Preface

We take immense pleasure in presenting you the comprehensive book containing all the questions that has been asked in GATE examination. This will help you in preparing for different exams such as GATE, ICAR JRF/SRF, ARS,, State Engineering Exams, Maharashtra Agriculture Service, IBPS AFO & IFS.

This book is written by Sagar Khurana, an alumni of IISc (Indian Institute of Science), Bangalore with a vision to provide quality examination content for Agriculture Engineering students. It comprises of

If you have any query, please write to us at enquirygateforall@gmail.com

Wishing You All the Best
GateForAll

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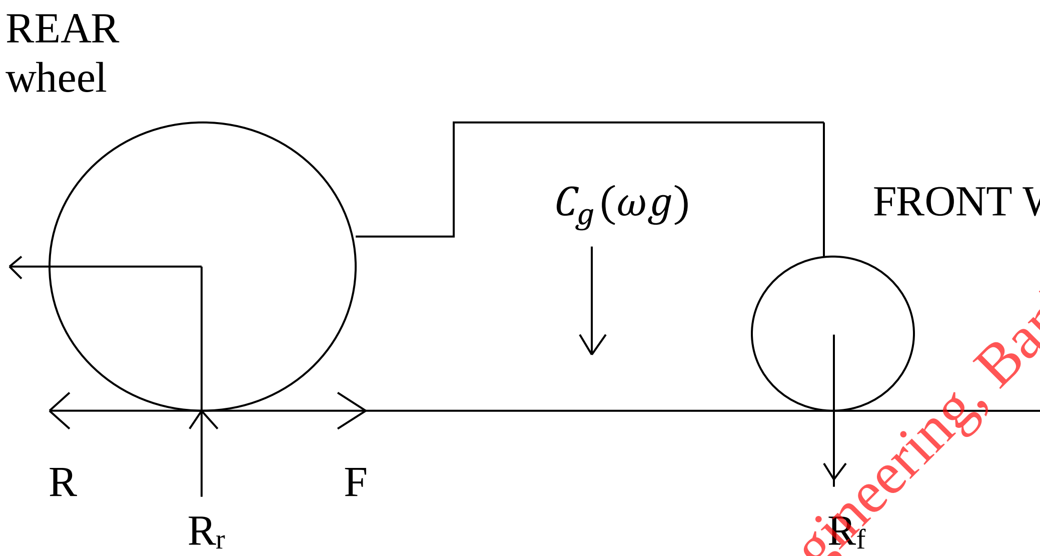
Chapter2- Tractor



$C_g = (Center\ of\ gravity$

$P = Pull\ [Net\ tractive\ force]$

$R_r = Reaction\ at\ rear\ wheel$

$R_f = Reation\ at\ front\ wheel$

$W_t = weight\ of\ tractor$

$F = Gross\ tructive\ force$

$P = {}^{Pull}/_{net\ trative\ force}$

$R = Rolling\ Resistonce$

$$\boxed{F = P + R}$$

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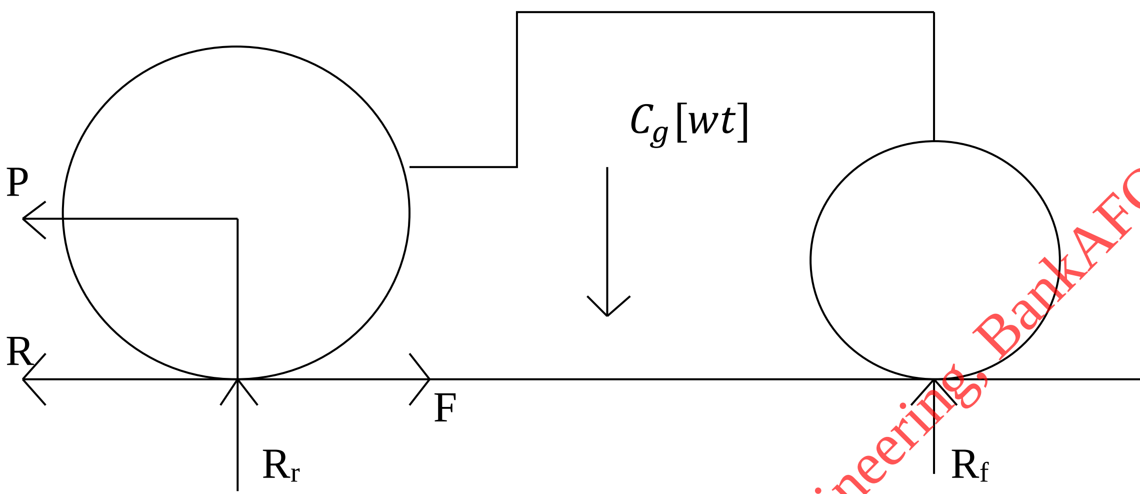
Gross Tractive Coefficient



$$F = P + R$$

$$\frac{F}{N} = \frac{P}{N} + \frac{R}{N}$$

→ (Normal force)

$$\frac{F}{N} = \mu_g [Gross\ tractive\ coefficient]$$

$$\frac{P}{N} = \mu\ [net\ tractive\ force\ coefficient$$

$$\frac{R}{N} = \rho\ [Rolling\ resistance]$$

$$\mu_g = \mu + \rho$$

$$N \rightarrow weight\ of\ troctor\ [\ if\ pull\ is\ acting\ at\ horizontal]$$

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Slip

Travel reduction

$$\% \, S = \left(1 - \frac{V_a}{V_t}\right)$$

$$V_a = actual\ speed$$

$$V_t = Theoritical\ speed$$

$$V_t = \frac{\pi . D . N}{60}$$

$$V_t = r\omega$$

$$= r . \frac{2\pi N}{60}$$

$$= \frac{(2r)\pi N}{60}$$

$$= \frac{\pi DN}{60}$$

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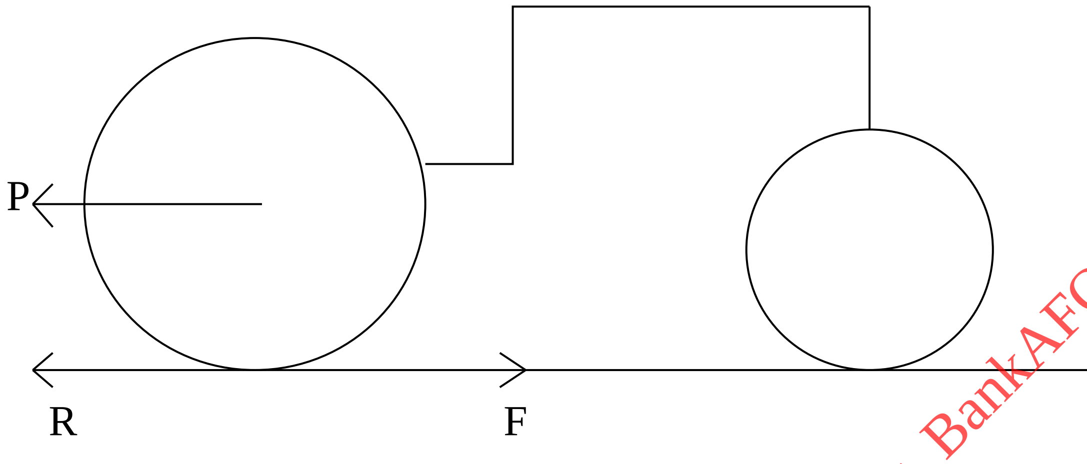
Rolling Resistance



