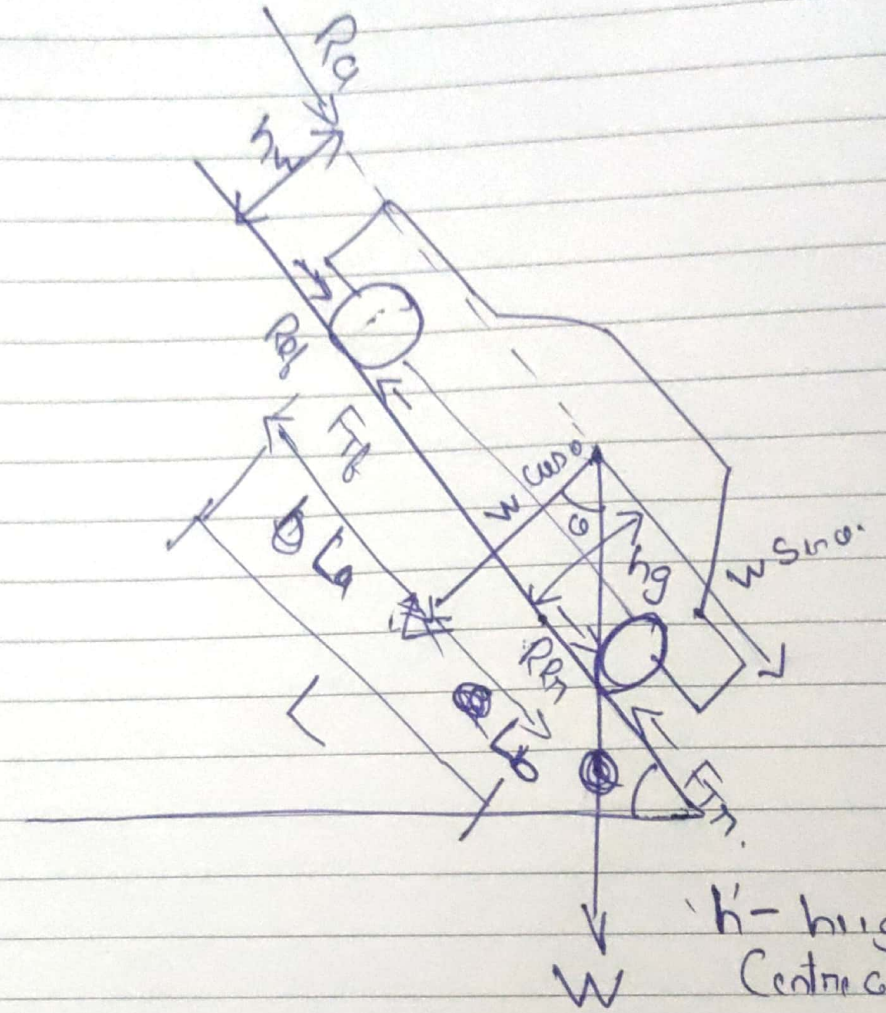
ADD Assignment No: 2

SSanath.

1)



Aerodynamic Resistance (Ra):

$$Ra = \frac{1}{2} \times \rho \times Cd \times A \times V^2$$

ρ = 1.255 kg/m³ (Air density)

A = Projected area of vehicle

Cd = Drag Coefficient

→ Gravitational force / Gradient Resistance (Rg)

where $R_g = W \sin\theta$

θ → Inclination angle / gradient angle.

→ Rolling Resistance (R_R)

→ Acting at Contact path.

RR is divided into 2

1) In the rear wheel and front wheel rolling resistance

$R_R = R_{Rf} + R_{Rr}$.
(Front) (Rear wheel)

$RR = P_L R_{rg} C_{osc}$.

P → Normal load acting on the centre of Rolling

Value of VR for different surface over wheel

1) Asphalt → 0.02

2) mud → 0.3

3) Sand → 0.01 → 0.7.

→ The body with low Cd will be more efficient

→ Aerodynamic force has 2 component

1) Pressure drag.

Pressure drag depends on form factor

i) How big the body is
ii) Shape of body

2) Skin friction

But comes into action when

Velocity > 200km/hr.

3) Traction force (F_T)

(Force needed to propel the vehicle upward.)

$$F_T = F_{Tf} + F_{TR}$$

→ For 4 wheel drive Tractive force will be divided as

1) Front wheel will behaving more Tractive force than rear wheel.

