HIGHER MATHS 2025

Paper 2

(1) a) $M_{AC} = \frac{-14+24}{-9-21}$

$= \frac{10}{-30}$

$= -\frac{1}{3}$

$\therefore M_{alt} = 3$

$y - 20 = 3(x-9)$

$y - 20 = 3x - 27$

$y = 3x - 7$

b) mid $= (15, -2)$

$M_{med} = \frac{-2+14}{15+9}$

$= \frac{12}{24}$

$= \frac{1}{2}$

$y + 2 = \frac{1}{2}(x-15)$

$2y + 4 = x - 15$

$2y = x - 19$

c) $3x - y = 7$ (1)

$x - 2y = 19$ (2)

(1) $\times 2$ $6x - 2y = 14$ (3)

(3) $-$ (2) $5x = -5$

$x = -1$

$y = 3(-1) - 7$

$= -10$

$\therefore (-1, -10)$

(2) $p(x+q)^2 + r$

$= p(x^2 + 2qx + q^2) + r$

$= px^2 + 2pqx + pq^2 + r$

$2x^2 + 16x + 5$

$\therefore p = 2$

$2pq = 16$

$2(2)q = 16$

$4q = 16$

$q = 4$

$pq^2 + r = 5$

$2(4)^2 + r = 5$

$2(16) + r = 5$

$32 + r = 5$

$r = -27$

$\therefore 2(x+4)^2 - 27$

(3) $\int_2^4 (x^2 - 2x + 3)\,dx$

$= \left[\frac{x^3}{3} - \frac{2x^2}{2} + 3x\right]_2^4$

$= \left[\frac{x^3}{3} - x^2 + 3x\right]_2^4$

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

$= \left(\frac{64}{3} - 16 + 12\right) - \left(\frac{8}{3} - 4 + 6\right)$

$= \left(\frac{64}{3} - 4\right) - \left(\frac{8}{3} + 2\right)$

$= \left(\frac{64}{3} - \frac{12}{3}\right) - \left(\frac{8}{3} + \frac{6}{3}\right)$

$= \frac{52}{3} - \frac{14}{3}$

$= \frac{38}{3}u^2$

(5) a) $\overrightarrow{AB} = \underline{b} - \underline{a}$

$= \begin{pmatrix} 6 \\ -1 \\ 5 \end{pmatrix} - \begin{pmatrix} -3 \\ 2 \\ -1 \end{pmatrix}$

$= \begin{pmatrix} 9 \\ -3 \\ 6 \end{pmatrix} = 3\begin{pmatrix} 3 \\ -1 \\ 2 \end{pmatrix}$

$\overrightarrow{BC} = \underline{c} - \underline{b}$

$= \begin{pmatrix} 12 \\ -3 \\ 9 \end{pmatrix} - \begin{pmatrix} 6 \\ -1 \\ 5 \end{pmatrix}$

$= \begin{pmatrix} 6 \\ -2 \\ 4 \end{pmatrix} = 2\begin{pmatrix} 3 \\ -1 \\ 2 \end{pmatrix}$

$\overrightarrow{AB} = \frac{3}{2}\overrightarrow{BC}$ ∴ vectors are parallel

B is common ∴ points are collinear

b) 3 : 2

(6) a) $k\cos(x+\alpha)$

$= k\cos x\cos\alpha - k\sin x\sin\alpha$

$+ k\cos\alpha\cos x \quad - k\sin\alpha\sin x$

$5\cos x - 9\sin x$

$-k\sin\alpha = -9$

$k\sin\alpha = 9$

$k\cos\alpha = 5$

$k^2 = 9^2 + 5^2$

$= 81 + 25$

$k = \sqrt{106}$

$\tan\alpha = \frac{9}{5}$

$\alpha = \tan^{-1}\left(\frac{9}{5}\right)$

$= 1.06$

$k\sin\alpha$ = POS

$k\cos\alpha$ = POS

S	A
T	C

∴ Q1

∴ $5\cos x - 9\sin x$

$= \sqrt{106}\cos(x + 1.06)$

b) $\sqrt{106}\cos(x+1.06) = 7$

$\cos(x+1.06) = \frac{7}{\sqrt{106}}$

$x + 1.06 = \cos^{-1}\left(\frac{7}{\sqrt{106}}\right)$

$x + 1.06 = 0.82, 5.46$

$x = -0.24, 1.40$

$x = 1.4, 6.04$

~~S~~ A

~~T~~ C $2\pi - x$

$2\pi - 0.82$

$= 5.46$

(7) $\int (3x+2)^7 dx$

$= \frac{(3x+2)^8}{8 \times 3} + C$

$= \frac{1}{24}(3x+2)^8 + C$

(8) $\overrightarrow{BE} = \overrightarrow{BC} + \overrightarrow{CD} + \overrightarrow{DE}$

$= \overrightarrow{AD} - \overrightarrow{DC} + \overrightarrow{DE}$

$= \begin{pmatrix} 6 \\ 4 \\ 2 \end{pmatrix} - \begin{pmatrix} 2 \\ -4 \\ 2 \end{pmatrix} + \begin{pmatrix} -4 \\ -3 \\ 4 \end{pmatrix}$

$= \begin{pmatrix} -8 \\ 5 \\ 4 \end{pmatrix}$

∴ $-8\underline{i} + 5\underline{j} + 4\underline{k}$

(9) a) $L = \frac{b}{1-a}$

$10 = \frac{4}{1-a}$

$1-a = \frac{4}{10}$

$1-a = 0.4$

$a = 0.6$

b) $u_{n+1} = 0.6u_n + 4$

$19 = 0.6u_0 + 4$

$0.6u_0 = 15$

$u_0 = \frac{15}{0.6}$

$u_0 = 25$

(10) a) Triangle $A = \frac{1}{2}bh$

$= \frac{1}{2}(4x)(3x)$

$= \frac{1}{2}(12x^2)$

$= 6x^2$

Rectangle $A = lb$

$= 5xy$

$\therefore$ Area $= 150$

$5xy + 6x^2 = 150$

$5y = 150 - 6x^2$

$y = \frac{30}{x} - \frac{6}{5}x$

Perimeter $= 4x + 3x + 5x + 2y$

$= 12x + 2\left(\frac{30}{x} - \frac{6}{5}x\right)$

$= 12x + \frac{60}{x} - \frac{12}{5}x$

$= 9.6x + \frac{60}{x}$

(as required)

b) SP's @ $\frac{dP}{dx} = 0$.