$$\mu\ [\ Net\ tractive\ Coefficient] \rightarrow$$

$$\mu = \frac{P}{N}$$

If pull is acting as horizontal then

N will be equal to weight of trator

$$N = \omega$$

$$\rho = \frac{Rolling\ resistance\ [R]}{Normal\ lood\ [R]}$$

if pull is acting as horizontal then

N will be equal to the weight of tractor

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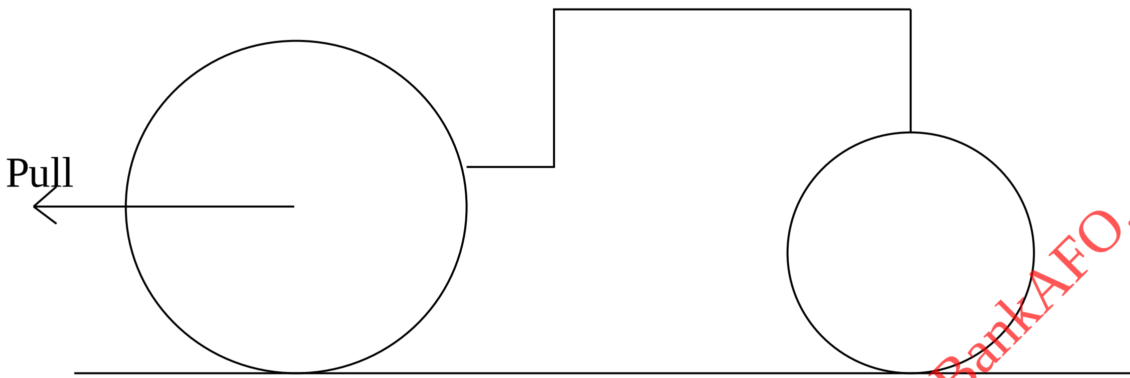
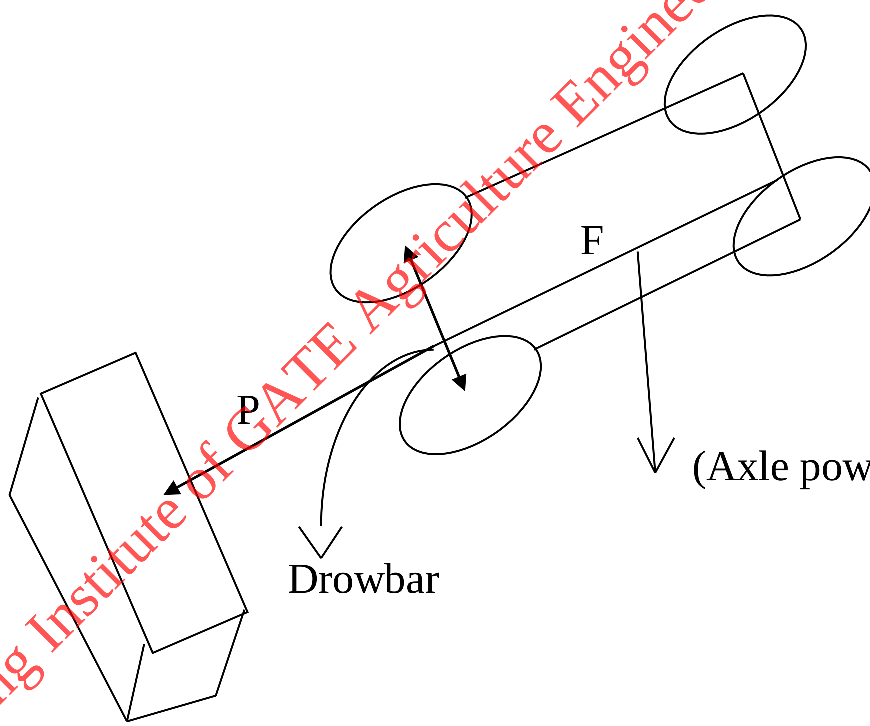
Tractive Efficiency





$$Tractive\ Efficiency = \frac{Output\ power}{Input\ Power}$$

$$= \frac{Drowbar\ Power}{Axle\ power}$$

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$$T.E = \frac{P \times Ya}{F \times Vt}$$

Tractive Efficiency

$$T.E. = \left(\frac{P}{F}\right) \times \frac{Va}{Vt}$$

$$T.E. = \left(\frac{P}{F}\right)(1 - S)$$

$$P = Pull\ [Net\ tractive\ force]$$

$$F = Gross\ tractive\ force$$

$$S = Slip$$

$$T.E. = \left[\frac{P/_N}{F/_N}\right](1 - S)$$

$$T.E. = \frac{\mu}{\mu g}\ (1 - S)$$

$$\boxed{T.E. = \frac{drowbar\ power}{axle\ power}}$$

$$\boxed{T.E. = \frac{P}{F}\ (1 - S)}$$

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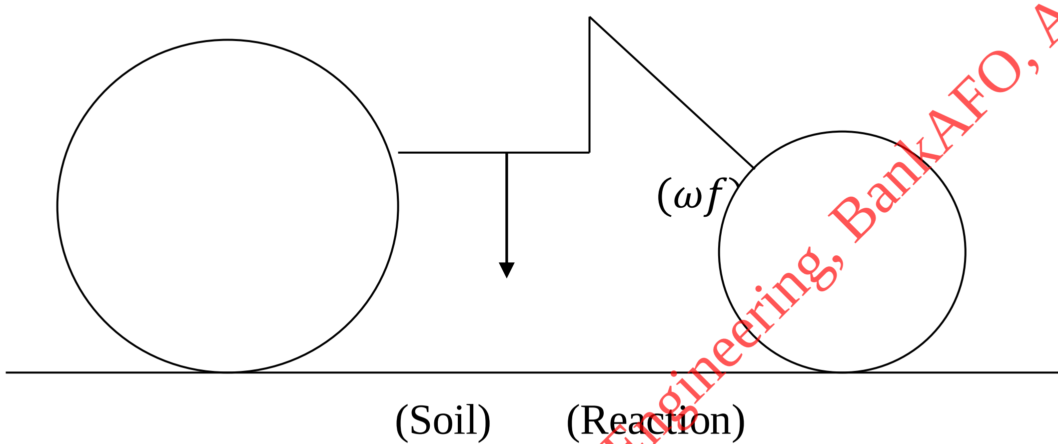
Gross Tractive Force



$$\frac{Shear\ force}{Per\ track} = A.C + (\frac{\omega t}{2}) \tan \varphi$$

$$C = Cohesion\ force$$

$$A = Area$$

$$\omega t = Weight\ of\ tractor$$

$$\varphi = Angle\ of\ internul\ friction$$

$$F = 2 \times [shear\ force\ per\ troch]$$

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Numerical

Q1., A Tractor wheel having 600mm diameter was testes in a soil bin and the following data was recorder: Angular speed of the wheel is 10 rev / min, Input torque is 60 N-m, drawbar pull is 150 N , normal load on the wheel axle is 500N , wheel forward speed is 0.25 m / sec. Calculate (a) Coefficient of tractor (b) wheel slippage (c) Tractive efficiency [GATE 1991]

Q2. Predict the maximum traction thrust of a track type tractor with two tracks each 360 mm wide and 1680 mm long. The weight of the tractor is 31.75 kN . The soil is sheared off in the plane area at the ends of lugs. Soil Parameter are C= 14 Kpa and Angle of internal friction is 30 degree [GATE 1994]

Q3. A tractor pulls 8 KN drawbar pulls against 4KN rolling resistance. If the tractor develops 57 percent tractive efficiency then slip experienced by the tractor is [GATE 2017]

