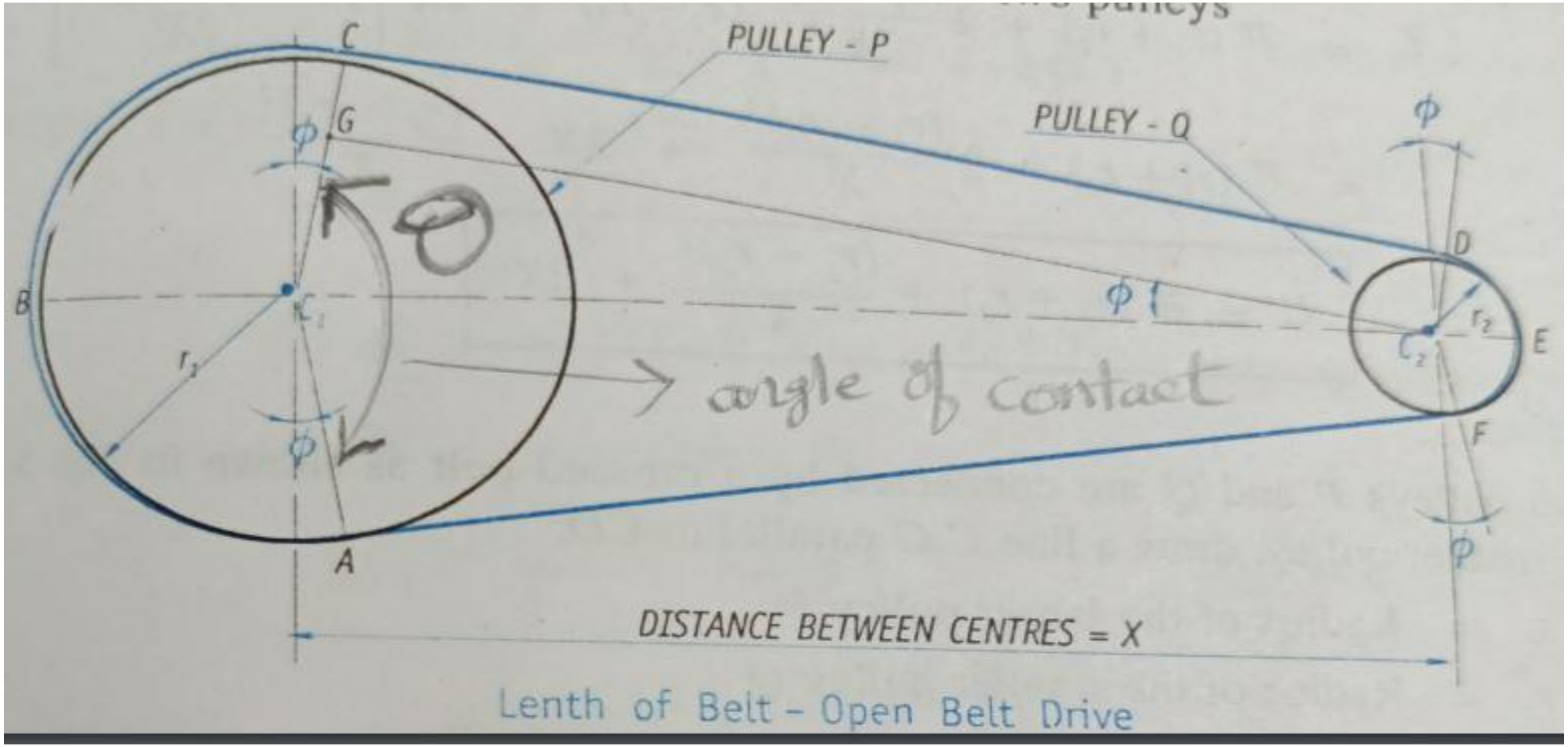
