Problems

1) A vehicle has its wheel base equal to 3 times the height of its CG above the ground. If the vehicle is braked on all four wheels over a road whose adhesion factor is 0.6, determine the weight transferred from the rear to front wheel.

Given:

$$b = 3h$$

$$\mu = 0.6$$

To find: W_t

Solution:

$$W_t = \frac{\mu h}{b} \times \frac{f}{g} \times W$$

For four wheel braking

$$f = \mu g$$

$$= \frac{\mu h}{3h} \times \frac{\mu g}{g} \times W$$

$$W_t = \frac{\mu^2 W}{3} = \frac{0.6^2 \times W}{3}$$

$$\boxed{W_t = 0.12\ W}$$

% of weight transfer = $\left(\frac{W_t}{W}\right) \times 100$

$= \frac{0.12 W}{W} \times 100$

$= 12\%$

Result:

% of weight transfer = 12%

2. Calculate the minimum stopping distance for a vehicle travelling at 60 km/h with a deceleration equal to acceleration due to gravity

Given:

$U = 60 \text{ km/hr} = 16.67 \text{ m/s}$

$f = 9.81 \text{ m/s}^2$

To find: S

Solution: $S = \frac{U^2}{2f} = \frac{16.67^2}{2 \times 9.81}$

$S = 14.16 \text{ m}$

Result:

$S = 14.16 \text{ m}$

3. A car of mass 800 kg is travelling at 36 km/h. Determine

(a) The kinetic energy it posses

(b) The Average braking force to bring it to rest in 20 meters

Given data:

$m = 800 kg$

$U = 36 km/hr = 10 m/s.$

$S = 20$ meter

To find:

(i) K.E

(ii) F

Solution:

$$K.E = \frac{1}{2} mU^2 = \frac{1}{2} \times 800 \times 10^2 = 40000$$

$$\boxed{K.E = 40 KJ}$$

$$F = \frac{MU^2}{2S} = \frac{800 \times 10^2}{2 \times 20} = 2000$$

$$\boxed{F = 2 kN}$$

Result:

(i) K.E = 40 KJ

(ii) F = 2 KN

4. Determine the braking efficiency of a vehicle if the brakes bring the vehicle to rest from 60 km/h in a distance of 15 meter.

Given:

$U = 60 \text{ km/h}$

$S = 15 \text{ m}$

To find: η

Solution:

$$\eta = \frac{0.4 \times U^2}{S} = \frac{0.4 \times 60^2}{15}$$

$$\boxed{\eta = 96\%}$$

Result: $\eta = 96\%$

5. A motor car has a wheelbase of 2.64 m, the height of its CG above the ground is 0.61 m and it is 1.12 m in front of the rear axle. If the car is travelling at 40 km/h on a level track, determine the minimum distance in which the car may be stopped when

(a) The rear wheels are braked

(b) The front wheels are braked

(c) All wheels are braked

The coefficient of friction b/w tyre and road is taken as 0.6

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Given data:

$b = 2.64\,m$

$h = 0.61\,m$

$l = 1.12\,m$

$V = 40\,km/hr = 11.1\,m/s$

$\mu = 0.6$

Given that car is travelling in level track so, $\theta = 0$

$\cos\theta = 1$

$\sin\theta = 0$

To find:

(i) S → when rear wheels braked

(ii) S → when front wheels are braked

(iii) S → All wheels are braked

Solution:

For stopping distance $S = \frac{V^2}{2f}$

(i) When rear wheel braked.

$$\frac{f}{g} = \frac{\mu(b-l)}{b+\mu h}\cos\theta - \sin\theta$$

$$\frac{f}{9.81} = \frac{0.6(2.64-1.12)}{2.64+(0.6\times0.61)}\cos 0 - \sin 0$$

$$f = 2.98\,m/s^2$$

$$S = \frac{V^2}{2f} = \frac{11.1^2}{2\times2.98} = 20.67$$

$$S = 20.67\,m$$

(b) When front wheel braked

$$\frac{f}{g} = \frac{\mu l \cos\theta}{b - \mu h} - \sin\theta$$

$$\frac{f}{9.81} = \frac{0.6 \times 1.12 \times \cos 0}{2.64 - (0.6 \times 0.61)} - \sin 0$$

$$\boxed{f = 2.9\ m/s^2}$$

$$S = \frac{v^2}{2f} = \frac{11.1^2}{2 \times 2.9}$$

$$\boxed{S = 21.25\ m}$$

(c) When All wheels are braked

$$\frac{f}{g} = \mu \cos\theta - \sin\theta$$

$$\frac{f}{9.81} = 0.6 \times \cos 0 - \sin 0$$

$$\boxed{f = 5.886\ m/s^2}$$

$$S = \frac{v^2}{2f} = \frac{11.1^2}{2 \times 5.886}$$

$$\boxed{S = 10.47\ m}$$

Result: (a) When rear wheel braked, S = 20.67 m
(b) When front wheel braked, S = 21.25 m
(c) When All wheel braked S = 10.47 m