

MICHAEL LEIGHTON JONES

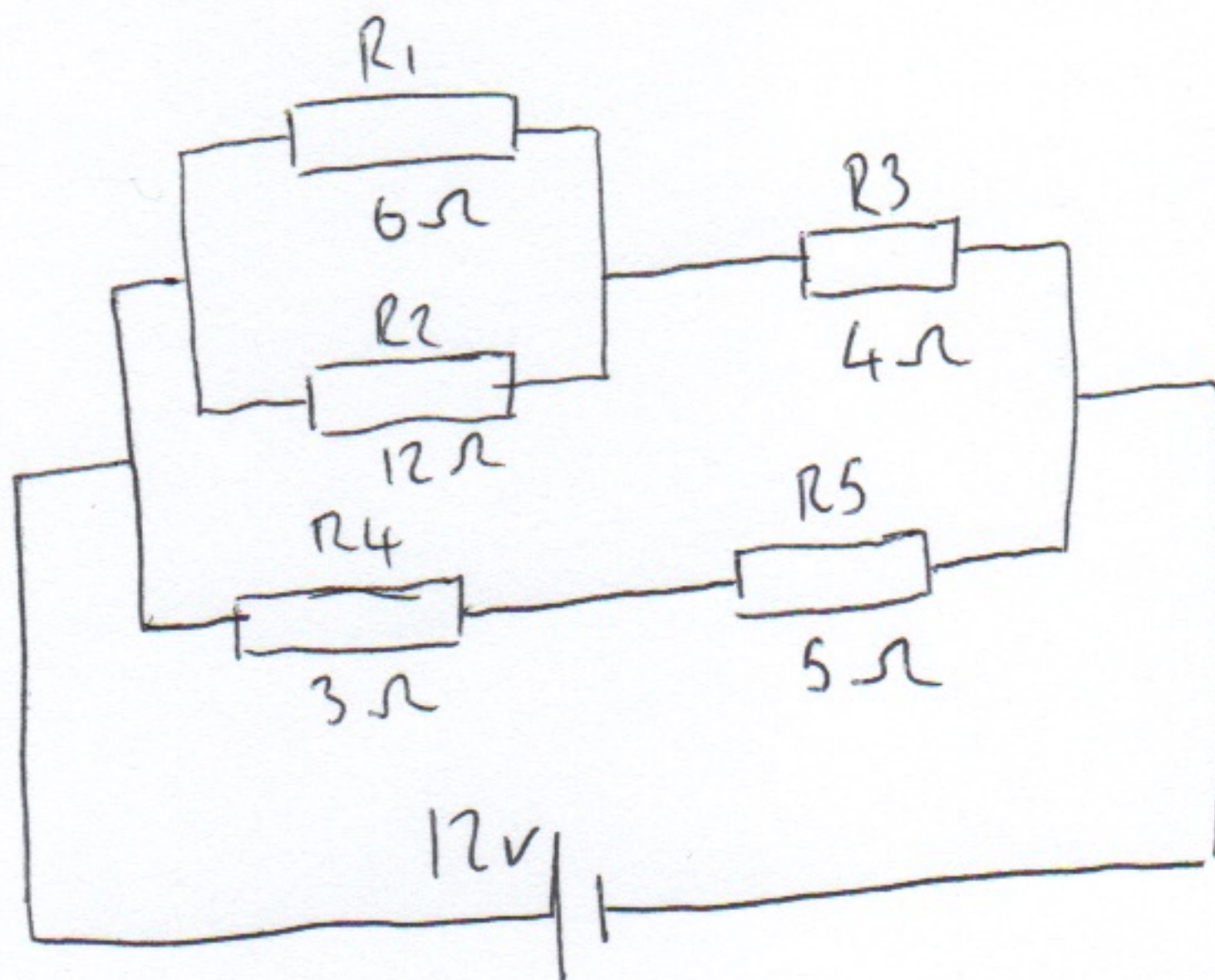
JON11802754

DATE: 18/05/2020

START TIME: 13:00

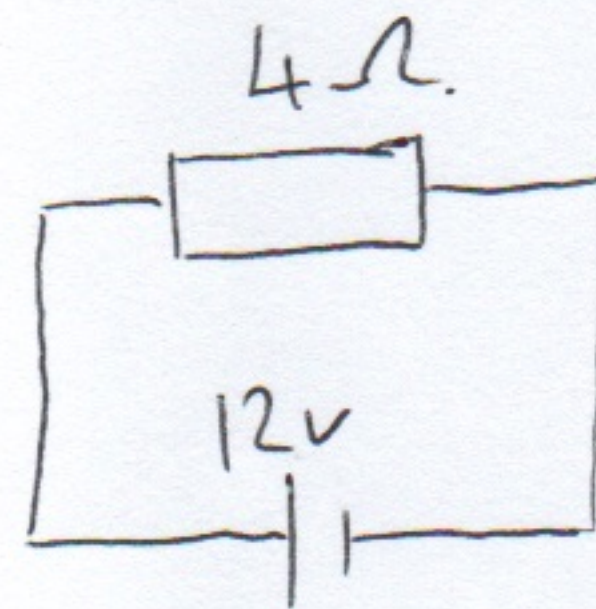
M4X00935

Q1



ai) Equivalent resistance.

$$R_{12} = \frac{(6 \times 12)}{(6 + 12)} = 4 \Omega.$$



$$R_{123} = R_{12} + R_3 = 4 + 4 = 8 \Omega.$$

$$R_{45} = R_4 + R_5 = 3 + 5 = 8 \Omega.$$

$$R_T = \frac{R_{123} \times R_{45}}{R_{123} + R_{45}} = \frac{8 \times 8}{8 + 8} = \boxed{4 \Omega}$$

ii) Total current is $\frac{V}{R_T} = \frac{12}{4} = \boxed{3A}.$

iii). Power dissipated, $P = I \times V.$
 $= 3 \times 12.$
 $= \boxed{36 W}$

Q₁

iv). current through 3Ω resistor

~~I_T~~ $I_T = 3A$. Half R_T $I_T = 1.5A$.

$$1.5/8 = 0.1875$$

$$0.1875 \times 3 = \boxed{0.56A}$$

v). voltage across 5Ω .

$$V = I \times R.$$

$$I = 1.5 - 0.56.$$

$$V = 0.94 \times 5$$

$$= \boxed{4.7V}$$

vi) voltage across 6Ω .

