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15/ENG04/057
EEE552

(1)

Solution

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

breaking retardation $B = 3 \times 5/18 = 5/6\ m/s^2$

$V = d/t \therefore t = d/V = 1500/10 = 15s$

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

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

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

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

$$= 5/3$$

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

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

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

$$= 1.7 Km/h/s$$

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

② $V_a = 36\,Km/hr = 36 \times \frac{5}{18} = 10\,m/s$

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

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

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

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

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

$= 11\,m/s = 11 \times \frac{18}{5}$

$= 39\,Km/hr$

(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 1000 Kg

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

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

$= 1020$ mJ

If 1 KWh $= 3.6$ mJ

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 $= \frac{283.3 \times 100}{324.1}$

$= 87.4\%$

(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 the impedance when heat is half becomes

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

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

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

No, 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) $\theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5) = 26.6^\circ$

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

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

$= 0.534 \ lm/m^2$

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.