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~~AE~~ 562 Assignment Solution

Parameters

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

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

Recall Velocity $V = \frac{\text{distance 'd'}}{\text{time t}}$

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

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

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

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

$K = D/V_m^2 (V_m/V_a - 1) \Rightarrow 1500/15^2 (1.25 - 1) \Rightarrow 5/3$

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

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

$50\alpha = 15 + 18\alpha$

$(50 - 18)\alpha = 15$

$32\alpha = 15$

$\alpha = 15/32 \Rightarrow 0.47 m/s$

$= 0.47 \times 18/5 = 1.7 \; km/h/s$

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

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

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

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

$t = 2000/10 = 200 S$

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

$$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K}$$

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

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

$= 39 km/h$

3 TSA of the Tank $= 6L^2$

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

Vol of the tank $= l^3 = 1m^3$

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

$1m^3$ of water $= 1000kg$

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

Heat required to raise the temp of water = ~~5400 × 4200~~ ×

$= 5400 \times 4200 \times (65 - 20)$

$= 1020mJ$

If $1kWh = 3.6mJ$

then $1020mJ = 1020 \div 3.6$

$= 283.3 kWh$

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

$= 40.8 kWh$

Energy supplied per day $= \frac{283.3}{324.1} \times 100$

$= 87.4\%$

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

Note: if reference quantity = Current, Secondary voltage => $V_2 = 20(0.6 + j0.8) = (12 + j16)$ V

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

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

If Secondary resistance is doubled while reactance is constant, then half full impedance becomes

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

Secondary Current $I_2 = \frac{20}{(4.8 \times j3.7) \times 10^{-4}}$

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

Power factor = $\cos 33.7 = 0.832$

$\therefore$ 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/m²

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

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

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

$\therefore E = 300 / 0.89 \times 500$

$= 0.534 \, lm/m^2$

with Reflector

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

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

$= 600\pi$ lumens

Illumination produced on disc $= 600\pi / 100\pi$

$= 6 \, lm/m^2$