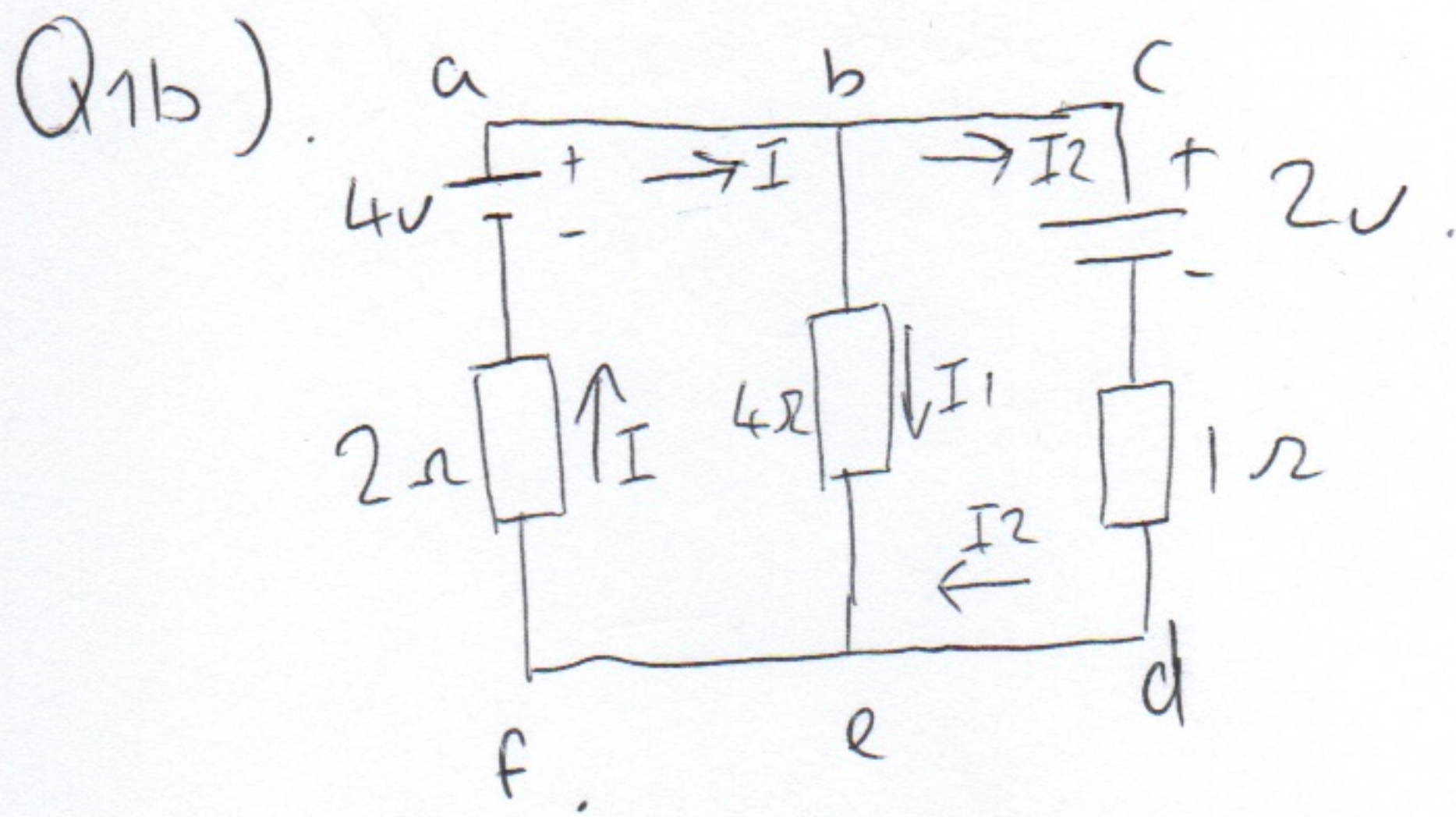
~~$$V = \frac{1}{3} \times 6V =$$~~

$$V_1 = V_2 = V_3.$$

$$\boxed{6V}$$

vii) current through 12Ω

$$= \frac{2}{3} \times 0.75A = \boxed{0.5A}.$$



$$I = I_1 + I_2 \dots$$

Loop a b e f a

