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**1.**

$(x+4)(x-2)$ B1

$\frac{(x+4)(x-2)+(x-8)-2(x-2)}{(x+4)(x-2)}$ M1

$\frac{x^2+x-12}{(x+4)(x-2)}$ M1

$\frac{(x+4)(x-3)}{(x+4)(x-2)}$ M1

$\frac{x-3}{x-2}$ OR $p=3$, $q=2$ A1

---

**2.** a) $\ln(2x-1) = 4-y$ M1

$2x-1 = e^{4-y}$ M1

$x = \frac{1}{2}(1+e^{4-y})$ o.e A1

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

b) $f(4)$ OR $4-\ln 1$ M1

$4-\ln 7$ c.a.o A1

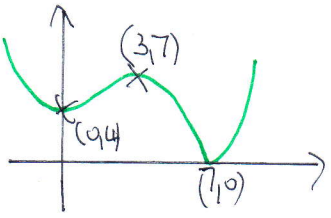
c) $4-\ln(2x-1) =$ "$f(f(1))$" M1 ft

$2x-1 = 7$ M1

$x = 4$ c.a.o A1

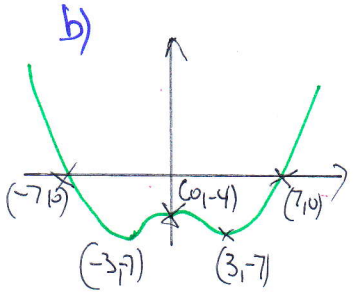
---

**3.** a)



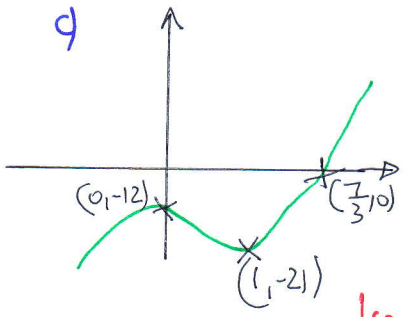

- CORRECT SHAPE B1
- ALL THREE COORDINATES CORRECT A1 dep

b)




- CORRECT SHAPE B1
- ALL FIVE COORDINATES CORRECT A1 dep

c)




CORRECT SHAPE dep

$(0,-12)$, $(1,-21)$, $(\frac{7}{3},0)$ A2

-1 eeoo

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4. a) $\sqrt{5}$ seen OR $\sin x = \frac{1}{\sqrt{5}}$ M1

$\operatorname{cosec} x = \sqrt{5}$ A1

b) $\frac{\tan x + \tan y}{1 - \tan x \tan y} = 2$ OR $\frac{\frac{1}{2} + \tan y}{1 - \frac{1}{2}\tan y} = 2$ M1

$\frac{1}{2} + \tan y = 2\left(1 - \frac{1}{2}\tan y\right)$ M1

$\tan y = \frac{3}{4}$ A1

---

5. a) 18 A1

b) $14 = 10 + 8e^{-\frac{1}{12}t}$ M1

$\frac{1}{2} = e^{-\frac{1}{12}t}$ OR $2 = e^{\frac{1}{12}t}$ M1

$-\frac{1}{12}t = \ln\frac{1}{2}$ OR $\frac{1}{12}t = \ln 2$ M1

$t = 12\ln 2$ OR $t = 8.317\ldots$ A1

08:19 A1

c) $\left(\frac{dV}{dt} =\right) -\frac{8}{12}e^{-\frac{1}{12}t}$ o.e M1

$\left(\frac{dV}{dt}\Big|_{t=12} =\right) -\frac{2}{3}e^{-\frac{1}{12}\times 12}$ M1

$-0.245\ldots$ A1

MINUS = DECREASE B1

d) 10 B1

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6. a) $2e^{2x}(x^2-4x-2) + e^{2x}(2x-4)$ M1 (PRODUCT STRUCTURE)

