Q1. drive the equat^n of motion and Maximum tractive effort for a car inclined at angle θ also give the expression of Maximum gradiability for 4 wheel drive.

G → Centre of Gravity

W → weight of the car

F → Max forward acceleration

F_F → Max Attractive effort.

R_r and R_F → Total normal react^n at front and rear wheels

h → height from road to G

I_F → inertial force

b → wheel base

$I_F = M \cdot F - W \sin\theta$

$= M \cdot F - mg \sin\theta$, $m = W/g$

$\therefore = W/g \cdot f - mg \sin\theta$ — (1)

$\Sigma V = 0$ — (2)

$\Sigma H = 0$ — (3)

(2) $\Rightarrow$ $W \cos\theta = R_f + R_r$ — (1)

(3) $\Rightarrow$ $f_f \times W/g \cdot F + W \sin\theta$

$MRf = W/g \cdot f + W \sin\theta$

$R_f = W/g \cdot f + W/\mu \sin\theta$

Moment $= x$

$R_f \times b + (W/g f + \sin\theta)\, h = W \cos\theta \times l$

$(\phi/g\ \theta/\mu + \phi/\mu \sin\alpha)\, b + W/g \cdot f\, \phi \sin\alpha$

$h = \phi \sin\alpha + l$

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

$$b/\mu\,(F/g + \sin\alpha) + (F/g + \sin\alpha)\, h = \cos\alpha\, l$$

$$(F/g + \sin\alpha) = \frac{\cos\alpha\, l}{(b/\mu + b} \quad \text{—— (8)}$$

$$F/g = \frac{\cos\alpha\, l}{(b/\mu + b)} - \sin\alpha$$

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

$$RF = \omega/\mu * \frac{\cos\alpha\, l}{(b/\mu + b)} \quad \text{—— (10)}$$

$$= \frac{\omega\, \cos\alpha\, l}{b + \mu h}$$

$$R_R = \omega\cos\alpha - R_F$$

$$= \omega\cos\alpha - \omega/\mu \frac{\cos\alpha\, l}{(b/\mu + b)}$$

$$= \omega\cos\alpha\left[1 - \frac{l}{(b + \mu b)}\right]$$

$$= \omega\cos\alpha\left[\frac{b + \mu h - l}{b + \mu h}\right]$$

$$F_F = \mu R_F = M \times \left[\frac{\omega\cos\alpha\, l}{b + \mu h}\right]$$

4 wheel drive

$$F = R_f + F_F = \mu R_r + \mu R_f$$

$$\Sigma V = 0$$

$$w = R_f + R_r$$

$$\Sigma H = 0$$

$$(w/g)F = \mu R_r + \mu R_f$$

$$= \mu (R_r + R_f)$$

$$= \mu w$$

$$F/g = \mu$$

$$\Sigma V = 0$$

$$w = R_r + R_f$$

$$\Sigma H = 0$$

$$(w/g)F = \mu R_r + \mu R_f$$

Assume slip to front wheels

First $R_F < R_r$

Then;

$$\Sigma M R = 0$$

$$2\mu R_F = (w/g)F$$

$$R_f b + (w/g) F h = w l$$

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

$$l = 2.84 M$$
$$a1 = 1.22 m$$
$$a2 = 1.62 m$$

load on front axles $F_{A1} = mg\left(\frac{a2}{l}\right)$

$$= 1765 \times 9.8 \left(\frac{1.62}{2.84 m}\right)$$
$$= 9866.7 aN$$

load on rear axles $F_{A2} = Mg\left(\frac{a1}{l}\right)$

$$= 1765 \times 9.8 \left(\frac{1.22}{2.84}\right)$$

$$F_{A2} = 7430.40 N$$

load on rear axles = 7430.40 N

Q3. what are the different parts of tires differentiate b/w types of tires on the basis of their construct°.

Tread

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

SIDE WALL

The area of a tire from the head to the tread the side of the tire is known as side wall. it forms a protective covering for the cord body.

Beads :-

Beads holds the tire to the rim or the outer edge of the wheel. They are Made of copper. brass or plated high tensile steel wires wound in to a rubber band. Tire beads prevent the tire from sliding out of place when the wheels roll.

Bead filler :-

It is a rubber Compound inside the tire's beads. It provides stability to the lower side wall and bead area. the density and stiffness of a tire, bead filler help to determine a tire performance characteristics.

BELT PLIES

These are two or More strong layers of 'Conjust' cinder the tread area of the tire. The primary funct of belt plies to the provide strength and stability to the tire tread. They play a role in improving tire Mileage, Impact resistance, and tract stel is the most Commonly used cord material in belt plies.

Radial Cord body

It gives the strength & transmits the Cornering force from the tread to the wheel rubber Cord. fabric cord called body belt plies. Make up the cord body. body plies can be Made of polyester, rayon or nylon. polyster is Most Commonly used.

INNER LINER

It is the rubber Compound bonded to the inside of the cord body that retains air under pressure. it has no cord reinforcement. and it functions like and inner tube. that Modern Car tires no longer have inner tire inside them.

A tires beads, filler and inner tire works together to hold air within the tirewall.

Types :-

Bas play	Radial
* The treads & side walls share the same casing plies * Reduced traction * nylone belts * Normal duty * Low cost and low life expectancy	* Cord plies are arranged to the directⁿ of travel * outstanding tractⁿ * steel belts * Extremidity * Expensive and long life expectancy