

Paper 1

$$\begin{aligned} \textcircled{1} \quad y &= 2^3 - 2(2)^2 + 5 \\ &= 8 - 8 + 5 \\ &= 5 \quad \therefore (2, 5) \end{aligned}$$

$$\begin{aligned} \frac{dy}{dx} &= 3x^2 - 4x \\ \therefore m &= 3(2)^2 - 4(2) \\ &= 12 - 8 \\ &= 4 \end{aligned}$$

$$\begin{aligned} y - 5 &= 4(x - 2) \\ y - 5 &= 4x - 8 \\ \underline{y &= 4x - 3} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \text{mid} &= \left( \frac{1+9}{2}, \frac{4+0}{2} \right) \\ &= (5, 7) \end{aligned}$$

$$\begin{aligned} m_{AB} &= \frac{10-4}{9-1} \\ &= \frac{6}{8} \\ &= \frac{3}{4} \end{aligned}$$

$$\therefore m_{PB} = -\frac{4}{3}$$

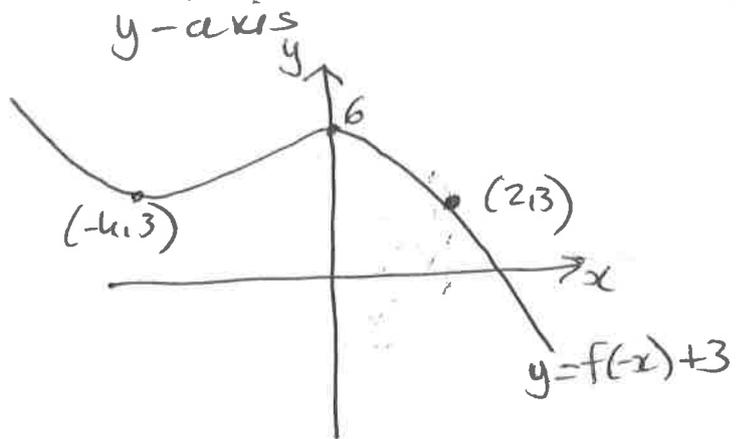
$$\begin{aligned} y - 7 &= -\frac{4}{3}(x - 5) \\ 3y - 21 &= -4x + 20 \\ \underline{3y &= -4x + 41} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \int (12x^{-2} + x^{1/2}) dx \\ &= \frac{12x^{-1}}{-1} + \frac{x^{3/2}}{\frac{3}{2}} + C \\ &= -12x^{-1} + \frac{2}{3}x^{3/2} + C \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad 3 \log_3 2 + \log_3 \frac{1}{24} \\ &= \log_3 2^3 + \log_3 \frac{1}{24} \\ &= \log_3 8 + \log_3 \frac{1}{24} \\ &= \log_3 \frac{8}{24} \\ &= \log_3 \frac{1}{3} \\ &= \log_3 (3^{-1}) \\ &= \underline{\underline{-1}} \end{aligned}$$

$$\textcircled{5} \quad y = f(-x) + 3$$

$\uparrow$  flip in  $y$ -axis       $\uparrow$  +3 vertically



$$\begin{aligned} \textcircled{6} \quad h^2 &= 5^2 + 1^2 \\ &= 26 \\ h &= \sqrt{26} \end{aligned}$$

$$\begin{aligned} \text{a) (i) } \sin 2\theta &= 2 \sin \theta \cos \theta \\ &= 2 \left( \frac{1}{\sqrt{26}} \right) \left( \frac{5}{\sqrt{26}} \right) \\ &= \frac{10}{26} \\ &= \frac{5}{13} \end{aligned}$$

$$\begin{aligned} \text{(ii) } \cos 2\theta &= \cos^2 \theta - \sin^2 \theta \\ &= \left( \frac{5}{\sqrt{26}} \right)^2 - \left( \frac{1}{\sqrt{26}} \right)^2 \\ &= \frac{25}{26} - \frac{1}{26} \\ &= \frac{24}{26} = \underline{\underline{\frac{12}{13}}} \end{aligned}$$

$$\begin{aligned}
 b) \sin(2q - r) &= \sin 2q \cos r - \cos 2q \sin r \\
 &= \left(\frac{5}{13} \times \frac{4}{\sqrt{17}}\right) - \left(\frac{12}{13} \times \frac{1}{\sqrt{17}}\right) \\
 &= \frac{20}{13\sqrt{17}} - \frac{12}{13\sqrt{17}} \\
 &= \frac{8}{13\sqrt{17}}
 \end{aligned}$$

$$\begin{aligned}
 ⑧ \log_a 75 &= 2 + \log_a 3 \\
 \log_a 75 - \log_a 3 &= 2 \\
 \log_a 25 &= 2 \\
 25 &= a^2 \\
 a &= \sqrt{25} \\
 a &= \cancel{5} \times 5 \\
 \therefore a &= \underline{\underline{5}}
 \end{aligned}$$

