Date.....
Page.....

Q1. Drive the equation of motion and maximum tractive effort for car inclined at angle $\theta$. Also give the expression of maximum gradibility for a 4 wheel drive.

Q2. Consider a car with the following specifications that is parked on a level road. find the load on the front and rear axles

$m = 1765$ kg, $I = 2.84$ m, $a_1 = 1.22$ m, $a_2 = 1.62$ m

Q3 what are the different parts of tires? difference between types of tires on basis of their construction.

Date
Page

1A. Traction force ($F_T$)

$F_T = (Ma) + (R_a + R_R + R_g)$

$R_a = \frac{1}{2} \rho \times C_d \times A \times V^2$ (Aerodynamic force/resistance)

$m$ = mass ; $a$ = acceleration

$R_R = \mu_R \cdot W \cdot \cos\theta$ (Rolling resistance)

$\mu_R$ = coefficient of Rolling resistance ; 0.02 - asphalt, 0.3 mud, 0.6 to 0.7 sand

$W$ = weight = $M \times 9.81$ = mass $\times$ 9.81

$\theta$ = angle of inclination of road

$R_g$ = gravitational resistance = $W \sin\theta$

$W$ = weight = mass $\times$ 9.81

on substituting $R_a$, $R_R$, $R_g$

$$F_T = (m \times a) + \left(\frac{1}{2} \rho C_d A V^2 + \mu_R (m \times 9.81) \cos\theta + (m \times 9.81) \sin\theta\right)$$

where $C_d$ = drag coefficient

$C_d$ = 0.4 ~ 0.5 (2 wheeler)

= 0.28 (4 wheeler)

∴ its case of 4 wheeler

$C_d$ = 0.28 is considered

$A$ = area of car = $w \times h \times$ (ratio) ($w$ = width, $h$ = height)

ratio = 0.85 ~ 0.9 for car

0.75 ~ 0.8 for 2 wheeler

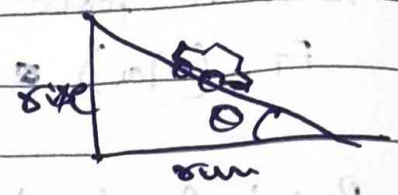
∴ its 4 wheeler 0.9 is taken into consid

$\rho$ = 1.225 kg/m³ (air)

Substituting in $F_T$ we get

$F_T = (m \times a) + \left(\frac{1}{2} \times 1.225 \times \omega \times h \times 0.9 \times 0.28 \times V^2 + 0.02 \times m \times 9.81 \cos\theta + m \times 9.81 \sin\theta\right)$

gradibility




$\tan\theta = \frac{\text{rise}}{\text{run}}$

gradibility = $\tan\theta \times 100$

convert it into % $\times 100$

2A mass of car ($m$) = 1765 kg

distance b/w front & back axles ($I$) = 2.84 m

distance b/w Center of gravity and front axle ($a_1$) = 1.22 m

distance b/w Center of gravity and rear axle ($a_2$) = 1.62 m

let $R_f$ and $R_b$ be forces exerted by level ground on front & real axle

$R_f + R_b = mg = 1765 \times 9.81 = 17314.7$ N

for torque about C.G we have

$R_f(1.22) = R_b(1.62)$

$R_f = \frac{1.62}{1.22} R_b = 1.33 R_b$

$R_f - 1.33 R_b = 0$ — (ii)

$R_f + R_b = 17314.7$ — (i)

(i) − (ii) $= (R_f + R_b) - (R_f - 1.33 R_b) = 17314.7 - 0$

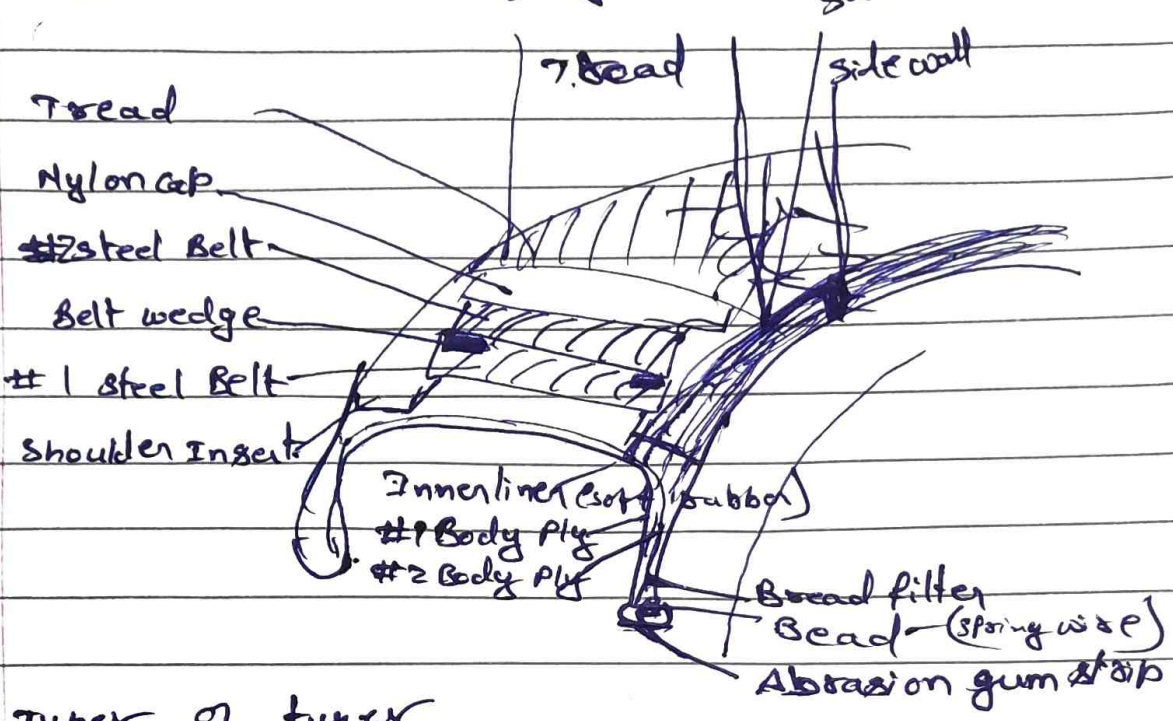
$2.33 R_b = 17314.7$

$R_b = 7431.2$ N

$R_f = 17314.7 - R_b = 9883.5$ N

Date.....
Page.....

3A Different Parts of tyre are




1.22 m

Types of tyres