

$$I = \frac{V_S}{R_S + R_L}$$

$$P = I^2 R_L$$

0.0

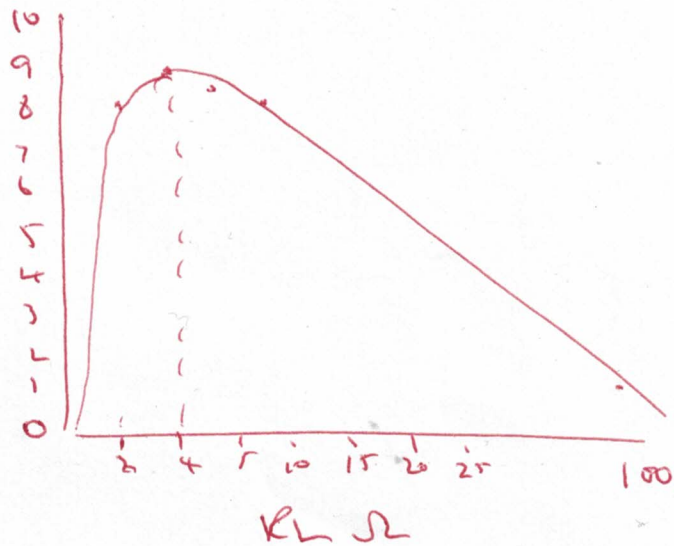
$$I = \frac{12}{4+8} = \frac{12}{12} = 1 \text{ A}$$

$$P = 1^2 \times 8 = 8 \text{ W.}$$

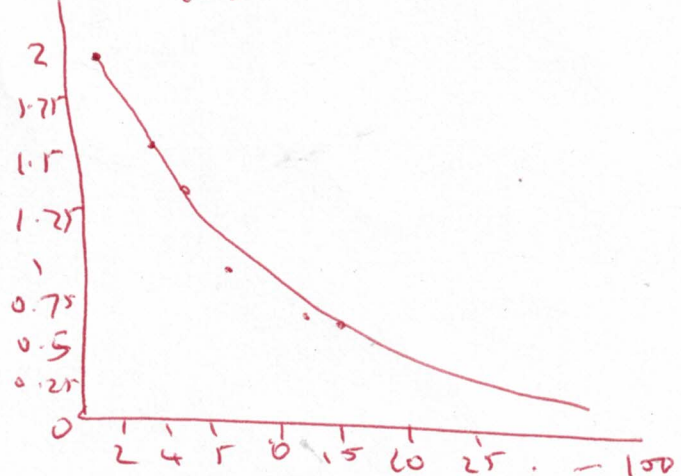
1B

R_L	I Amperes	P Watts
2	2	8
4	1.5	9
5	1.33	8.85
8	1.00	8.00
10	0.86	7.40
15	0.63	6.00
20	0.50	5.00
25	0.41	4.25
30	0.37	3.60
35	0.31	3.50
40	0.27	2.80
50	0.22	2.50
100	0.12	1

Power (W)



Current (I)



1B

$$P = I^2 R_L$$

$$= 1.5^2 \times 4$$

$$= 9 \text{ WATTS}$$

C1

$$R = \frac{l \times L}{A}$$

$$R \times A = l \times L$$

$$\frac{R \times A}{L} = l$$

$$\frac{R \times A}{l} = L$$

$$\frac{100 \times (\pi \times 0.00005^2)}{9.81 \times 10^{-8}}$$

$$= \frac{100 \times (7.85 \times 10^{-9})}{9.81 \times 10^{-8}}$$

$$= \frac{7.85 \times 10^{-7}}{9.81 \times 10^{-8}}$$

$$= \underline{0.08002 \text{ m}}$$

C2

$$V = \pi r^2 \times L$$

$$= (\pi \times 0.00005^2) \times 0.08002$$

$$= 7.85 \times 10^{-7} \times 0.08002$$

$$= 6.28 \times 10^{-8} \text{ m}^3$$

$$= 6.28 \times 10^{-2} \text{ mm}^3$$

C3

$$21450 \text{ kg/m}^3$$

$$\therefore 21450 \times 6.28 \times 10^{-8}$$

$$= 1.34706 \times 10^{-3}$$

$$= 0.00134706 \text{ kg}$$

$$= \underline{13.47}$$

C4

$$R = \frac{l \times L}{A}$$

$$R \times A = l \times L$$

$$A = \frac{l \times L}{R}$$

$$\frac{9.81 \times 10^{-8} \times 0.75}{125} =$$

$$= \frac{9.81 \times 10^{-8} \times 7.5 \times 10^{-1}}{125}$$

$$= \frac{7.3575 \times 10^{-8}}{125}$$

$$A = 5.886 \times 10^{-10}$$

$$\text{Thickness} = \frac{A}{\frac{5.886 \times 10^{-10}}{3.5 \times 10^{-4}}} = 1.681 \times 10^{-6}$$

