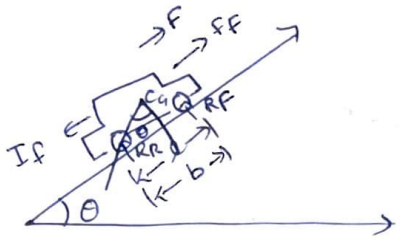
10)

Ans:



W = weight of car

CG = centre of gravity

b = wheel base

F = maxm forward acceleration

F_F = maxm tractive effort

R & F = Rear & Front wheel

R_R & R_F = Total normal reaction at front and rear wheel

h = height from CG to road

IF = Inertia force = M.F $\bullet$ $W \sin\theta$

$= M.F - mg\sin\theta$

$= \frac{W}{g}.F - W\sin\theta$ — (1)

$\Sigma V = 0$ — (2)

$\Sigma H = 0$ — (3)

using (2)

$W\cos\theta = R_F + R_R$ — (4)

using ③

$$F_F = \frac{w}{g} \cdot f + w \sin\theta$$

$$\mu \cdot R_F = \frac{w}{g} \cdot f + w \sin\theta$$

$$R_F = \frac{w}{g} f + \frac{w}{\mu} \sin\theta \quad - ⑦ \qquad \frac{w}{\mu}\left(\frac{f}{g} + \sin\theta\right)$$

Taking moment load

$$R_F \times b + \left(\frac{w}{g} \cdot f + \sin\theta\right) h = w\cos\theta \times l$$

$$\left(\frac{w}{g} \times \frac{\theta}{\mu} + \frac{w}{\mu}\sin\theta\right) b + \left(\frac{w}{g} f + w\sin\theta\right) \times h = w\cos\theta \times l$$

$$\left(\frac{F}{g\mu} + \frac{\sin\theta}{\mu}\right) b + \left(\frac{f}{g} + \sin\theta\right) h = \cos\theta \, l$$

$$\frac{b}{\mu}\left(\frac{F}{g} + \sin\theta\right) + \left(\frac{F}{g} + \sin\theta\right) h = \cos\theta \, l$$

$$\left(\frac{F}{g} + \sin\theta\right)\left(\frac{b}{\mu} + h\right) = \cos\theta \, l$$

$$\left(\frac{F}{g} + \sin\theta\right) = \frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)} \quad - ⑧$$

$$\frac{F}{g} = \left(\frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}\right) - \sin\theta$$

$$F = g\left[\left[\frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}\right] - \sin\theta\right] \quad - ⑨$$

$$R_F = \frac{W}{u} \times \frac{\cos\theta\, l}{\left(\frac{b}{u} + h\right)} \quad - (10)$$

$$= \frac{W \cos\theta\, l}{b + uh}$$

$$R_R = W\cos\theta - R_F$$

$$= W\cos\theta - \frac{W}{u} \frac{\cos\theta\, l}{\left(\frac{b}{u} + h\right)}$$

$$= W\cos\theta \left[1 - \frac{l}{(b + uh)} \right]$$

$$= W\cos\theta \left[\frac{b + uh - l}{b + uh} \right]$$

$$F_F = u R_F = u \times \left[\frac{W\cos\theta\, l}{b + uh} \right]$$

Four wheel drive

$$F = R_F + F_F = uR_R + uR_F$$

$$\Sigma V = 0$$

$$W = R_F + R_R \qquad \Sigma H = 0$$

$$(W/g) F = uR_R + uR_F$$

$$= u(R_R + R_F) = uW$$

$$(F/g) = u$$

$$\Sigma V = 0$$

$$W = R_R + R_F$$

$$\Sigma H = 0$$

$$\left(\frac{\omega}{g}\right)F = \mu_{RR} + \mu_{RF}$$

Assuming slip to occur at front wheels

First $R_F < R_R$ then

$\Sigma M_R = 0$ $\qquad 2\mu R_F = (\omega/g)F$

$$R_F b + (\omega/g)F h = \omega_1$$

2(i) $m = 1765\,kg$ $\quad l = 2.84\,m$ $\quad a1 = 1.22\,m$ $\quad a2 = 1.62\,m$

$$F_{z\,\text{axle}} = \frac{1}{2} mg \left(\frac{a_2}{l}\right)$$

$$= \frac{1}{2} \times 1765 \times 9.8 \times \frac{1.62}{2.84}$$

$$= \underline{\underline{9866.59}}\ N$$

$$F_{zr}_{axle} = \frac{1}{2} mg \left(\frac{a_1}{l}\right)$$

$$= \frac{1}{2} \times 1765 \times 9.8 \times \frac{1.22}{2.84}$$

3

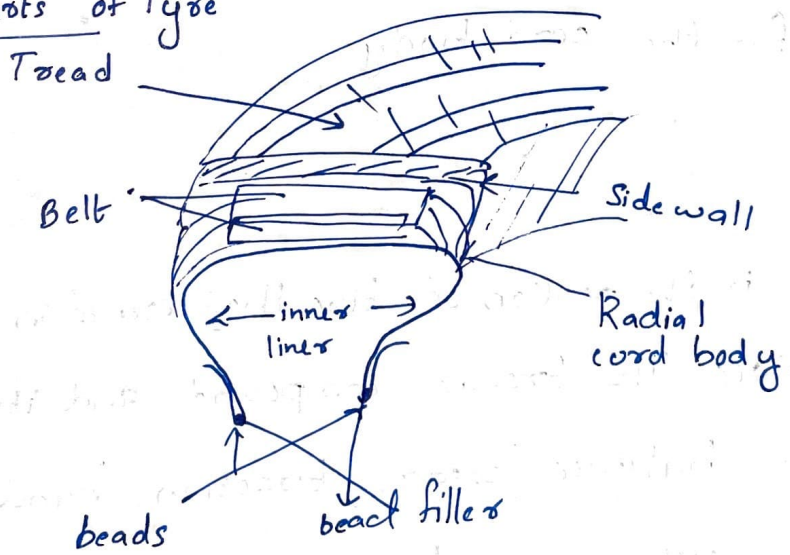
$$= 7430.40 N$$

3 (b) Tyre classification

Based on construction

(i) Radial (ii) Bias

Different parts of Tyre



1) Beads - They are made of coppers, brass or bronze-plated high tensile steel wires. Tire beads prevent the tire from sliding out of place when the wheel rolls.

2) Bead Filler - Bead filler is compound inside the tire beads. It provides stability to lower side and bead area. The density and stiffness of tires bead filler help to determine tires performance characteristics.

3) Radial cord Body :- It gives strength and transmits coneving forces from the tread to wheel. Rubber coated fabric cord, called body piles can be make up the upper body.

4) Inner liner :- It retains air pressure. A tires beads, bead filler and inner liner helps to hold air within side walls.

5) Belt Plies :- They are two or more strong layers of cord just under the tread area of tire. They improve tire mileage, impact resistance and traction. Steel is most commonly used. ~~They play a~~ Steel is the most commonly used material in belt plies.

6) Side wall

The area of a tire from bead to thread. The side of tire is called the side wall. It forms the protective covering for the cord body

7) Tread

The tread is the position of tire that comes in contact with road surface. The treads compound and its design have to balance wear, traction, handling, fuel economy, resistance and other characteristics of tire.