

Q3.D.  $N_1 = 320 \text{ rpm}$ ,  $D = 1.2 \text{ m}$ ,  $R = 0.6 \text{ m}$ ,  $d = 0.8 \text{ m}$ ,  $r = 0.4 \text{ m}$   
 $C = 4 \text{ m}$ ,  $\mu = 0.25$ ,  $m = 1.8 \text{ kg/m}$ ,  $T_0 = 2800 \text{ N}$ .

$$v = \frac{\pi d N_1}{60} = \frac{\pi \times 0.8 \times 320}{60} = 13.4 \text{ m/s}$$

$$T_c = m v^2 = 1.8 \times 13.4^2 = 323.4 \text{ N}$$

$$T_0 = \frac{T_1 + T_2}{2} + T_c$$

$$\therefore 2800 = \frac{T_1 + T_2}{2} + 323.4 \Rightarrow T_1 + T_2 = 4953 \text{ N.} \quad \text{--- (1)}$$

$$\theta = \pi - 2 \sin^{-1} \left( \frac{R-r}{C} \right) = \pi - 2 \sin^{-1} \left( \frac{0.6-0.4}{2} \right)$$

$$\theta = \pi - 5.73^\circ = \pi - 0.01 = 3.042 \text{ radian}$$

$$\frac{T_1}{T_2} = e^{\mu \theta} \therefore \frac{T_1}{T_2} = e^{0.25 \times 3.042} = 2.14$$

$$\therefore T_1 = 2.14 T_2. \quad \text{--- (2)}$$

From (1) & (2)  $T_1 = 3376 \text{ N}$ ,  $T_2 = 1577 \text{ N}$ .

$$P = (T_1 - T_2) v = (3376 - 1577) \times 13.4 = 24106 \text{ W, or } 24.1 \text{ kW.}$$

Q3.C. speed of Cam  $N = 1000 \text{ rpm}$

$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 1000}{60} = 104.66 \text{ rad/s}$$

Min radius of cam  $r_b = 30 \text{ mm}$

Lift of follower  $S = 30 \text{ mm}$

Diameter of roller  $d_r = 10 \text{ mm} \therefore r_r = 5 \text{ mm}$

Angle of rise,  $\theta_o = 150^\circ$

Angle of dwell  $\theta_d = 30^\circ$

Angle of return  $\theta_r = 90^\circ$

Max velocity during outstroke,  $V_o(\text{max}) = \frac{\pi S \omega}{\theta_o 2}$

$$= \frac{\pi}{\left(150 \times \frac{\pi}{180}\right)} \times \frac{30}{2} \times 104.66$$

$$= \frac{\pi}{\frac{150\pi}{180}} \times 15 \times 104.66 = \frac{180\pi}{150\pi} \times 15 \times 104.66 = 1883.88 \text{ mm/s}$$



$$P_L = 0.5 P N$$

$$\therefore \sqrt{r_A^2 - r^2 \cos^2 \phi} - r \sin \phi = 0.5 \times R \sin \phi$$

$$\sqrt{r_A^2 - 72^2 \cos^2 20} - 72 \sin 20 = 0.5 \times 144 \sin 20$$

$$\sqrt{r_A^2 - 72^2 \cos^2 20} = 24.624 + 24.624 = 49.248$$

$$r_A^2 - 72^2 \cos^2 20 = 2425.36$$

$$r_A^2 = 4576.68 + 2425.36 = 83.66 \text{ mm.}$$

$$r_f = 83.66 - r = 83.66 - 72 = 11.66 \text{ mm}$$

$$KL = KP + PL = 0.5 r \sin \phi + 0.5 R \sin \phi$$

$$= 0.5 \times 72 \times \sin 20 + 0.5 \times 144 \times \sin 20$$

$$= 12.312 + 24.62 = 36.936 \text{ mm}$$

$$\text{Length of arc of contact} = \frac{KL}{\cos \phi} = \frac{36.936}{0.9396} = 39.31 \text{ mm.}$$

$$\text{Contact ratio} = \frac{39.31}{\pi m} = \frac{39.31}{\pi \times 6} \approx \underline{\underline{2}}$$

Q. d)  $N = 15$   
 $N = \frac{n(n-1)}{2}$

$$V_A = \frac{O_1 B}{O_1 A}$$

$$V_C = \frac{AC}{V_A}$$

$$V_A = 0.41 \text{ m/s}$$

$$V_C = 0.312 \text{ m/s}$$

$$V_D = 28.84 \text{ m/sec.}$$

$$V_D = \frac{CD}{V_C}$$