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EEE 552 Assignment II

(1) $D = 1500m$, schedule speed $= 36km/hr = 36 \times \frac{5}{18} = 10m/s$
Braking retardation, $\beta = 3 \times 5/18 = 5/6 \, m/s^2$
$v = d/t \therefore t = d/v = 1500/10 = 15s$
Actual time of run $= 150 - 25 = 125s$

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

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

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

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

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

$$\alpha = 0.4m/s^2 = 0.47 \times 18/5 = 1.7km/h/s$$

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

(2) $V_a = 36km/h = 36 \times 5/18 = 10m/s$
$\alpha = 1.8km/h/s = 1.8 \times 5/18 = 0.5m/s^2$
$\beta = 3.6km/h/s = 3.6 \times 5/18 = 1.0m/s^2$
$t = 2000/10 = 200s$

$$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{(0.8 + 1.6)}{2(0.5 \times 1)} = 1.5$$

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

$$= 11m/s = 11 \times 18/5 = 39km/h$$

(3) T.S.A of the tank $= 6L^2$
$\therefore 6L^2 = 6$, $L = 6/6 = 1m^2$
Volume of the tank $= 1^3 = 1m^3$
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 required to raise the temp of water $= 5400 \times 4200 \times (65 - 20)$
$= 1020MJ$

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If 1kwh = 3.6mJ
then 1020mJ = 1020/3.3 = 283.3kwh
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 = 324.1kwh
Loading in kwh = 324.1/24 = 3.5kw
Efficiency of the tank = $\frac{283.3}{32p.1} \times 100 = 87.4\%$

(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 secondary resistance is doubled while resistance remains constant, the impedance when hearth is half-full becomes
$Z_2 = (4.8 + j3.2) \times 10^{-4}$ ohm
Now secondary current $I_2 = \frac{20}{(4.8 \times j3.2) \times 10^{-4}} = 3.466 \angle -33.7^\circ \times 10^4 A.$
Now, Pf = Cos33.7 = 0.832
Hence, power absorbed = $20 \times 3.466 \times 10^4 \times 0.832 \times 10^4$
= 580kw

(5) Without reflector
(a) $E = \frac{300}{20^2} = 0.75 lm/m^2$
(b) $\theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5) = 26.6^\circ$
$\cos\theta = 0.89$, $x^2 = 10^2 + 20^2 = 500$
$\therefore E = \frac{300}{0.89 \times 500} = 0.534 lm/m^2$

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

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~~It~~ Illumination produced on the disc $= \frac{600\pi}{100\pi} = 6 lm/m^2$

It is the same at every point on the disc.