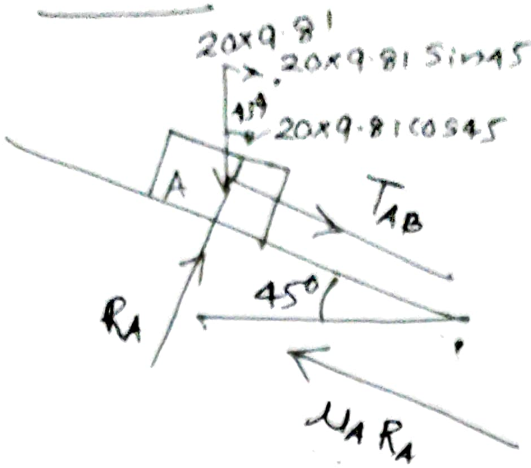
17a) Consider upper block A



Resolving the forces perpendicular to the Plane.

$$R_A - 20\times9.81\cos45 = 0$$

$$R_A = 138.73\ N$$

Resolving the forces Parallel to the Inclined Plane

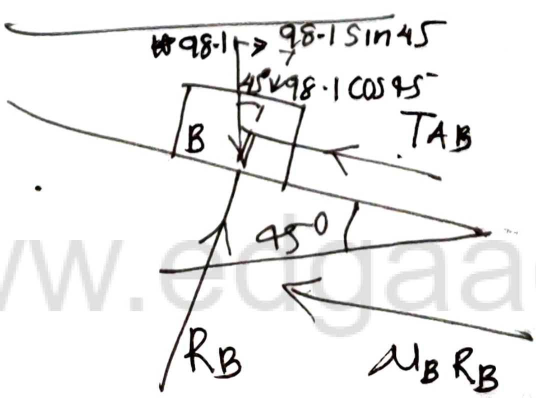
$$\cancel{T_{AB} + 20\times9.81\sin45 - 0.2\times138.73 = 0}$$

$$\cancel{T_{AB} = 110.984}$$

$$T_{AB} + 20\times9.81\times\sin45 - 0.2\times138.73 = 20\times a$$

$$T_{AB} - 20a + 110.98 = 0 \rightarrow (1)$$

Consider lower block B



Resolving the forces Perpendicular to the plane

$$R_B - 98.1\cos 45 = 0$$

$$R_B = \underline{69.36\,N}$$

Resolving the forces Parallel to the plane

$$98.1\sin 45 - T_{AB} - \mu_B R_B = 10 \times a$$

$$T_{AB} + 10a + 0.4 \times 69.36 - 69.36 = 0$$

$$T_{AB} + 10a - 41.616 = 0 \rightarrow (2)$$

On solving (1) and (2)

we get

$$T_{AB} = 9.249 \approx \underline{9.25\,N}$$

$$\underline{a = 5\,m/s^2}$$

17(b) Initial velocity,

$$u = 60 \times \frac{5}{18} = 16.66\ m/s$$

Final velocity

$$V = 0$$

$$\mu = 0.3$$

$$W = 50kN = 50 \times 10^3\ N$$

Frictional force, $F^1 = \mu W$

$$= 0.3 \times 50 \times 10^3$$

$$= 15000\ N$$

Applied force, $F = ma$

$$= \frac{50 \times 10^3}{9.81} a = 5096.84a$$

$F^1 = F$, $15000 = 5096.84\ a$

$$a = 2.94\ m/s^2 \longrightarrow$$ Here 'a' is taken (-ve)

$$V = u + at$$

$$0 = 16.66 - 2.94 \times t$$

$$2.94t = 16.66$$

$$\boxed{t = \frac{16.66}{2.94} = 5.66\ sec}$$

18(b) $u = 0$ $R = 250\,m$

$V = 18\,km/hr$

$= 18 \times \frac{5}{18} = 5\,m/s$

$\omega_1 = \frac{V}{R} = \frac{5}{250} = 0.02\,rad/s$

$\omega_0 = 0$

$\omega_1 = \omega_0 + \alpha t$

$0.02 = 0 + \alpha \times 60$

$\therefore \alpha = 3.33 \times 10^{-4}\,rad/s^2$

$\omega_2 = \omega_0 + \alpha t$

$= 0 + 3.33 \times 10^{-4} \times 30$

$= 0.01\,rad/s$

Tangential acceleration, $a_t = r\alpha$

$= 250 \times 3.33 \times 10^{-4}$

$= 0.083\,m/s^2$

Normal acceleration, $a_n = r\omega_2^2$

$= 250 \times 0.01^2$

$= 0.025\,m/s^2$

19 (b)