$$\text{CF } V = 5.886 \times 10^{-10} \times 7.5 \times 10^{-1} = 4.4 \times 10^{-10} \text{ m}^3$$
$$= 4.4 \times 10^{-6}$$

d(1)

$$R = \frac{l \times L}{A}$$

$$R \times A = l \times L$$

$$\frac{R \times A}{L} = l$$

$$\therefore \text{CPA} = \pi \times 3.7^2$$
$$= 43.014 \text{ mm}^2$$

$$= 4.3014 \times 10^{-5} \text{ m}^2$$

3 of 15

$$\frac{\left(\frac{3.3}{1000}\right) \times 4.3014 \times 10^{-5}}{1000} = \frac{1.419462 \times 10^{-7}}{1000} = 1.419 \times 10^{-10}$$

d(n)

A

The conductors act as resistors in parallel with the aluminium conductors offering lower resistances

~~d(n)~~ B In addition there are seven conductors in total which also reduces the proportion of current moving in the steel conductor.

d(n) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_7}$

$$\begin{aligned} & \therefore \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{1.1} + \frac{1}{3.3} \\ & = (0.9091 \times 6) + 0.3030 \\ & = \frac{1}{5.76} = 0.174 \Omega \end{aligned}$$

$$I = \frac{V}{R} = \frac{75}{0.174} = 431 \text{ A}$$

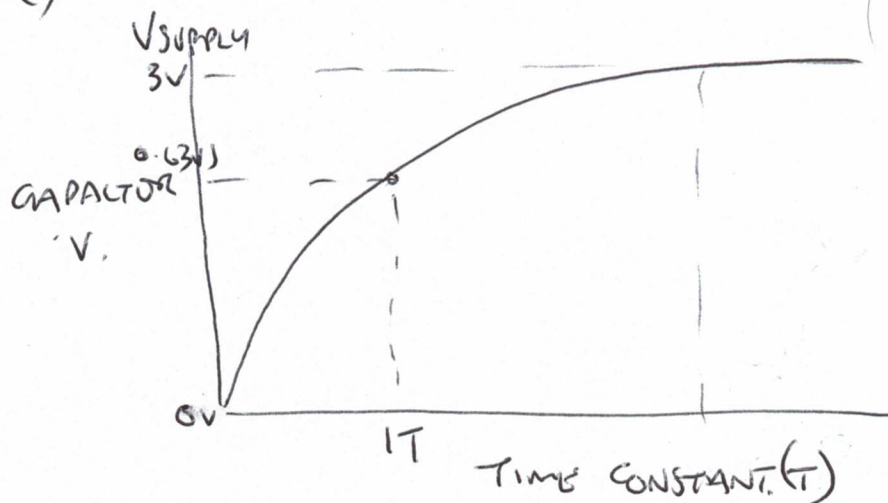
$$P = 431^2 \times R = \underline{32327.59 \text{ W.}}$$

$$\begin{aligned} \text{or } P &= IV \\ &= 75 \times 431 \\ &= 32325 \text{ W} \end{aligned}$$

Rounding

40/15

2a(i)



2a(ii)

When the diaphragm moves in response to sound vibrations the capacitance of the microphone changes. Each change results in a positive or negative change in capacitance and hence the voltage across the capacitor which can be measured. $\therefore$ Voltage fluctuates according to capacitance and sound changes.

2b(i)

$$C = F \times V$$

$$= 0.22 \times 0.095$$

$$= 0.0209 \text{ C}$$

$$C = \text{Coulombs}$$

$$F = \text{Farads}$$

$$V = \text{volts}$$

2b(ii)

This indicates that the capacitor steady state charge is not being drained by the voltmeter. There can be two causes for this.

(i) The capacitor is large with a significant charge

(ii) The voltmeter is very high resistance relative to the capacitor.