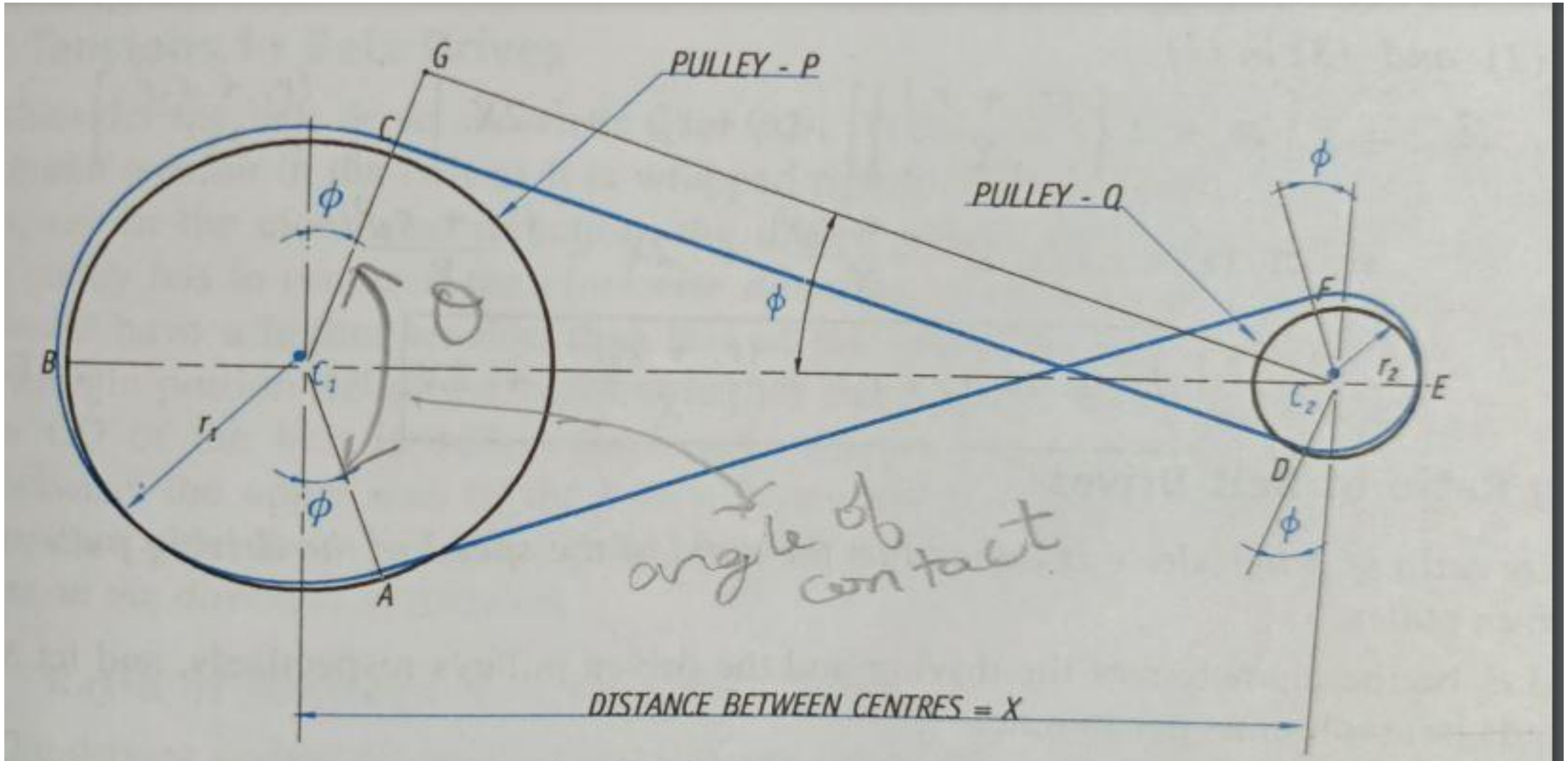
Numericals on Belt Drives



