

1804234 – Sam Johns

Engineering Science 2

M4X000386

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$$i. V = IR \quad E = \frac{V}{R} = \frac{9}{4} = 2.25 A$$

$$ii. V = \frac{1}{\frac{1}{R}} = \frac{1}{\frac{1}{2}} = \frac{1}{\frac{1}{2}} = 1V$$

$$iii. \cancel{V = IR} = V = E - Ir \quad V = IR \quad I = \frac{V}{R}$$

$$\cancel{9 - 1 = 8} \quad E = 9 \quad I = 1 \quad V$$

$$\frac{V - E}{I} = \frac{E - V}{I} = \frac{9 - 7}{1} = 2 \Omega$$

$$iii. P = IV \quad P = 9 \times 300 = 2700 J$$

$$60 \times 5 = 300s$$

1V. A lower internal resistance means you have a greater current.

2. a. ~~Root mean square is a method of do~~
~~RMS is the same produces the same dc equivalent~~

$$b. V_{rms} = \frac{V_0}{\sqrt{2}} \quad V_0 = V_{rms} \times \sqrt{2} = 230 \times \sqrt{2} = 325.27V$$

$$c. P = I_{rms} \times V_{rms} = 0.26 \times 230 = 59.8 W$$

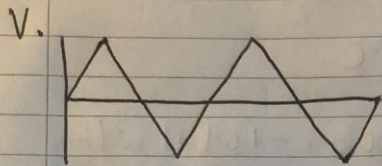
$$d. f = \frac{1}{T} = T = \frac{1}{f} = \frac{1}{50} = 0.02 s$$

$$e. i f = \frac{1}{40 \times 10^{-3}} = 25 Hz$$

$$ii \quad V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{45}{\sqrt{2}} = 31.82V$$

$$iii \quad 45 \times 2 = 90 \quad P_{LP} = 90V \quad Peak = 45V$$

$$iv \quad P_{LP} = 45 \times 2 = 90V$$



$$vi \quad 4 \times 2.5 = 10 \text{ cycles} \quad \text{There are 4 times the amount of cycles}$$

3.a) The ability of a system to hold charge.

$$b.i) \quad C = 330 \mu F = 330 \times 10^{-6}$$

$$p_d = 9V$$

$$R = 470 k\Omega \quad E = \frac{1}{2} CV^2 = \frac{1}{2} (330 \times 10^{-6}) (9)^2 = 0.0134J$$

$$ii \quad \tau = RC = 470 \times 330 \times 10^{-6} = 155.1s$$

$$iii \quad V = V_0 e^{-t/\tau} = 9 e^{-\frac{60}{155.1}} = 6.11V$$

$$c.i \quad 0.1 \times 0.37 = 0.037s \quad \tau = RC = 0.1 \times 0.37 = 0.037s$$

$$ii \quad Q = It =$$

$$d.i. \quad p_d = 27V @ t = 0$$

$$ii \quad \tau = RC = \ln(2.17) = 0.765$$

iii

4.

i $m = 5 \text{ kg}$

$P_1 = 100 \text{ kPa}$

$x = 0.35721$

$V = 110 \text{ V}$

$\Delta u = Q - W$

$W_e = V \cdot I \Delta t$

$V_1 = V_2$

$T_1 = 99.61^\circ \text{C}$

$V_{fg} = V_g - V_f$

$V_g @ 100 \text{ kPa} = 1.6941 \text{ m}^3/\text{kg}$

$V_f @ 100 \text{ kPa} = 0.001043 \text{ m}^3/\text{kg}$

$V_{fg} = 1.6941 - 0.001043 = 1.693057 \text{ m}^3/\text{kg} \times 5 = 8.4653 \text{ V/kg}$

~~$V = V_f + x \times V_{fg} = 0.001043 + 0.35721 \times 1.693057 = 0.6058 \text{ V}$~~

