mtt multi - tecnik & trade.
Electrical, Mechanical Engineering Services & General Contractors.
No. 22A Ijebu/Court Road, Sabon Gari, P. O. Box 15039, Kano.

Q1

Data

$D = 1.5km = 1500m$ Scheduled Speed $= 36km/h$

$= 36 \times \frac{5}{18}$

$= 10m/s$.

Braking Retardation, $\beta = 3km/h/s$

$= 3 \times \frac{5}{18} = \frac{5}{6} m/s^2$

Estimated run time $= \frac{1500}{10} = 150s$

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

Hence,

$V_a = \frac{1500}{125}$ $V_{max} = 1.25 \times 12$

$= 12m/s$ $= 15m/s$.

$$K = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}\left(\frac{15}{12} - 1\right)$$

$= 6.667(1.25 - 1)$

$= 6.667(0.25)$

$K = 1.667$

Recall:

$K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

$1.667 = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{6}{5}\right)$

$\alpha = 0.47m/s^2 = 0.47 \times \frac{18}{5} = 1.7km/h/s$.

Acceleration $= 1.7km/h/s$.

Q2

Data:

$V_a = 36 km/h = 36 \times \frac{5}{18} = 10 m/s$

$\alpha = 1.8 km/h/s = 1.8 \times \frac{5}{18} = 0.5 m/s.$

$\beta = 3.6 km/h/s = 3.6 \times \frac{5}{18} = 1 m/s$

$\text{time } (t) = \frac{2000}{10} = 200 s$

NB

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

$= \frac{1.5}{1} \Rightarrow 1.5$

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

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

$V_m = \frac{200 - 167.33}{3} = 10.89$

$\cong 11 m/s \Rightarrow 11 \times \frac{18}{5}$

$= 39 km/h$

Shot on S10 lite

Q3

Data

Total Surface Area of Tank $= 6l^2 = 6$

$\Rightarrow l = 6/6 = 1m^2.$

Volume of water to be heated daily

$\Rightarrow 6(1 \times 0.9)$

$= 5.4 m^3$

but note that $1m^3$ of water weighs 1000kg

$\therefore$ mass of water to be heated daily

$\Rightarrow 5.4 \times 1000$

$= 5400$ kg.

Required heat to raise the temp. of water

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

$= 1020$ mJ

but if $1kw \cdot h = 3.6$ mJ

hence $1020 \text{ mJ} = \frac{1020}{3.6} = 283.3$ kw.h

Daily loss from tank $= 6.3 \times 6(65-20) \times \frac{24}{1000}$

$= 40.8$ kw.h.

Daily Energy Supplied

$\Rightarrow 283.3 + 40.8 = 324.1$ kw.h

$\therefore$ loading in kw $= \frac{324.1}{24} = 35$ kw

$\therefore$ Efficiency of tank $= 283.3 \times \frac{1000}{324.1} = 87.4\%$

XH

Data

Secondary voltage = 20v at 0.6 pf.

P = 600 kw.

∴ Secondary current $= \frac{600 \times 10}{20 \times 0.6} = 50000$

$= 5 \times 10^4$ A

Recall: $V_2 = V_1(\cos\theta + j\sin\theta)$

$V_2 = 20(0.6 + j0.8)$

$= (12 + j16)$ v

Secondary Impedance:

$Z_2 = \frac{V_2}{I} = \frac{(12 + j16)}{5 \times 10^4}$

$= (2.4 + j3.2) \times 10^4$ ohm

When secondary resistance is doubled & reactance is constant then

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

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

$= 3.466 \angle -33.7^\circ \times 10^4$ A

pf = cos 33.7 = 0.832

∴ Power absorbed $= 20 \times 3.466 \times 10^4$

= 580 kw

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Q5

(a) $E = \frac{300}{20^2}$ [without reflector)

$= 0.75 \text{ lm/m}^2$

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

$= \tan^{-1}(0.5) = 26.6^\circ$

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

$= 800$

$\therefore E = \frac{300}{0.89 \times 800}$

$= 0.534 \text{ lm/m}^2$.

2. with reflector

Luminous output of lamp $= 300 \times 4\pi$ lumen

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

$= 600\pi$ lm

Illumination produced on the disc.

$= \frac{600\pi}{100\pi}$

$= 6 \text{ lm/m}^2$

$\therefore$ Illumination is the same at every point on the disc