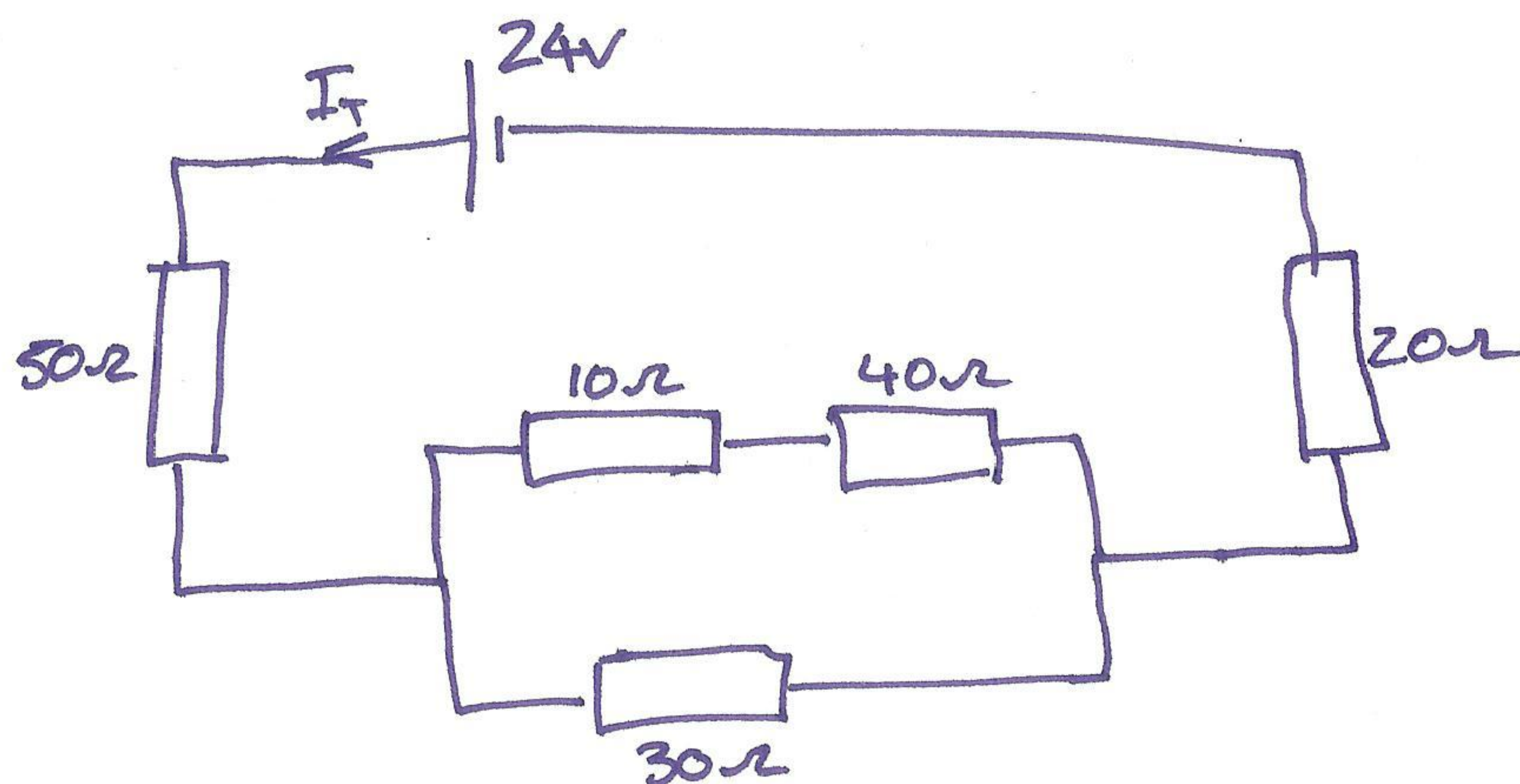


# Foundation Year Electronics Practice Questions

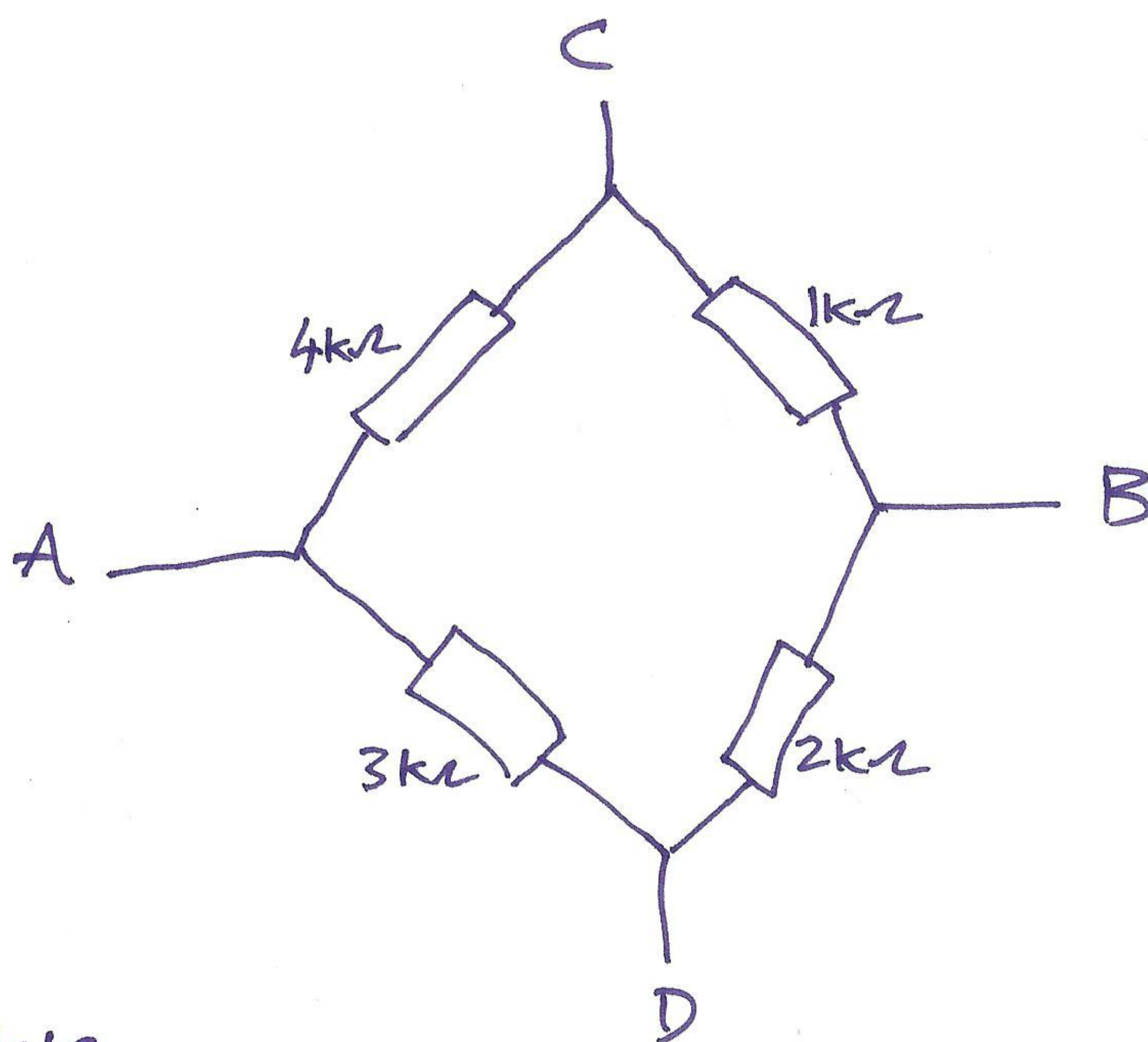
## Question 1



- Calculate

- Total Resistance
- Total Current,  $I_T$
- Total power dissipated by the 20Ω resistor
- Total power dissipated by circuit.