For Front wheel drive

$$F_T = F_{Tf}$$

For Rear wheel drive

$$F_T = F_{TR}$$

$$F_T - (R_a + R_g + R_R) = ma$$

$$M\frac{dV}{dt} + F_T = ma + (R_a + R_g + R_R).$$

Gradeability

It the vehicle ability to climb slope

$$\text{Gradeability} = 100 \times \frac{T_f}{\text{Gravity} \times \text{GVW}} - \text{RR Coefficient (MR).}$$

C → Rear

b - Front

GTV W -> Gross vehicle weight

Tf - Tractive force

Acceleration Resistance (Fa

The total mass of the vehicle and the inertial mass of the rotating parts of the drive accelerated can be neglected as the factors influencing the resistance to acceleration

$$Fa = M \frac{dV}{dt}.$$

By Summing the moments of all Forces about point R, the normal load on the front axle will be written as

$I_w = R_a$ $I_g = R_g$ n_d = drum radius $f_R = R_R$

Rolling resistance of R_{Rf} and R_{Rm} can be represented by rolling resistance I_{rf} and I_{rm}

By summing the moments of all forces

At front Axle

$$W_f = \frac{mgL_b\cos\theta - (I_{rf} + I_{rm} + R_a h_w + mgh_g \sin\theta + Mh_g \frac{dV}{dt})}{L}$$

At rear axle

$$W_r = \frac{mgL_a\cos\alpha - (I_{rf} + I_{rm} + R_a h_w + mgh_g \sin\theta + Mh_g \frac{dV}{dt})}{L}$$

For paddergon cars $h_w = h_g$

$$W_f = \frac{L_b}{L} mg\cos\theta - \frac{h_g}{L}\left(R_a + R_g + mg R_R \frac{n_d}{h_g}\cos\theta + m\frac{dV}{dt}\right) \quad \text{---(1)}$$

$$W_r = \frac{L_a}{L} mg\cos\theta - \frac{h_g}{L}\left(R_a + R_g + mg R_R \frac{n_d}{h_g}\cos\theta + m\frac{dV}{dt}\right) \quad \text{---(2)}$$

Where

$r_d \rightarrow$ effective radius

By adding

$$F_R = \mu P_{UR} \cos\theta$$

We Considering ① and ② to

$$W_f = \frac{L_b}{L} mg\cos\theta - \frac{h_g}{L}\left(F_T - R_R\left(1 - \frac{r_d}{h_g}\right)\right)$$

$$W_R = \frac{L_a}{L} mg\cos\theta - \frac{h_g}{L}\left(F_T - R_R\left(1 - \frac{r_d}{h_g}\right)\right)$$

For Front wheel F_t max is given by

$$F_{t\,max} = N_{wf}$$

$$F_t = N\left[\frac{L_b}{L} mg\cos\theta - \frac{h_g}{L}\left(F_{t\,max} - F_R\left(1 - \frac{r_d}{h_g}\right)\right)\right]$$

For rear wheel drive

~~TP -> Torque output~~

Tp -> Torque output

η_0 -> Transmission of final drive

η_g -> Transmission of Transmission

η - Efficiency of driveline

When vehicle drives on an road with moderate small grade and constant speed, the tractive effort and resistance equilibrium condition at

$$\frac{T_p \eta_0 \eta_g \eta_t}{r_d} = mg f_r + \frac{1}{2} \rho C_D A V^2 + mg i$$

$$i = \frac{\left(\frac{T_p \eta_0 \eta_g \eta_t}{r_d}\right) - mg R_R - \frac{1}{2} \rho C_d A V^2}{mg} = d - f_r'$$

$$d = \frac{F_t - R_a}{mg} = \frac{T_p \eta_0 \eta_g \eta_t / r_d}{mg}$$

$$d = \frac{F_T - F_W}{mg} = \frac{(T_{P10}\, i_g\, i_t / r_d) - \frac{1}{2}\rho C_d v^2 A}{mg}$$

is called performance factor. While the vehicle drives on a road with long grade, the maximum grad ability of the vehicle can be calculated as

