WS-11 for 8th class

T task

① Given $t = 1 sec$

$\omega_1 = 60 rpm =$

$\omega_2 = 120 rpm$ $1 rpm = \frac{2\pi}{60} rad/sec$

$\omega_2 - \omega_1 = 120 - 60$

$= 60 rpm$

$= 60 \times \frac{2\pi}{60} = 2\pi rad/sec$

$\alpha = \frac{d\omega}{t} = \frac{2\pi}{1} = 2\pi rad/s^2$

② Given. As Angular velocity changes from $0 \to \omega$ the body completes $N_1 = x$ rot.

From $\omega \to 2\omega$ $N_2 = ?$

From the relation $\omega^2 - \omega_0^2 = 2\alpha\theta$

$\Rightarrow \omega^2 - \omega_0^2 \propto \theta$

$\Rightarrow \frac{\omega^2 - \omega_0^2}{\omega_0'^2 - \omega_0'^2} = \frac{\theta_1}{\theta_2} \Rightarrow \frac{\omega^2}{(2\omega)^2 - \omega^2} = \frac{2\pi x}{2\pi N_2}$

$\Rightarrow \frac{\omega^2}{3\omega^2} = \frac{x}{N_2} \Rightarrow N_2 = 3x$

③ Given $\omega' = 60 rad/sec$

After 10 sec $\omega'' = 80 rad/sec$

use $\omega = \omega_0 + \alpha t$

Before t After

$\omega' = \omega_0 + \alpha t$

$\Rightarrow 60 = \omega_0 + 2 \times 10$

$\Rightarrow 60 = \omega_0 + 20$

$\Rightarrow \omega_0 = 40$

$\omega'' = \omega' + \alpha t$

$\Rightarrow 80 = 60 + 10\alpha$

$\Rightarrow 80 - 60 = 10\alpha$

$\Rightarrow \alpha = 20 rad/s^2$

④ Given $\omega_0 = 600 rpm$

$\omega = 1200 rpm$

$\omega = \omega_0 + \alpha t$.

change in Angular velocity $= \omega - \omega_0$

$= 1200 - 600$

$= 600 rpm$

$= 600 \times \frac{2\pi}{60}$

$= 20\pi rad/sec$

⑤ Given $\omega_0 = 2\pi rad/sec$

$\omega = 4\pi rad/sec$

$\alpha = ?$

From $\omega = \omega_0 + \alpha t$

$\Rightarrow 4\pi = 2\pi + \alpha(2)$

$\Rightarrow 2\pi = 2\alpha \Rightarrow \alpha = \pi rad/$

From $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\Rightarrow 2\pi N = 2\pi \times 2 + \frac{1}{2}\pi \times 2^2$

$\Rightarrow 2\pi N = 4\pi + 2\pi$

$\Rightarrow N = 3$

⑥ $\omega_0 = 1200 rpm = \frac{1200 \times 2\pi}{60}$ (20)

$\alpha = 4 rad/s^2$ $\Rightarrow 40\pi$

$\omega^2 - \omega_0^2 = 2\alpha\theta$

$\Rightarrow 0^2 - (40\pi)^2 = 2(-4)(2\pi N)$

$\Rightarrow -1600\pi^2 = -16\pi N$ (100)

$\Rightarrow N = 100 \times \pi$

$= 314.$

⑦ ω_0 —— 2 sec —— t —— $\theta = 10 \times 2\pi$ In (t+2) sec

$1 rot = 2\pi rad.$

In $t = 2 sec \to N = 10 rev$

$N = 2\pi \times 10$

$\Rightarrow \theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\Rightarrow 20\pi = 0 \times 2 + \frac{1}{2}\alpha(2)^2$

$\Rightarrow 20\pi = 2\alpha$

$\Rightarrow \alpha = 10\pi rad/s^2$

$\theta_T = 2\pi \times 20 = 40\pi$

$\theta_T = \omega_0 t + \frac{1}{2}\alpha t^2$

$\Rightarrow 40\pi = 0(t+2) + \frac{1}{2}10\pi(t+2)^2$

$\Rightarrow 40\pi = 5\pi(t+2)^2$

$\Rightarrow 8 = (t+2)^2$

$\Rightarrow t+2 = 2\sqrt{2}$

$t = 2(\sqrt{2}-1) sec$

⑧ In $t = 4 sec$ $\omega_0 = \pi rad/sec$

$\omega = 4\pi rad/sec$

$N = 5$.

