Candidate 1 evidence — question 1

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

$$= \int 3 + 2x - x^2$$

$$= 3x + \frac{2x^2}{2} - \frac{x^3}{3}$$

$$= 3x + x^2 - \frac{x^3}{3}$$

$$\left[3x + x^2 - \frac{x^3}{3}\right]_{-1}^{3}$$

$$\left(3\times3 + 3^2 - \frac{3^3}{3}\right) - \left((3\times-1) + (-1)^2 - \frac{-1^3}{3}\right)$$

$$9 + 9 - 9 - -3 + 1 + \frac{1}{3}$$

$$18 - 9 + 3 + 1 + \frac{1}{3}$$

$$9 + 4\tfrac{1}{3}$$

$$= 13\tfrac{1}{3} \text{ units}$$

Candidate 2 evidence — question 1

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

$$\int_{-1}^{3} (3 + 2x - x^2)\, dx$$

$$\left[3x + x^2 - \frac{x^3}{3}\right]_{-1}^{3}$$

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

$$9 + 9 - 9 - \left(-3 + 1 - \left(\frac{-1}{3}\right)\right)$$

$$9 - \left(-2 + \frac{1}{3}\right)$$

$$10 + \frac{1}{3}$$

$$\frac{30}{3} + \frac{1}{3}$$

$$= \frac{31}{3} \text{ units}^2$$

Candidate 3 evidence — question 2(b)

$$\cos\theta = \frac{\underline{u}\cdot\underline{v}}{|\underline{u}||\underline{v}|}$$

$$\underline{u}\cdot\underline{v} = 24$$

$$|\underline{u}| = \sqrt{-1^2+4^2-3^2} = \sqrt{26}$$

$$|\underline{v}| = \sqrt{-7^2+8^2+5^2} = \sqrt{138}$$

$$\theta = \cos^{-1}\left(\frac{24}{\sqrt{26}\times\sqrt{138}}\right)$$

$$\underline{\underline{\theta = 66.4^\circ}}$$

Candidate 4 evidence — question 3

$$f(x) = x^3 - 7x - 6$$

$$\cancel{f'(x) = 3x^2 - 7x}$$

$$f(2) = 2^3 - 7(2) - 6$$

$$= -12$$

so decreasing when $x = 2$ as $-12 < 0$

Candidate 5 evidence — question 3

$f(x) = x^3 - 7x - 6$

$f'(x) = 3x^2 - 7$

~~for SPs $f'(x) = 0$~~

~~$3x^2 - 7 = 0$~~

	$\underset{\rightarrow}{1{\cdot}9}$	2	$\underset{\rightarrow}{3}$
$3x^2 - 7$	$+$	$+$	$+$

when $x = 2$

the function is increasing

when $X = 2$ the function is increasing

Candidate 6 evidence — question 3

$f(x) = x^3 - 7x - 6$

$f'(x) = 3x^2 - 7$

x	2^-	2	2^+
$f'(x)$	$-$	0	$+$
Slope			

$x = 2$ is decreasing as its a minimum TP at $x = 2$.

Candidate 7 evidence — question 4

$-3x^2 - 6x + 7$

$-3\left(x^2 + 2x - \frac{7}{3}\right)$

$-3\left[(x+1)^2 - (1)^2 - \frac{7}{3}\right]$

$-3\left[(x+1)^2 - 1 - \frac{7}{3}\right]$

$-3(x+1)^2 + 3 + 7$

$-3(x+1)^2 + 10$

$a = -3$

$b = 1$

$c = 10$

Candidate 8 evidence — question 4

$$-3x^2-6x+7$$

$$-1(3x^2+6x-7)$$

$$3(x^2+2x-\frac{7}{3})$$

$$-3(x+1)^2-1-\frac{7}{3}$$

$$3(x+1)^2+3+7$$

$$-3(x+1)^2+10$$

$$-3(x+1)^2+10$$

$$\underline{\underline{-3(x+1)^2+10}}$$

Candidate 9 evidence — question 5(b)

$3y + x = 25$

$y = x - 5$ (1)

$3y = 25 - x$

$y = \frac{25}{3} - \frac{1}{3}x$

Sub $x = 10$ into (1)

