1. (a) $2x = \ln 9$ M1

$x = \frac{1}{2}\ln 9$ OR $x = \ln 3$ A1

$4 - y = e^2$ M1

$y = 4 - e^2$ A1

$\ln 3t = \ln 12$ OR $\ln t = \ln 4$ M1

$t = 4$ A1

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2. (a) $f(x) = e^{3x} - x - 20$ OR $f(x) = x + 20 - e^{3x}$

$f(1) = \mp 0.914$

OR $f(2) = \pm 381.42$ M1

dep on both

COMMENT ABOUT CHANGE OF SIGN & EXISTENCE OF ROOT E1

b) $x_1 = 1.0227$ A1

$x_2 = 1.0152$ A1

$x_3 = 1.0151$ A1

c) $f(x) = e^{3x} - x - 20$ OR $f(x) = x + 20 - e^{3x}$ B1

(MAY APPEAR IN PART a)

$f(1.01505) = \mp 0.0019$

$f(1.01515) = \pm 0.0043$ BOTH M1

CHANGE OF SIGN $0.01505 < \alpha < 0.01515$ ETC.... E1

3. (a) $R\cos x\cos\alpha + R\sin x\sin\alpha$ M1

$R\cos\alpha = \sqrt{3}$ OR $R\sin\alpha = 1$ A1

$R = 2$ B1 c.a.o

$\alpha = \frac{\pi}{6}$ A1 c.a.o

b)

	MIN	MAX
$f(x)$	-2	2
$(f(x))^2$	0	4
$\frac{1}{5+f(x)}$	$\frac{1}{7}$	$\frac{1}{3}$

B6 ft from their R

e.g. $\begin{pmatrix} -R & R \\ 0 & R^2 \\ \frac{1}{5+R} & \frac{1}{5-R} \end{pmatrix}$

4. a) FACTORIZES EITHER DENOMINATOR B1

$(2x+3)(x-2)$ OR $(x-2)(x+1)$

CANCELS $2x+3$ M1

$\frac{x(x+1)-6}{(x-2)(x+1)}$ M1

$\frac{x^2+x-6}{(x-2)(x+1)}$ M1

FACTORIZES & CANCELS TO ANSWER A1

$\frac{(x+3)\cancel{(x-2)}}{(x+1)\cancel{(x-2)}}$

b) $\frac{dy}{dx} = \frac{(x+1)\times 1 - (x+3)\times 1}{(x+1)^2} = \frac{-2}{(x+1)^2}$ M3 All marks dependent on quotient rule