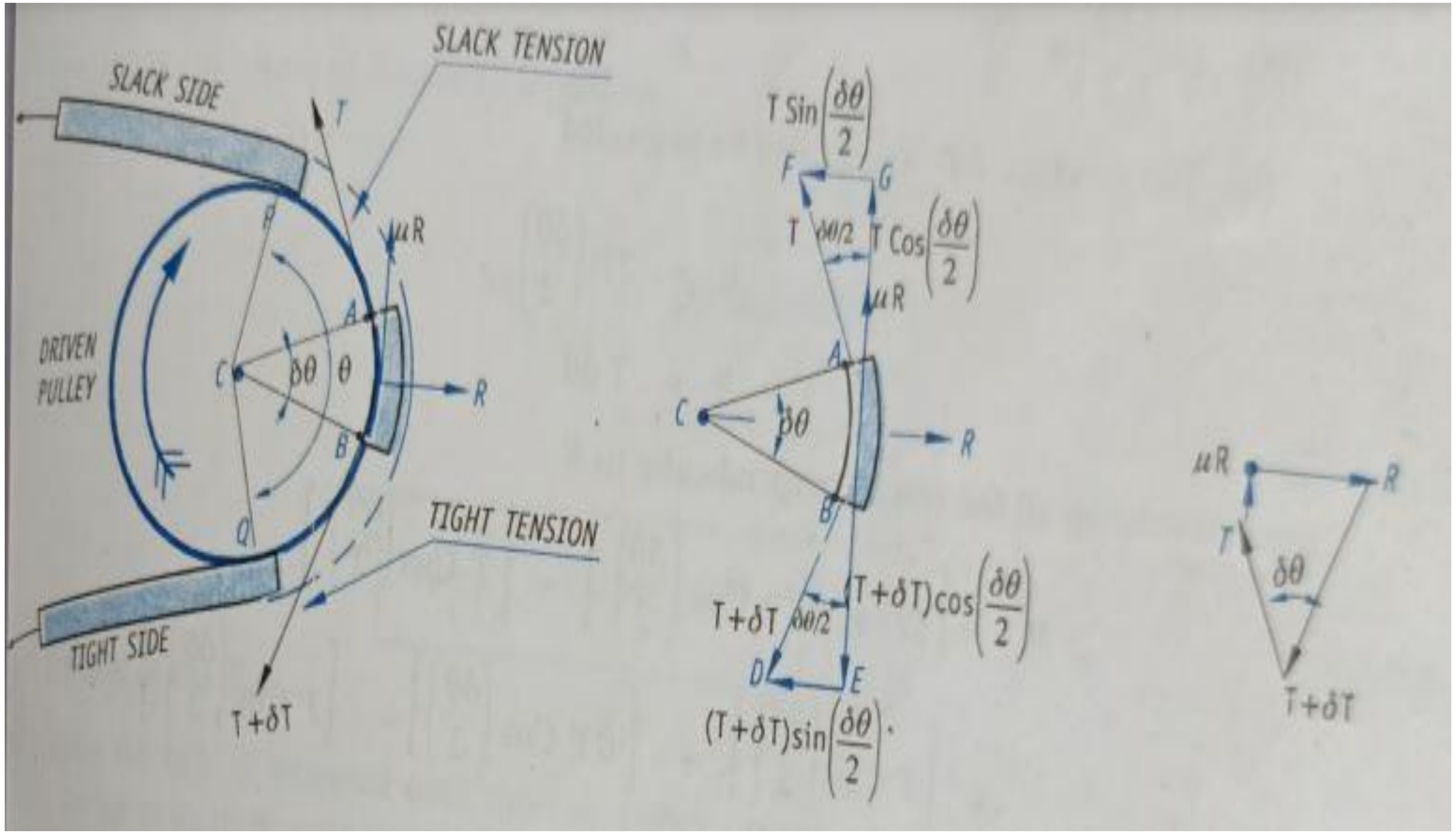
L = Π (r1 + r2) + (r1-r2)^2/X + 2X (open belt drive)