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Q. 1 → GATE 1991

$$N_L = 500N$$

$$V_F = Actual\ speed = 0.25\ {}^{m}/_{sec}$$

$$N = 10\ rpm$$

$$Torque = 60\ N - m$$

$$Pull\ (P) = 150\ N$$

$$\mu = \frac{P}{N_L}$$

Pull is acting as horizontal

$$\mu = \frac{P}{N_L} = \frac{P}{500} = \frac{150}{150} = \frac{1}{3}$$

$$wheel\ S = \left(1 - \frac{actual\ speed}{theoritical\ speed}\right) \times 100$$

$$V_a = 0.25\ {}^{m}/_{sec}$$

$$V_t = \frac{\pi DN}{60} = 0.314\,{}^{m}/_{sec}$$

$$S = \left(1 - \frac{0.25}{0.314}\right) \times 100 = 20\%$$

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3. Tractive Efficiency

GATE 1991

$$T.E. = \frac{D.P.}{Axle\ power}$$

$$= \frac{P}{F}(1-s)$$

$$= \frac{150\,(1-s)}{F}$$

$$F = \frac{T}{r} = \frac{60}{\left(\frac{D}{2}\right)} = \frac{60}{\left(\frac{0.6}{2}\right)}$$

$$= \frac{600}{0.3} = 200$$

$$T.E. = \frac{150}{200}(1-0.2032)$$

$$\boxed{T.E. = 59.76\ \%}$$

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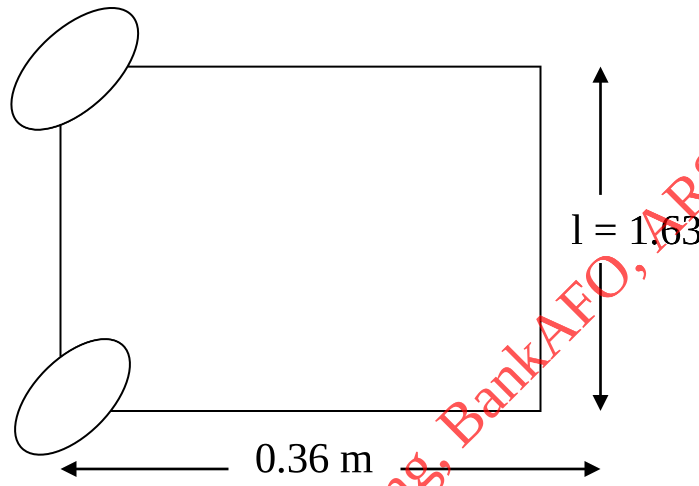
$Q.2 \rightarrow$ GATE 1994

two track



$b = 0.36$

$l = \frac{1680}{1000} = 1.68\ m$

$\omega = 31.75\ KN$

$C_p = 14 \times 10^3 \qquad \varphi = 30°$

lugs

Angle of internal friction

$S = C + N\tan\varphi$

S → sher force; C → Cohesion force; N → $\left(\frac{Normal}{2}\right)$ [for each truck]; φ → Angle of internal friction

$$Cohesion\ force = Cohesion\ \varphi ressure \times Area$$

$$\boxed{S = (C_p) \times A + \left(\frac{N}{2}\right) tan\varphi}$$

$$A = 1.68 \times 0.36 = 0.6048 m^2$$

$$S = (14 \times 10^3) \times 0.6048 + \left(\frac{31.75 \times 10^3}{2}\right) tan30°$$

$$\boxed{\begin{array}{c} S = 17362\ N\ [For\ single\ truck] \\ for\ Both\ truck\ S = 35265.27\ N \end{array}}$$

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$Q.3 \rightarrow$ GATE 2017

$$P = 8\ KN$$

$$R = 4\ KN$$

$$n_T = 57\%$$

$$n_T = \frac{P}{F}(1 - s)$$

$$0.57 = \left(\frac{P}{P + R}\right)(1 - s)$$

$$0.57 = \frac{2}{3}(1 - s)$$

$$1 - s = 0.855$$

$$s = 0.145$$

$$s = 14.5\%$$

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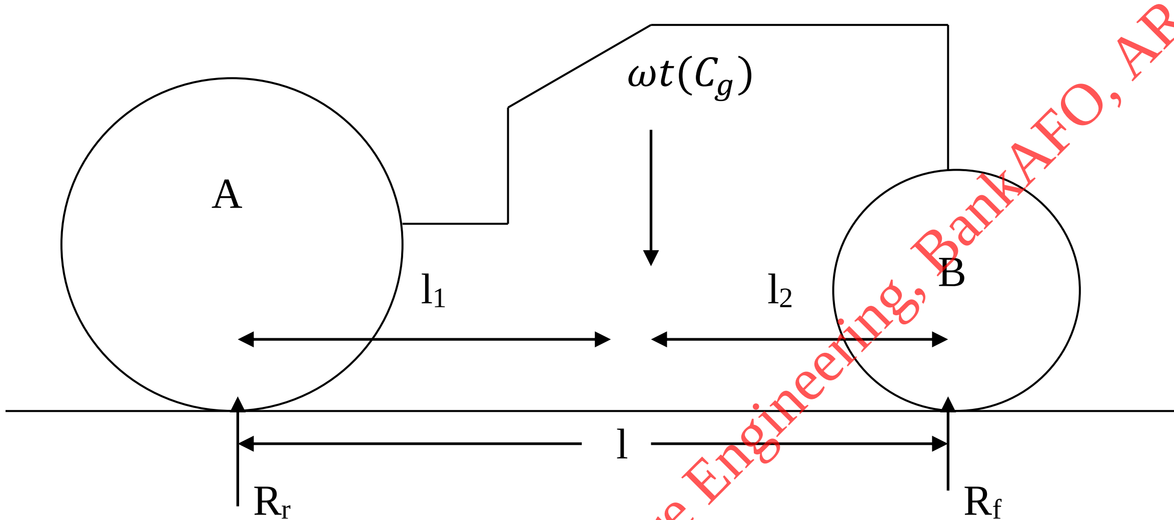
Chapter3-Tractor Mechanism

(Resting on Ground)



