

Q1)

$$a) i) \frac{3x-1}{5} = \frac{6x+5}{9}$$

$$= 9(3x-1) = 5(6x+5)$$

$$= 27x-9 = 30x+25$$

$$= -9-25 = 30x-27x$$

$$= -34 = 3x$$

$$\frac{-34}{3} = x$$

$$\boxed{-11.33 = x}$$

$$ii) 1 + \frac{5}{x} = \frac{-6}{x^2} \quad \times x^2$$

$$= \frac{x^3 + 5x^2}{x^2} = \frac{-6x^2}{x^2}$$

$$= x^2 + 5x = -6$$

$$= x^2 + 5x + 6 = 0$$

$$(x+2)(x+3) = 0$$

$$\boxed{x = -2} \quad \boxed{x = -3}$$

$$iii) 2 \log(3x+1) = \log(x+3) + \log(x+7)$$

$$= \log(3x+1)^2 = \log(x+3)(x+7)$$

$$= (3x+1)(3x+1) = x^2 + 7x + 3x + 21$$

$$= 9x^2 + 6x + 1 = x^2 + 10x + 21$$

$$= 9x^2 - x^2 + 6x - 10x + 1 - 21 = 0$$

$$= 8x^2 - 4x - 20 = 0$$

$$= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = 0$$

$$= \frac{-(-1) \pm \sqrt{(-1)^2 - 4(8)(-20)}}{2(8)}$$

$$= \frac{1 \pm \sqrt{1+640}}{16}$$

$$= \frac{1 \pm 25.32}{16}$$

$$x = \frac{1 + 25.32}{16}$$

$$x = 1.645$$

$$x = \frac{1 - 25.32}{16}$$

$$x = -1.52$$

$$\begin{aligned} b) i) & 8P^3Q^2 - 4P^2Q^3 + 2P^3Q \\ &= 2PQ(4P^2Q - 2PQ^2 + 1P^2) \\ &= (2PQ)(P)(4PQ - 2Q^2 + P) \\ &= (2P^2Q)(4PQ - 2Q^2 + P) \end{aligned}$$

$$\begin{aligned} ii) & x^2 - y^2 \\ &= (x+y)(x-y) \end{aligned}$$

$$\begin{aligned} c) i) & x^2 + 12x + 20 = 0 \\ &= (x+2)(x+10) = 0 \\ & \quad x = -2 \quad x = -10 \end{aligned}$$

$$\begin{aligned} ii) & 2x^2 + x - 15 = 0 \\ & (2x-5)(x+3) = 0 \end{aligned}$$

$$\begin{aligned} 2x &= 5 \\ x &= 2.5 \end{aligned}$$

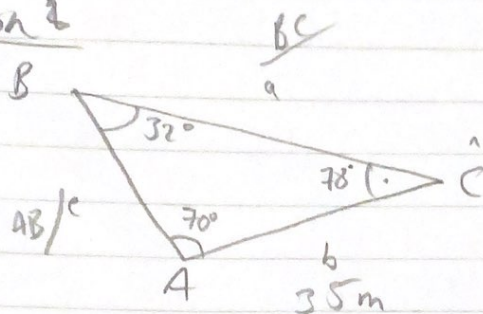
$$x = -3$$

$$\begin{aligned} iii) & x^2 - 400 = 0 \\ & (x+20)(x-20) = 0 \end{aligned}$$

$$x = -20$$

$$x = 20$$

Question 2



i) $180 - 32 - 70$
 $\hat{C} = 78^\circ$

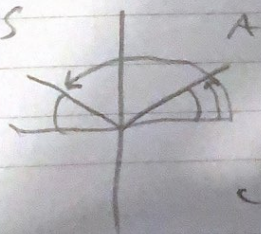
ii) $AB = \frac{BC}{\sin 78^\circ} = \frac{35}{\sin 32}$
 $= \frac{35(\sin 78)}{\sin 32}$
 $= \frac{35(0.9781)}{0.5299}$
 $= 64.60m$

iii) $BC = \frac{AB}{\sin 70} = \frac{35}{\sin 32}$
 $BC = \frac{35(\sin 70)}{\sin 32}$
 $BC = \frac{35(0.9397)}{0.5299}$
 $= 62.07m$