2b (ii)

$$T = RC$$

Question three

1

$$M_1 = 3 \text{ kg} \quad , \quad M_2 = 2.7 \text{ kg}$$

$$P_1 = 1.6 \text{ MPa} \quad , \quad P_2 = 1.2 \text{ MPa}$$

$$T_2 = 120^\circ\text{C} \quad x_1 = 0.4$$

Tank A	Tank B
3 kg	2.7 kg
1.6 MPa	1.2 MPa
$x = 0.4$	120°C
R-134a	R-134a

1.) $(h_{f1} = 135.93 \text{ kJ/kg} , (h_{fg})_1 = 141.93 \text{ kJ/kg}) \rightarrow$
~~for~~ $(P_1 = 1.6 \text{ MPa})$

2.) For $P_2 = 1.2 \text{ MPa}$ and $T_{\text{superheated}} = 120^\circ\text{C}$
 $h_2 = 354.11 \text{ kJ/kg}$

$$h_1 = x_1(h_{fg})_1 + h_{f1} = 0.4 \times 141.93 + 135.93$$

$$h_1 = 192.702 \text{ kJ/kg}$$

(a) $M_2 + M_1 = M_3$ ~~1.8~~ $2.7 + 3 = M_3$
 $M_3 = 5.7 \text{ kg}$

$$(b) \quad m_1 h_1 + m_2 h_2 = m_3 h_3 + Q_{\text{loss}} \quad 2$$

Closed System

$$V_1 + V_2 = V_3 \quad = \quad m_1 v_1 + m_2 v_2 = m_3 v_3$$

Tank A: $P_1 = 1.6 \text{ MPa} \quad x = 0.4$

$$V_1 = 0.0054132 \text{ m}^3/\text{kg}$$

Tank B

$$V_2 = 0.024228 \text{ m}^3/\text{kg}$$

$$(3 \times 0.0054132) + (2.7 \times 0.024228) = 5.7 \times u_3$$

$$\frac{0.0816552}{5.7} = u_3$$

~~$$u_3 = 0.01432 \text{ m}^3/\text{kg}$$~~

$$u_3 = 0.01432 \text{ m}^3/\text{kg}$$

$$P_3 = 900 \text{ kPa}$$

When ~~P~~ $P = 900 \text{ KPa}$

(3.)

$$v_{f3} = 0.000858 \text{ m}^3/\text{kg}$$

$$v_{g3} = 0.022683 \text{ m}^3/\text{kg}$$

$$v_3 = (v_f)_3 + x_3(v_g - v_f)_3$$

$$0.01432 = 0.000858 + x_3(0.021825)$$

$$x_3 = 0.617$$

(I.) The refrigerant R134a after mixing becomes wet vapour which of friction ($x = 0.617$)

