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1. $D = 1500\,m$

Schedule speed $= 36\,km/h = \frac{36 \times 1000}{3600}\,m/s$

$= 10\,m/s$

$\beta = 3\,km/h/s = \frac{3 \times 1000}{3600}\,m/s^2$

$= 5/6\,m/s^2$

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

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

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

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

$K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right]$

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

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

such $K = 5/3$

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

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

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

$\alpha = 0.469 m/s^2$

$\alpha = 0.469 \times \frac{3600}{1000}$ km/h/s

∴ acceleration $= 1.689$ km/h/s

2) $D = 2km = 2000m$

$V_a = 36 km/h = 36 \times \frac{1000}{3600} m/s = 10 m/s$

$\alpha = 1.8 km/h/s = 1.8 \times \frac{1000}{3600} m/s^2 = 0.5 m/s^2$

$\beta = 3.6 km = 36 \times \frac{1000}{3600} m/s^2 = 1 m/s^2$

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

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

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

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

$V_m = 10.89 m/s$

$V_m = 10.89 \times \frac{3600}{1000}$ km/h

$= 39.20 km/h$

3 Let the side of the tank be: l

formula for total surface area ÷ $6l^2$

total surface area of tank $= 6.0 m^2$

$6L^2 = 6.0$

$L = \sqrt{6/6} = 1m^2$

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

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

Since the tank is filled to 90% capacity

Density $= \frac{mass}{vol}$ => mass = Density x vol

Density of water $= 1g/cm^3 = \frac{1 \times (100)^3}{1000} kg/m^3$

$= 1000 kg/m^3$

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

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

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

$= 1020.6 MJ$

$= 1020.6/3.6$ kWh

$= 283.5kWh$

Daily loss from the tank surface $= 6.3 \times 6 \times (65-20)$

$\times 24 \times 1000$

$= 40.82kWh$

Energy supplied per day $= (283.5 + 40.82)$ kWh

$= 324.32$ kWh

Loading in kW $= \frac{324.32}{24}$

$= 13.51kw$

Efficiency of the tank $= \frac{283.5}{324.32} \times 100$

$= 87.41\%$

4) Secondary current $= \frac{600\times10^3}{20} = 5\times10^4 A$

Taking the current as the reference quantity secondary voltage is:

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

Secondary impedance:

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

If secondary resistance is double, then total impedance when the hearth is full is:

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

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

$= 3.4668\times10^4 \angle -33.7^\circ A$

Now p.f $= \cos(33.7) = 0.832$

Power absorbed $= 20\times3.4668\times10^4\times0.832\times10^{-3}$

$= 576.86 kW$

5) without reflector

using $E = \frac{I\cos\theta}{r^2}$

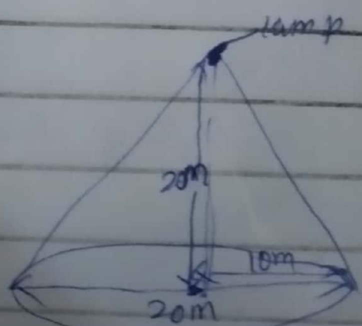
(a) a $\theta = 0^\circ$

$E = \frac{300\times\cos 0}{20^2} = 0.75 lm/m^2$

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

$= 26.6^\circ$

$\cos 26.6 = 0.89$



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

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

$= 0.534 lm/m^2$

With Reflector

Luminous output of the lamb $= 300 \times 4\pi$ lumens

Flux directed by the reflector $= 0.5 \times 300 \times 4\pi$

$= 600\pi$ lumens

Illumination produced on the disk:

$= \frac{600\pi}{100\pi} = 6 lm/m^2$

It is the same at every point of the disc.