– 5 + 12 i	M1 A1	2	
(ii)	Squaring their answer to (i) or use of the binomial theorem: – 119 – 120 i	M1 A1√	2	ft

Roots of Quadratic Equations

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9(a)(i)	$\alpha+\beta=-4;\alpha\beta=13$	B1		
	$\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$	M1		or $(\alpha+\beta)(\alpha^2-\alpha\beta+\beta^2)$ good attempt, correct in terms of $\alpha+\beta$ and $\alpha\beta$
	$=-64+156 \quad =92$	A1 A1	4	
(ii)	$\frac{\alpha}{\beta^2}+\frac{\beta}{\alpha^2}=\frac{\alpha^3+\beta^3}{(\alpha\beta)^2}$	M1		
	$=\frac{92}{169}$	A1√	2	ft 'their' $\alpha^3+\beta^3$
(b)	product of roots $=\frac{1}{\alpha\beta} \quad = \frac{1}{13}$	B1		
	$x^2-\frac{92}{169}x+\frac{1}{13}=0$	M1		their values – any variable
	$169x^2-92x+13=0$	A1	3	
(c)	$(x+2)^2=-9$ $x+2=\pm 3\text{i}$	M1 M1		or use of formula dealing with $\sqrt{-36}$
	Total		**12**	

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1(a)(i)	$\alpha+\beta=-4;\qquad \alpha\beta=-3$	B1		Likely to be earned in (ii)
	$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$	M1		oe
	$=16+6=22$	A1		
(ii)	$\alpha^2\beta^2+2(\alpha+\beta)+\dfrac{4}{\alpha\beta}$	B1		
	$9-8-\dfrac{4}{3}$	M1		Substitution into similar form as above
	$=-\dfrac{1}{3}$	A1	6	
(b)	Sum of roots $=\alpha^2+\beta^2+\dfrac{2}{\alpha}+\dfrac{2}{\beta}$			
	$=\alpha^2+\beta^2+\dfrac{2}{\alpha\beta}(\alpha+\beta)$	M1		
	$=22+\dfrac{2}{-3}\times-4\quad=\dfrac{74}{3}$	A1		
	New equation $y^2-(\text{sum of new roots})\,y+\text{product}=0$	M1		
	$\Rightarrow y^2-\dfrac{74}{3}y-\dfrac{1}{3}=0$			
	$\Rightarrow 3y^2-74y-1=0$	A1ft	4	(ft any variable fractional values) Must have = 0
	Total		**10**	

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7(a)	$\alpha+\beta=-3; \qquad \alpha\beta=-2$	B1	1	
(b)(i)	$\dfrac{\alpha^2+\beta^2}{\alpha^2\beta^2} \qquad =\dfrac{(\alpha+\beta)^2-2\alpha\beta}{\alpha^2\beta^2}$	M1 m1		
	$=\dfrac{13}{4}$	A1√	3	ft their (a) values
(ii)	$\alpha\beta-\dfrac{3}{\alpha}-\dfrac{3}{\beta}+\dfrac{9}{\alpha^2\beta^2}$	M1		Good attempt at multiplying out
	$=\alpha\beta-\dfrac{3(\alpha+\beta)}{\alpha\beta}+\dfrac{9}{\alpha^2\beta^2}$	m1		In a form ready for substitution
	$=-\dfrac{17}{4}$	A1√	3	ft their (a) values
(c)	Sum of roots			
	$=\alpha+\beta-3\left(\dfrac{1}{\alpha^2}+\dfrac{1}{\beta^2}\right)$	M1		
	$=-3-\dfrac{39}{4}= -\dfrac{51}{4}$	A1		
	New equation			Condone single sign error or missing $=0$
	$y^2-(\text{sum of new roots})\,y+\text{product}=0$	M1		$\Rightarrow y^2+\dfrac{51}{4}y-\dfrac{17}{4}=0$
	$\Rightarrow 4y^2+51y-17=0$	A1	4	Must have $=0$
	Total		**11**	