$\theta = 2\pi N = 10\pi rad$

From $\omega = \omega_0 + \alpha t$

$\Rightarrow 4\pi = \pi + \alpha(4)$

$\Rightarrow 3\pi = 4\alpha \Rightarrow \alpha = \frac{3\pi}{4} rad/s^2$

~~From $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$~~

~~$= \pi \times 4 + \frac{1}{2}\frac{3\pi}{4}(4)^2$~~

~~$= 4\pi + \frac{1}{2} 3\pi \times 4^2$~~

~~$\theta = 10\pi$~~

From $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\Rightarrow 10\pi = \pi t + \frac{1}{2}\frac{3\pi}{4}t^2$

$\Rightarrow 10 = t + \frac{3}{8}t^2$

$\Rightarrow 80 = 8t + 3t^2$

$\Rightarrow 3t^2 + 8t - 80 = 0$

For $t = 4 sec$ eqn satisfy

(9) Given $\omega_0 = 0$

$\alpha = 2\pi$ rad/s²

$t = 4$ sec $\Rightarrow \alpha = 0$

From $\omega = \omega_0 + \alpha t$

$\Rightarrow \omega = 0 + (2\pi)(4)$

$\Rightarrow \omega = 8\pi$ rad/sec

From $\theta = \omega t + \frac{1}{2}\alpha t^2$

$\Rightarrow \theta = 8\pi(4) + \frac{1}{2}(0)t^2$

$\theta = 32\pi$

(10) Given $\omega_0 = 0$; $t = 3$ sec.

From $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\Rightarrow \theta = 0 \times 3 + \frac{1}{2}(\alpha)(3)^2$

$\Rightarrow \theta = \frac{9}{2}\alpha$

$\Rightarrow \alpha = \frac{2\theta}{9}$ rad/s²

From $\theta_n = \omega_0 + \frac{\alpha}{2}(2n-1)$

$\theta_n = 0 + \frac{2\theta}{9 \times 2}(2n-1)$

$\theta_n = \frac{\theta}{9} \times 5$

$\theta_n = \frac{5\theta}{9}$

(14) $m = 1$ kg

$l = 0.5$ m

$N = 10$

$t = 1.57$ sec.

Time Period $= \frac{t}{10}$

$\Rightarrow \frac{15.7}{10} = 1.57$ sec

$T = \frac{2\pi}{\omega}$

$\Rightarrow \omega = \frac{2\pi}{T}$

$\Rightarrow \omega = \frac{2 \times 3.14}{1.57}$

$= 4$ rad/sec.

(15) $T = m r \omega^2$ (Tension)

$= 1 \times 0.5 \times 4^2$

$= 0.5 \times 16$

$= 8$ N

(16) As the car is making turn centripetal force is balanced with component of tension

$\tan\theta = \frac{v^2}{rg} = \frac{(10)^2}{10 \times 10}$

$\tan\theta = 1$

$\theta = 45°$

LTasic

(1) Given $l = 2$m ; $m = 0.2$ kg

$T = 4$ N.

$T\cos\theta = mg$; $T\sin\theta = F_c$

$\Rightarrow 4\cos\theta = 0.2 \times 10$

$\Rightarrow \cos\theta = \frac{2}{4} = \frac{1}{2}$

$\theta = 60°$

(2) Given $\omega = 1200$ rpm

$= 1200 \times \frac{2\pi}{60}$

$\omega = 40\pi$ rad/sec

Acceleration

$a = r\omega^2$

$= (\frac{1}{2})(40\pi)^2$

$= 800\pi^2$

(3) Given $m = \frac{1}{2}$ kg ; $r = 0.5$ m

$v = 1$ m/sec ; $T = ?$

when stone is moving in horizontal circle

$\tan\theta = \frac{v^2}{rg}$

$\tan\theta = \frac{1^2}{0.5 \times 10} = \frac{1}{5}$

$\tan\theta = \frac{1}{5}$

$\cos\theta = \frac{5}{\sqrt{26}}$

$T\cos\theta = mg$

$\Rightarrow T \times \frac{5}{\sqrt{26}} = \frac{1}{2} \times 10$

$\Rightarrow T = \sqrt{26}$

$\Rightarrow T = 5.01$ N

$= 5.01 \times 10^5$ dyne.