$\in Y = 0$

$$R_r + R_f = \omega t$$

Moment about A should bezero

$R_f \times l - \omega t \times l_1 = 0$

$R_f = \dfrac{\omega t \times l_1}{l}$	$R_r = \dfrac{\omega t \times l_2}{l}$

$l = wheel\ base$

$R_f = Reaction\ at\ front\ wheel$

$l_1 = distance\ of\ center\ of\ gravity\ from\ real\ wheel$

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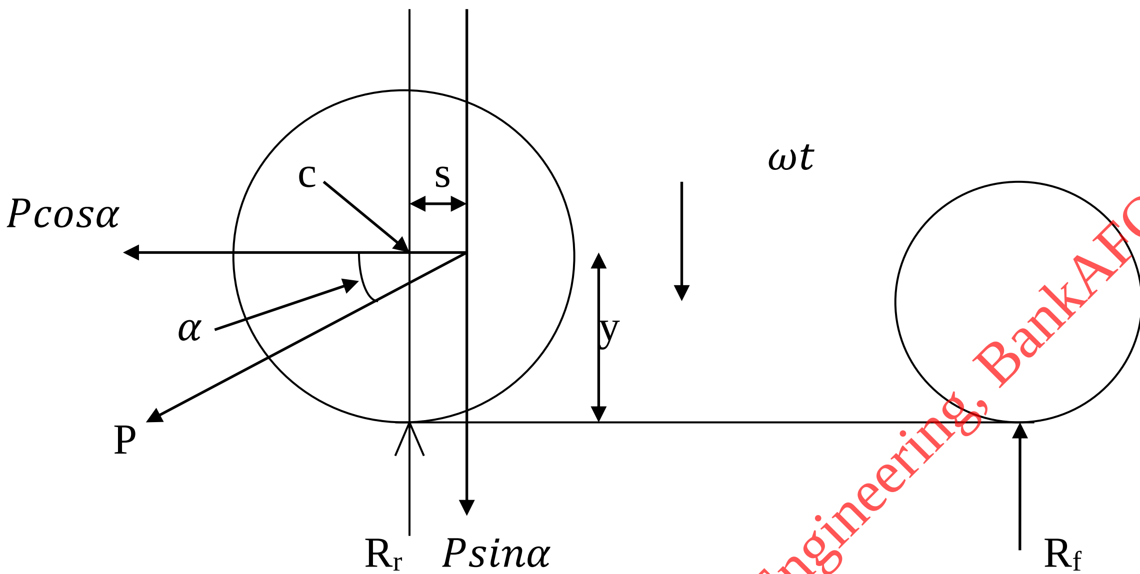
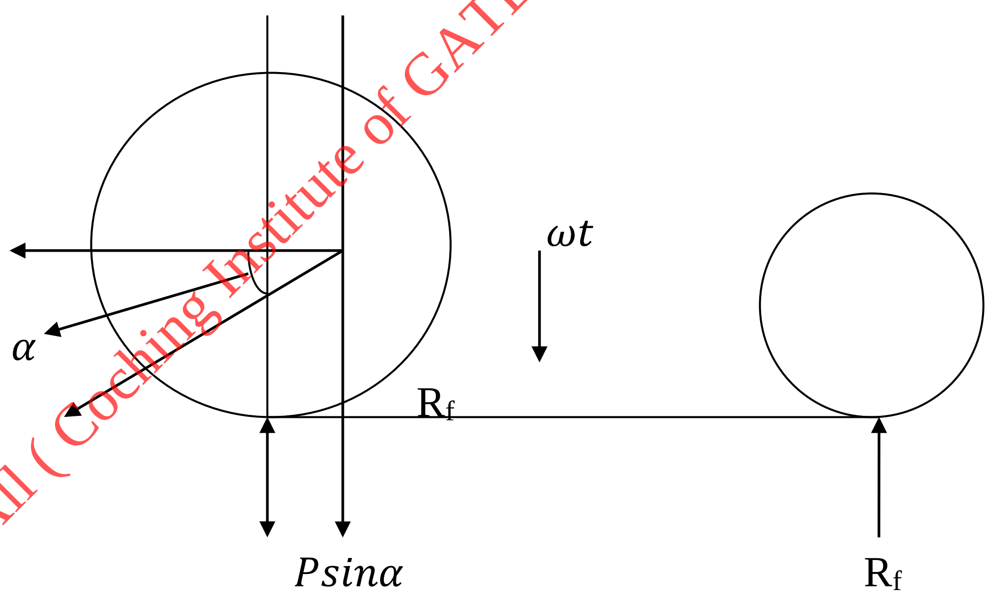


$y = hitch\ height$

$S = distance\ ^{b}/_{\omega}\ (pull\ line)and\ wheel\ center\ line$

$\alpha = angle\ of\ pull$



$$R_f + R_r = \omega t + P sin\alpha$$

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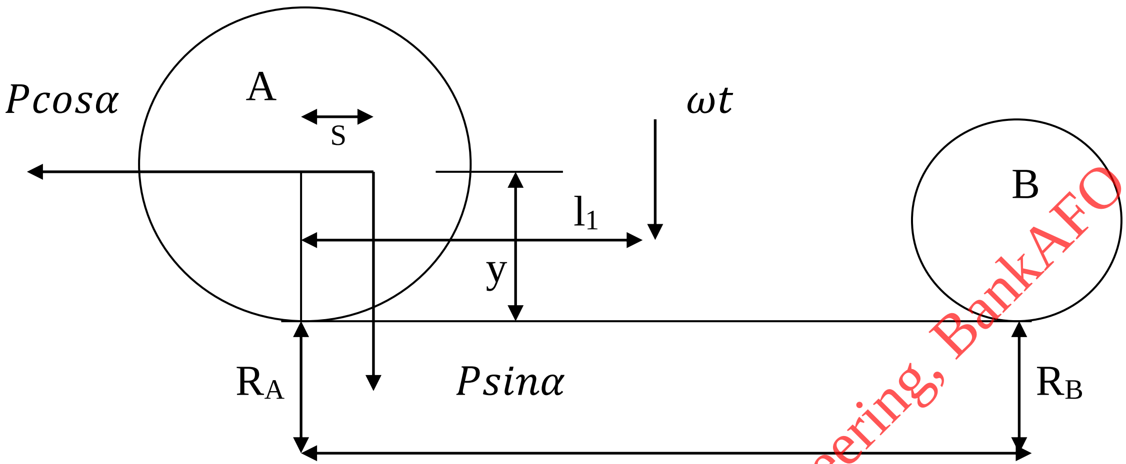
Taking moment about A



$$\omega t \times D_1 - R_f \times D - (Pcos\alpha).y - (psin\alpha)s = 0$$

$$\frac{\omega t \times l_1}{l} - R_f - \frac{[(Pcos\alpha)y + (psin\alpha)s]}{l}$$

$$R_f = \frac{\omega t \times l_1}{l} - \left(\frac{(Pcos\alpha)y + (Psin\alpha)s}{l}\right)$$

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Weight transfer when pull is an angle

$$wight\ transfer = \frac{(Pcos\alpha) \times y + (Psin\alpha) \times s}{l}$$

$$P = Pull$$

$$Y = hitch\ height$$

$$\theta = angle\ of\ pull$$

$$S = distance\ between\ pull\ and\ verticle\ line$$

$$l = wheel\ base$$

$$hitch\ height = 0$$

and

$$y = 0$$

$$weight\ trsansfer\ when\ \alpha = 0°$$

$$weight\ transfer = \left(\frac{Pull \times y}{l}\right)$$

$$\omega t = \frac{(Pull) \times (hitch\ height)}{wheel\ base}$$

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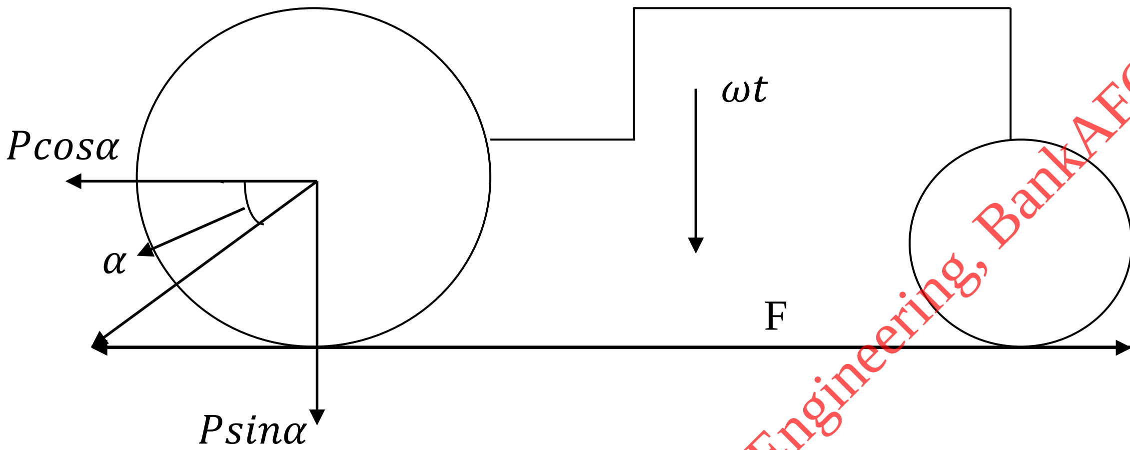
Coefficient of friction when pull is acting an angle.



