ADESOYE ADEDAMOLA 15/ENG04/002

1. Given $D = 1500\,m$

$V_{sch} = 36\,km/hr = 36 \times \frac{5}{18} = 10\,m/s$

braking retardation $= 3\,km/h/s = 3 \times \frac{5}{18} = 0.833\,m/s/s$

$$time = \frac{D}{V_{sch}}$$

$$= \frac{1500}{10}$$

$$= 150\,s$$

$t_{stop} = 25\,s$

$t = time - t_{stop}$

$= 150 - 25$

$t = 125\,s$

$$V_{avg} = \frac{D}{t}$$

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

$$\frac{V_{max}}{V_{avg}} = 1.25$$

$V_{max} = 1.25 \times V_{avg}$

$V_{max} = 15\,m/s$

$K = [D/(V_m \times V_m)] \times [(V_m/V_a) - 1]$

$$K = \left(\frac{1500}{15^2}\right) \times \left(\frac{15}{12\cancel{.11}} - 1\right)$$

$K = 0.66 \times \cancel{1.3636}\ (1.25 - 1)$

$K = \cancel{0.9090}\ 1.667$

~~acceleration~~ alpha $= \dfrac{\text{break retardation}}{(2 + k \times \text{break retardation}) - 1}$

$$\alpha = \frac{0.833}{(2 + \cancel{0.9090}\ 1.667 \times 0.833) - 1} = \cancel{1.67}\ 1.7\,km/h/s \text{ or } 0.469\,m/s/s$$

Scanned with CamScanner

2.) $V_a = \frac{36 \times 5}{18} = 10\ m/s$

alpha = 1.8 km/h/s

beta = 3.6 km/h/s

$D = 2000$

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

$t = 200s$

$k = (alpha + beta)/(2 \times alpha \times beta)$

$k = (1.8 + 3.6)/(2 * 1.8 * 3.6)$

$k = 0.4167$

$V_m = \frac{(t - \sqrt{t \times t - 4 \times k \times D})}{2k}$

$V_m = \frac{200s - \sqrt{200 * 200 - 4 \times 0.4167 * 2000}}{2 * 0.4167}$

$V_m = \cancel{V_m}\ 10.89\ m/s$

$V_m = 39.2\ km/h$

3.) (i) $A = 6.0 m^2$

$T_2 = 65°C$

$T_1 = 20°C$

$loss = 6.3 W/m^2/°C$

Specific heat $h_s = 4200 J/kg/°C$

$l = \sqrt{\frac{A}{6}}$

$l = \sqrt{\frac{6}{6}}$

$l = 1m$

$V = l^3$

$V = 1^3$

$V = 1 m^3$

~~mass of water~~ $V_2 = 6 \times V \times 0.9$

$V_2 = 6 \times 1 \times 0.9 = 5.4 m^3$

mass of water = density of water $\times V_2$

$m = 1000 \times V_2 = 5400 kg$

Heat required to raise temp, $H = mass \times h_s \times (T_2 - T_1)$

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

$H = 1020.6 MJ = \cancel{2835 kWh}$ 283.3 kWh

Daily loss from surface, $L = 6 \times loss \times (T_2 - T_1) \times (24/1000)$

$L = 6 \times 6.3 \times (65-20) \times (24/1000)$

$L = 40.824 kWh$

Total energy required, T = $L + H = 40.824 + \cancel{2835}$ 283.5

$T = \cancel{2875.824 kWh}$ $\cancel{43.657}$ 324.324

Load $= T/24 = \cancel{119.826 kW}$

$= \frac{324.324}{24} = 13.51 kW$

(ii) Efficiency = $(H/T) \times 100$

$= \cancel{\dfrac{2835}{2875.824} \times 100}$

$= \dfrac{283.5}{324.324} \times 100$

$= 87.41\%$

4. $V = 20V$

$P = 600 kW$

$pf = 0.6$

~~2~~ Initial secondary current $I_{sec} = P/(V * pf)$

$I_{sec} = \dfrac{600k}{20 \times 0.6}$

$I_{sec} = 50 kA$

$V_r = V * pf = 20 \times 0.6$

$V_r = 12V$

$V_x = V \times \sqrt{1 - pf^2}$

$V_x = 20 \times \sqrt{1 - 0.6^2}$

$V_x = 20 \times \sqrt{1 - 0.36}$

$V_x = 20 \times 0.8$

$V_x = 16V$

$R = V_r / I_{sec}$

$R = \dfrac{12}{50k}$

$R = 2.4 \times 10^{-4} \Omega$

$X = V_x / I_{sec}$

$X = \dfrac{16}{50k}$

$R = \cancel{V_r / I_{se}}$ $X = 3.2 \times 10^{-4}\,\Omega$

$\cancel{R_2}$ When the hearth is half full

$R_2 = 2 \times R$

$R_2 = 2 \times 2.4 \times 10^{-4}\,\Omega$

$R_2 = 4.8 \times 10^{-4}\,\Omega$

$X_2 = X$

$\therefore X_2 = 3.2 \times 10^{-4}\,\Omega$

$$pf = \frac{R_2}{\sqrt{R_2^2 + X_2^2}}$$

$$p.f = \frac{4.8 \times 10^{-4}}{\sqrt{(4.8 \times 10^{-4})^2 + (3.2 \times 10^{-4})^2}}$$

$= 0.8321$

$p.f = 0.83$

$V_r = V \times pf$

$V_r = 20 \times 0.83$

$V_r = 16.6\,V$

$$I = \frac{V_r}{R_2} = \frac{16.6}{4.8 \times 10^{-4}}$$

$I = 34.583\,kA$

$Power = I \times V \times pf$

$= 34.583k \times 20 \times 0.83$

$P = 574.083\,kW$

(ii) Effic

4.

5.) $I = 300$ cd

$h = 20$ m

$d = 20$ m

(i) Without reflector

$E_c = I/h^2$

$E_c = 300/400$

$E_c = 0.75$ lm/m^2

$\theta = \tan^{-1}\left(\frac{d}{2h}\right)$

$\theta = \tan^{-1}\left(\frac{20}{40}\right)$

$\theta = 26.57^\circ$

$l = \sqrt{h^2 + \left(\frac{d}{2}\right)^2}$

$l = \sqrt{20^2 + 10^2}$

$l = \sqrt{500}$

$l = 22.36$ m

$E_b = \frac{I}{l^2 \times \cos\theta}$

$= \frac{300}{22.36^2 \times \cos(26.57^\circ)}$

$E_b = \cancel{0.6709}\ 0.54$ lm/m^2

(ii) $l_{flux} = I \times 4 \times 3.142$

$l_{flux} = 300 \times 4 \times 3.142$

$l_{flux} = 3770.4$ lm

$\phi_{ref_{1\times 7}} = 0.5 \times \phi_{Lamp}$

$= 0.5 \times 3770.4$

$= 1885.2 lm$

$A = 3.142 \times \frac{(d^2)}{4}$

$A = 3.142 \times \frac{20^2}{4}$

$A = 314.2 m^2$

$E_t = \phi_{ref\,Lamp}/A$

$= \frac{1885.2}{314.2}$

$E_t = 6 lm/m^2$