The Coefficient of rolling resistance for a truck weighing 62293.5 N is 0.018 and the Coefficient of air resistance is 0.0276 in the formula $R = KW + K_a AV^2$, where A is m^2 of frontal area and V the speed in Km/hr. The transmission efficiency in top gear of 6.2:1 is 90% and that in the second gear of 15:1 is 80%. The frontal area is 5.574 m^2. If the truck has to have a maximum speed of 88 Km/hr in top gear, calculate

(i) The Engine BP required

(ii) The engine speed if the driving wheel have an effective diameter of 0.8125 m

(iii) The maximum grade the truck can negotiate at the above engine speed in Second gear

(iv) The maximum ~~draw pull bar~~ drawbar pull available on level at the above engine speed in Second gear.

Given data:

$W = 62293.5\ N$

$K\ (\text{or})\ \mu = 0.018$

$K_a = 0.0276$

$R = KW + K_a A V^2$

η_t in top gear $= 90\%$

Gear ratio in top gear $G_r = 6.2 : 1$

η_t in Second gear $= 80\%$

Gear ratio in Second gear $G_r = 15 : 1$

$A = 5.574\ m^2$

$V = 88\ km/hr$ [At Top Speed]

$d = 0.8125\ m$

To find:

(i) BP

(ii) N_e

(iii) G

(iv) D

Solution:

$$R = KW + K_a A V^2$$

$$= (0.018 \times 62293.5) + (0.0276 \times 5.574 \times 88^2)$$

$$\boxed{R = 2312.64\ N}$$

$$BP (or) P = \frac{R_T V}{3600 \eta_t}$$

$$= \frac{2312.64 \times 88}{3600 \times 0.9}$$

$$\boxed{BP = 62.8 \text{ kW}}$$

(ii)

$$V = \frac{\pi D N_w \times 60}{1000}$$

$$N_w = \frac{N_e}{G_r} = \frac{N_e}{6.2}$$

$$88 = \frac{\pi \times 0.8125 \times \frac{N_e}{6.2} \times 60}{1000}$$

$$\boxed{N_e = 3562.5 \text{ rpm}}$$

(iii)

$$R_T = \underbrace{R_a + R_r}_{R} + R_g$$

$$R_T = R + R_g$$

$$R_T = KW + k_a A V^2 + W \sin\theta$$

$$V = \frac{\pi D N_w \times 60}{1000}$$

$$N_w = \frac{N_e}{G_r} = \frac{3562.5}{15}$$

$$\boxed{N_w = 237.5}$$

$$V = \frac{\pi \times 0.8125 \times 237.5 \times 60}{1000}$$

$$\boxed{V = 36.37 \text{ km/hr}}$$

$R_T = T.E$

$$T.E = \frac{BP \times \eta_t \times 3600}{V}$$

$$= \frac{62.8 \times 0.8 \times 3600}{36.37}$$

$$\boxed{T.E = 4972.38 \ N}$$

$$\boxed{R_T = 4972.38 N}$$

$$R_T = kW + K_a A v^2 + W \sin\theta .$$

$$4972.38 = [0.018 \times 62293.5] + [0.0276 \times 5.574 \times 36.37^2] + 62293.5 \sin\theta .$$

$$62293.5 \sin\theta = 3647.6$$

$$\sin\theta = \frac{3647.6}{62293.5}$$

$$\sin\theta = 0.058$$

$$\sin\theta = G$$

$$G = 0.058$$

$$\boxed{G = \frac{1}{17.1}}$$

Maximum Draw Pull bar $D = R_T - R$.

$$D = 4972.38 - [KW + K_a A V^2]$$

$$= 4972.38 - [(0.018 \times 62293.5) + (0.0276 \times 5.574 \times 36.37^2)]$$

$$= 4972.38 - 1324.8$$

$$\boxed{D = 3647.5\ N}$$

Result:

(i) $BP = 62.8\ kW$

(ii) $N_e = 3562.5\ rpm$

(iii) $G = \frac{1}{17.1}$

(iv) $D = 3647.5\ N$