Question 3

a) $\sin x = 0.67$
 $x = \sin^{-1}(0.67)$
 $x = 42.07^\circ$

$y = 180 - 42.07$
 $= 137.93^\circ$



3) ii) $\tan^2 x - 7 \tan x + 10 = 0$

$$(\tan - 2)(\tan - 5) = 0$$

$$\tan x = 2$$

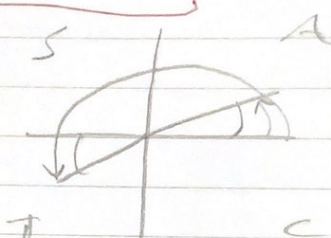
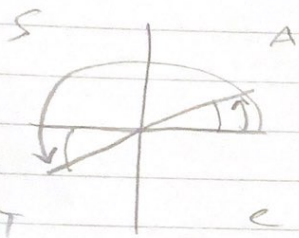
$$x = \tan^{-1}(2)$$

$$x = 63.43^\circ$$

$$\tan x = 5$$

$$x = \tan^{-1}(5)$$

$$x = 78.69^\circ$$



$$x = 180 + 63.43$$

$$x = 243.43^\circ$$

$$x = 180 + 78.69$$

$$x = 258.69^\circ$$

Question 4

$$y = 5x^2 + 12x - 14 \quad (1)$$

$$y = 4x^2 + 3x - 4 \quad (2)$$

$$(1) \quad 5x^2 + 12x - 14 - y = 0$$

$$5x^2 + 12x - 14 - (4x^2 + 3x - 4) = 0$$

$$x^2 + 9x - 10 = 0$$

$$(x - 1)(x + 10) = 0$$

$$x = 1 \text{ or } x = -10 \quad \text{Sub into (2)}$$

~~$$y = 4x^2 + 3x - 4$$~~

~~$$y = 4(1)^2 + 3(1) - 4$$~~

~~$$y = 4 + 3 - 4$$~~

$$y = 3 \text{ when } x = 1$$

$$y = 4(-1)^2 + 3(-1) - 4$$

$$y = 4(1) - 3 - 4$$

$$y = -3, \text{ when } x = -1$$

Question 5

$$z_1 = 3 + 7j, \quad z_2 = 2 - 10j$$

$$\begin{aligned} \text{i) } z_1 + z_2 &= (3 + 7j) + (2 - 10j) \\ &= 5 - 3j \end{aligned}$$

$$\text{ii) } z_1 - \bar{z}_2$$

$$\bar{z}_2 = 2 + 10j$$

$$\begin{aligned} &= (3 + 7j) - (2 + 10j) \\ &= 1 - 3j \end{aligned}$$

$$\begin{aligned} \text{iii) } \frac{z_1}{z_2} &= \frac{3 + 7j}{2 - 10j} \\ &= \frac{(3 + 7j)(2 + 10j)}{(2 - 10j)(2 + 10j)} \\ &= \frac{6 + 30j + 14j + 70j^2}{4 + 20j - 20j - 100j^2} \end{aligned}$$

