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15/ENG04/054

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

breaking petrdaction $\beta = 3 \times 5/18 = 5/6$

$r = d/t \therefore t = d/v = 1500/10 = 15s$

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

$V_a = \frac{1500}{120} = 12m/s$

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

$k = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{150}{15^2}(1.25 - 1)$

$= 5/3$

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

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

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

$= 1.7 km/h/s$

$\therefore$ acceleration $\alpha = 1.7 km/h/s$

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

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

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

$t = 2000/10 = 200s$

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

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

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

$= 39 km/h$

3 TSA 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 $= 6 \times (1 \times 0.9) = 5.4m^2$

Since $1m^3$ of water weight 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 $1 kwh = 3.6 MJ$

then $1020MJ = 1020/3.6 = 283.3 kwh$

Scanned with CamScanner

Daily loss from the tank: $63 \times 6 \times (65-20) \times 24/1000$

$= 40.8\,kWh$

Energy supplied per day $= 283.3 + 40.8 = 324.1\,kWh$

loading in kWh $= 324.1/24$

$= 3.5\,kW$

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

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

Now if the sec resistance is doubled while reactance remains constant, then impedance when load is half full becomes

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

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

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) a without Reflector

$E = \frac{300}{20^2}$

$= 0.751\,lm/m^2$

b) $\theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5) = 26.6°$

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

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

$= 0.534\,lm/m^2$

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.