1. FACTORIZES DENOMINATOR $(x-6)(x+1)$ B1

$$\frac{3x-4-2(x+1)}{(x-6)(x+1)}$$ M1 MUST HAVE DENOMINATOR

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

$$\frac{1}{x+1}$$ A1 c.a.o

---

2. a) $-\frac{1}{2}(1-2x)^{-\frac{3}{2}} \times (-2)$ M1 M1

b) $3e^{3x}(\sin x+\cos x) + e^{3x}(\cos x-\sin x)$ B1 B1

M1 FOR BOTH

c) $$\frac{x^2 \times \frac{1}{x} - \ln x \times 2x}{x^4}$$ M1 M1 M1

- These marks are dependent on quotient rule attempt
- DO NOT ACCEPT $(x^2)^2$

---

3.

$$\frac{\operatorname{cosec}^2\theta}{2\cot\theta}$$ M1

$$\frac{\frac{1}{\sin^2\theta}}{\frac{2\cos\theta}{\sin\theta}}$$ OR $$\frac{\sin\theta}{\sin^2\theta \times 2\cos\theta}$$ M1

$$\frac{1}{2\sin\theta\cos\theta}$$ M1

$$\frac{1}{\sin 2\theta}$$ STATING AFTER $= \operatorname{cosec}2\theta$ M1

ALTERNATIVE

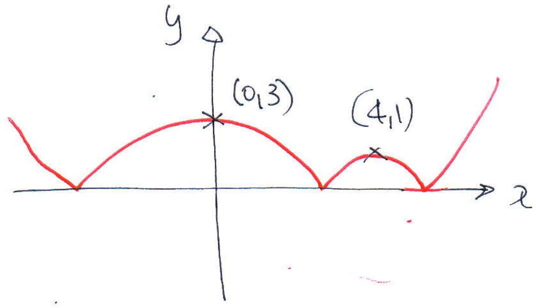
$$\frac{1+\frac{\cos^2\theta}{\sin^2\theta}}{\frac{2\cos\theta}{\sin\theta}}$$

$$\frac{\sin^2\theta+\cos^2\theta}{2\cos\theta\sin\theta}$$

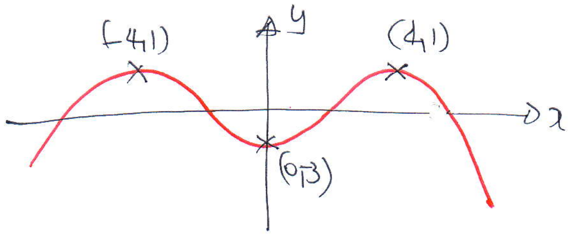
$$\frac{1}{2\cos\theta\sin\theta}$$

AS OPPOSITE

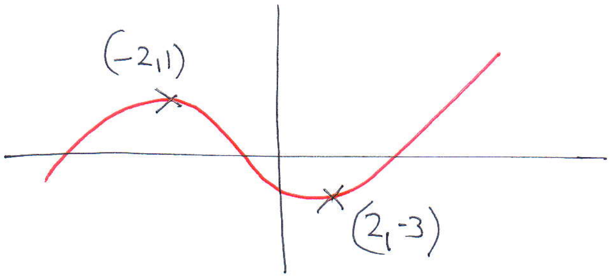
4. a)




M1 CORRECT SHAPE & POSITION
M1 CORRECT (0,3) & (4,1)



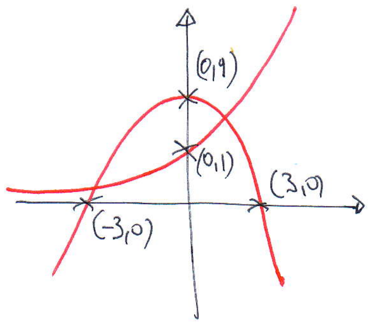

M1 RIGHT BRANCH CORRECT
M1 LEFT BRANCH CORRECT
M1 (-4,1) (4,1) (0,-3) CORRECT




M1 CORRECT SHAPE WITH TP's IN THE CORRECT QUADRANTS
M1 BOTH (-2,1) & (2,-3)

---

5. a)