(4) From $\tan\theta = \frac{v^2}{rg}$

$\tan\theta = \frac{10^2}{50 \times 10}$

$\tan\theta = \frac{1}{5}$

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

(5) when string is rotating in horizontal circle.

$T\sin\theta = \frac{mv^2}{r} \rightarrow (1)$

$T\cos\theta = mg \rightarrow (2)$

$\frac{(1)}{(2)} = \tan\theta = \frac{v^2}{rg}$

Given $m = 50$ gm

$= 50 \times 10^{-3}$ kg

$\Rightarrow \tan\theta = \frac{2^2}{2 \times 10}$

$\Rightarrow \tan\theta = \frac{1}{5}$

$\Rightarrow \cos\theta = \frac{5}{\sqrt{26}}$

From (2)

$T\cos\theta = mg$

$\Rightarrow T \frac{5}{\sqrt{26}} = 50 \times 10^{-3} \times 10$

$\Rightarrow \frac{T}{\sqrt{26}} = 100 \times 10^{-3}$

$\Rightarrow T = \sqrt{26} \times 10^{-1}$

$\Rightarrow T = 0.501$ N

(6) Given $v = 18\ m/s$

$D = 3m$; $r = \frac{D}{2} = 1.5m$

From $v = r\omega$

$\Rightarrow 18 = \frac{3}{2}\omega$

$\Rightarrow \omega = 12\ rad/sec$

(7) $\omega = 1\ rps$

$= 2\pi\ rad/sec$

$r = 20 \times 10^{-3}\ m$

$F_c = mr\omega^2$

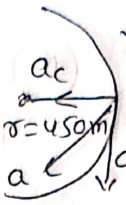
$\Rightarrow ma_c = mr\omega^2$

$\Rightarrow a_c = r\omega^2$

$\Rightarrow a_c = (20\times10^{-3})(2\pi)^2$

$= 8 \times 10^{-5}\ m/s^2$

(8)



$v = 30\ m/s^2 \Rightarrow a_t = \frac{dv}{dt} = 2m/s^2$

$a_c = \frac{v^2}{r} = \frac{30^2}{450} = 2m/s^2$

$a = \sqrt{a_c^2 + a_t^2} \Rightarrow \sqrt{2^2+2^2} = 2\sqrt{2}\ m/s^2$

(9) $a_c = 980\ cm/s^2$

$\omega = ?$ $r = l = 20cm$

$\Rightarrow a_c = r\omega^2$

$\Rightarrow 980 = (20)\omega^2$

$\Rightarrow \omega^2 = 49$

$\Rightarrow \omega = \sqrt{49}$

$\Rightarrow \omega = 7\ rad/sec$

(10) $100\ link = 1m$

$\therefore l = 2\pi r$

$\Rightarrow r = \frac{1}{2\pi}m.$

$m = 2\ kg$

$\omega = 300\ rpm$

$\omega = 300 \times \frac{2\pi}{60}$

$= 10\pi\ rad/sec.$

$F = mr\omega^2$

$= 2 \times \frac{1}{2\pi}(10\pi)^2$

$F = 314\ N$

(11) $F_c = mr\omega^2$

$F_c = 0.02 \times 0.2 \times (\frac{\pi}{5})^2$

$= 0.04 \times \frac{\pi^2}{25}$

$= 0.0158\ N$

(15) (i) $m = 200gm$

$= 0.2\ kg$

$r = 20 \times 10^{-2}\ m$

$= 0.2\ m.$

$\omega = 6\ rpm$

$= 6 \times \frac{2\pi}{60}$

$\omega = \frac{\pi}{5}\ rad/sec.$

(16) $\theta = 0$

Time Period $T = 2\pi\sqrt{\frac{l\cos\theta}{g}}$

$T = 2\pi\sqrt{\frac{2\times\frac{1}{2}}{10}}$

$T = 2\pi\sqrt{\frac{1}{10}}$

$T = 2.0348sec$

(17) $v = 36\ kmph$

$v = 36 \times \frac{5}{18} = 10\ m/sec$

$r = 25m$

$a = \frac{v^2}{r} = \frac{10^2}{25}$

$a = 4\ m/s^2$