ADEWJI FAVOUR
15/ENG04/003
ELECTRICAL ELECTRONICS

1. $D = 1500m$, schedule speed $= 36km/hr = 36 \times 5/18 = 10m/s$

Breaking retardation $\beta = 3 \times 5/18 = 5/6 \, m/s^2$

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

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

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

$$K = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}(1.25 - 1) = 5/3$$

Recall $K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

$$= \frac{5}{3} = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{6}{5}\right)$$

$$\alpha = 0.4m/s^2 = 0.4 \times 18/5 = 1.7Km/h/s$$

$\therefore$ Acceleration $\alpha = 1.7Km/h/s$

2) $V_a = 36Km/h = 36 \times 5/18 = 10m/s$

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

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

$t = 2000/10 = 200s$

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

$$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K} = \frac{200 - \sqrt{200^2 - 4 \times 1.5 \times 2000}}{2 \times 1.5}$$

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

$$= 39Km/h$$

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

$\therefore 6L^2 = 6$, $L = 6/6 = 1m^2$

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

Volume of water to be heated daily = $6 \times (1 \times 0.9) = 5.4 m^3$

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

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

Heat required 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 = $6.3 \times 6 \times (65-20) \times 24/1000$

$= 40.8$ Kwh

Energy supplied per day = $283.3 + 40.8 = 324.1$ Kwh

Loading in Kwh = $324/24 = 3.5$ 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, the sec voltage is

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

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

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

Now, if the secondary resistance is doubled while reactance remains constant, the impedance when hearth is half-full becomes

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

Now, Sec current $I_2 = \frac{20}{(4.8 + j3.2) \times 10^{-4}}$

$= 3.466 \angle -33.7° \times 10^4 A$

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) $\theta = \tan^{-1}(10/20) = \tan^{-1}(0.5) = 26.6°$

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

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

$= 0.534 lm/m^2$

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 $= \frac{600\pi}{100\pi}$

$= 6 lm/m^2$

It is the same at every point on the disc.