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15/ ENG04 / 058

(1)

Parameters ; schedule speed = 36Km/hr = $36 \times 5/18 \Rightarrow 10\,m/s$

Distance = 1500m

$B = 3 \times 5/18 = 5/6\,m/s^2$

$v = d/t$; $t = d/v = 1500/10 = 150s$

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

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

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

$K = D/V_m^2 \left[V_m/V_a - 1 \right] = 1500/15^2 \times \left[1.25 - 1 \right]$

$= 5/3$

Recall that $K = 1/2 \left[1/\alpha + 1/B \right]$

$5/3 = 1/2 \left[1/\alpha + 6/5 \right]$

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

$\therefore$ Acceleration $(\alpha) = 1.7\,Kmh^{-1}s^{-1}$

(2)

Parameters ; $V_a = 36Km/h$; $36 \times 5/18 = 10\,m/s$

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

$B = 3.6\,km/h/s = 3.6 \times 5/18 = 1.0\,m/s^2$

$t = 2000/10 = 200$ seconds

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

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

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

$= 11\,m/s$

$\Rightarrow 11 \times 18/5 = 39\,km/h$

(3)

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

making l subject of the formula in $6l^2 = 6$

$l = 6/6 = 1m^2$

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

vol of water to be heated daily = $6 \times (1 \times 0.9) =$ ~~5.4m3~~

$5.4m^3$

since (1m³ of water weighs 1000kg) then mass of water to be heated daily = (5.4 × 1000) = 5400kg

Heat required to raise the temp of water ; 5400 × 4200 × (65 − 20)

= 1020MJ

(1KWH = 3.6MJ) then 1020MJ = 283.3KWH

Daily loss from tank = 6.3 × 6 × (65 − 20) × 24/1000

= 40.8KWH

Energy supplied per day = 283.3 + 40.8 = 324.1KWH

Loading in KWH = 324.1 / 24hours

= 3.5KW

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

= 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

If the secondary resistance is doubled while reactance remains constant, the impedance when ~~heater~~ is half-full

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

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

$= 3.466 \angle -33.7^\circ \times 104$ A.

$pf = \cos 33.7 = 0.832$

Power absorbed $= 20 \times (3.466 \times 104) \times 0.832 \times 104$

$= 580$ KW

(5)

WITHOUT REFLECTOR

(a) $E = \frac{300}{20^2} = 0.75$ lm/m2

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

$\cos\theta = 0.89$, $x^2 = 10^2 + 20^2 = 500$

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

$= 0.534$ lm/m2

WITH REFLECTOR

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

Flux directed by the reflector $= 0.5 \times 1200\pi = 600\pi$ lm

Illumination produced on the disc $= \frac{600\pi}{100\pi} = 6$ lm/m2

Illumination is the same @ every point on the disc.