~~$V = 3.6248 \text{ m}^3/\text{kg}$~~

$-W = \Delta u = V_i \Delta T$

$$\begin{aligned} \text{b. } P_1 &= 120 \text{ kPa} & P_2 &= 160 \text{ kPa} \\ T_1 &= 20^\circ\text{C} & T_2 &= 300^\circ\text{C} \\ x &= 0.1 \end{aligned}$$

$$\text{i } \dot{m} \text{ Mass balance} = \sum_{\text{in}} \dot{m} = \sum_{\text{out}} \dot{m}$$

$$\dot{m}_1 = \dot{m}_2$$

Energy balance:

$$Q - W = \sum_{\text{out}} \dot{m} \left(h + \frac{1}{2} C^2 + g x \right) - \sum_{\text{in}} \dot{m} \left(h + \frac{1}{2} C^2 + g x \right)$$

$$-400 + 4000 = \dot{m} (h_2 - h_1)$$

$$h_2 - h_1 = \Delta h = C_p \Delta T \quad \dot{m} = \frac{-Q + W}{C_p \Delta T}$$

$$\dot{m} = \frac{-Q + W}{C_p \Delta T} \quad \dot{m} = \frac{-400 + 4000}{C_p \Delta T}$$

$$\dot{m} = \frac{3600}{C_p \Delta T}$$

$$\Delta T = T_2 - T_1 = 300 - 20 = 280^\circ\text{C}$$

$$C_p = 1.005$$

$$\dot{m} = \frac{3600}{1.005 \times 280} = 12.74 \text{ kg/s}$$

~~$$P \cdot V = R \cdot T \quad P \cdot \frac{V}{\dot{m}} = R \cdot T \quad V = \frac{R \cdot T \cdot \dot{m}}{P}$$~~

$$\text{ii } P \cdot V = R \cdot T \quad P \cdot \frac{V}{\dot{m}} = R \cdot T \quad \frac{V}{\dot{m}} = \frac{R \cdot T}{P}$$

$$\dot{V} = \frac{0.287 \times 293}{120} = 0.7 \text{ m}^3/\text{kg} \times \dot{m} = V = 0.7 \times 12.74 = 89.53$$

$$\dot{V} = \dot{V} \cdot \dot{m} \quad 89.53 \times 160 = 8953 \text{ litre/s}$$

$$V_2 = \frac{0.287 \times (300 + 273)}{100} = 1.645 \text{ m}^3/\text{kg}$$

$$V = 1.645 \times 12.79 = 21.03955 \times 100 = 2103.9 \text{ litres/s}$$

6. Mass balance:

$$m_{in} - m_{out} = \Delta m$$

$$m_i - m_e = (m_2 - m_1) \Delta t$$

Energy balance =

$$Q - W = \sum_{out} m h - \sum_{in} m h + (m_2 u_2 - m_1 u_1) \Delta t$$

$$\begin{aligned} i \quad V_1 &= 0.8 \text{ m}^3 & P_2 &= 600 \text{ kPa} \\ P_1 &= 1.2 \text{ MPa} & V_2 &= 0.6 \text{ m}^3 \\ T_1 &= 120^\circ\text{C} & T_2 &= 90^\circ\text{C} \end{aligned}$$

$$W_b = \frac{P_1 + P_2}{2} (V_1 - V_2)$$

$$W_b = \frac{1.2 \times 10^6 + 600 \times 10^3}{2} \times (0.8 - 0.6) = 270 \text{ kJ}$$

$$\begin{aligned} h_1 &\text{ @ } 120^\circ\text{C and } 1.2 \text{ MPa} = 354.11 \text{ kJ/kg} \\ h_2 &\text{ @ } 90^\circ\text{C and } 600 \text{ kPa} = 329.46 \text{ kJ/kg} \end{aligned}$$

$$h_e = \frac{h_1 + h_2}{2} = \frac{354.11 + 329.46}{2}$$

$$h_e = 341.785 \text{ kJ/kg}$$

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