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EEE 552 Assignment

1) $D = 1500m$

Schedule speed $= 36km/hr = 36 \times 5/18$
$= 10m/s$

braking retardation $\beta = 3km/h/s = 3 \times 5/18$
$= 5/6\ m/s^2$

$v = d/t$

$\therefore t = \frac{1500}{10} = 150s$

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

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

$\frac{\text{max speed}}{\text{Ave speed}} = 1.25$

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

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

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

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

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

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

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

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

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

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

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

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

$$= 11 m/s = 11 \times {}^{18}/_{5}$$

$$= 39.6 km/h$$

3) $A = 6m^2$, $C = 4{,}200 J/kg/°C$

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

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

volume of water to be heated daily $= 6 \times (1 \times 0.9)$

$= 5.4m^3$

Since $1m^3$ of water weighs 1000kg, mass of water $= 5.4 \times 1000$

$= 5400kg$

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

$= 1020 mJ$

1kwh $\rightarrow$ 3.6mJ

$x \rightarrow$ 1020mJ

$= 1020/3.6$

$= 283.3 kwh$

Daily loss from the surface of 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 $= \frac{324.1}{24}$

$= 3.5kw$

Efficiency of the tank $= \frac{283.3}{324.1} \times 100 = 87.4\%$

4) Secondary current $= \frac{600 \times 10^3}{20 \times 0.6} = 5 \times 10^4 A$

Sec voltage $V_2 = V(\cos\theta + j\sin\theta)$

$\cos\theta = 0.6$, $\theta = 53.13°$

$\therefore \sin\theta = 0.8$

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

Sec impedance $Z_2 = \frac{(12+j16)}{(5\times10^4)} = (2.4 + j3.2)\times10^{-4}$ ohm

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

$$Z_2 = (4.8 + j3.2)\times10^{-4} \text{ ohm}$$

Sec. current $I_2 = \frac{20}{(4.8+j3.2)\times10^{-4}}$

$= 3.466 \angle -33.7^0 \times10^4$ A

$pf = \cos 33.7 = 0.832$

Hence, power absorbed $= 20 \times 3.466\times10^4 \times 0.832 \times 10^4$

$= 580kw$

5) It should be noted that the formula $E = I\cos\theta/r^2$ will not be applicable when a reflector is used.

Without reflector

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

b) $\theta = \tan^{-1}(10/20) = 26.6^0$

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

$\therefore E = \frac{300}{0.89\times500} = 0.534\,lm/m^2$

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

$= 6\,lm/m^2$

Here, illumination is the same at every point on the disc.