A2

EXPANDS CORRECTLY OR FACTORISES $e^{2x}$

e.g. $2x^2e^{2x} - 8xe^{2x} - 4e^{2x} + 2xe^{2x} - 4e^{2x}$

OR $e^{2x}[2(x^2-4x-2)+(2x-4)]$ } M1

SIMPLIFIES CORRECTLY TO ANSWER $2e^{2x}(x^2-3x-4)$ A1

b) $x^2-3x-4=0$ OR $2e^{2x}(x^2-3x-4)=0$ M1

$(x+1)(x-4)$ M1

$(-1, 3e^{-2})$ $(4, 2e^8)$ OR EXACT EQUIVALENT A2

---

7. a) $\left(\frac{dy}{dx} =\right) \frac{1}{2}(e^{2x}-2x)^{-\frac{1}{2}}(2e^{2x}-2)$ A1 A1 A1

LAST MARK IS ALL CORRECT WITH CORRECT BRACKETING

$\frac{e^{2p}-1}{\sqrt{e^{2p}-2p}}$ OR "THIS" $\left.\frac{dy}{dx}\right|_{x=p}$ M1 dep

$P\left(p, (e^{2p}-2p)^{\frac{1}{2}}\right)$ OR $\left(x, (e^{2x}-2x)^{\frac{1}{2}}\right)$ B1

MUST BE IN CO-ORDS OR $y=(e^{2p}-2p)^{\frac{1}{2}}$ ONLY

$y-(e^{2p}-2p)^{\frac{1}{2}} = \frac{e^{2p}-1}{(e^{2p}-2p)^{\frac{1}{2}}}(x-p)$ M1

ABOUT EQUATION WRITTEN WITH $x=y=0$ M1 dep

SIMPLIFIES CONVINCINGLY TO THE ANSWER $(1-x)e^{2x}=x$ A1 (MAY BE IN $p$)

b) $(1-x)e^{2x}-x=0$ OR $x-(1-x)e^{2x}=0$ OR $f(x)=\pm[(1-x)e^{2x}-x]$ B1

$f(0.8)=0.1906\ldots$ OR $f(1)=-1$ M1

CONCLUDES CORRECTLY WITH REFERENCE TO CHANGE OF SIGN E1

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c) $x_1 = 0.838$ A1

$x_4 = 0.844$ A1

d) ATTEMPTS $f(0.84385) = +0.000460$
$f(0.84395) = -0.000014$ } M1

CONCLUDES CORRECTLY WITH REFERENCE TO SIGN A1

ALTERNATIVE

STORES $x_1$ — ---

TO 5/6 d.p

E.g. 0.83848
0.84325
0.84386
0.84394
0.84395
0.84395 — 0.843947
0.84395 — 0.843947

M1

CONVINCINGLY ARGUES CASE E1

---

8. a) $R\cos x\cos\alpha - R\sin x\sin\alpha$ M1

$R = 2$ OR IMPLIED A1

$\alpha = \frac{\pi}{6}$ OR IMPLIED A1

b) (MAX IS) 2 (MUST BE CLEAR) B1

$x + \frac{\pi}{6} = 0$ M1

$x = \frac{11\pi}{6}$ A1

c) ($D_{MAX}$ IS) IS (MUST BE CLEAR) B1

$\frac{\pi t}{6} = \frac{11\pi}{6}$ M1

$t = 11$ OR $t = 23$ OR 11:00 OR 23:00 A1

d) $12 = 13 + 2\cos\left(\frac{\pi t}{6} + \frac{\pi}{6}\right)$ M1

$\cos\left(\frac{\pi t}{6} + \frac{\pi}{6}\right) = -\frac{1}{2}$ A1

$\frac{\pi t}{6} + \frac{\pi}{6} = \frac{2\pi}{3}$ M1

$\frac{\pi t}{6} + \frac{\pi}{6} = \frac{4\pi}{3}$ M1

$t = 3, 7, 15, 19$ OR IN 24 CLOCK NOTATION A2

ANY 2 CORRECT AWARD M1