Lenth of Belt – Crossed Belt Drive

$$L = \Pi\,(r1 + r2) + (r1+r2)^2/X + 2X \text{ (crossed belt drive)}$$

Ratio of tensions in a belt drive



T_1 / T_2 = $e^{\mu \theta}$

T_1= tension in the tight side of belt in newton

T_2= tension in the slack side of the belt in newton

θ= angle of contact in radians
μ= coefficient of friction
(0.2 to 0.3)

Initial tension in the belt drive
Initial Tension = $T_0 = (T_1 + T_2) / 2$

Power Transmitted in a belt drive
$P= (T_1 - T_2) * v / (60 \times 1000)$ kW
v= velocity of the belt in m/min

Velocity ratio in a belt drive= Speed of driven pulley/speed of driving pulley
$V.R = N_2/N_1 = D_1/D_2$
N1= speed of driving pulley
N2= speed of driven pulley
D1= diameter of driving pulley
D2= diameter of driven pulley

1. A motor running at 1750 rpm drives a line shaft at 800 rpm. If the diameter of the pulley on the motor shaft is 160 mm, find that of the pulley on the line shaft.

Solution:

Data: Driving System: $N_1 = 1750$ rpm, $d_1 = 160$ mm

Driven System: $N_2 = 800$ rpm, $d_2 = ?$

Velocity Ratio $= N_2/N_1 = d_1/d_2$

$$800 / 1750 = 160 / d_2$$

$$d_2 = 160 \times 1750 / 800$$

$$d_2 = 350 \text{ mm}$$

2. The sum of the diameters of two pulleys A and B connected by a belt is 900 mm. If they run at 700 and 1400 rpm respectively, determine the diameter of each pulley.

Solution:

$d_A + d_B = 900$ mm , $N_A = 700$ rpm , $N_B = 1400$ rpm

Velocity ratio $= N_B / N_A = d_A / d_B$

$1400/700 = d_A / d_B$

Therefore $d_A = 2\ d_B$

$2\ d_B + d_B = 900$

$3\ d_B = 900$

$d_B = 300$ mm

and $d_A = 600$ mm

3. In an open belt drive running in the clockwise direction, the tension in the tight side is 3000 N and the arc of contact is 150^0. If the coefficient of friction is 0.3. Find the tension on the slack side of the belt.

Solution:

$T_1 = 3000$ N, $\mu = 0.3$, $\theta = 150^o = 150 \times \Pi / 180$ radians

$T_1 / T_2 = e^{\mu \theta}$

$3000 / T_2 = e^{(0.3 \times 150 \times \Pi / 180)}$

$3000 / T_2 = 2.193$

Therefore $T_2 = 1367.9$ N

4. In a belt drive, the angle of lap on the driven pulley is 160^0 and the coefficient of friction between the pulley and belt material is 0.28. If the width of belt is 200 mm and the maximum tension in the belt is not to exceed 50 N per mm width, find the initial tension in the belt drive.

Solution: T_1 = 50 N / mm width, $\mu = 0.28$, $\theta = 160^o = 160 \times \Pi / 180$ radians

Width of belt = 200 mm, T_1 = 50 N/mm width x 200 mm = 10000 N

$$T_1 / T_2 = e^{\mu \theta}$$

$$T_1 / T_2 = e^{0.28 \times 160 \times \Pi / 180}$$

$$T_1 / T_2 = 2.187$$

Therefore T_2 = 10000 / 2.187 = 4572.4 N

Initial Tension = $T_0 = (T_1 + T_2) / 2$ = (10000 + 4572.4)/2

Therefore T_0 = 7286.2 N

5. The driven pulley of 400 mm diameter of a belt drive runs at 200 rpm. The angle of lap is 165^0 and the coefficient of friction between the pulley and belt material is 0.25. Find the power transmitted if the initial tension is not to exceed 10kN.

Solution:

$N_1 = 200$ rpm , $T_0 = 10$ kN, $\theta = 165^o$, $\mu = 0.25$, Power, P = ?