$y = x - 5$

$y = 10 - 5$

$y = 5$

POI = $(10, 5)$

$3y = 25 - x$

$y = -5 + x$

$\frac{25}{3} - \frac{1}{3}x = x - 5$

$\frac{25}{3} + 5 = x + \frac{1}{3}x$

$\frac{40}{3} = \frac{4}{3}x$

$\frac{4}{3}x = \frac{40}{3}$

$x = \frac{40/3}{4/3}$

$x = 10$

Candidate 10 evidence — question 5(b) and 5(c)

$3y+x=25$

$y+x=\frac{25}{3}$

$y=-x+\frac{25}{3}$

$+\quad y=x-5$

$2y=\frac{10}{3}$

$y=\frac{5}{3}$

$x=\frac{25}{3}-y$

$x=\frac{25}{3}-\frac{5}{3}$

$x=\frac{20}{3}$

$\left(\frac{20}{3},\frac{5}{3}\right)$ (a, b)

$(x-a)^2+(y-b)^2=r^2$ $\quad (3,4)$ $\quad$ centre(a,b)

$\left(3-\frac{20}{3}\right)^2+\left(4-\frac{5}{3}\right)^2=r^2$

$\frac{121}{9}+\frac{49}{9}=r^2$

$\frac{170}{9}=r^2$

$r=\sqrt{\frac{170}{9}}$

$r=4.34$

$\left(x-\frac{20}{3}\right)^2+\left(y-\frac{5}{3}\right)^2=\frac{170}{9}$

Candidate 11 evidence — question 6(b)

$3 + \cos 2x = 6 + 2\cos x$

$\cancel{3 + \cos 2x - 6 + 2\cos x = 0}$

$\cancel{-3 - \cos 2x = 0}$

$\cancel{0 = 6 + 2\cos x - 3 - \cos 2x}$

$3 + \cos x = 0$

$3 + \cos 2x - 6 - 2\cos x = 0$

$\cos x$

$\cos 2x - 2\cos x = 3$

$2\cos^2 x - 1 - 2\cos x = 3$

$2\cos^2 x - 2\cos x = 4$

$\cos^2 x - \cos x = 2$

$\cos(\cos x - x) = 2$

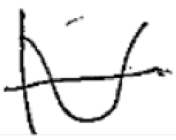
$\cancel{\cos 2x}$

$\cos x - x = 2$

$\cancel{\cos}\, 2\cos x = 2$

$\cos x = 1$

$= 0, \pi, 2\pi$



Candidate 12 evidence — question 7(a) and 7(c)

$$\begin{array}{c|cccc} 2 & 2 & -3 & -3 & 2 \\ & \downarrow & 4 & 2 & -2 \\ \hline & 2 & 1 & -1 & \boxed{0} \end{array} \Rightarrow f(2)=0\text{, so }(x-2)\text{ is a factor}$$

~~[illegible]~~

$\Rightarrow (x-2)\,(2x^2-x-1)=0$

$\Rightarrow (x-2)\,(2x^2+2x \,\vdots\, -x-1)=0$

$\Rightarrow (x-2)\,(2x(x+1)-1(x+1))=0$

$\Rightarrow (x-2)\,(2x-1)\,(x+1)=0$

$x-2=0$ $\quad 2x-1=0$ $\quad x+1=0$

$\underline{\underline{x=2}}$ $\quad 2x=1$ $\quad \underline{\underline{x=-1}}$

$\underline{\underline{x=1/2}}$

$$\begin{array}{cc} \multicolumn{2}{c}{-2} \\ \hline -1 & +2 \end{array}$$

$U_7 = U_5$

$f(a)=2a^3-3a^2-a-1=2a-3$

$f(x)=2a^3-3a^2-a+2=2a$

$f(x)=2a^3-3a^2-3a+2=0$

DIFFERENTIATE

$f'(x)= 6a^2-6a-3=0$

$$\begin{array}{cc} \multicolumn{2}{c}{18} \\ \hline 1 & 18 \\ 2 & 9 \\ 3 & 6 \end{array}$$

Candidate 13 evidence — question 8(a)

$2\cos x - \sin x^\circ \quad k\cos(x-a)^\circ \quad 0<a<360$

$k\cos x\cos a + k\sin x\sin a$

$k\cos a\cos x + k\sin a\sin x$

$k\sin a = -1 \qquad \tan a = \dfrac{k\sin a}{k\cos a} \qquad k = \sqrt{(-1)^2+2^2}$