$$\mu = \frac{Pcos\alpha}{N} = \frac{Pcos\alpha}{Psin\alpha + R_r + weight\ transfer}$$

$N = vertical\ weight$

$= (Psin\alpha) + R_r + (weight\ transfer)$

$$weight\ transfer = \frac{(Pcos\alpha)y + (Psin\alpha).S}{l}$$

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Numerical

Q1. A rear wheel drive tractor wheel weighing 18KN has the static weight divided in such a way that 12 KN in on the rear wheels and 6KN on the front wheels. The Tractor is pulling a plough at a speed of 5 km/hr. The Plough exerts an inclined drawbar pull of 10 KN with the line of pull making an angle of 15 degree with the horizontal. The axle power is 20 KW and the wheel base of the tractor is 2100mm and hitch height is 500mm Calculate

(a) The dynamic weight on the rear axle is

(b) The tractive efficiency of the tractor is [GATE 2003]

Q2. A rear wheel drive tractor wheel weighing 20 KN has 40 percent of his supported by the front wheels. The Tractor is pulling a plough at a speed of 8 km/hr. The Plough exerts an inclined drawbar pull of 8 KN with the line of pull making an angle of 15 degree with the horizontal. The Coefficient of rolling resistance is 0.04 and the wheel base of the tractor is 2100mm and hitch height is 500mm .Calculate (a) the coefficient of traction

(b) If the wheel slip is 20 percent, find out the tractive efficiency [GATE 2008]

Q3. A rear wheel drive tractor wheel weighing 23 KN has a wheel base of the 2100mm and centre of gravity is 710mm ahead of rear axle centre line. The Tractor is pulling a implement at a speed of 6 km/hr. The implement exerts an drawbar pull of 15 KN and the hitch height is 485mm. The axle power is 33.3 KW. Determine

(a) Weight transfer on rear axle

(b) The coefficient of traction

(c) tractive efficiency [GATE 1999]

Q4. A 2 wheel drive 35 hp tractor has 1.5 m rear wheel diameter. The engine runs at 1200 rev / min and the total reduction of the speed is 30: 1,. Find out the travelling speed of the tractor and the tractive force at each driving wheel. [GATE 1992]

Q5. A 35 kW two-wheel drive tractor weighing 20 kN is fitted with 6-16 8PR tyre at the front axle and 13.6-28 12PR tyre at the rear axle. The ratio of section height and section width for all tyres is 0.75. The tractor has a wheel base of 2.1 m and the center of gravity is located 0.7 m ahead of the rear axle center on a horizontal plane. The tractor is to be towed on a level ground having sandy clay loam soil at 10% moisture content with a cone index of 1200 kPa.

[GATE 2007]

The wheel numeric for each of the rear wheels is

(A) 39.50 (B) 58.17 (C) 79.01 (D) 116.37

Rolling resistance of each of the front wheels is

(A) 0.244 kN (B) 0.354 kN (C) 0.575 kN (D) 0.707 kN

(B)

Q6. A two-wheel drive tractor is pulling a load of 12 kN horizontally on a leveled surface at a forward speed of 5.0 km h-1. The rolling radius of the traction wheel and wheel slip are 0.65 m and 20% respectively. If the rear axle torque is 9 kN m, the tractive efficiency

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(A) 56.7% (B) 62.1% (C) 69.3% (D) 78.5% . [GATE 2009]

Q7. The diameter of an undeflected tractor wheel fitted with 13.6 — 28, 12 PR tyre with an aspect ratio of 0.75 is [GATE 2009]

(A) 0.99 m (B) 1.05 m
(C) 1.23 m (D) 1.40 m

Q8. A 37 kW two-wheel drive tractor weighing 20 kN with a wheel base of 2.1 m is having the option to be fitted with either 12.4 - 2 12PR or 13.6 - 28 12 PR at the rear axle. The ratio of section height and section width for all tyres is 0.75. On a level ground, the weight distribution on the front and rear axles is 35 and 65% of the total tractor weight, respectively. Cone index of soil is 1200 kPa.
(a)The motion resistance ratio of each of the rear wheels when fitted with the above-mentioned tyres at normal tyre inflation pressure while moving on a level ground will be [GATE 2010]

(A) 0.04. (1.04 (8)0.047. 0..055 (C) 0.051. 0.049 (D) 0,057. 0.055

(b)Net traction developed in kN by the rear wheels when fitted with 13.6 - 28 12 PR tyre at normal inflation pressure on a level ground with IS% wheel slip will be

(A) 8.79 (B) 9.18 (C) 9.78 MI) 10.32

Q9. A towed pneumatic wheel (width to diameter ratio of 0.3) is to be rolled on a leveled concrete surface. Total wheel load is 2000 N. [GATE 2011]
(a)The force in N required to roll the wheel on the horizontal concrete surface would be

(A) 80 (B) 91 (C) 800 (D) 912

(b) The minimum slope in degrees of the concrete surface with respect to the horizontal at which the Wheel itself will start rolling downward is

(A) 2.29 (B) 5.28 (C) 23.58 (D) 27.13

Q10. Which one of the following is NOT a towed wheel? [GATE 2011]

(A) wheels of power tiller (B) front wheels of two wheel drive tractor
(C) wheels of bullock cart (D) wheels of trailer

Q11. Which one of the following statements is NOT appropriate regarding cone index [[GATE 2012]

(A) It reflects strength of soil
(B) It is a composite parameter
(C)It is dimensionless
(D) It is measured at a constant penetration rate of 30 mm/s

Q12. A two wheel drive tractor, weighing 15.84 kN with a wheel base of 2160 mm, has the static weight divided between the front and rear axles in the ratio of 30 : 70 on a horizontal level surface. The hitch point is at a height of 700 mm from the ground and at

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a horizontal distance of 120 mm to the rear side from the center of the rear axle. Pull acts at an angle of 12° downwards from the horizontal. The maximum pull in kN, when the front wheels would just start rising from the ground is [GATE 2012]

Q13. A four-wheel-drive tractor has a static weight of 50 kN with 40% weight on rear ax axle. The wheel base is 2 m. The tractor is pulling a disc harrow that exerts a level dra height of 0.5 m from the ground. During the operation, when the dynamic reaction on ea dynamic traction ratio developed by the tractor is _ [GATE 2014]

(A) 0.2 (B) 0.4 (C) 0.5 (D).8

Q14. A tractor weighing 21 kN has 70% static weight on rear axle and its wheel base is 1.8 m. The drawbar hitch is located 25 cm behind the rear axle centre and 35 cm above the ground level. To overcome longitudinal instability, the front end loading is provided at a distance of 20 cm ahead of the front axle centre. It is observed that, there is front-end instability in the tractor due to a pull of 30 kN inclined at 20 downward from the horizontal. A minimum front-end load required to overcome the instability in N is ___________ [GATE 2016]

Q15. A two-wheel drive tractor weighing 18 kN has a wheel base 1.8 m. Its centre of gravity is located 600 mm ahead of the rear axle centre, under static condition, on a level ground. When this tractor is used to pull a disc plough hitched at a height of 390 mm from the ground, the draft observed is 6 kN. The change in reaction on rear wheels of the tractor due to pull in kN is [GATE 2018]

