MOKOLO RA-[MOTE] EBUBECHUKWU
16/ENG04/067
ELECT/ELECT

(1) D = 1500m

schedule speed $= 36 km/hr = 36 \times \frac{5}{18} = 10 m/s$

braking reterdation (B) $= 3 \times \frac{5}{18} = 5/6 \, m/s^2$

$V = d/t \therefore t = d/v = \frac{1500}{10} = 150s$

Actual time of run $= 150 - 25 = 125s$

$V_a = \frac{1500}{125} = 12 m/s$

$V_{max} = 1.25 \times 12 = 15 m/s$

$K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right] = \frac{1500}{15^2}[1.25 - 1]$

$= \frac{5}{3}$

Recall $K = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right]$

$\frac{5}{3} = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{6}{5}\right]$

$\alpha = 0.47 m/s^2 = 0.47 \times 18/5$

$= 1.7 Km/h/s$

$\therefore$ acceleration $(\alpha) = 1.7 Km/h/s$

2 $V_a = 36\,km/h = 36 \times 5/18 = 10\,m/s$

$\alpha = 1.8\,km/h/s = 1.8 \times 5/18 = 0.5\,m/s^2$

$\beta = 3.6\,km/h/s = 3.6 \times 5/18 = 1.0\,m/s^2$

$$t = \frac{2000}{10} = 200\,s$$

$$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{0.5 + 1.0}{2(0.5 \times 1)} = 1.5$$

$$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K}$$

$$= \frac{200 - \sqrt{200^2 - 4 \times 1.5 \times 2000}}{2 \times 1.5}$$

$= 11\,m/s = 11 \times 18/5$

$\simeq 39\,km/h$

3 T.S.A of the tank $= 6L^2$

$\therefore 6L^2 = 6$

$L = 6/6 = 1m^2$

Vol of the tank $= L^3 = 1m^3$

Vol of water to be heated daily $= 6 \times (1 \times 0.9)$

$= 5.4m^3$

Since $1m^3$ of water weighs 1000kg

mass of water $= 5.4 \times 1000 = 5400kg$

Heat req to raise the temp of water

$= 5400 \times 4200 \times (65 - 20)$

$= 1020$ mJ

if 1kwh = 3.6mJ

Then 1020 mJ = 1020/3.6

= 283.3 kwh

Daily loss from the tank $= 6.3 \times 6 \times (65-20) \times \frac{24}{1000}$

= 40.8 kwh

Energy supplied per day = 283.3 + 40.8

= 324.1 kwh

loading in kwh = 324.1/24

= 3.5 kw

Efficiency of the tank $= \frac{283.3}{324.1} \times 100$

$= 87.4\%$

4 Secondary Current $= \frac{600 \times 10^3}{20 \times 0.6} = 5 \times 10^4$ A

If this current is taken as the reference quantity, then sec voltage is

$V_2 = 20(0.6 + j0.8) = (12 + j16)$ V

Secondary impedance $Z_2 = \frac{(12 + j16)}{(5 \times 10^4)}$

$= (2.4 + j3.2) \times 10^{-4}\ \Omega$

Now, if the sec resistance is doubled while reactance remains constant, the impedance is half becomes

$Z_2 = (4.8 \times j3.2) \times 10^{-4}\ \Omega$

Now, sec Current $(I_2) = \frac{20}{(4.8 \times j3.7) \times 10^{-4}}$

$= 3.466 \angle -33.7° \times 10^4$ A

Now, pf $= \cos 33.7° = 0.832$

Hence, power absorbed

$= 20 \times 3.466 \times 10^4 \times 0.832 \times 10^4$

$= 580 kW$

(5) without Reflector

(a) $E = \frac{300}{20^2}$

$= 0.75 \; lm/m^2$

(b) $\theta = \tan^{-1}[10/20] = \tan^{-1}(0.5) = 26.6^0$

$\cos\theta = 0.89, \; x^2 = 10^2 + 20^2 = 500$

$\therefore E = \frac{300}{0.89 \times 500}$

$= 0.534 \; lm/m^2$

* with Reflector

Luminous output of the lamp = $300 \times 4\pi$ lumen

flux directed by the reflector = $0.5 \times 1200\pi$

$= 600\pi \, lm$

Illumination produced on the disc = $\frac{600\pi}{100\pi}$

$= 6 \, lm/m^2$