II.)
$$h_3 = 101.61 + 0.617 \times (167.66) \quad h_3 = 205.05$$

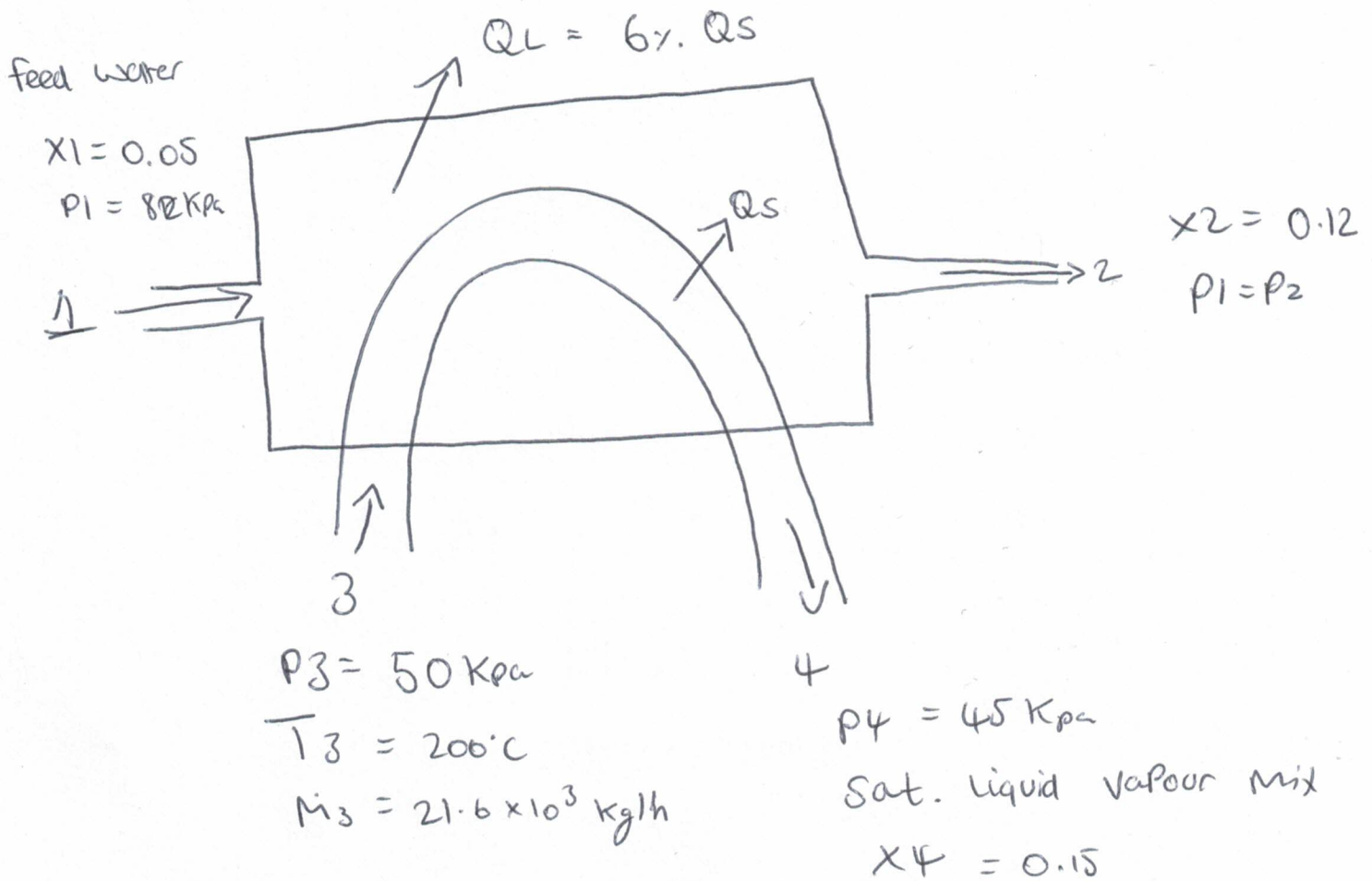
Using values h_1 , h_2 and h_3

$$(3 \times 192.702) + (2.7 \times 354.11) = (5.7 \times 205.05) + Q_{\text{loss}}$$

$$Q_{\text{loss}} = 365.418 \text{ KJ}$$

Question 4

1



$$\frac{21.6 \times 10^3}{3600} = 6 \text{ Kg/s}$$

MB : $\dot{m}_1 = \dot{m}_2$
 $\dot{m}_3 = \dot{m}_4$

$$\dot{Q}_T = (\dot{m}_2 h_2 + \dot{m}_4 h_4) - (\dot{m}_1 h_1 + \dot{m}_3 h_3)$$

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

$$E_b = Q_L + Q_S = \dot{m}_2 h_2 - \dot{m}_1 h_1$$

$$a) Q_s = ?$$

(2)

$$h_3 : T_3 = 200^\circ\text{C}$$

$$P_3 = 50 \text{ KPa}$$

$$h_4 : P_4 = 45 \text{ KPa}$$

$$x_4 = 0.15$$

$$h_4 = \text{Table A-5}$$

$$h_4 = h_f + x + h_{fg}$$

$$\Delta \text{KPa} \quad \begin{pmatrix} 40 \\ 45 \\ 50 \end{pmatrix}$$

$$\Delta h_{fg} \quad \begin{pmatrix} 2318.4 \\ h_{fg} \\ 2304.7 \end{pmatrix}$$

$$\begin{array}{cc} 10 & 13.7 \\ 5 & \Delta h_{fg} \end{array}$$

$$5 \times 13.7 = 10 \Delta h_{fg}$$

$$5 \times 13.7 = \Delta h_{fg}$$

$$10$$

$$6.85 = \Delta h_{fg}$$

$$h_{fg} = 2318.4 - \Delta h_{fg} = 2318.4 - 6.88 = 2311.55 \text{ kJ/kg} \quad (5)$$