(A) 1.30 (B) 1.95 (C) 3.90 (D) 5.85

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$Q.1 \rightarrow$ GATE 2003

$\omega t = 18\ KN$

$R_r = 12\ KN$

$R_f = 6\ KN$

$V_a = 5\ {}^{km}/_{hr}$

$y = 0.5$

$P = 10\ KN$

$\alpha = 15°$

$Axle\ power = 20\ kw$

$l = 2.1\ m$

(A) Dynomic weight (N)

$$N = Psin\alpha + R_r + (weight\ transfer)$$

$$weight\ transfer = \frac{(Pcos\alpha)y + (Psin\alpha)s}{l}$$

$$= \frac{(10cos15°)0.5 + (10sin15°)0}{2.1}$$

$$= 4.59KN \times 0.5 = 2.295$$

$$N = \left(10sin15° + 12 + \frac{4.59}{2}\right)KN$$

$$\boxed{N = 16.88\ KN}$$

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B) Tractive Efficiency

$$= \frac{Drowbar\ power}{Axle\ power}$$

$$Axle\ power = 20\ kw$$

$$Drowbar\ power = Pull \times Velosity$$

$$= Pcos\alpha \times Y_a$$

$$= (10cos15°)5 \times \frac{5}{18}$$

$$= 13.41\ kw$$

$$T.E = \left(\frac{13.41}{20}\right) \times 100$$

$$\boxed{T.E = 67.07\%}$$

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$Q.2 \rightarrow$ GATE 2008

$\omega t = 20\ KN$

$R_f = 12\ KN$

$V_a = 8\ {}^{km}/_{hr}$

$P = 8KN$

$\alpha = 10°$

$y = 500\ mm \quad (height)$

$l = 2.1\ m$

(a) $\mu = \frac{Pull}{N} = \frac{Pcos\alpha}{N}$

$$N = R_r + Psin\alpha + (weight\ transfer)$$

$$R_r = 12$$

$$weight\ transfer = \frac{(Pcos\alpha)y + (Psin\alpha)S}{l}$$

$$= \frac{(8cos10) \times 0.5}{2.1}$$

$$= 1.87$$

$$\mu = \frac{12cos10}{12 + 12sin10 + 1.87} = 0.74$$

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$$S = 20\% \qquad \rho = 0.04$$

$$T.E = \frac{P}{F}(1-s)$$

$$= \frac{\mu}{\mu+\rho}(1-s)$$

$$= \left(\frac{0.74}{0.74+0.04}\right)(1-0.2)$$

$$= 75.89\%$$

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(c) $T.E = Tractive\ efficiency$

$$= \frac{Drowbar\ Power}{axle\ power}$$

$D.P = P \times V_a$

$$= 1500 \times 6 \times \frac{5}{18} \times 10$$

$$T.E = \frac{2.5}{33.33} \times 100$$

$$\boxed{TE = 74.4\%}$$

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$Q.4 \rightarrow$ GATE 1992

$P = 35\ hp$

$D = 1.5\ m$

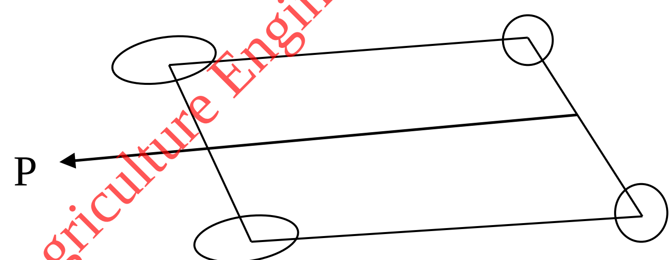
$N_e = 1200\ rpm$

$Total\ Reduction = 30:1$

$$V_t = \frac{\pi . D . N}{60}$$

$$V_t = \frac{3.14 \times 1.5 \times 20}{60}$$

$$\boxed{V_t = 94.2\ {}^{m}/_{sec}}$$



$speed\ reduction = 30:1$

$$Actual\ speed = \frac{1}{3} \times 94.2$$

$V_a = 3.1\ {}^{m}/_{sec}$

$Power = P \times V_a$

$35 \times 746 = P \times 3.1$

$$\boxed{P = 8422.58\ N}$$

$$\boxed{\begin{aligned} Force\ at\ each\ wheel &= 4211.29 \\ &= 4.2 KN \end{aligned}}$$

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$Q.5 \rightarrow$ GATE 2007

Tractor

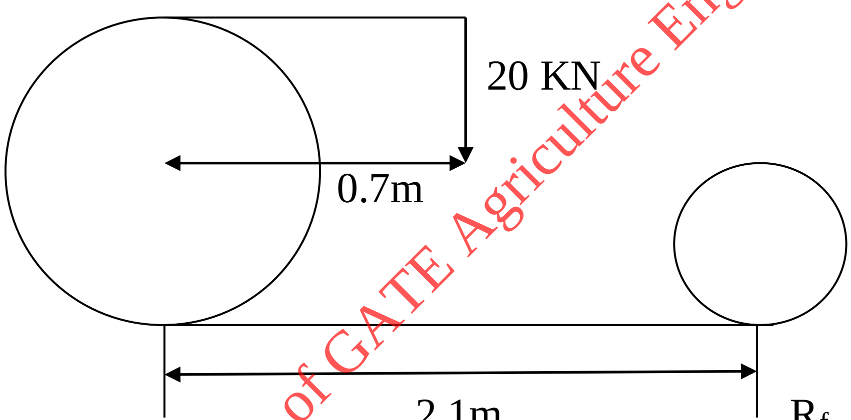
$$P = 35k\omega$$

$$\omega = 20KN$$

$\underline{6-16}$ 8 PR type $\underline{\text{Front}}$

$$\frac{h}{b} = 0.75$$

$$l = 2.1m$$



$$C.I = 1200 \times 10^3 Pascal$$

Static

$$R_f = \frac{\omega_t \times l_1}{l}$$

$$= \frac{20 \times 0.7}{2.1} = 6.66\ KM$$

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For Rear Wheel

$$R_r = 13.33\ KN$$

13.6 – 28 12 Pr type

$$b = 13.6 \times 0.0254 = 0.345\ m$$

$$d_{rim} = 28 \times 0.0254 = 0.712\ m$$

$$C_n = \frac{(C.I)bd}{R_r f}$$

$$\frac{h}{b} = 0.75$$

$$d = 1.062 \times drm + 2 \times h$$

$$= 1.062 \times 0.7112 + 2 \times 0.75 \times 0.345$$

$$\boxed{d = 1.272}$$

$$C.I = 1200$$

$$C_n = \frac{(C.I)bd}{R_{rs}}$$

$$R_{rs} = \frac{13.33}{2}$$

$$= 6.67$$

$$= \frac{1200 \times 0.345 \times 1.272}{6.67}$$

$$= 78.95 \approx 79$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

Front

$$C_n = \frac{(C.I)bd}{R_{rs}}$$

$\underline{6 - 16 \quad 8\,PR}$

$$R_f = 6.66$$

$$R_f = w_t - R_f = 13.33\ kN$$

$$R_{rs} = \frac{13.33}{2} = 6.665\ kN$$

$$inch = 0.0254\ m$$

$$b = 6\ inch = 6 \times 0.0254\ m = 0.1524\ m$$

$$d_{rim} = 16\ inch = 16 \times 0.0254 = 0.4064$$

$$d = 1.062 \times d + 2 \times h \qquad \frac{h}{b} = 0.75$$

$$= 1.062 \times 0.4064 + 2 \times 0.75 \times 0.1524$$

$$d = 0.6601\ m$$

$$R_{fs} = \frac{6.66}{2} = 3.33$$

$$C_n = \frac{(C.I)bd}{R_{fs}}$$

$$= \frac{1200 \times 10^3 \times 01524 \times 0.6601}{3.33 \times 10^3} = 36.25$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$$\rho = \frac{1.2}{36.25} + 0.04$$

$$= 0.0781$$

$$\rho = \frac{R}{R_{fs}}$$

$$R = 0.0731 \times 3.33$$

$$\boxed{R = 0.243\ KN}$$

$$C_n = \infty$$

$$\rho = \frac{1.2}{C_n} + 0.04$$

$$\rho = 0.04 = \frac{R}{wt}$$

$$towed\ force\ (F) = 0.04 \times 20$$

$$= 0.8\ KN$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.6 \rightarrow$ GATE 2009

$$P = 12\ KN$$

$$V = 5\ {}^{km}/_{hr}$$

$$r = 0.65$$

$$s = 20\%$$

$$T = 9\ KN - m$$

$$T.E. = \frac{P}{F}(1 - s)$$

$$T = F \times r$$

$$9 \times 10^3 = F \times 0.65$$

$$F = \frac{9 \times 10^3}{0.65} = 13.84$$

$$T.E. = \frac{12}{13.84}(1 - 0.2)$$

$$69.27\%$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.7 \rightarrow$ GATE 2009

