1)

$$\frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 6\sin\theta$$

C F

$$m^2 + 4m + 5 = 0$$

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

$$\frac{-4 \pm \sqrt{4^2 - 4(1)(5)}}{2(1)} = m$$

$$\frac{-4 \pm \sqrt{16 - 20}}{2}$$

$$\frac{-4}{2} \pm \frac{\sqrt{-4}}{2}$$

$$-2 \pm \frac{j2}{2}$$

$$m = -2 \pm j$$

$$y = e^{-2\theta}(A\cos\theta + B\sin\theta)$$

P. I

$$y = C\sin\theta + D\cos\theta$$

$$\frac{dy}{d\theta} = C\cos\theta - D\sin\theta$$

$$\frac{d^2y}{d\theta^2} = -C\sin\theta - D\cos\theta$$

$$-C\sin\theta - D\cos\theta + 4(C\cos\theta - D\sin\theta) + 5(C\sin\theta + D\cos\theta) = 6\sin\theta$$

$$-C\sin\theta - D\cos\theta + 4C\cos\theta - 4D\sin\theta + 5C\sin\theta + 5D\cos\theta = 6\sin\theta$$

Comparing coefficients,

$$-C - 4D + 5C = 6 \quad -(i)$$

$$-D + 4C + 5D = 0 \quad -(ii)$$

$$4C - 4D = 6$$

$$\underline{4D + 4C = 0}$$

$$8D = 6$$

$$D = -\frac{6}{8} = -\frac{3}{4}$$

$4C = -4D$

$C = -D$

$C = \frac{3}{4}$

$PI = \frac{3}{4}\sin\theta - \frac{3}{4}\cos\theta$

$= \frac{3}{4}(\sin\theta - \cos\theta)$

$GF = CF + PI$

$= e^{-2\theta}(A\cos\theta + B\sin\theta) + \frac{3}{4}(\sin\theta - \cos\theta)$

ii) $y = \frac{3}{4}(\sin\theta - \cos\theta)$

For $\theta = 0$ to $270°$

iii) at steady state $\frac{dy}{d\theta} = 0 \quad \theta = \alpha$

$y = e^{-2\theta}(A\cos\theta + B\sin\theta) + \frac{3}{4}(\sin\theta - \cos\theta)$

$\frac{dy}{d\theta} = e^{-2\theta}(-A\sin\theta + B\cos\theta) + (A\cos\theta + B\sin\theta)\cdot -2e^{-2\theta} + \frac{3}{4}(\cos\theta + \sin\theta)$