M1 CORRECT QUADRATIC SHAPE & POSITION
M1 CORRECT $y = e^x$ SHAPE & POSITION
M1 (3,0) (-3,0) (0,9) ALL CORRECT
M1 (0,1) CORRECTLY MARKED

b) $9 - x^2 = \frac{1}{e^{-x}}$ FOLLOWED BY $9 - x^2 = e^x$ M1

CORRECT COMMENT ABOUT INTERSECTIONS E1

c) $x_2 = -2.94169$ $x_3 = -2.94162$ $x_4 = -2.99162$ A2 -1eeoo

d) EXPLANATION INDICATING THE ARGUMENT OF THE SQUARE ROOT BECOMES NEGATIVE

e.g. $9 - e^{2.3327} < 0$ E1

6. (a) 40 c.a.o — A1

b) "20" $= 8 + 32e^{-2k}$ o.e — M1 ft

$e^{2k} = \frac{8}{3}$ or $e^{-2k} = \frac{3}{8}$ — M1 ft

$2k = \ln\frac{8}{3}$ or $-2k = \ln\frac{3}{8}$ — M1 ft

$k = \frac{1}{2}\ln\frac{8}{3}$ or $0.49041\ldots$ — A1

c) $4 = 32e^{-0.4904t}$ — M1

$0.4904t = \ln 8$ or $-0.4904t = -\ln 8$ — M1

$t = 4.24$ (a.w.r.t) — A1

d) $\left(\frac{dP}{dt} =\right) -15.6928\ldots\, e^{-0.4904t}$ — M1

SUBSTITUTES OR IMPLIES SUBSTITUTION $t=1$ — M1

$(-)9.61$ — A1 c.a.o

[ • IF NO MARK IS AWARDED IN PART (d) AWARD B1 FOR SIGHT OF $\frac{dP}{dt}$ ]

7. a) $g(x) \geq 2$ A1 c.a.o

b) $\dfrac{2(x^2+3)+3}{2(x^2+2)-3}$

$\dfrac{2x^2+7}{2x^2+1}$

c) $2xy - 3y = 2x + 3$ o.e M1

$2xy - 2x = 3y + 3$ o.e
OR
$x(2y-2) = 3y+3$ M1

$x = \dfrac{3y+3}{2y-2}$ A1

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

$(2x+3)(2x-2) = (3x+3)(2x-3)$ o.E M1

$2x^2 - 5x - 3 = 0$ o.E A1

$(2x+1)(x-3)$ M1

$x = 3, -\frac{1}{2}$ BOTH A1

---

8. $\dfrac{(2-\cos x)(\cos x) - \sin x(\sin x)}{(2-\cos x)^2}$ M3 ← ANY OF THESE MARKS ARE DEP ON QUOTIENT RULE STRUCTURE $\dfrac{(\ldots) - (\ldots)}{(\quad)^2}$

SETS TO ZERO B1

"NUMERATOR" $= 0$ OR $2\cos x - \cos^2 x - \sin^2 x = 0$ M1

$2\cos x = 1$ OR $\cos x = \frac{1}{2}$ A1

$\left(\frac{\pi}{3}, \frac{\sqrt{3}}{3}\right)$ A2

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

$R\cos\alpha = 2$ OR $R\sin\alpha = 2$ M1

$R = \sqrt{8}$ OR $2\sqrt{2}$ A1

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

b) $\cos\left(x - \frac{\pi}{4}\right) = 0$ OR $x - \frac{\pi}{4} = \frac{\pi}{2}$ M1

$x = \frac{3\pi}{4}$ OR $b = \frac{3\pi}{4}$ A1

c) $\frac{6}{\sqrt{8}\cos\left(3x - \frac{\pi}{4}\right)} - \sqrt{6} = 0$ B1

$\sqrt{48}\cos\left(3x - \frac{\pi}{4}\right) = 6$ OR $\cos\left(3x - \frac{\pi}{4}\right) = \frac{\sqrt{3}}{2}$ A1

$3x - \frac{\pi}{4} = \frac{\pi}{6}$ M1

$3x - \pi = \frac{11\pi}{6}$ OR $3x - \frac{\pi}{6} = -\frac{\pi}{6}$ M1

$3x = \frac{5\pi}{12}$ OR $3x = \frac{25\pi}{12}$ OR $3x = \frac{\pi}{12}$ M1

$\frac{5\pi}{36}, \frac{29\pi}{36}$ BOTH A1

$\frac{25\pi}{36}, \frac{\pi}{36}$ BOTH A1