$\underline{13.6 - 28\ }$ $12\ P_r$

$b = 13.6\ inch = 13.6 \times 0.0254 = 0.345$

$d_{rim} = 28\ inch = 28 \times 0.0254 = 0.7112$

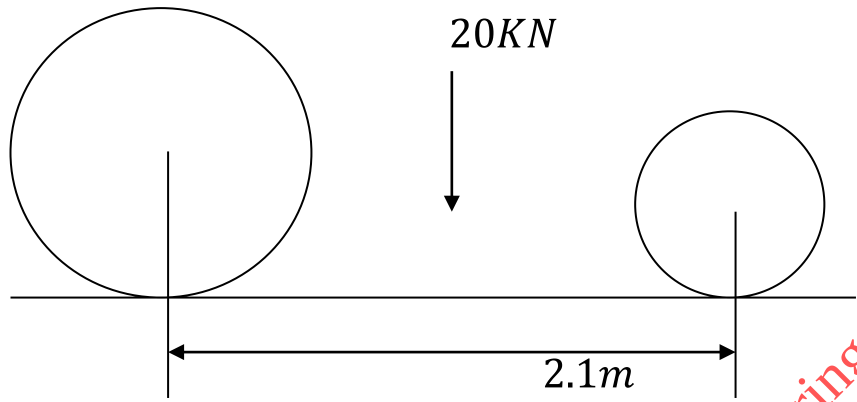
$d = d_{rim} + 2 \times h$

$$d = 0.7712 + 2 \times 0.75 \times 0.345$$

$$= 1.2287 \approx 1.23\ m$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.8 \rightarrow$ GATE 2010



$$C.I. = 1200\ kPa$$

$$C_n = \frac{(C.I.).bd}{R_{rf}}$$

$\underline{For\ \ 12.4 - 28\ \ P_r\ type}$

$$b = 12.4 \times 0.0284 = 0.31496$$

$$d_{rim} = 28 \times 0.0254 = 0.7112$$

$$d = 1.062 \times d_{rim} + 2 \times h$$

$$= 1.062 \times 0.7112 + 2 \times 0.75 \times 0.315$$

$$\boxed{d = 1.2277\ m}$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$$C_n = \frac{(C.I.)bd}{R_{fw}}$$

$$= \frac{1200 \times 0.315 \times 0.7112}{R_{fw}}$$

$$R_r = 0.65 \times 20$$

$$= 13$$

$$wt = 20$$

$$R_f = 0.35 \times 20 = 7.0$$

$$R_{fw} = \frac{7}{2} = 3.5\ KN$$

$$C_n = \frac{1200 \times 0.3196 \times 0.7112}{6.5}$$

$$C_n = 71.93 = 71.355$$

$$\rho = \frac{1.2}{C_n} + 0.04$$

$$\rho_{front} = 0.056$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$$\underline{for \quad 18.6-28 \quad 12\, pr\, type}$$

$$C.I. = \frac{(C.I.)bd}{R_{rs}}$$

$$R_{rs} = \frac{13}{2} = 6.5\ KN$$

$$b = 0.345$$

$$d_{rim} = 0.7112$$

$$C.I. = \frac{1200 \times 1.272 \times 0.345}{6.5}$$

$$= 81.1$$

$$\rho = \frac{1.2}{81} + 0.04$$

$$\boxed{\rho = 0.0548}$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$8 \rightarrow (b)$

$$\mu_g = 0.75[1 - e^{-0.3CnS}]$$

$$\delta = 0.15$$

$$C_n = 81$$

$$\mu_g = 0.75[1 - e^{-0.3\times 81\times 0.15}]$$

$$= 0.73$$

$$\mu_g = \frac{F}{R_r}$$

$$F = 13 \times 0.7306$$

$$\boxed{F = 9.496}$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.9 \rightarrow$ GATE 2011

$$w = 2000N$$

$$\rho = \frac{1.2}{C_n} + 0.04$$

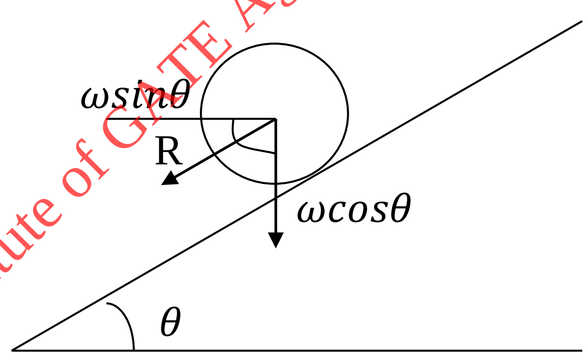
$$C_n = \infty$$

$$\rho = 0.04$$

$$\rho = \frac{R}{\omega}$$

$$R = 0.04 \times 2000$$

$$\boxed{R = 80N}$$



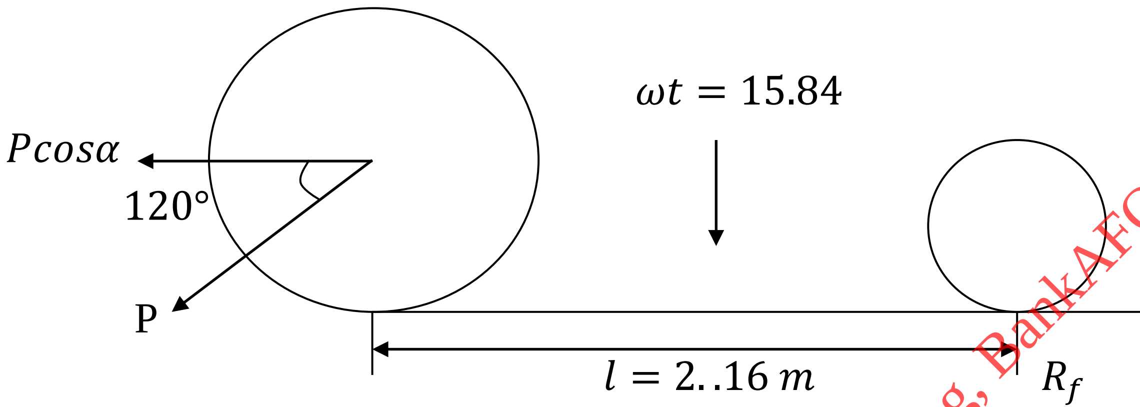
$$\omega sin\theta = 80$$

$$sin\theta = \frac{80}{2000} = 0.04$$

$$\theta = 2.292°$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.11 \rightarrow$ GATE 2012