$k\cos a = 2 \qquad = \dfrac{-1}{2} \qquad = \sqrt{1+4}$

$= \sqrt{5}$

$a = -26.56\ldots$

$\therefore 2\cos x - \sin x^\circ = \sqrt{5}\cos(x+26.56)$

Candidate 14 evidence — question 8(a)

$2\cos x - \sin x = \cos x \cos a + \sin x \sin a$

$2 = \cos a$ $\tan = \dfrac{\sin}{\cos}$ $r\alpha = \tan^{-1}\left(\frac{1}{2}\right)$

$-1 = \sin a$ $= 26.565\ldots$

$= \dfrac{-1}{2}$

$K = \sqrt{2^2 + 1^2}$

$= \sqrt{5}$ $= -\frac{1}{2}$

$\begin{array}{c|c} S & A \checkmark \\ \hline T & C \checkmark \end{array}$

$2\cos x - \sin x = \sqrt{5}\cos(x - 333.4)$ $360 - 26.565$

$= 333.436\ldots$

$= 333.4^\circ$

Candidate 15 evidence — question 8(a)

180 − x, S, A x, 180 + x, T, C, 360 − x

$2\cos x - \sin x = k\cos(x - a)$

$\cancel{k\cos(x-a)}$

$= \cos x \cos a + \sin x \sin a$

Equate

$k\cos x = 2$

$k\sin x = -1$

Angle

$\tan a = \frac{k\sin x}{k\cos x}$

$= \frac{-1}{2}$

$a = \tan^{-1}\left(\frac{-1}{2}\right)$

$a = 26{\cdot}57$

Find K

$k^2 = 2^2 + -1^2$

$k^2 = 3$

$k = \sqrt{3}$

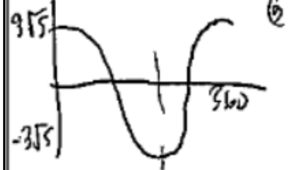
$\cancel{\sqrt{3}\cos}$ $2\cos x - \sin x =$

$\sqrt{3}\cos(x - 26{\cdot}57)$

Candidate 16 evidence — question 8(b)

$\sqrt{5} \times 3 = 3\sqrt{5}$

minimum value $= \underline{\underline{-3\sqrt{5}}}$



$3\sqrt{5}\cos x$

$6\cos x - 3\sin x = 3\sqrt{5}\cos(x - 333.4)$

$\cancel{\therefore -3\sqrt{5} = \sqrt{5}\cos(x - 333.4)}$

$\cancel{\cos(x - 333.4) = -3}$

$\cancel{x - 333.4 =}$ no solution

$180° + 333.4 = 513.4$

$513.4 - 360 = \underline{\underline{153.4°}}$

Candidate 17 evidence — question 9

$P(x) = 2x + \cancel{\frac{128}{x}}\ 128x^{-1}$

$P'(x) = 2 - 128x^{-2}$

$= 2 - \frac{128}{x^2}$

~~St~~ Stationary Points when $P'(x) = 0$

$2 - \frac{128}{x^2} = 0$

$\frac{128}{x^2} = 2$

$128 = 2x^2$

$x^2 = 64$

$x = \pm\sqrt{64}$

$x = 8,\ \cancel{x = -8}$

Radius can't be negative

x	$\rightarrow$	-8	$\rightarrow$	8	$\rightarrow$
$P'(x)$	$+$	0	$-$	0	$+$
Shape					

Min TP when $x = 8$

When $x = 8$, $P = 2(8) + \frac{128}{8}$

$= 32$

Minimum Value of $\underline{P = 32}$

(Occurs when $x = 8$)