$$4I_1 + 2I - 4 = 0$$

$$4I_1 + 2(I_1 + I_2) - 4 = 0$$

$$6I_1 + 2I_2 - 4 = 0$$

Loop b c d e b

$$2 + I_2 - 4I_1 = 0$$

$$6I_1 + 2I_2 - 4 = 0 \quad \times 2$$

$$-4I_1 + I_2 + 2 = 0 \quad \times 3$$

$$12I_1 + 4I_2 - 8 = 0$$

$$-12I_1 + 3I_2 + 6 = 0$$

$$7I_2 = 2$$

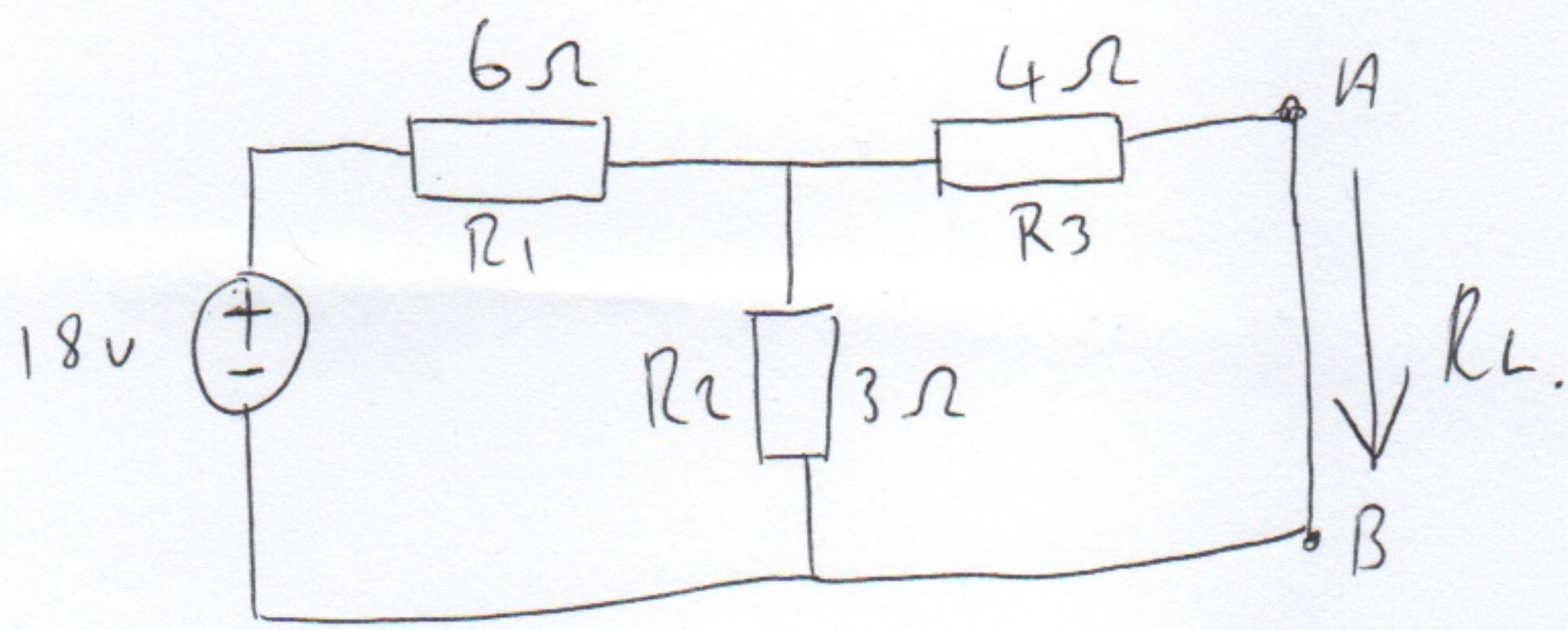
$$I_2 = \frac{2}{7} = 0.29 \text{ A}$$

Sub back in

$$6I_1 + (2 \times 0.29) - 4 = 0$$

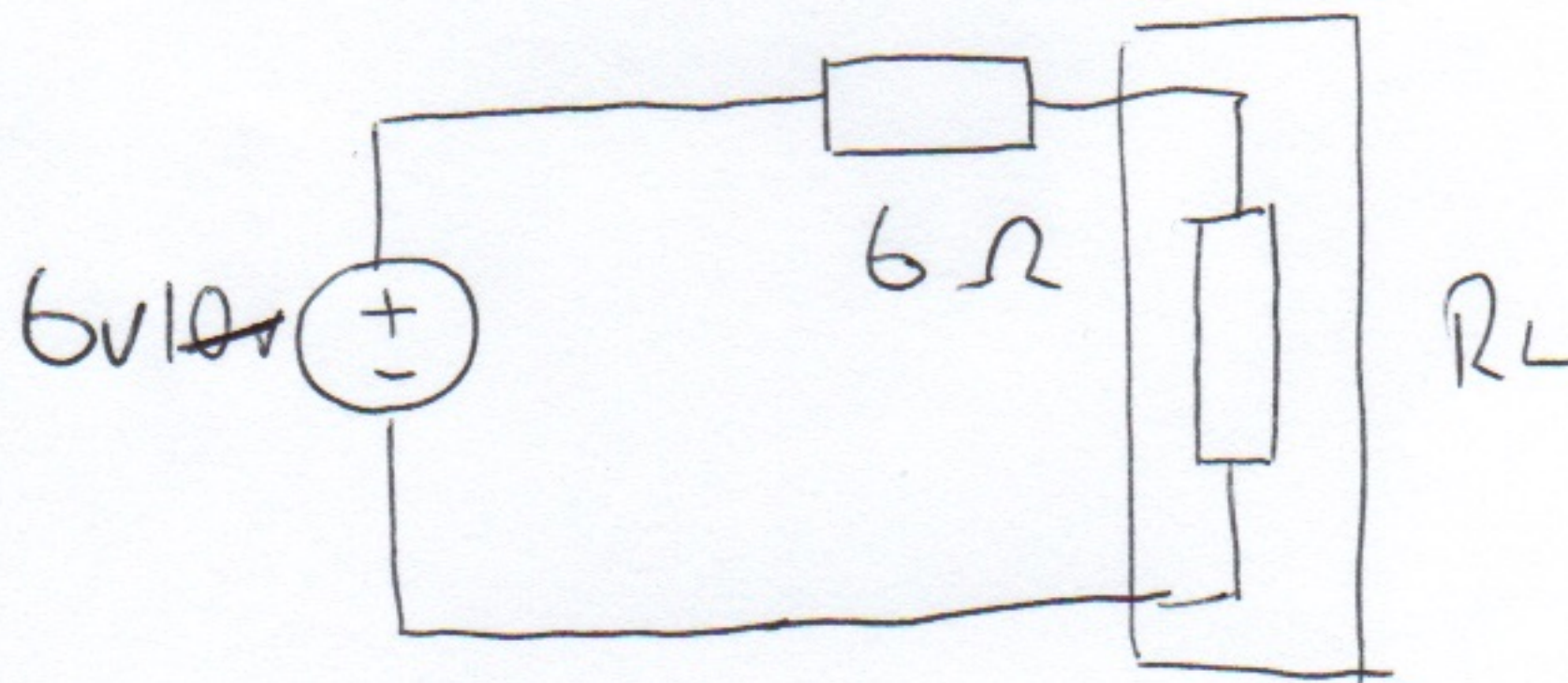
$$6I_1 = 4.58 \quad I_1 = 0.76 \text{ A}$$