$$\begin{aligned}
 ⑦ a) \text{ let } f(x) &= 5x^3 + 16x^2 - x - 12 \\
 f(-3) &= 5(-3)^3 + 16(-3)^2 - (-3) - 12 \\
 &= 5(-27) + 16(9) + 3 - 12 \\
 &= -135 + 144 + 3 - 12 \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 ⑨ x^2 + (x+1)^2 - 2x + 6(x+1) - 15 &= 0 \\
 x^2 + x^2 + 2x + 1 - 2x + 6x + 6 - 15 &= 0 \\
 2x^2 + 6x - 8 &= 0 \\
 2(x^2 + 3x - 4) &= 0 \\
 2(x+4)(x-1) &= 0 \\
 x &= -4 \quad x = 1 \\
 y &= -3 \quad y = 2 \\
 \therefore \underline{\underline{(-4, -3) \quad (1, 2)}}
 \end{aligned}$$

$$\begin{aligned}
 b) \quad &5x^2 + x - 4 \\
 x \quad &\begin{array}{|c|c|c|} \hline 5x^3 & +x^2 & -4x \\ \hline \end{array} \\
 +3 \quad &\begin{array}{|c|c|c|} \hline +15x^2 & +3x & -12 \\ \hline \end{array} \\
 \therefore f(x) &= (x+3)(5x^2+x-4)
 \end{aligned}$$

$$\begin{array}{c}
 5x - 4 \\
 x \quad \begin{array}{|c|c|} \hline 5x^2 & -4x \\ \hline \end{array} \\
 +1 \quad \begin{array}{|c|c|} \hline +5x & -4 \\ \hline \end{array} \\
 \begin{array}{c} \frac{20}{1 \quad 20} \\ \frac{2 \quad 10}{\underline{4 \quad 5}} \end{array}
 \end{array}$$

$$\therefore \underline{\underline{f(x) = (x+3)(x+1)(5x-4)}}$$

$$\begin{aligned}
 ⑩ \underline{u} \cdot \underline{v} &= (1 \times 1) + (1 \times 3) + (0 \times k) \\
 &= 1 + 3 + 0 \\
 &= \underline{\underline{4}}
 \end{aligned}$$

$$\begin{aligned}
 |\underline{u}| &= \sqrt{1^2 + 1^2 + 0^2} \\
 &= \sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 |\underline{v}| &= \sqrt{1^2 + 3^2 + k^2} \\
 &= \sqrt{k^2 + 10}
 \end{aligned}$$

⑪  $a=9$   $b=3k$   $c=k$

For real, distinct roots

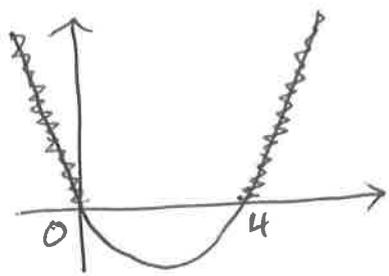
$$b^2 - 4ac > 0$$

$$\therefore (3k)^2 - 4(9)(k) > 0$$

$$9k^2 - 36k > 0$$

$$9k(k-4) > 0$$

roots @  $k=0, k=4$



$$\therefore k < 0, k > 4$$

⑫  $y = \int (6 \cos x + 8 \sin 2x) dx$   
 $= 6 \sin x - \frac{8}{2} \cos 2x + C$   
 $= 6 \sin x - 4 \cos 2x + C$

$$\therefore 6 \sin\left(\frac{\pi}{6}\right) - 4 \cos 2\left(\frac{\pi}{6}\right) + C = 4$$

$$6 \sin 30^\circ - 4 \cos 60^\circ + C = 4$$

$$6\left(\frac{1}{2}\right) - 4\left(\frac{1}{2}\right) + C = 4$$

$$3 - 2 + C = 4$$

$$C + 1 = 4$$

$$\underline{C = 3}$$

$$\therefore y = 6 \sin x - 4 \cos 2x + 3$$

⑬ a) SP's @  $f'(x) = 0$

$$\therefore (x+5)(2-x) = 0$$

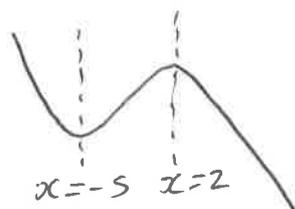
$$x = -5 \quad x = 2$$

$x$	$\xrightarrow{-6}$	$-5$	$\xrightarrow{0}$	$0$	$\xrightarrow{2}$	$3$
$f'(x)$		$-$	$0$	$+$	$+$	$0$
shape		$\backslash$	$-$	$/$	$/$	$-$

$\therefore$  Min TP @  $x = -5$

Max TP @  $x = 2$

b) from a): slope is



•  $f(0) < 0 \rightarrow$  y-intercept is negative.

•  $f(x) = 0$  one solution  
 $\rightarrow$  one root, between  $-10$  and  $10$ .

y-axis must be between the min and max TP.

Since only one root, the Max TP must be below the x-axis.