h_{pa}

(40
45
50) ↓

(317.62
Δh_f
340.54) ↓ Δh_f

$$\begin{array}{r} 10 \\ 5 \end{array} \times \begin{array}{r} 22.92 \\ \Delta h_f \end{array}$$

$$5 \times 22.92 = 10 \Delta h_f$$

$$\frac{5 \times 22.92}{10} = \Delta h_f$$

$$\Delta h_f = 11.46$$

$$h_f = 317.62 + \Delta h_f = 317.62 + 11.46 = 329.08 \text{ kJ/kg}$$

$$h_4 = h_f + x \times h_{fg}$$

$$h_4 = 329.08 + 0.15 \times 2311.55$$

$$h_4 = 675.8125 \text{ kJ/kg}$$

$$Q_2 = m_4 h_4 - m_3 h_3$$

Table A-6

$$h_3 = 2877.8 \text{ kJ/kg}$$

$$\dot{Q}_S = (6)(675.8125) - (6)(2877.8)$$

$$Q_S = 4054.875 - 17266.8$$

$$Q_S = -13211.925 \text{ kJ}$$

$$Q_S = 13211.925 \text{ kJ/s}$$

~~6.7.11~~

b.) $MW = ?$

$$M_1 = M_2 \quad \rightarrow \quad MW$$

$$M_3 = M_4$$

$$Q_T = (m_2 h_2 + m_4 h_4) - (m_1 h_1 + m_3 h_3)$$

h_2 h_{fg} table A-5

*KPA

75
82
100

h_{fg}

~~2278.0~~ 2278.0
 Δh_{fg}
2257.5

$$\begin{array}{cc} 25 & 20.5 \\ 7 & \Delta h_{fg} \end{array}$$

$$7 \times 20.5 = 25 \Delta h_{fg}$$

$$\frac{7 \times 20.5}{25} = \Delta h_{fg}$$

$$5.74 = \Delta h_{fg}$$

$$h_{fg} = 2278 - 5.74 = 2272.26 \text{ kJ/kg}$$

⑤

K₈₀

h_f

~~105~~ 75
82
100

384.44
Δh_f
417.51

25 X 33.07
7 Δh_f

$$33.07 \times 7 = 25 \Delta h_f$$

$$\frac{33.07 \times 7}{25} = \Delta h_f$$

$$9.2596 = \Delta h_f$$

$$h_f = 384.44 + 9.2596 = 393.6946 \text{ kJ/kg}$$

$$x_2 = 0.12$$

*

h₂ = h_f + x × h_{fg}

$$h_2 = 393.6946 + 0.12 \times 2272.26$$

$$h_2 = 666.3708 \text{ kJ/kg}$$

$$P_1 = P_2$$

$$x_1 = 0.05$$

h₂

$$h_1 = h_f + x \times h_{fg}$$

$$h_1 = 393.6946 + 0.05 \times 2272.26$$

$$h_1 = 507.3126 \text{ kJ/kg}$$

$$Q_T = (m_2 h_2 + m_4 h_4) - (m_1 h_1 + m_3 h_3)$$

$$Q_T = Q_s + Q_L$$

$$Q_T = 13211.925 + 6\%$$

$$Q_T = 13211.925 \times 1.06 = 14004.6408 \text{ KJ/s}$$

$$m_3 = m_4 = 6 \text{ kg/s}$$

$$h_1 = 507.3126 \text{ KJ/kg}$$

$$h_2 = 666.3708 \text{ KJ/kg}$$

$$h_3 = ~~2877.8~~ 2877.8 \text{ KJ/kg}$$

$$h_4 = 675.8125 \text{ KJ/kg}$$

$$m_1 = m_2 = m_w$$

$$Q_T = (m_2 h_2 + m_4 h_4) - (m_1 h_1 + m_3 h_3)$$

$$Q_T = m_2 h_2 + m_4 h_4 - m_1 h_1 - m_3 h_3$$

$$Q_T = m_2 h_2 - m_1 h_1 + m_4 h_4 - m_3 h_3$$

$$Q_T = m_w (h_2 - h_1) + m_4 h_4 - m_3 h_3$$

$$Q_T - m_4 h_4 + m_3 h_3 = m_w (h_2 - h_1)$$

$$14004.6408 - (6 \times 675.8125) + (6 \times 2877.8) = m_w (666.3708 - 507.3126)$$

$$\underline{27216.5655} = m_w$$

$$159.0882$$

$$m_w = 171.11 \text{ kg/s}$$