$$\begin{aligned} &= \frac{6 + 44j + 70(-1)}{4 - 100(-1)} \end{aligned}$$

$$= \frac{-70 + 6 + 44j}{14 + 100}$$

$$= \frac{-64 + 44j}{114}$$

$$b) \quad 7x^2 = -2x - 11$$

$$7x^2 + 2x + 11 = 0$$

$$x = \frac{-(2) \pm \sqrt{(2)^2 - 4(7)(11)}}{2(7)}$$

$$= \frac{-2 \pm \sqrt{4 - 308}}{14}$$

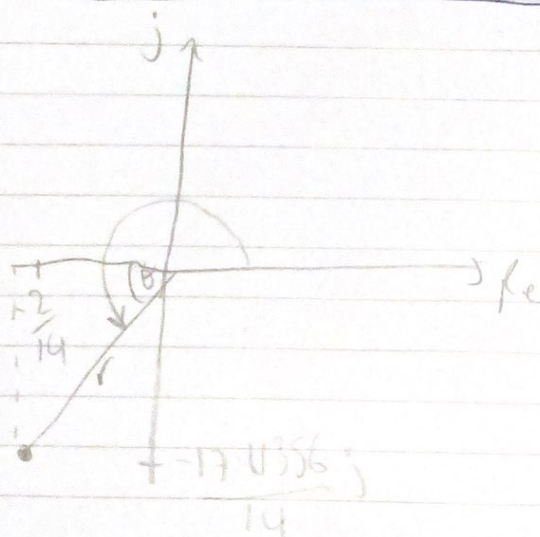
$$= \frac{-2 \pm \sqrt{-304}}{14}$$

$$= \frac{-2 \pm \sqrt{304} \sqrt{-1}}{14}$$

$$= \frac{-2 \pm 17.4356j}{14}$$

$$x = \frac{-2}{14} + \frac{17.4356j}{14}$$

$$x = \frac{-2}{14} - \frac{17.4356j}{14}$$



$$r = \sqrt{\left(\frac{-2}{14}\right)^2 + \left(\frac{-17.4356}{14}\right)^2}$$

$$r = \sqrt{1.5714}$$

$$r = 1.25$$

$$\tan \theta = \frac{17.4356}{14}$$

$$\frac{17.4356}{14} = 1.2454$$

$$\tan^{-1} 1.2454 = 0.1029$$

$$\tan^{-1} 1.09 = 0.1029$$

$$\tan^{-1} 1.09 = 0.1029$$

$$\theta = \tan^{-1}(1.09)$$

$$\theta = 47.47$$

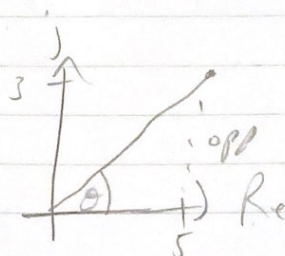
P.F.

$$1.25(\cos 47.47 + j \sin 47.47)$$

c)
i) $(5 + 3j)^4$

$$r = \sqrt{25 + 9}$$

$$r = 5.83$$



$$\tan \theta = \frac{3}{5}$$

$$\theta = \tan^{-1}\left(\frac{3}{5}\right)$$

$$\theta = 30.96^\circ$$

$$(5.83)^4 (\cos 4 \times 30.96 + j \sin 4 \times 30.96)$$

$$= 1155.25 (\cos 123.84 + j \sin 123.84)$$

$$= -643.33 + 959.55j$$

Question Six

i) $\frac{dy}{dx} = 27x^2 + 14x$

ii) $y = 6x^2 - 10x + 9x - 15$
 $= 6x^2 - x - 15$

$\frac{dy}{dx} = 12x - 1$

iii) $y = 2 \ln x + 5x^{-1}$
 $\frac{dy}{dx} = \frac{2}{x} - 5x^{-2}$

iv) $\frac{dy}{dx} = 7 \cos x - 6 \sin 2x + \frac{1}{2} \sec^2 x$

v) $\frac{dy}{dx} = 5x (2 \cos 2x)$
 $= 10x \cos 2x$

(vi) $y = \frac{e^{3x}}{x^3}$

$y = e^{3x} x^{-3}$
 $\frac{dy}{dx} = 3e^{3x} - 3e^{3x} x^{-4}$

vii) $y = 5x^{10} - 2x^5 + 1$
 $\frac{dy}{dx} = 50x^9 - 10x^4$

Question 7

$$9) i) \frac{x^6}{6} + \frac{2x^3}{3} + \frac{x^2}{2} - \frac{10x}{1} + c$$

$$\begin{aligned}
 ii) & \int (2x^3 - 2x + 5x^2 - 5) dx \\
 &= \int (2x^3 + 5x^2 - 2x - 5) dx \\
 &= \frac{2x^4}{4} + \frac{5x^3}{3} - \frac{2x^2}{2} - \frac{5x}{1} + c
 \end{aligned}$$

$$iii) \int_2^5 2x^4 + 6x^2$$

$$\frac{2}{5} \left[\frac{2x^5}{5} + \frac{6x^3}{3} \right]$$

$$\left[\frac{2(5)^5}{5} + \frac{6(5)^3}{3} \right] - \left[\frac{2(2)^5}{5} + \frac{6(2)^3}{3} \right]$$

$$= 1500 - 28.8$$

$$= 1471.2$$

$$iv) \int 5 \sin 3x - \cos \frac{x}{3} dx$$

$$\int 5 \sin 3x - \cos x^{-3} dx$$

$$= 5 \left(-\frac{1}{3} \right) \cos 3x - \sin x^{-3} + c$$

$$= -\frac{5}{3} \cos 3x - \frac{\sin x}{3} + c$$