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9(a)(i)	$\alpha+\beta=3;\quad \alpha\beta=1$	B1		Withhold if obviously incorrect in (ii)
	$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$	M1		
	$=9-2=7$	A1	3	**ag** However, condone $(-3)^2$
(ii)	$\alpha^3+\beta^3=(\alpha+\beta)(\alpha^2-\alpha\beta+\beta^2)$	M1 A1		Good attempt at any equivalent Correct formula
	$=18$	A1	3	
(b)(i)	$(\alpha^2+\beta^2)^2=\alpha^4+2\alpha^2\beta^2+\beta^4$			
	$\Rightarrow \alpha^4+\beta^4=(\alpha^2+\beta^2)^2-2(\alpha\beta)^2$	B1	1	**ag** Be generous here.
(ii)	$\alpha^4+\beta^4=49-2$ $=47$	M1 A1	2	Substitute candidate's $\alpha\beta$
(c)	Sum of roots $=\alpha^3+\beta^3-(\alpha+\beta)$ $=15$	M1 A1		
	Product $=(\alpha\beta)^3+\alpha\beta-(\alpha^4+\beta^4)$ $=1+1-47=\ -45$	M1 A1		Condone one slip
	New equation $y^2-15y-45=0$	B1√	5	ft any variable, integer coefficients Must have = 0
	Total		**14**	

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1(a)(i)	$\alpha+\beta=-2,\quad \alpha\beta=3$	B1 B1	2	
(ii)	$(\alpha+\beta)^3-3\,\alpha\beta\,(\alpha+\beta)$	M1 A1		Or $(\alpha+\beta)(\alpha^2-\alpha\beta+\beta^2)$ & $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$
	$\Rightarrow \alpha^3+\beta^3=10$	A1	3	**ag**
(iii)	$\dfrac{\alpha^3+\beta^3}{(\alpha\beta)^3}=\dfrac{10}{27}$	M1 A1	2	
(b)	New product of roots $=\dfrac{1}{(\alpha\beta)^3}=\dfrac{1}{27}$	B1		
	x^2 – [cand's (a) (iii)] x + [cand's product]	M1		
	$\Rightarrow\quad 27x^2-10x+1=0$	A1√	3	ft Must have integer coefficients and be an equation
	Total		**10**	

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3(a)(i)	$\alpha+\beta=-(7+p)$	B1		
	$\alpha\beta=p$	B1	2	
(b)	$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$	M1		
	$=\ (7+p)^2-2p$	A1	2	oe $p^2+12p+49$
(c)(i)	$(\alpha-\beta)^2=\alpha^2+\beta^2-2\alpha\beta$	M1		
	$=p^2+12p+49-2p=p^2+10p+49$	A1	2	**ag**
(ii)	$(\alpha-\beta)^2=25$	B1		
	$p^2+10p+49=25\quad\Rightarrow p^2+10p+24=0$	M1		May be using 5 etc instead of 25
	$p=-4,\ p=-6$	A1	3	
	Total		**9**	

Series

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3(a)(i)	25 502 500	B1	1	
(ii)	Attempt to find $S_{100} - S_{50}$ using $\sum r^3$ $=$ 23 876 875	M1 A1	2	Formula in booklet. Condone $S_{100} - \begin{cases} S_{51} \\ S_{49} \end{cases}$
(b)	$S_n = \frac{1}{2}n(2a+(n-1)d)$ formula attempted (condone one slip)	M1		**Or** $\dfrac{n(\text{first}+\text{last})}{2}$ attempted **Or** $S_{100} - S_{50/\ 51/\ 49}$ using $\sum r = \frac{1}{2}n(n+1)$
	correct values substituted, candidate's 25 (51+100)	m1		**Or** candidate's $50\times101-25\times51$
	$=$ 3775	A1	3	**sc** B3 for correct answer without working **sc** B2 for correct answer without working
(c)	Use of (a)(ii) – 6325 (b) $=$ 0	M1 A1	2	
	Total		**8**	

