1. $\frac{dy}{dx} = \frac{1}{2}(x^2+1)^{-\frac{1}{2}} \times 2x$ M1 M1

$y=2$ OR $(1, \sqrt{2})$ A1

$\left.\frac{dy}{dx}\right|_{x=1} = \frac{1}{\sqrt{2}}$ OR $\frac{\sqrt{2}}{2}$ A1

NORMAL GRADIENT $-\sqrt{2}$ B1 ft

$y - \sqrt{2} = -\sqrt{2}(x-1)$ M1 ft

CONVINCING SIMPLIFICATION TO $y = \sqrt{2}(2-x)$ A1

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2. a) $f(x) = e^{-x} + \sqrt{x} - 2$ OR $f(x) = 2 - e^{-x} - \sqrt{x}$ M1

$f(3) = \pm 0.218$
$f(4) = \pm 0.018$ M1

COMMENT ON CHANGE OF SIGN, THUS ROOT A1

b) $x_1 = 3.927$ A1

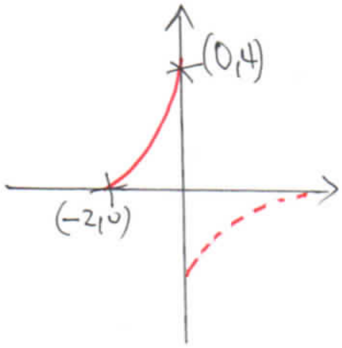
$x_2 = 3.922$ A1

$x_3 = 3.921$ A1

c) $f(3.92105)$
$f(3.29115)$ BOTH EVALUATED M1

$3.92105 < \alpha < 3.29115$ & SUITABLE COMMENT. A1

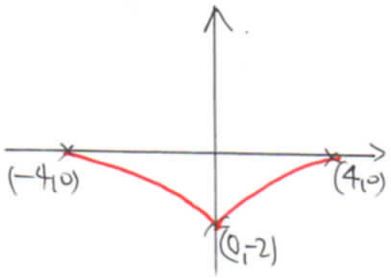
3. (a)



M1 CORRECT REFLECTION OR SIGHT OF $y=x$

M1 $(0,4)$ & $(-2,0)$ BOTH CORRECT

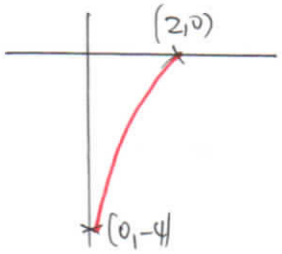
(b)



M1 CORRECT SHAPE

M1 ALL "THREE CO-ORDINATES" MARKED

(c)



M1 ALL GRAPH CORRECTLY DRAWN IN 4th QUADRANT (SCALE UNIMPORTANT)

M1 $(2,0)$ & $(0,-4)$ CORRECT

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

$R\cos\alpha = 2\sqrt{2}$ OR $R\sin\alpha = 2\sqrt{2}$ M1

$R = 4$ A1

$\alpha = \frac{\pi}{4}$ A1

b) $\sin\left(x+\frac{\pi}{4}\right) = \frac{1}{2}$ M1

$x+\frac{\pi}{4} = \frac{\pi}{6}$ M1

$x+\frac{\pi}{4} = \frac{5\pi}{6}$ M1

$x = \frac{23\pi}{12}$ OR $6.02138\ldots$ A1

$x = \frac{7\pi}{12}$ OR $1.83259\ldots$ A1

c) $y_{MAX} = 4$ B1 ft from their "R"

d) $x+\frac{\pi}{4} = \frac{\pi}{2}$ M1

$x = \frac{\pi}{4}$ A1 dep

5. a) $\frac{dy}{dx} = \underbrace{1 \times e^{-\frac{1}{2}x^2}}_{M1} + \underbrace{x e^{-\frac{1}{2}x^2}(-x)}_{M1}$ o.e .M1

b) " $e^{-\frac{1}{2}x^2} - x^2 e^{-\frac{1}{2}x^2} = 0$ " M1 ft

$1 - x^2 = 0$ M1

$e^{-\frac{1}{2}x^2} \neq 0$ MUST BE STATED OR CLEARLY IMPLIED B1

$x = \pm 1$ A1

$(1, e^{-\frac{1}{2}})$ $(-1, -e^{-\frac{1}{2}})$ o.e A2 c.a.o

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6. a) $(2x-3)(x+2)$ B1

$\frac{(2x-3)+(2x+11)}{(2x-3)(x+2)}$ M1

$\frac{4x+8}{(2x-3)(x+2)}$ A1

FACTORIZES & CANCELS CONVINCINGLY TO ANSWER A1

b) $2xy - 3y = 4$ M1

$2xy = 4 + 3y$ M1

$x = \frac{4+3y}{2y}$ A1

$f^{-1}(x) = \frac{4+3x}{2x}$ A1 c.a.o

c) $x > 0$ B1 c.a.o

d) $\frac{4}{2\ln(x-1)-3}$ M1

$4\ln(x-1) = 2$ OR $\ln(x-1) = \frac{1}{2}$ M1

$x - 1 = e^{\frac{1}{2}}$ M1

$x = 1 + e^{\frac{1}{2}}$ o.e A1

7.

$y = e^{2x+3}$ M1

$\ln y = 2x+3$ M1

$4x+6 = 2x+3$ M1

$x = -\frac{3}{2}$ A1

$\ln y = 2\left(-\frac{3}{2}\right)+3$ OR $\ln y = 0$ M1

$y = 1$ A1

Allow sensible alternatives

8. a)

$\dfrac{\operatorname{cosec}^2 x}{\cot x \operatorname{cosec} x}$ M1

$\dfrac{\operatorname{cosec} x}{\cot x}$ M1

$\dfrac{\frac{1}{\sin x}}{\frac{\cos x}{\sin x}}$ M1

$\dfrac{\cancel{\sin x}}{\cancel{\sin x}\cos x}$ OR $\dfrac{1}{\cos x} = \ldots$ M1

OR

$\dfrac{1+\frac{\sin^2 x}{\cos^2 x}}{\frac{\cos x}{\sin x} \times \frac{1}{\sin x}}$ OR M1

$\dfrac{\frac{\cos^2 x+\sin^2 x}{\cos^2 x}}{\frac{\cos x}{\sin^2 x}}$ M1

$\dfrac{\sin^2 x + \cos^2 x}{\cos x}$ M1

$\dfrac{1}{\cos x} = \ldots$ M1

b)

$4\sec x = \tan^2 x + 5$ M1

$4\sec x = (\sec^2 x - 1) + 5$ M1

$\sec^2 x - 4\sec + 4 = 0$ M1

$(\sec x - 2)^2$ OR $\sec x = 2$ M1

$\cos x = \frac{1}{2}$ M1

$x = \frac{\pi}{3}, \frac{5\pi}{3}$ O.E A2

9.

$\arccos(x+1) = \frac{\pi}{3}$ M1

$x+1 = \cos\left(\frac{\pi}{3}\right)$ OR $x+1 = \frac{1}{2}$ M1

$x = -\frac{1}{2}$ O.E. A1 c.a.o