$$\sin\alpha = \frac{d - R_R\sqrt{1 - d^2 + R_R^2}}{1 + R_R^2}$$

2) $m = 1765\,kg$

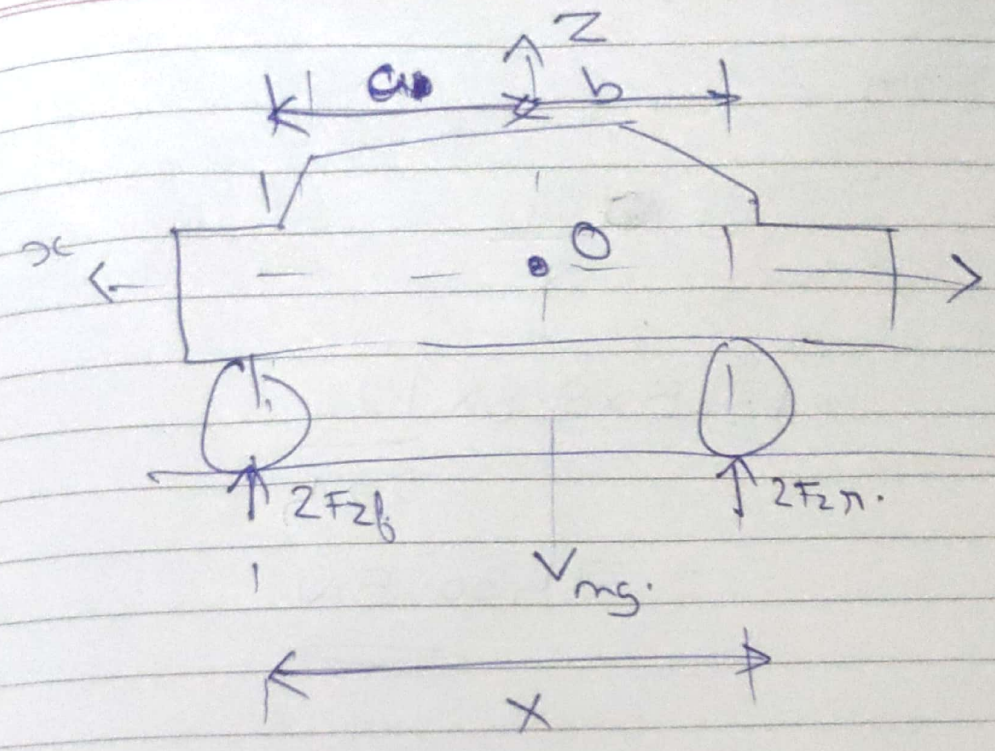
$L = 2.84\,m$

$a_1 = 1.22\,m$

$a_2 = 1.62.$

(a)

Car is parked on a level road.