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6 (a)	Use of $\dfrac{n}{6}(n+1)(2n+1)$	M1		$\dfrac{29}{6}\times30\times59$
	$= 8\ 555$	A1	2	
(b) (i)	common difference, $d = 4$	B1		
	Use of $a+(r-1)d$	M1		Condone $a+(n-1)d$
	$u_r = 4r-1$	A1	3	Condone $4n-1$
(ii)	Upper limit 200 and lower limit 1 on $\sum$	B1		Or equivalent
	$\sum_{r=1}^{200} 4r-1$	B1√	2	ft their u_r (ignore limits) Two B marks are independent
	Total		**7**	

Calculus

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(d) (i)	$y(1+h) = 1+2h+h^2-6-6h+10$	M1		Subs $1+h$ and attempt to multiply out
	Gradient $= \dfrac{y(1+h)-y(1)}{h}$	m1		$y(1) = 5$
	$= \dfrac{h^2-4h}{h} = h-4$	A1	3	**ag**
(ii)	As $h \to 0$, gradient at $P = -4$	B1	1	Must use limit and not calculus rule

Linear Laws

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6(a)	$\ln E = \ln K + \alpha \ln B$	B1	1	
(b)	$\ln B$ 1.151 2.258 2.907			3.367 3.723
	$\ln E$ 0 0.693 1.099	B2 (−1 ee)		1.386 1.609
	plotting points – roughly correct	M1	3	
(c)	straight line of reasonable fit	B1	1	
(d)(i)	$B = 25.5 \Rightarrow \ln B = 3.2387$	M1		
	From graph $\ln E \approx 1.31$	M1		
	$\Rightarrow E = 3.7$	A1	3	Condone 3.6 to 3.8
(ii)	gradient = $\alpha = \dfrac{\Delta \ln E}{\Delta \ln B}$	M1		
	$= \dfrac{1.792}{2.865} \approx 0.63$	A1		Condone 0.62 to 0.64
	Intercept used/or 2 points	M1		full attempt to find k
	$k \approx 0.48 / 0.49$	A1	4	
	Total		**12**	

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5(a)	ln 1.43 = 0.358…	M1		
	From graph $\ln P$ = 2.4…	m1		Expected in range 2.43 to 2.45
	Hence P = 11.4/5/6	A1	3	Follow through their values within range
(b)(i)	$\ln P = \ln k + \alpha \ln x$	B1	1	
(ii)	$\ln k$ is intercept on vertical axis	M1		$\ln k = 1.9$ (or use of formula)
	$k = 6.7$ (to 2 SF)	A1		
	Gradient of graph gives α	M1		M0 if further wrong calculation using exponentials
	$\alpha = 1.5$(to 2 SF)	A1	4	
	Total		**8**	

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7(a)	2.52 $N = 10^{2.52}$ $= 331$	B1 M1 A1	3	Seen (even if log of this value taken) Accept 300 or 330 following correct logs
(b)(i)	$\log_{10} N = \log_{10} a + t \log_{10} b$	B2	2	B1 if ln used or $\log_{10} b^t$ not simplified
(ii)	$\log_{10} a$ is intercept on $\log_{10} N$ axis $a = 251$ Gradient is $\log_{10} b = \frac{0.12}{5}$ etc $b = 1.06$	M1 A1 M1 A1	4	$\log_{10} a = 2.4$ Must be 3sf or better Must be 3sf or better May score M1 for setting up 2 equations M1 for solving one or two equations A2, 1 for correct answers
(c)	Growth limited by test tube; some die etc	E1	1	
	Total		**10**	

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5(a)	$\ln Q = \ln a + b \ln x$	B1	1	
(b)(i)	$\ln x$: –0.92 –0.69 –0.51 –0.36 –0.22 $\ln Q$: 0.54 1.11 1.56 1.94 2.28 Points plotted on graph provided	B1 B1 B1	3	Most correct At most one error Reasonably accurately
(ii)	"Good" line of best fit drawn	B1	1	
(c)(i)	$\ln Q = 1.29 - 1.30 \Rightarrow Q \approx 3.6 - 3.7$	M1 A1	2	
(ii)	Method for finding gradient: $b = 2.5$ Reading off y-intercept: $\ln a \approx 2.8$ $a = 16 - 17$	M1 A1 M1 A1	4	± 0.1 Give M marks for simultaneous equations approach
	Total		**11**	

