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Assignment

1.) $D = 1500m$

Schedule speed $= 36 Km/h = 36 \times \frac{5}{18} = 10 m/s$

Braking retardation, $\beta = 3 Km/h/s = 3 \times \frac{5}{18} = 5/6 \ m/s^2$

Schedule time of run $= 1500/10 = 150s$

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

$\therefore V_a = 1500/125 = 12 m/s$

$V_m = 1.25 \times 12 = 15 m/s$

$$K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right] = \frac{1500}{15^2}\left[\frac{15}{12} - 1\right] = \frac{5}{3}$$

also, $K = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right]$

$$\frac{5}{3} = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{6}{5}\right]$$

$$\frac{10}{3} = \frac{1}{\alpha} + \frac{6}{5}$$

$$\frac{1}{\alpha} = \frac{10}{3} - \frac{6}{5} = \frac{32}{15}$$

$$\alpha = \frac{15}{32} = 0.47 m/s^2$$

$$0.47 \times \frac{18}{5} = 1.7 Km/h/s$$

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

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

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

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

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

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

$= 11\ m/s$

$= 11 \times \frac{18}{5}$

$= 39.6\ Km/h$

3.) Assuming S is the side of the tank

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

S.A of the tank $= 6m^2$

$\therefore 6S^2 = 6m^2$

$S^2 = 1m^2$

$S = 1m$

Volume of the tank $= S^3 = 1m^3$

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

mass of water to be heated daily $= 5.4 \times 1000 = 5400\ Kg$

Heat required to raise temp. of water = $mc\Delta\theta$

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

$= 1020$ MJ

$1020/3.6$

$= 283.3$ KWh

Daily loss from the surface of the tank

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

$= 40.8$ KW/h

Loading in KW $= 324.1/24 = 3.5$ KW

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

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

Secondary voltage $V_2 = 20(0.6 + j0.8) = (12 + j16)$ V

Secondary impedance $Z_2 = \frac{(12 + j16)}{(5 \times 10^4)} = (2.4 + j3.2) \times 10^{-4} \Omega$

If resistance is doubled while reactance remains constant, the impedance when hearth is half full becomes

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

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

$= 3.466 \angle -33.7° \times 10^4$ A

$pf = \cos 33.7^\circ = 0.832$

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

$= 580 kW$

5.) Without reflector

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

$= 0.75$ Lumen/m^2

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

$\cos\theta = 0.89$

$x^2 = 10^2 + 20^2 = 500$

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

$= 0.534$ lumen/m^2

With reflector

luminous output of the lamp $= 300 \times 4\pi$ lumen $= 1200\pi$ lumen

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

$= 600\pi$ lumen

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

$= 6$ lumen/m^2