$P = 9.6x + 60x^{-1}$

$\therefore \frac{dP}{dx} = 9.6 - 60x^{-2}$

$= 9.6 - \frac{60}{x^2}$

$\therefore 9.6 - \frac{60}{x^2} = 0$

$9.6 = \frac{60}{x^2}$

$x^2 = \frac{60}{9.6}$

$x = \sqrt{\frac{60}{9.6}}$

$x = 2.5, \cancel{-2.5}$

x	$\xrightarrow{2}$	2.5	$\xrightarrow{3}$
$\frac{dP}{dx}$	−	0	+
shape	\	—	/

$\therefore$ minimum @ $x = 2.5$

$\therefore P = 9.6(2.5) + \frac{60}{2.5}$

$= 48$ cm

(11) $3\sin 2x + 4\cos x = 0$

$3(2\sin x \cos x) + 4\cos x = 0$

$6\sin x \cos x + 4\cos x = 0$

$2\cos x(3\sin x + 2) = 0$

$2\cos x = 0$ $\quad$ $3\sin x + 2 = 0$

$\cos x = 0$ $\quad$ $\sin x = -\frac{2}{3}$

$x = 90°, 270°$ $\quad$ $x =$ "$-41.8°$"

$x = 221.8°, 318.2°$

$\therefore x = 90°, 221.8°, 270°, 318.2°$

(12) a) $f(g(x))$

$= f(1-x^3)$

$= (1-x^3)^5 + 3$

b) $h(x) = (1-x^3)^5 + 3$

$h'(x) = 5(1-x^3)^4 \times (-3x^2)$

$= -15x^2(1-x^3)^4$

(13) a) 150 mg

b) $120 = 150e^{-0.0054t}$

$\frac{120}{150} = e^{-0.0054t}$

$\ln\left(\frac{120}{150}\right) = -0.0054t$

$t = \frac{\ln\left(\frac{120}{150}\right)}{-0.0054}$

$t = 41.32$ years

(14) a) $C_1 = (-5, 6)$

$r_1 = 3$

b) $2g = -14 \quad 2f = 6 \quad c = 54$

$g = -7 \quad f = 3$

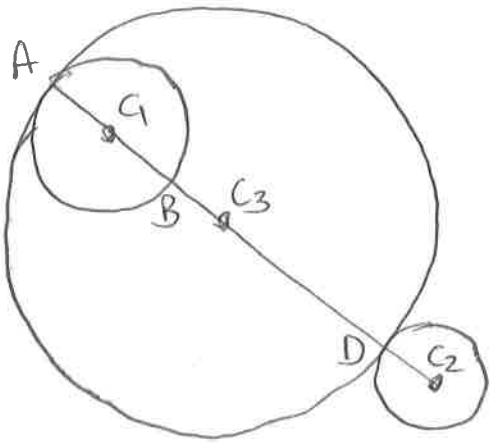
$C_2 = (7, -3)$

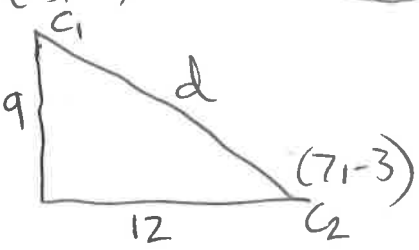
$r_2 = \sqrt{(-7)^2 + 3^2 - 54}$

$= \sqrt{4}$

$= 2$

c)





$C_1 \to C_2$

$d^2 = 9^2 + 12^2$

$= 225$

$d = 15$

$A \to C_1 = 3$ so $A \to C_2 = 3 + 15$

$= 18$

$D \to C_2 = 2$ so $A \to D = 18 - 2$

$= 16$

$\therefore$ diameter $= 16$, radius $= 8$

$A \to B = 6$ and $A \to C_3 = 8$

so $B \to C_3 = 2$

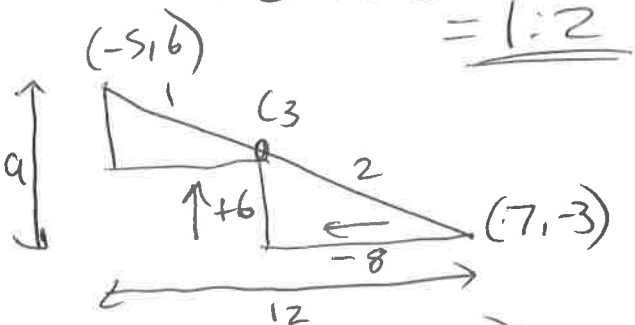
and $C_1 \to C_3 = 5$

$C_3 \to D = 8$ and $D \to C_2 = 2$

so $C_3 \to C_2 = 10$

$\therefore$ C_3 splits $C_1 \to C_2$ in the ratio 5:10

$= 1:2$



$\therefore C_3 = (-1, 3)$

$\therefore (x+1)^2 + (y-3)^2 = 64$