$T_1 / T_2 = e^{\mu \theta}$

$T_1 / T_2 = e^{0.25 \times 165 \times \Pi / 180}$

$T_1 / T_2 = 2.054$

Initial Tension = $T_0 = (T_1 + T_2) / 2$

Therefore , $(T_1 + T_2) = 2 T_0 = 2 \times 10000 = 20000$ N

$2.054 T_2 + T_2 = 20000$

$3.054 T_2 = 20000$

$T_2 = 20000 / 3.054 = 6548.8$ N

and Therefore $T_1 = 2.054 \times 6548.8 = 13451.2$ N

Now, to calculate Power, we have

Power, $P = (T_1 - T_2)\, v / (60 \times 1000)$

Belt speed $v = \Pi\, dN$

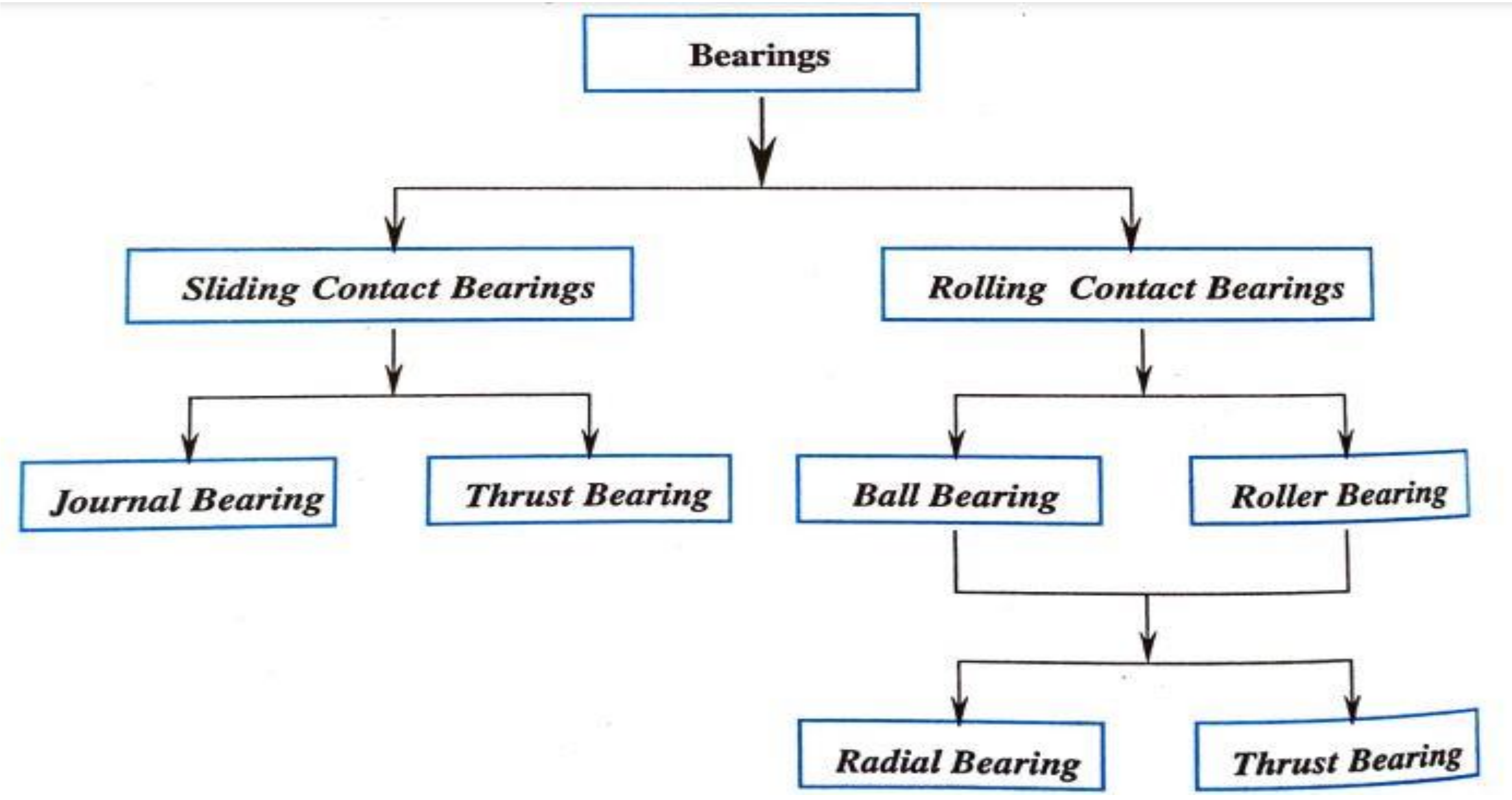
$v = \Pi \times 0.4 \times 200$

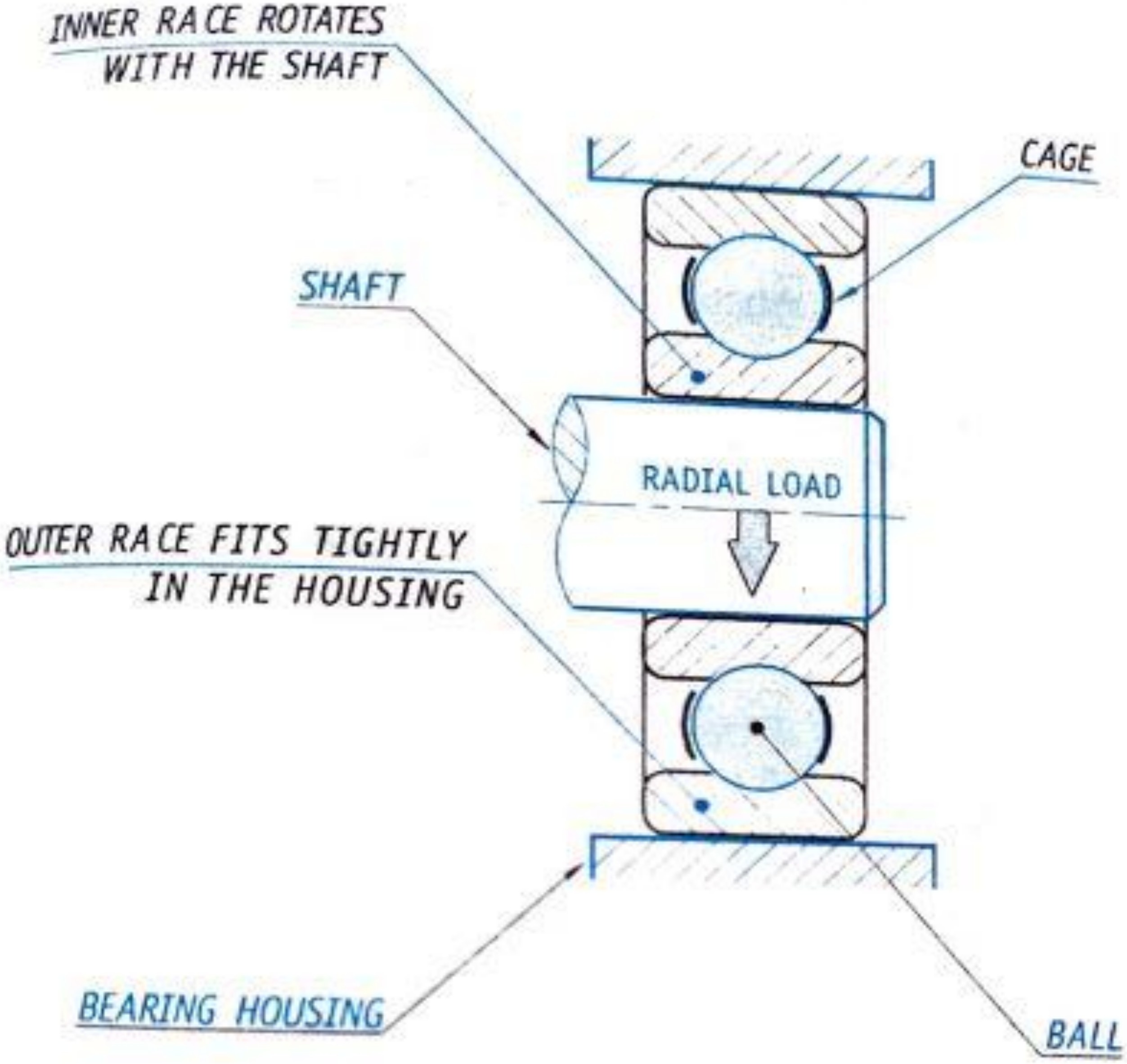
$v = 251.32$ m / min