at $\theta = \alpha$

$\frac{dy}{d\theta} = \frac{3}{4}(\cos\theta + \sin\theta)$

$0 = \frac{3}{4}(\cos\theta + \sin\theta)$

$0 = \cos\theta + \sin\theta$

$\sin\theta = -\cos\theta$

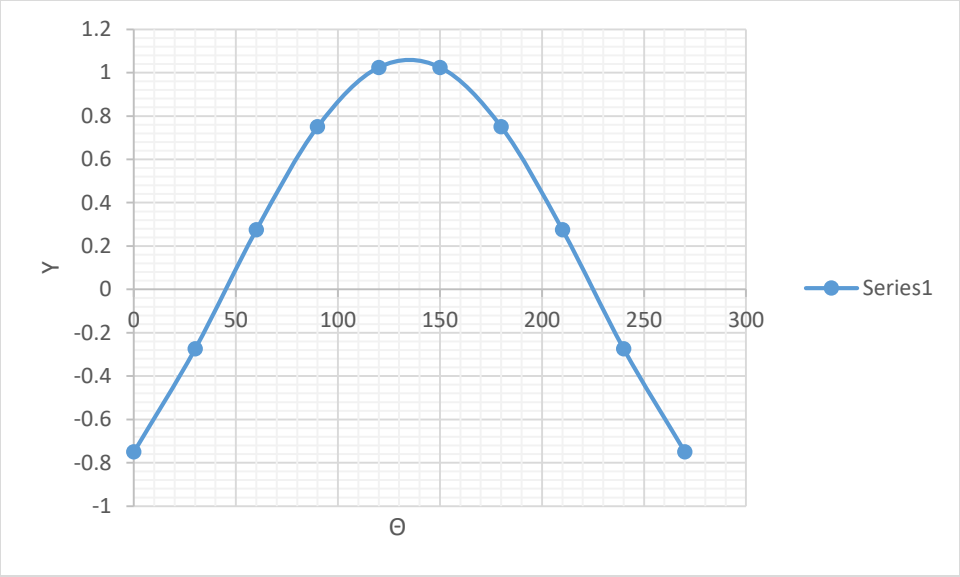
Dividing by $\cos\theta$

$\frac{\sin\theta}{\cos\theta} = \frac{-\cos\theta}{\cos\theta}$

$\tan\theta = -1$

$\theta = \tan^{-1}-1$

$\theta = -45°$ $\therefore \theta = 135°$ or $315°$



Θ	y
0	-0.75
30	-0.27452
60	0.274519
90	0.75
120	1.024519
150	1.024519
180	0.75
210	0.274519
240	-0.27452
270	-0.75

2 $EI\frac{d^2y}{dx^2} = \frac{w}{2}(L-x)^2$

Solution

C.F

$EIm^2 = 0$

$m^2 = 0$

$m = \sqrt{0}$

$m = 0$

$y = e^{0x}(A+Bx)$

$y = A+Bx$

P.I

$y = Gx^2 + Hx^3 + Zx^4$

$\frac{dy}{dx} = 2Gx + 3Hx^2 + 4Zx^3$

$\frac{d^2y}{dx^2} = 2G + 6Hx + 12Zx^2$

$EI(2G+6Hx+12Zx^2) = \frac{w}{2}(L-x)^2$

$2GEI + 6HxEI + 12Zx^2EI = \frac{w}{2}(L^2-2Lx+x^2)$

$4GEI + 12HxEI + 24Zx^2EI = w(L^2-2Lx+x^2)$

Comparing Coefficient,

x^2 $24ZEI = w$

$Z = \frac{w}{24EI}$

x $12HEI = -2wL$

$H = \frac{-2wL}{12EI}$

$H = \frac{-wL}{6EI}$

$$4GEI = wL^2$$

$$G = \frac{wL^2}{4EI}$$

$$y = \left(\frac{wL^2}{4EI}\right)x^2 + \left(\frac{-wL}{6EI}\right)x^3 + \left(\frac{w}{24EI}\right)x^4$$

$$y = \frac{wL^2x^2}{4EI} - \frac{wLx^3}{6EI} + \frac{wx^4}{24EI}$$

$$y = \frac{6wL^2x^2 - 4wLx^3 + wx^4}{24EI}$$

$$y = \frac{w}{24EI}\left(6L^2x^2 - 4Lx^3 + x^4\right)$$

G.S

$$y = A + Bx + \frac{w}{24EI}\left(6L^2x^2 - 4Lx^3 + x^4\right)$$

at $y = 0$, $x = 0$ $\quad \frac{dy}{dx} = 0$

$$0 = A + B(0) + \frac{w}{24EI}\left(6L^2(0)^2 - 4L(0)^3 + 0^4\right)$$

$$0 = A$$

$$A = 0$$

$$\frac{dy}{dx} = B + \frac{w}{24EI}\left(12L^2x - 12Lx^2 + 4x^3\right)$$

$$0 = B + \frac{w}{24EI}\left(12L^2(0) - 12L(0)^2 + 4(0)\right)$$

$$B = 0$$

P.S

$$y = \frac{w}{24EI}\left(6L^2x^2 - 4Lx^3 + x^4\right)$$

$$y = \frac{w}{24EI} x^2 (6L^2 - 4Lx + x^2)$$

$x = L$

$$y = \frac{wL^2}{24EI} (6L^2 - 4L^2 + L^2)$$

$$y = \frac{wL^2}{24EI} (3L^2)$$

$$y = \frac{3wL^4}{24EI}$$

$$y = \frac{wL^4}{8EI}$$