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15/ENG04/042
EEE 552

1) $D = 1500m$, Scheduled speed $= 36 \, Km/hr = 36 \times 5/18 = 10m/s$

$B = 3 \times (5/18) = 5/6 \, m/s^2$

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

$V_a = 1500/125 = 12m/s$

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

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

$$= 15/3$$

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

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

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

$\alpha = 0.4m/s^2 = 0.47 \times 18/5 = 1.7 Km/h/s$

$\therefore$ acceleration $\alpha = 1.7 \, Km/h/s$

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

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

$B = 3.6 \, Km/h/s = 3.6 \times 5/18 = 10 m/s^2$

$t = 2000/10 = 200s$

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

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

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

$= 39 \, Km/h$

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

$6l^2 = 6$, $l = 6/6 = 1m^2$

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

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

Since $1m^3$ of water = 1000kg Then,

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

Heat required to raise the temp of water = $5400 \times 4200 \times (65-20)$

= 1020mJ.

If 1Kwh = 3.6mJ

Then 1020mJ = $1020/3.6 = 283.3$ Kwh.

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

= 40.8Kwh.

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 the Current is taken ~~[struck out]~~, the voltage is

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

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

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

If the Secondary resistance is double and the reactance remains Constant, Z_2 becomes

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

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

$= 3.466 \angle -33.7^\circ \times 10^4 A$.

Now pf $= \cos 33.7 = 0.832$

Hence, the power absorbed $= 20 \times 3.46 \times 10^4 \times 0.83 \times 10^4$

$= 580$ Kilo watts

5) with absence of Reflector

a) $E = \frac{300}{20^2} = 0.75 \, lm/m^2$

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

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

$\therefore E = \frac{300}{0.89 \times 500} = 0.534 \, lm/m^2$

with Reflector

luminous output of lamp $= 300 \times 4\pi$ lumens

Flux directed to the Reflector $= 0.5 \times 1200\pi$

$= 600\pi \, lm$

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Illumination produced on disc $= \frac{600\pi}{100\pi} = 6 \, lm/m^2$