Candidate 18 evidence — question 9

$2 - \frac{128}{7^2}$ $\quad$ $2 - \frac{128}{9^2}$

$\frac{dy}{dx} = 2 + 128x^{-1}$

$2 - 128x^{-2}$

$= 2 - \frac{128}{x^2}$

$2 - \frac{128}{x^2} = 0$

$-128 = -2x^2$

$64 = x^2$

$x = 8$

x	7	8	9
$\frac{dy}{dx}$	-ve	0	+ve
slope	\	—	/

minimum 8 ∴ P

at p = 8

Candidate 19 evidence — question 10

$x^2 + (m-3)x + m = 0$

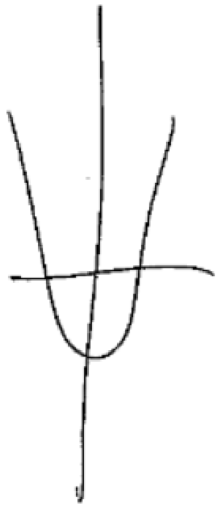
$(m-3)^2 - 4 \times 1 \times m > 0$

$m^2 - 6m + 9 - 4m > 0$

$m^2 - 10m + 9 > 0$

$(m-9)(m-1) > 0$

$m > 9 \quad m < 1$



Candidate 20 evidence — question 10

$x^2 + (m-3)x + m = 0$

$a = 1$
$b = (m-3)$
$c = m$

$b^2 - 4ac > 0$

$(m-3)^2 - 4 \times 1 \times m > 0$

$m^2 - 3m - 3m + 9 - 4m > 0$

$m^2 - 10m + 9 > 0$

$(m-9)(m-1) > 0$

$m > 9 \quad m > 1$

$\therefore 1 < m > 9$

Candidate 21 evidence — question 11(a)

$P = 100(1 - e^{kt})$

$50 = 100(1 - e^{k\cancel{t}3}$

$50 = 100 - 100e^{k\cancel{t}3}$

$\frac{1}{2} = -100e^{3k}$

$\cancel{\frac{1}{200} = e^{3k}}$

$\cancel{\ln\frac{1}{200} = \ln e^{3k}}$

$\ln\frac{1}{2} = -100\ln e^{3k}$

$-0.693 = -100\,3k$

$3k = 0.00693$

$k = 0.00231$

Candidate 22 evidence — question 11(a)

$50 = 100(1 - e^{k \times 3})$

$0 \cdot 5 = 1 - e^{\times k \times 3}$

$\ln -0 \cdot 5 = \ln e \times k \times 3$

$-0 \cdot 7 = k \times 3$

$k = -0 \cdot 23$

Candidate 23 evidence — question 12(a)(ii)

$C_2 = x^2 + y^2 + 14x - 22y + C = 0$

$2g = 14 \qquad 2f = -22$

$g = 7 \qquad f = -11$

Centre $= (-7, 11)$

$\underset{x_1 \quad y_1}{(-7, 11)} \quad \underset{x_2 \quad y_2}{(13, -4)}$

Distance $= \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$

$= \sqrt{(-4-11)^2 + (13+7)^2}$

$= \sqrt{(-15)^2 + (20)^2}$

$= \sqrt{625}$

$= 25$

$7^2 + (-11^2) = 170$

$170 - 625 = -455$

Candidate 24 evidence — question 12(b)

C_2 radius = 25

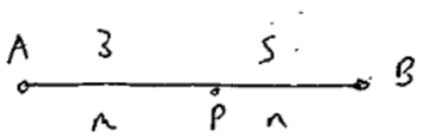
C_1 radius = 10

$25 - 10 = 15$

$\frac{15}{25} \times 100 = 60$

$\frac{60}{100} = \frac{3}{5}$

P divides the lines in the ratio 3:5



$A = \text{Centre } C_2 = (-7, 11)$

$B = \text{Centre } C_1 = (13, -4)$

$\cancel{AB = \begin{pmatrix} -7 \\ 11 \end{pmatrix} - \begin{pmatrix} 13 \\ -4 \end{pmatrix}}$

$\cancel{= \begin{pmatrix} -91 \\ -44 \end{pmatrix}}$

$\frac{3}{5} \begin{pmatrix} -91 \\ 44 \end{pmatrix}$

$P = \frac{n}{m+n} \underline{a} + \frac{m}{m+n} \underline{b}$

$P = \frac{5}{8} \begin{pmatrix} -7 \\ 11 \end{pmatrix} + \frac{3}{8} \begin{pmatrix} +13 \\ -4 \end{pmatrix}$

$P = \begin{pmatrix} \frac{-35}{8} \\ \frac{55}{8} \end{pmatrix} + \begin{pmatrix} \frac{39}{8} \\ \frac{-12}{8} \end{pmatrix}$

$P = \left(\frac{1}{2}, \frac{43}{8} \right)$