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6(a)	ln3 = 1.0986... $\ln y = 1.33$ $y = 3.8$	M1 m1 A1	3	 Condone 1.30 to 1.35 Accept 3.7 to 3.9
(b)(i)	$\ln y = \ln A + n \ln x$	B1	1	
(ii)	$\ln A = 0.80$ (intercept on ln y-axis) $A = 2.2$ n = gradient of line $= 0.48$	M1 A1 M1 A1	4	 Condone value rounding to this Accept value rounding to 0.47, 0.48 or 0.49
	Total		**8**	

Numerical Methods

Pure 4 January 2002

2(a)	$\mathrm{p}\left(-\frac{1}{2}\right)=4\left(-\frac{1}{8}\right)-5\left(\frac{1}{4}\right)+2$	M1		must attempt $\mathrm{p}\left(-\frac{1}{2}\right)$ or long division to remainder.
	$=0.25 \Rightarrow \text{Remainder}=0.25$	A1	2	
(b)	$\mathrm{p}'(x)=12x^2-10x$	B1		denominator 8 may imply B1
	$-0.5-\mathrm{p}(-0.5)/\mathrm{p}'(-0.5)$	M1		
	$=-0.5-\frac{0.25}{8}=-0.531$	A1	3	condone more sf
	Total		**5**	

Pure 4 January 2003

2(a)	$x\ln 2=\ln 7$	M1		May use $\log_{10}$
	$\Rightarrow x=2.81$	A1	2	2.80735… Accept more than 3 SF
(b) (i)	$\mathrm{f}(x)=2^x-7+x$;			
	f(2.0) = –1 ; f(2.4) = 0.678…			
	⇒ root lies in interval (2.0, 2.4)	B1	1	Or equivalent considering both sides but must contain a valid conclusion
(ii)	Considering f(2.2) **first** f(2.2) = –0.2052…	M1		M0 if bisection method NOT used
	⇒ root lies in interval (2.2, 2.4) f(2.3) = 0.224…	A1		
	⇒ root lies in interval (2.2, 2.3)	A1	3	SC1 if correct interval given but bisection method not used
	Total		**6**	

Pure 4 June 2003

5(a)(i)	$\frac{dy}{dx}=2+2\cos 2x$	M1 A1	2	$k\cos 2x$ or $k\cos x$ correct derivative
(ii)	$0.2-\frac{y(0.2)}{y'(0.2)}$	M1		Used, since formula in booklet
	= 0.255 to 3 sig figs	A1	2	Must be to 3sf

Pure 4 June 2004

4(a)	p(3) = 27 – 54 + 36 – 11	M1		Must consider p(3) or full long division to remainder
	= –2 (is remainder)	A1	2	
(b)(i)	p(4) = 64 – 96 + 48 – 11 = 5			
	[Change of sign] $\Rightarrow \alpha$ lies between 3 and 4	B1	1	Both p(3) and p(4) must be correct and there must be some statement/conclusion
(ii)	p(3.5) used first (=0.375)	M1		$\Rightarrow$ root lies between 3 and 3.5
	p(3.25) = –1.046875	m1		
	$\Rightarrow$ root lies between 3.25 and 3.5	B1	3	

Matrix Transformations

Pure 3 January 2002

2(a)	Shear invariant line $y = 0$	M1		
	mapping (0, 1) to (1,1) **o.e**	A1	2	
(b)	$A^2 = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$	M1		
	$A^3 = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$	A1	2	
	Total		**4**	

Pure 3 January 2003

2(a)	$M^2 = \begin{bmatrix} -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & -\frac{1}{2} \end{bmatrix}$	M1 A1		Attempt to multiply matrices correctly Correct
	$M^3 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	A1	3	
(b)	Rotation (about origin)	M1		
	through $\frac{2\pi}{3}$ (anticlockwise)	A1	2	Or equivalent clockwise turn
	Total		**5**	