



Q1.

(a)(i) $(f \circ g)(4) = 6$

$f(g(4)) = 6$

$$k^2 - \frac{1}{\sqrt{4+5}} + 3 = 6$$

$$\frac{k^2}{3} = 3 \quad k = \pm 3$$

(ii) $|5x-7| \geq 3 \Rightarrow \pm(5x-7) \geq 3$

$$\Rightarrow 5x-7 \geq 3 \quad \text{or} \quad 7-5x \geq 3$$

$$\Rightarrow 5x \geq 10 \quad \Rightarrow -5x \geq -4$$

$$\Rightarrow x \geq 2 \quad \Rightarrow x \leq \frac{4}{5}$$

$$x \geq 2 \text{ or } x \leq \frac{4}{5}$$

(iii) $\log_{10}(x-1) + \log_{10}(x-2) - \log_{10} 3 = \log_{10} 2$

$$\Rightarrow \log_{10}[(x-1)(x-2)] - \log_{10} 3 = \log_{10} 2$$

$$\Rightarrow \log_{10}(x-1)(x-2) - 3 = \log_{10} 2$$

$$\Rightarrow (x-1)(x-2) - 3 = 2$$

$$\Rightarrow x^2 - 3x + 2 = 6$$

$$\Rightarrow x^2 - 3x - 4 = 0$$

$$\Rightarrow x = 3 \text{ or } x = -1$$

(iv) $e^x = 2^{(x+3)}$

$$\Rightarrow \log e^x = \log 2^{(x+3)}$$

$$\Rightarrow x = (x+3) \log 2$$

$$\Rightarrow \frac{x}{x+3} = 0.30$$



$$\Rightarrow x = 0.30(x+3)$$

$$\Rightarrow 0.7x = 0.9$$

$$x = 1.29$$

$$(b) (i) \quad 2x^2 - 20x + 47 \\ = 2(x^2 - 10x + \frac{47}{2})$$

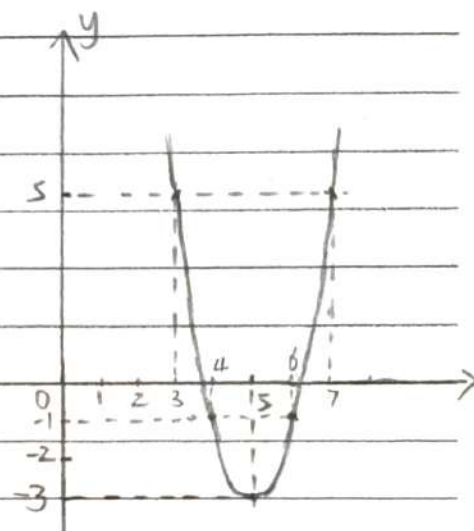
$$= 2(x^2 - 10x + 25 - 25 + \frac{47}{2})$$

$$= 2(x-5)^2 + 2(-25 + \frac{47}{2})$$

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

$$(ii) \quad R_f = [-3, +\infty)$$

(iii)



$$(c) \quad 9e^{2x} + 12e^x - 5 = 0$$

$$\Rightarrow 9(e^x)^2 + 12e^x - 5 = 0$$

$$\Rightarrow 9t^2 + 12t - 5 = 0$$

$$\text{use the formula to know } t_1 = -\frac{5}{3} \quad t_2 = \frac{1}{3}$$

$$e^x = -\frac{5}{3} \quad \text{or} \quad e^x = \frac{1}{3}$$

$$\text{but since } e^x > 0$$

$$e^x = \frac{1}{3}$$



Q2.

$$\begin{aligned} (a) (i) &= \operatorname{cosec}^2 \theta \times \sin^2 \theta + \sec^2 \theta \times \cos^2 \theta \\ &= 1 + 1 \\ &= 2. \end{aligned}$$

$$(ii) \quad \frac{\tan 70^\circ + \tan 50^\circ}{1 - \tan 70^\circ \cdot \tan 50^\circ} = \tan(70^\circ + 50^\circ) = \tan 120^\circ = -\sqrt{3}$$

$$\Rightarrow \frac{\tan 70^\circ + \tan 50^\circ}{1 - \tan 70^\circ \cdot \tan 50^\circ} - \sqrt{3} = \sqrt{3} - \sqrt{3} = 0.$$

$$(iii) \quad \text{LHS} = \frac{3 \sin \theta - 4 \sin^3 \theta - \sin \theta}{\cos^2 \theta - \sin^2 \theta}$$

$$= \frac{-2 \sin \theta (2 \sin^2 \theta - 1)}{\cos 2\theta}$$

$$= \frac{-2 \sin \theta (-\cos 2\theta)}{\cos 2\theta} = 2 \sin \theta = \text{RHS}$$