Q2. i).



$$V_{TH} = V_{AB} = 18 \left(\frac{3}{3+6} \right) = 6V.$$

$$R_{TH} = 4 + \left(\frac{6 \times 3}{6+3} \right) \\ = 6\Omega.$$



ii). R_L must be the same value as the equivalent resistance to achieve maximum power,

$$\text{So } R_L = \boxed{6\Omega}.$$

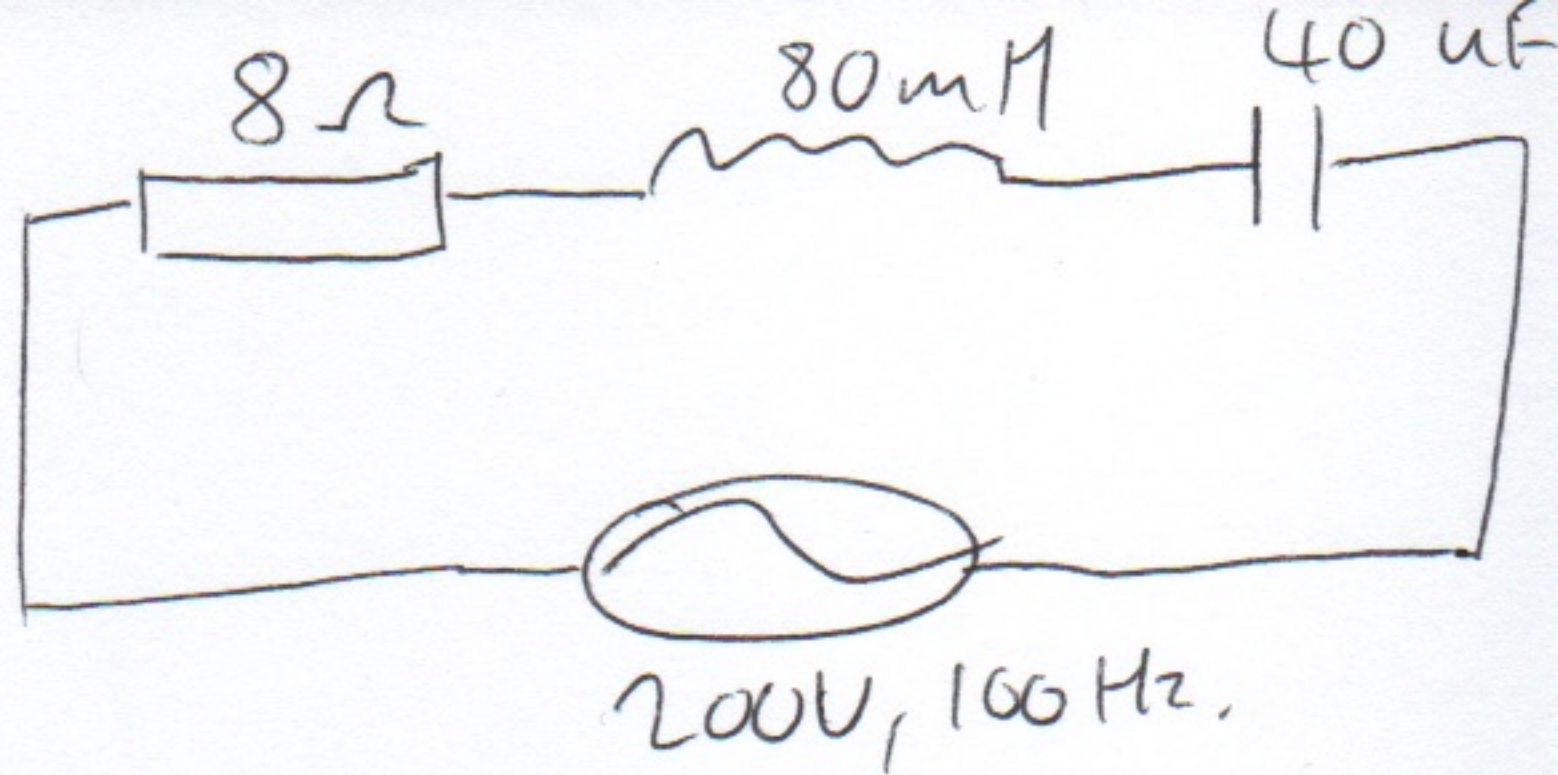
Q2iii). max power.