"GRAD" $= -\frac{1}{2}$ A1

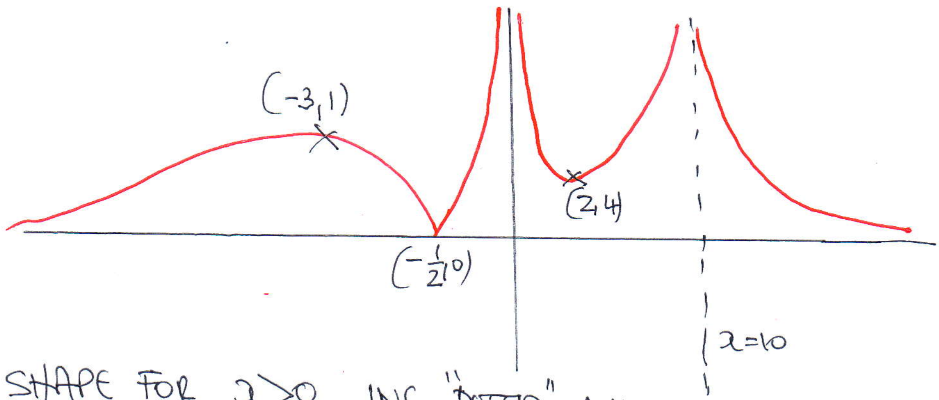
NORMAL GRAD $= 2$ M1 ft

$y = 2$ OR $(1, 2)$ B1

$y - 2 = $ "2"$(x-1)$ M1 ft

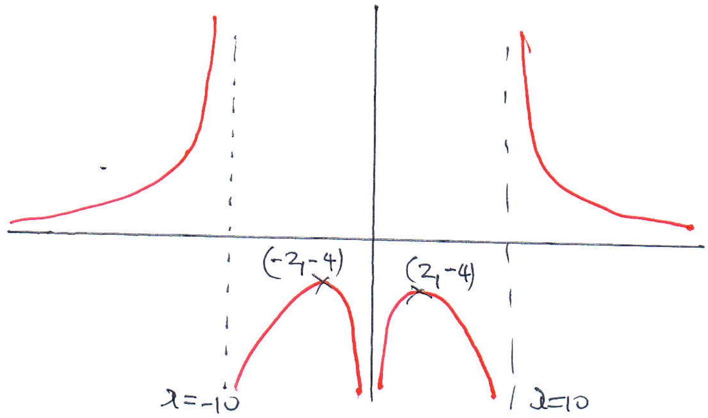
$y = 2x$ + COMMENT A1

5. a)



- SHAPE FOR $x>0$ INC "DOTTED" ASYMPTOTE, IGNORE LABEL B1
- SHAPE FOR $x<0$ B1
- $(-3,1)$ $(-\frac{1}{2},0)$ $(2,4)$ A2 -1eeoo

b)



- SHAPE FOR >0 B1
- SHAPE FOR <0 B1

$(-2,-4)$ AND $(2,-4)$ BOTH A1 dep

SHAPE MUST INCLUDE DOTTED LINE FOR ASYMPTOTE, BUT IGNORE MISSING LABEL — DO NOT PENALIZE MISSING ASYMPTOTE TWICE IF OVERALL SHAPE IS CORRECT

6. $x = \frac{1}{5}y^2 - \frac{1}{5}y + \frac{3}{5}$ M1

$\frac{dx}{dy} = \frac{2}{5}y - \frac{1}{5}$ A1

$\frac{dy}{dx} = \frac{1}{\frac{2}{5}y - \frac{1}{5}}$ OR $\frac{5}{2y-1}$ A1

ALTERNATIVE

$y^2 - y = 5x - 3$

$2y\frac{dy}{dx} - \frac{dy}{dx} = 5$

$(2y-1)\frac{dy}{dx} = 5$

$\frac{dy}{dx} = \frac{5}{2y-1}$

$y^2 - y - 12 = 0$ M1

$(y+3)(y-4)$ M1

$y = 4, -3$ A1

$\frac{5}{7}$, $\frac{-5}{7}$ BOTH A2

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7. a) $(7\cot\alpha - 1)(\cot\alpha + 1) = 0$ M1

$\cot\alpha = -1, \frac{1}{7}$ A1

$\tan\alpha = \cancel{-1}, 7$ A1 ft. so long as one ⊕ one ⊖

b) use of $1 + \tan^2\theta \equiv \sec^2\theta$ B1

$(\tan\theta - 3)^2$ or $(\tan\theta - 3)(\tan\theta - 3)$ M1

$\tan\theta = 3$ A1

c) $\frac{"7" + "3"}{1 - "3" \times "7"}$ M1 ft.

$\frac{10}{-20} = -\frac{1}{2}$ A1 (MUST SHOW $-\frac{10}{20}$ FIRST)

8\. a) $f(x) \geq 0$ A1 c.a.o

b) $\frac{1}{(x+2)^2}$ B1

$(x+2)^2 = \frac{9}{4}$ OR $4(x^2+4x+4)=9$ OR $4x^2+16x+7=0$ M1

$x+2 = \pm\frac{3}{2}$ OR $(2x-7)(2x-1)=0$ M1

$x = -\frac{1}{2}, -\frac{7}{2}$ A2

c) $yx + 2y = 1$ OR $x+2 = \frac{1}{y}$ M1

$x = \frac{1-2y}{y}$ OR $x = \frac{1}{y} - 2$ M1

$f^{-1}(x) = \frac{1-2x}{x}$ A1 c.a.o

9\. $4 - 4(1-2\sin^2\theta) = \frac{1}{\sin\theta}$ B2

$8\sin^2\theta = \frac{1}{\sin\theta}$ M1

$\sin\theta = \frac{1}{2}$ A1

$\theta = \frac{\pi}{6}$ A1 ft

$\theta = \frac{5\pi}{6}$ A1 ft