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15/ENG04/036
Elect/Elect

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

$\beta = 3 \times 5/18 = 5/6 \; m/s^2$

$V = d/t \therefore t = d/V = 1500/10 = 150s$

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

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

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

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

Recall $k = 1/2 \cdot (1/\alpha + 1/\beta)$

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

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

$= 1.7km/h/s$

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

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

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

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

$t = 2000/10 = 200s$

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

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

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

$= 39 km/h$

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

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

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 $1kwh = 3.6mJ$

then $1020mJ = 1020/3.6$

$= 283.3 kwh$

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

$= 40.8 kwh$

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 Secondary 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 health is half full becomes

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

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

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

Now, pf = Cos 33.7 = 0.832

Hence, Power absorbed = $20 \times 3.466 \times 10^4 \times 0832 \times 10^4$

= 58 kw.

5 Without reflector

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

$= 0.75$ lm/m^2

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

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

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

$= 0.534 \, lm/m^2$

With reflector

luminous output of the lamp = $300 \times 4\pi$ Lumen

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

$= 600\pi / m$

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

$= 6 \, lm/m^2$

It is the same at every point on the disc.