$$(b) (i) \quad f(x) = 5 \left(\frac{4}{5} \sin x + \frac{3}{5} \cos x \right)$$

$$= 5 (\sin 53^\circ \sin x + \cos 53^\circ \cos x)$$

$$= 5 \cos(x - 53^\circ) = 5 \cos\left(x - \frac{53\pi}{180}\right)$$

$$(ii) \quad 5 \cos(x - 53^\circ) = 4$$

$$\Rightarrow \cos(x - 53^\circ) = \frac{4}{5}$$

$$\text{since } \cos(\pm 37^\circ) = \frac{4}{5}$$

$$\Rightarrow x - 53^\circ = \pm 37^\circ$$

$$x = 90^\circ \text{ or } x = 16^\circ$$

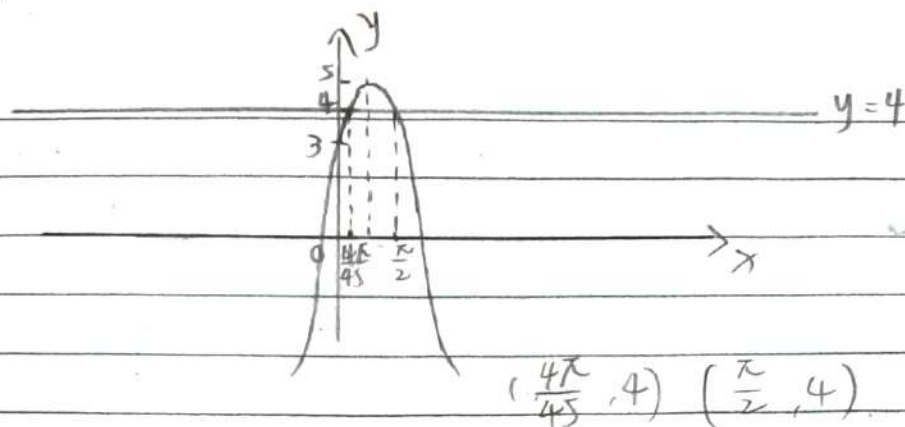
$$\text{but } 0 < x < \pi$$

$$x = 16^\circ = \frac{4\pi}{45}$$



Q2(b)

(iii)



(c)(i)

$$\begin{array}{r|rrrr} -2 & 2 & -3 & -11 & 6 \\ & & -4 & 14 & -6 \\ \hline & 2 & -7 & 3 & 0 \end{array}$$

← since this digit is 0,
 $(x+2)$ is a factor of $p(x)$

(ii) $p(x) = (x+2)(2x^2-7x+3)$

use the quadratic formula in $(2x^2-7x+3)$
 $\Rightarrow x_1 = 3, x_2 = \frac{1}{2}$

$$\begin{aligned} p(x) &= 2(x+2)(x-3)(x-\frac{1}{2}) \\ &= (x+2)(x-3)(2x-1) \end{aligned}$$



Q4

$$(a)(i) \quad \frac{5x+6}{(x+2)(x+1)} = \frac{A}{(x+2)} + \frac{B}{(x+1)}$$

$$A(x+1) + B(x+2) = 5x+6$$

$$x = -1, B = 1$$

$$x = -2, -A = -4 \quad A = 4$$

$$\frac{5x+6}{(x+2)(x+1)} = \frac{4}{x+2} + \frac{1}{x+1}$$

$$(ii) \quad \frac{3(x^2-3)}{(x^2+2)(x-1)} = \frac{Ax+B}{(x^2+2)} + \frac{C}{(x-1)}$$

$$(Ax+B)(x-1) + (x^2+2)C = 3(x^2-3)$$

$$x=1, 3C = -6 \quad C = -2$$

$$Ax^2 - 2x^2 = 3x^2 \Rightarrow A = 5$$

$$-B + 2x(-2) = -9 \Rightarrow B = 5$$

$$\frac{3(x^2-3)}{(x^2+2)(x-1)} = \frac{5x+5}{x^2+2} + \frac{-2}{x-1}$$

$$(b)(i) \quad = \frac{|\bar{z}_1| |z_2|^6}{|\bar{z}_1| |z_3|} \quad (ii) \quad r = \sqrt{(-1)^2 + (-5)^2} = \sqrt{26}$$

$$= \frac{|z_1| |z_2|^6}{|z_1| |z_3|}$$

$$\tan \theta = \frac{1}{5} \quad \theta = 11.31^\circ = 0.063\pi$$

$$z = \sqrt{26} (\cos 0.063\pi + i \sin 0.063\pi)$$

$$= \frac{2^6}{\sqrt{5}} = \frac{64\sqrt{5}}{5}$$



$$(c)(i) \begin{cases} a+8d=60 \\ a+19d=38 \end{cases} \Rightarrow \begin{cases} a=76 \\ d=-2 \end{cases}$$

$$14^{\text{th}} \text{ term} = a+13d = 76-2 \times 13 = 50$$

$$(ii) 1.123123\overline{123} = 1 + \left(\frac{123}{10^3} + \frac{123}{10^6} + \frac{123}{10^9} + \dots \right) \rightarrow \text{GP}$$

$$a = \frac{123}{10^3} \quad r = \frac{1}{10^3}$$

$$\frac{123}{10^3} + \frac{123}{10^6} + \dots = \frac{\frac{123}{10^3}}{1 - \frac{1}{10^3}} = \frac{123}{999} = \frac{43}{333}$$

$$\Rightarrow 1.123123\overline{123} = 1 + \frac{43}{333} = \frac{376}{333}$$

$$\begin{aligned} (iii) \sum_1^n (6n^2 + 4n - 1) &= \sum_1^n 6n^2 + \sum_1^n 4n - n \\ &= \frac{6n(n+1)(2n+1)}{6} + \frac{4n(n+1)}{2} - n \\ &= n(n+1)(2n+3) - n \\ &= n(2n^2 + 5n + 3 - 1) \\ &= n(2n^2 + 5n + 2) \\ &= n(n+2)(2n+1) \end{aligned}$$

$$\begin{aligned} (iv) \frac{1}{(n+2)(n+3)} &= \frac{1}{n+2} - \frac{1}{n+3} \\ \sum_1^{\infty} \left(\frac{1}{n+2} - \frac{1}{n+3} \right) \\ &= \left(\frac{1}{1+2} - \frac{1}{1+3} \right) + \left(\frac{1}{1+3} - \frac{1}{1+4} \right) + \dots + \left(\frac{1}{n+2} - \frac{1}{n+3} \right) \end{aligned}$$

$$\lim_{n \rightarrow \infty} \left(\frac{1}{1+2} - \frac{1}{n+3} \right) = \frac{1}{3} - 0 = \frac{1}{3}$$