1. a) "$f(x)$" $= x^3 - x^2 - 6x - 6$ OR $-x^3 + x^2 + 6x + 6$

$f(3) = \pm 6$
$f(4) = \mp 18$ } M1

COMMENT (ON CONTINUITY) & CHANGE OF SIGN E1

b) $x^2(x-1) = 6x + 6$ M1

$x^2 = \frac{6x+6}{x-1}$ & SUBS ANSWER A1

c) ANY TWO VALID ANSWERS E.G 1 OR 0.5 B2

d) $x_1 = 3.349$ $x_2 = 3.333$ x_3 3.338 $x_4 = 3.336$ A3 -1 eeoo

e) $f(x) = \pm(x^3 - x^2 - 6x - 6)$ B1 MAY APPEAR IN (a)

$f(3.336905) = \mp 0.00014$
$f(3.336915) = \pm 0.00006$ } M1

CHANGE OF SIGN $\Rightarrow$ $3.336905 < \alpha < 3.336915$ +TWICE.... A1

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2 a) 70 C.A.O A1

b) 26.76676... ACCEPT 27 WITH WORKINGS A1

c) $15 = 50e^{-\frac{t}{15}}$ M1

$\frac{15}{50} = e^{-\frac{t}{15}}$ OR $\frac{50}{15} = e^{\frac{t}{15}}$ O.E M1

$-\frac{t}{15} = \ln\frac{15}{50}$ OR $\frac{t}{15} = \ln\frac{50}{15}$ O.E M1

$t = 15\ln\frac{10}{3} \approx 18$ A1

3. $\frac{dy}{dx} = \frac{3}{2} \times \frac{1}{6}(x^2+5)^{\frac{1}{2}} \times 2x$ M1 M1

O.E

$\left.\frac{dy}{dx}\right|_{x=2}$ OR $\frac{1}{2} \times 2 \times (2^2+5)^{\frac{1}{2}}$ O.E. M1

IMPLIES GRADIENT 3 A1

$y = \frac{9}{2}$ OR $P(2, \frac{9}{2})$ A1

$y - "\frac{9}{2}" = "3"(x-2)$ O.E e.g. $y = 3x - \frac{3}{2}$, $2y = 6x - 3$ M1 ft

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4. $5[\sin 3x \cos x + \cos 3x \sin x] = 4$

OR

$\sin 3x \cos x + \cos 3x \sin x = \frac{4}{5}$ M1

$\sin(3x+x)$ OR $\sin 4x$ B1

$\sin 4x = \frac{4}{5}$ A1

$4x = 0.9273...$
$4x = 0.5536...$ M1, M1

$x = 0.23^c, 0.55^c, 1.80^c, 2.12^c$ A1

5. $(x+3)(x-1)$ B1

$\frac{x(x-3)(x-1) - 12 + 3(x+3)}{(x+3)(x-1)}$ A3

ALL THESE 3 MARKS ARE DEPENDANT ON "CORRECT FRACTION STRUCTURE"

$x^3 + 2x^2 - 3$ SEEN A1

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

CANCELS $(x-1)$ CONVINCINGLY IN A FRACTION TO GET ANSWER A1

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6. a) $g(x) \leq 7$ C.A.O A1

b) $\frac{(7-2x^2)+6}{(7-2x^2)+2}$ M1

$\frac{13-2x^2}{9-2x^2}$ A1

c) $yx + 2y = x + 6$ O.E f.g "GETS RID" OF DENOMINATORS M1

$x(y-1) = 6-2y$ O.E "FACTORIZES" x M1

$x = \frac{6-2y}{y-1}$ O.E A1

$f^{-1}(x) = \frac{6-2x}{x-1}$ OR $f^{-1}(x) = \frac{2x-6}{1-x}$ C.A.O A1

d) GETS RID OF DENOMINATORS M1

$3x^2 + 3x - 18$ OR $x^2 + x - 6$ A1

FACTORIZES TO $(x-2)(x+3)$ M1

$x = \begin{matrix} 2 \\ -3 \end{matrix}$ C.A.O (BOTH) A1

ACCEPT SOLUTIONS BASED ON $f(x) = x$ OR $f'(x) = 1$

7.

$$\frac{dy}{dx} = -e^{-x}\sin(\sqrt{3}x) + e^{-x} \times \sqrt{3}\cos(\sqrt{3}x) \quad \text{M3}$$

ONE MARK IS AWARDED FOR CORRECT PRODUCT RULE STRUCTURE

$$e^{-x}\left[\sqrt{3}\cos(\sqrt{3}x) - \sin(\sqrt{3}x)\right] \quad \text{M1}$$

$$R\cos(\sqrt{3}x)\cos\alpha - R\sin(\sqrt{3}x)\sin\alpha \quad \text{M1}$$

$R\sin\alpha = 1$

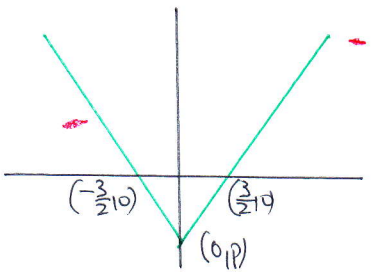
$R\cos\alpha = \sqrt{3}$ A1 both

$R = 2$ A1

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

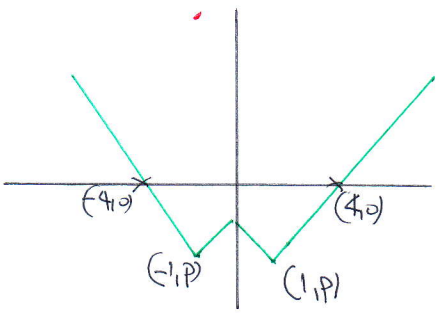
8.

a)



- CORRECT SHAPE IN CORRECT QUADRANTS B1
- $(0,p)$ B1
- $(\frac{3}{2},0)$, $(-\frac{3}{2},0)$ BOTH B1

b)



- CORRECT SHAPE IN CORRECT QUADRANTS B1
- $(4,0)$ $(-4,0)$ both B1
- $(1,p)$ $(-1,p)$ both B1

c) $P(0,-2)$ B1

$C(1,-3)$ B1

d) $|x-1| = 4x+3$ M1

$x-1 = 4x+3$ M1

$x-1 = -4x-3$ OR $1-x = 4x+3$ M1

$x = -\frac{4}{3}$ or $x = -\frac{2}{5}$ A1 BOTH

$x = -\frac{2}{5}$ ONLY A1 dep

9 $\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$ B1

$\tan\theta = \frac{1}{2}$ B1

$\cot 2\theta = \frac{3}{4}$ or $\tan 2\theta = \frac{4}{3}$ A1

$\tan 4\theta = \frac{2\tan 2\theta}{1-\tan^2 2\theta}$ B1

$\tan 4\theta = -\frac{24}{7}$ A1

$\frac{1}{2} \times \frac{3}{4} \times -\frac{24}{7} = -\frac{9}{7}$ M1