$W = 50N$

$m = \frac{W}{g} = \frac{50}{9.81} = 5.09\,kg$

$r = 7.5cm$

$= 0.075m$

$f = 1\,Hz$

$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$

$f^2 = \frac{1}{4\pi^2} \times \frac{K}{m}$

$K = 4\pi^2 m f^2$

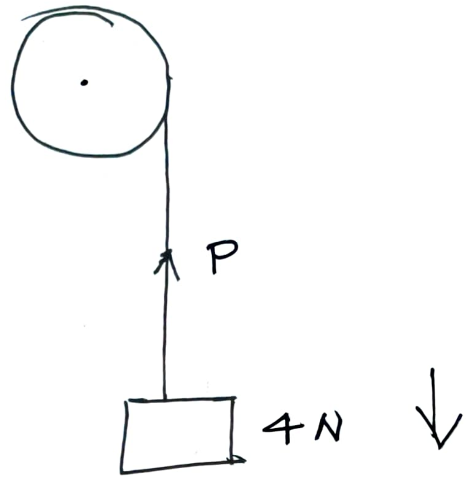
$= 4\pi^2 \times 5.09 \times 1^2 = 200.94\,N/m$

Tension, $T = K \times r$

$= 200.94 \times 0.075$

$= 15.07\,N$

20a)



considering downward motion of weight 4N.

$$\Sigma F = ma$$

$$4 - P = \frac{4}{9.81} a$$

$$P = 4 - \frac{4}{9.81} a$$

$$P = 4 - 0.41a \rightarrow (1)$$

consider rotation of pulley.

$$P \times r = I\alpha \qquad \text{But } \alpha = \frac{a}{r}$$

$$P \times 0.25 = \frac{mr^2}{2} \times \frac{a}{r}$$

$$P \times 0.25 = \frac{mr}{2} \times a$$

$$P \times 0.25 = \frac{48}{9.81} \times \frac{0.25}{2} \times a$$

$$P = 2.448\,a \rightarrow (2)$$

Substitute (2) in (1)

$$2.448\,a = 4 - 0.41\,a$$

$$2.858\,a = 4$$

$$a = \frac{4}{2.858} = \underline{1.39\ m/s^2} \approx 1.4$$

$$P = 2.448\,a$$

$$= 2.448 \times 1.4$$

$$= \underline{3.42\,N}$$

20b) $N = 30\,rpm$

$$\omega_1 = \frac{2\pi N}{60} = \frac{2 \times \pi \times 30}{60} = \underline{3.14}\ rad/s$$

$$t = 50\ sec$$

Revolution $= 40$ $\qquad \theta = \frac{40}{0.159} = \underline{251.57}$

$\cancel{\omega_2 = \omega_1 + \alpha t}$

$$\theta = \omega_1 t + \frac{1}{2}\alpha t^2$$

$$251.57 = 3.14 \times 50 + \frac{1}{2} \times \alpha \times 50^2$$

$$94.57 = 1250\,\alpha$$

$$\alpha = \underline{0.0756\ rad/s^2}$$

Angular velocity at the end of Interval

$$\omega_2 = \omega_1 + \alpha t$$

$$= 3.14 + 0.0756 \times 50$$

$$\boxed{\omega_2 = 6.92\ rad/s}$$

Time required for the speed to reach 80 revolutions per minute.

$$\omega_1 = 3.14\ rad/s$$

$$\omega_3 = \frac{2\pi N}{60} = \frac{2 \times \pi \times 80}{60} = 8.37\ rad/s$$

$$\alpha = 0.075\ rad/s^2$$

$$\omega_3 = \omega_1 + \alpha t$$

$$8.37 = 3.14 + 0.075 \times t$$

$$5.23 = 0.075t$$

$$t = \frac{5.23}{0.075} = \underline{\underline{69.73 sec}}$$