$$P = I^2 R_L$$

$$= \left(\frac{6}{12} \right)^2 \times 6 = 1.5 \text{ w.}$$

$$\text{iv). } I_T = \frac{V}{R} = \frac{6}{106} = 57 \text{ mA.}$$

Q3ai).



circuit impedance.

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$X_C = \frac{1}{2\pi f C} = 39.79 \Omega$$

$$X_L = 2\pi f L = 50.27$$

$$\begin{aligned} Z &= \sqrt{8^2 + (50.27 - 39.79)^2} \\ &= 13.18 \Omega \end{aligned}$$

ii) current flowing.

$$\begin{aligned} I &= \frac{V}{R} = \frac{200}{13.18} \\ &= 15.17 \text{ A} \end{aligned}$$

Q3a iii) voltage across coil.

$$V = 2\pi f I L$$
$$= 762.53 \text{ V.}$$

iv). voltage across capacitor

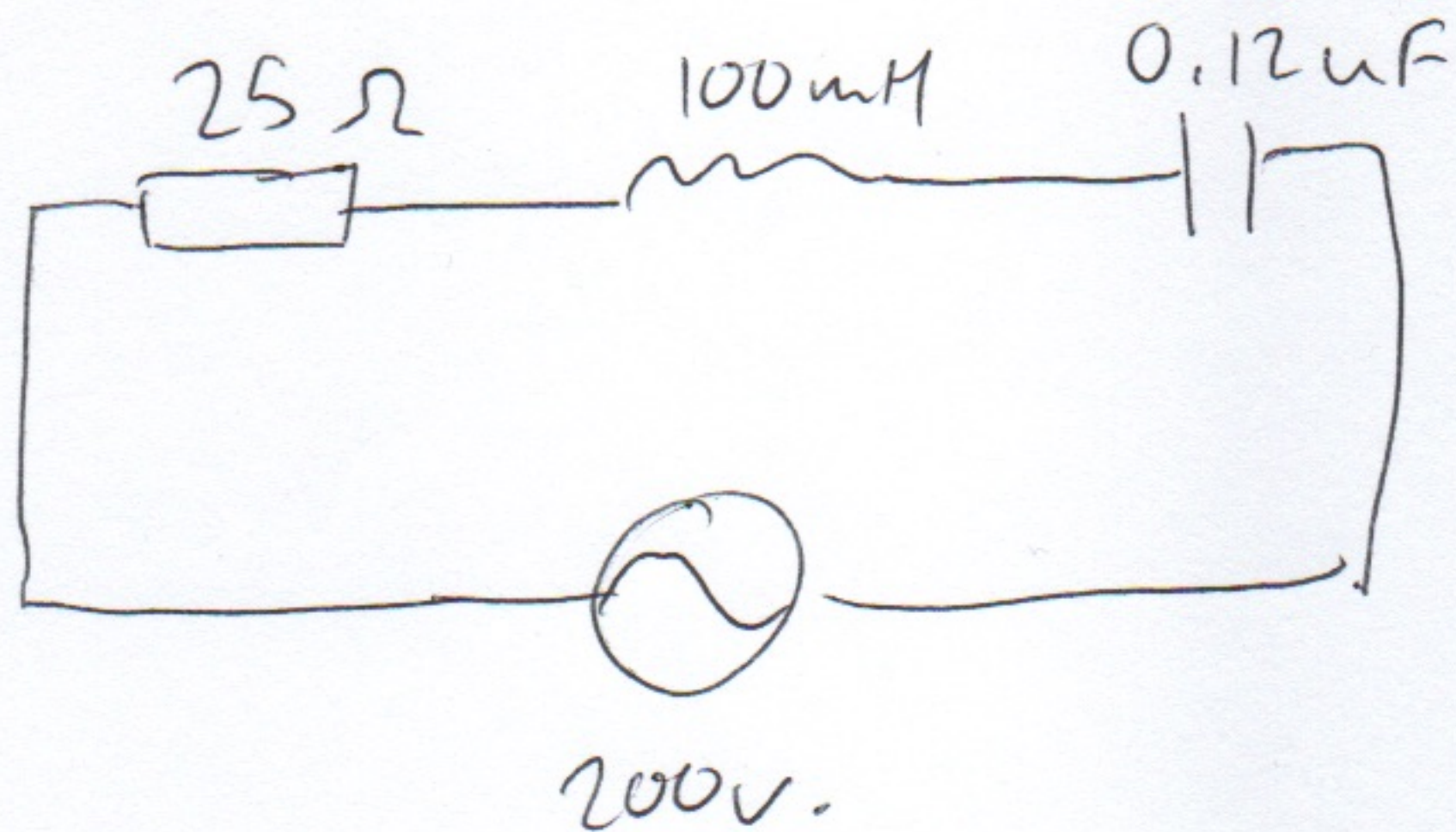
$$V = \frac{I}{2\pi f C}$$
$$= 603.6 \text{ V.}$$

v) phase angle.

$$\tan \phi = \frac{X_L - X_C}{R}$$

$$\tan^{-1} = 52.64^\circ$$

Q3 b i).



resonant frequency.

$$f = \frac{1}{2\pi\sqrt{LC}}$$
$$= 1,453 \text{ Hz.}$$

ii) Inductive reactance

$$2\pi fL = 912.95 \Omega \approx 913 \Omega$$

iii) capacitive reactance.

$$\frac{1}{2\pi fC} = 912.8 \Omega \approx 913 \Omega$$

Q3b iv). ~~Z~~ current.