$X = a - b$

~~$= 1221.62$~~

Normal force acting on each is Fz

At front axle Fzf

At Rear axle Fzn

$$F_{zf} = \frac{mg\,b}{x}$$

$$= 1765 \times 9.8 \times \frac{1.62}{2.54}$$

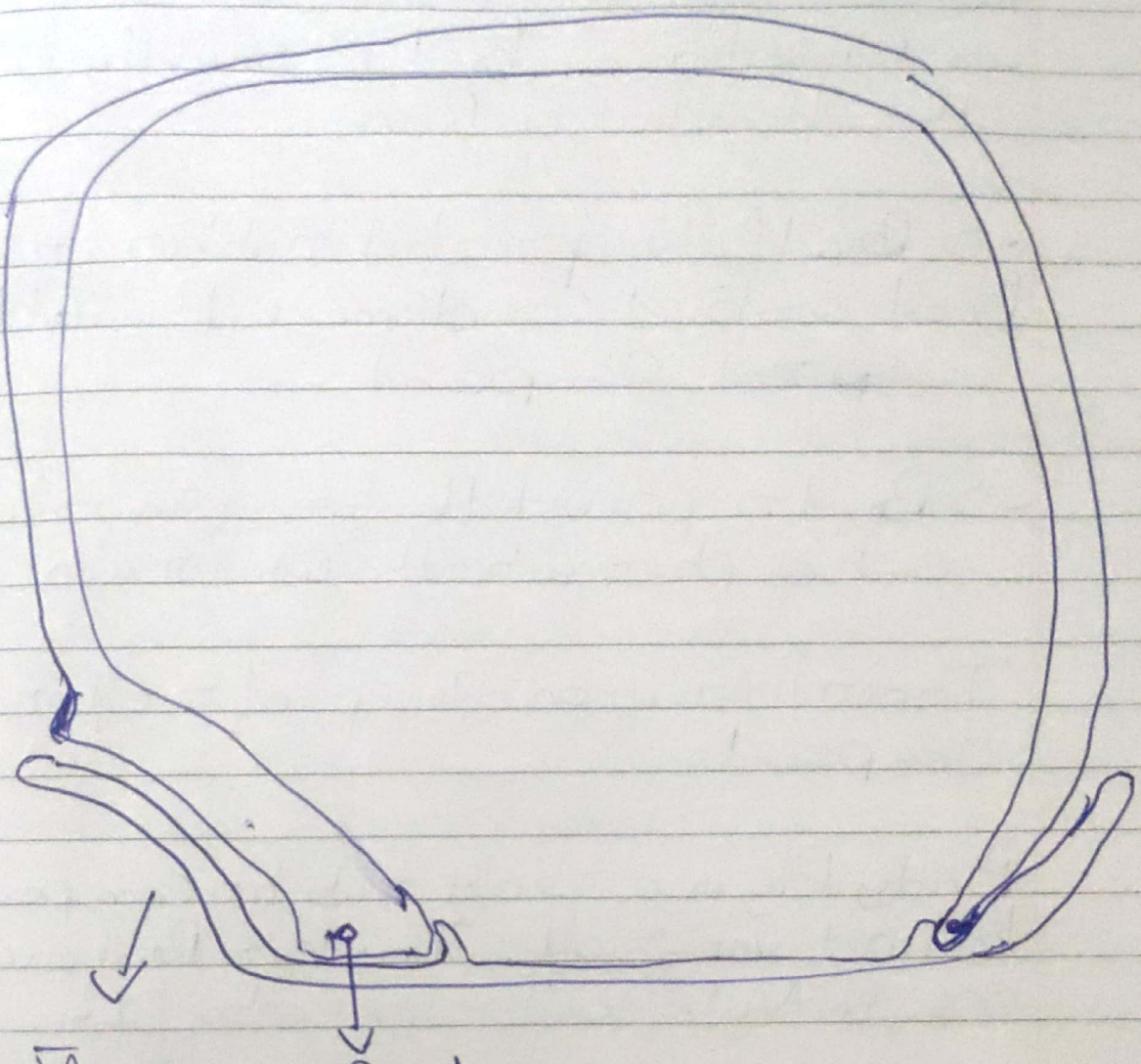
$$= 9866.5\,N$$

F_{zn}

$= mg \frac{a}{x}$

$= 1765 \times 9.8 \times \frac{1.22}{2.54}$

$= 7430.5N$



Components of tyre are

1) Beads

It is basically a spring wire in which no. of spring wires are connected together to form a bead

→ Bead is running inside the wire
→ Diameter of bead is slightly less than diameter of Rim

→ Bead filler protect rubber from bead as bead can damage the rubber Compound

→ Bead to prevent the tyre from sliding out of place when the wheel rolls

Inner liner is an add up of soft rubber compound

Body Ply is a soft rubber compound
→ but not very soft. This has Reinforcement may be Nylon, Kevlar or Carbon fibre

→ Role of body Ply is to give Structural Strength

→ It functions like a D. T inner tube, however modern car tyre no longer have inner tube inside them

→ A tyre beads, bead filler and Inner liner work together to hold air within tube wall

~~Sidewall -> The outer area of the tire~~

Sidewall - Side of the tyre is called as sidewall. It forms a protective cover over the cord body. Information of tyre is printed on it.

Steel belt - It will provide proper strength to the tyre

Shoulder - Uppermost part of tyre

Sub Shoulder Insert - Provides proper strength to the shoulder

Tread - Tread is the portion of tyre which comes into contact with road surface.

On the basis of tyre construction tyre can be classified as

1) Bias tyres

-> This is also known as Cross ply tyre. This tyre has better resistance against wear

-> They have good bonding to the road

→ Tyre consist of cancard layers made up of nylon cord which are placed diagonally along each other in the thread and the sidewalls at an angle of 90° 50°. Multiple rubber plies stacked over each other which forms a thick layer, which makes them less flexible as and it they are sensitive to overheating

Advantages (provides high stability)

Disadvantages (Due to high resistance of tyre fuel consumption is high)

Radial ply

This construction of a cancard ply which is formed by textile arcs running one bead to the other. Each ply embedded at an angle of 90° to the rolling direction. At the top of tyre

In this design, the cord plies are arranged at 90° to the direction of travel as radially. A Series of plies of cord reinforces a tyre.

Without this, a typical would be [illegible]
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