Therefore , $P = (13451.2 - 6548.8) \times 251.32 / 60000$

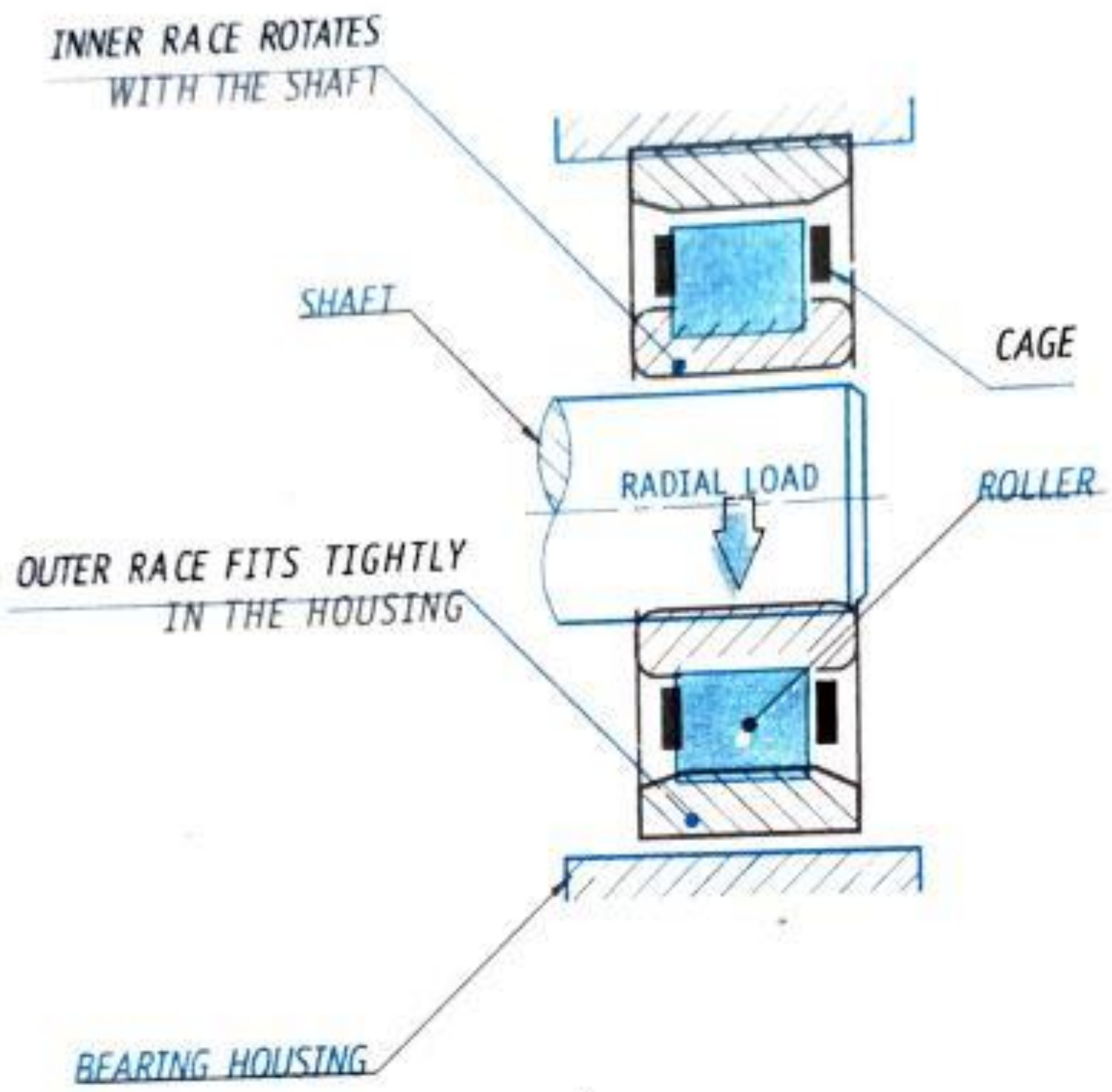
Power, $P = 28.91$ kW

Bearings


Bearings
Sliding Contact Bearings
Rolling Contact Bearings
Journal Bearing
Thrust Bearing
Ball Bearing
Roller Bearing
Radial Bearing
Thrust Bearing



Radial Ball Bearing



Radial Roller Bearing