$$Z = \sqrt{R^2 + (Z_L - X_C)^2}$$
$$= 25 A.$$

Q3b v). voltage across capacitor

$$V_C = \frac{I}{2\pi f C}$$

$$= 22,820 V.$$

vi) voltage across coil

$$V_L = 2\pi f I L$$

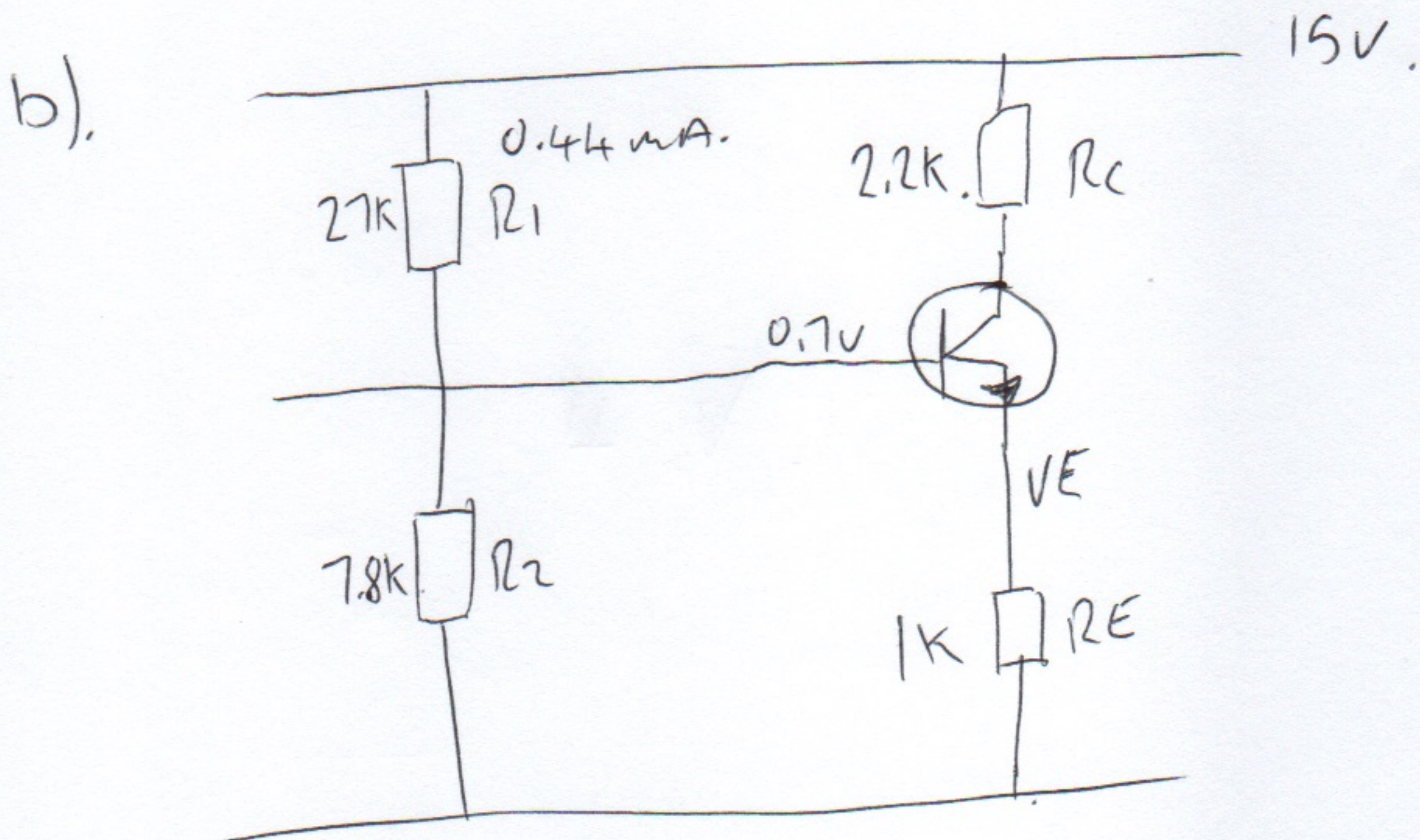
$$= 22,824 V.$$

$$vii). \frac{22,820}{200}$$

$$= \hat{\sim} 114$$

$$Q4a). i). I = \frac{V}{R} = \frac{(5 - 0.7)}{50} = 86 \text{ mA}.$$

$$ii) - I = \frac{V}{R} = \frac{(-5 - 0.7)}{50} = -114 \text{ mA}.$$



1). current R_2 .

$$V_{R1} = I \times R = 11.88.$$

$$V_{R2} = 15 - 11.88 = 3.12.$$

$$I = \frac{V}{R} = \frac{3.12}{7.8k} = 0.40 \text{ mA}.$$

Q4 bii). we assume $HFE = 100$.

$$100 \times 0.04 \text{ mA} = \boxed{4 \text{ mA}}.$$

$$\begin{aligned} \text{iii)} \quad A_{v_{mid}} &= \frac{R_C}{R_E} \\ &= 2.2. \end{aligned}$$