$y = 0.70$

$R_f = R_{fs} - weight\ transfer$

$$R_{fs} = \frac{\omega t \times l_1}{l} = 15.84 \times 0.30$$

$= 4.752$

$$weight\ transfer = \frac{Pcos\alpha \times y + Psin\alpha \times S}{l}$$

$$= P\left[\frac{cos12 \times 0.7 + sin12 \times 0.12}{2.16}\right]$$

$= 0.328P$

GateForAll (Coaching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$R_{f^1} = 0$ For max pull

$$R_{f^1} = R_{fs} - weight\ transfer$$

$$= 4.752 - 0.328P$$

$$P = \frac{4.752}{0.328}$$

$$P = 14.48\ KN$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.13 \rightarrow$ GATE 2014

$$wt = 50KN$$

40% Rear

60% Print

$L = 2m$

$y = 0.5$

$$R_f = 0.6 \times 50 = 30KN$$

$$R_r = 0.4 \times 50 = 20KN$$

$$\mu_d = \frac{P}{\omega t}$$

$$R_{f^1} = R_f - weight\ transfer$$

$$weight\ transfer = \frac{P \times y}{l} =$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$$weight\ transfer =$$

$$R_{f^1} = 30 - \frac{P \times 0.5}{2}$$

$$R_{f^1} = 30 - \frac{P \times 0.5}{2}$$

$$R_{f^1} = same = \frac{50}{2} = 25$$

$$25 = 30 - \frac{P \times 0.5}{2}$$

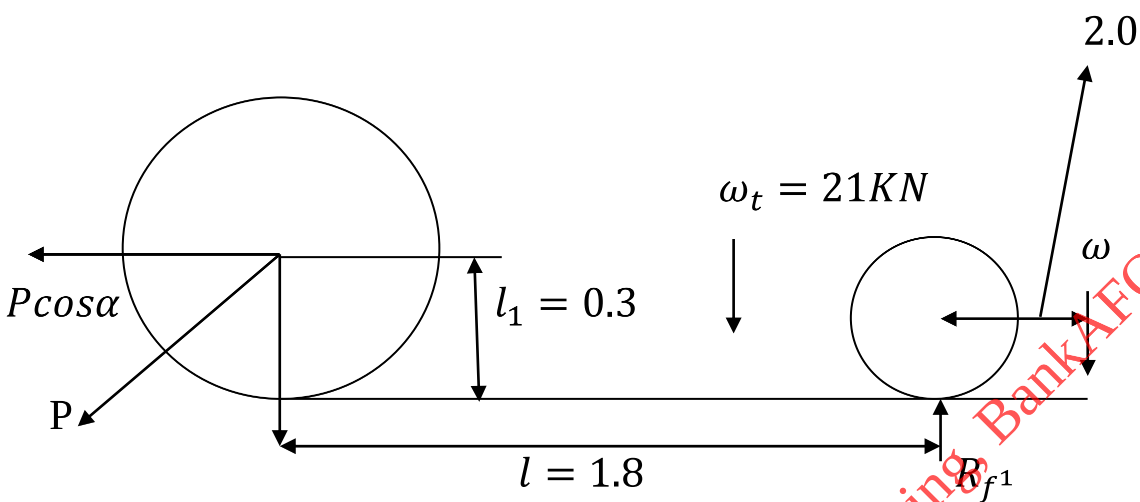
$$\frac{P \times 0.5}{2} = 5$$

$$P = \frac{100}{0.5} = 20$$

$$\mu d = \frac{P}{\omega} = \frac{20}{50} = 0.4$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.14 \rightarrow$ GATE 2016



$R_f = 21 \times 0.3 = 6.3$

$R_r = 21 \times 0.7 = 14.7$

$$R_f = 6.3 = \frac{\omega t \times l_1}{l}$$

$$6.3 = \frac{21 \times l_1}{1.8}$$

$l_1 = 0.54\ m$

$R_{f^1} \times 1.8 - \omega \times 0.2 - 21 \times 0.54 + 30cos20° \times 0.35 + 30sin20° \times 0.25 = 0$

$R_{f^1} = 0$

$\omega = 755\ KN$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.15 \rightarrow$ GATE 2018

static

$$R_f + R_r = \omega t$$

$$R_f = \frac{\omega t \times l_1}{l} = \frac{18 \times 0.6}{1.8}$$

$$= 6\ KN$$

$$P = 6\ KN$$

$$y = 0.39, \qquad l = 1.8$$

$$R_r = 12\ KN$$

Dynomic

$$R_{r^1} = Psin\alpha + weight\ transfer + R_r$$

$$R_{f^1} = R_f - (weight\ transfer)$$

$$R_{r^1} = 12 + \frac{P \times y}{l}$$

$$= 12 + \frac{6 \times 0.39}{1.8}$$

$$= 13.3\ KN$$

$$change\ in\ reaction = R_{r^1} - R_r$$

$$= 13.3 - 12 = 1.3\ KN$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$Q.16 \rightarrow$ GATE 2017

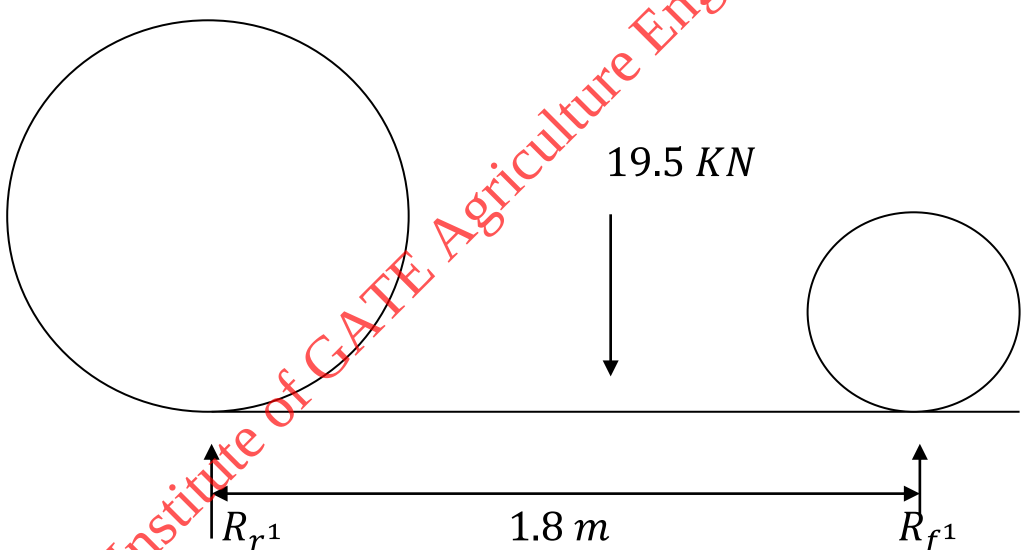
$$\omega = 19.5\ KN$$

$$R_r = 0.7 \times 19.5$$

$$R_f = 0.3 \times 19.5$$

$$P = 8\ KN \qquad Y = 0.450$$

$$R_{r^1} = Psin\alpha + R_r + weight\ transfer$$



$R_f = 5.85\ KN$

$R_r = 13.65$

$$R_{r^1} = 13.65 + \frac{P \times y}{l}$$

$$= 13.65 + \frac{8 \times 0.450}{1.8} = 15.65\ KN$$

GateForAll (Coaching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)

$$P_{cylinder} = 2188\ KPascal$$

$$P_{cylinder} = \frac{2188}{0.9}$$

$$= 2431\ k\ Pa$$

$$P_{total} = 2431 + 500$$

$$= 2931\ k\ Pa$$

$$P_i = \frac{25 \times 10^{-3}}{60} \times \frac{2931 \times 10^3}{0.80}$$

$$P_i = 1526\ watt$$

$$P_i = 1.526\ kw$$

GateForAll (Coching Institute of GATE Agriculture Engineering, BankAFO, ARS & ICAR)