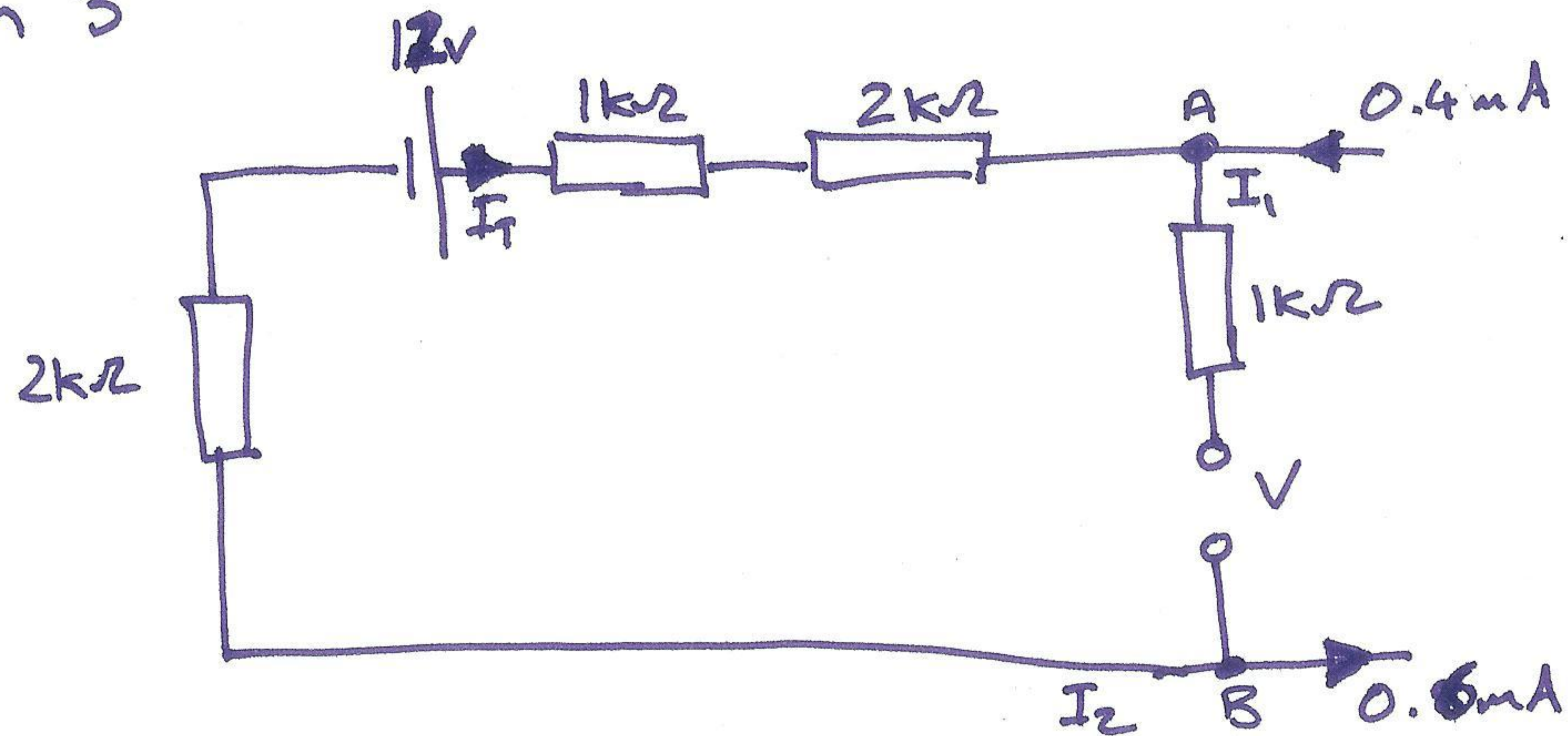
## Question 2



- Calculate

- The resistance between A and B.
- The resistance between C and D

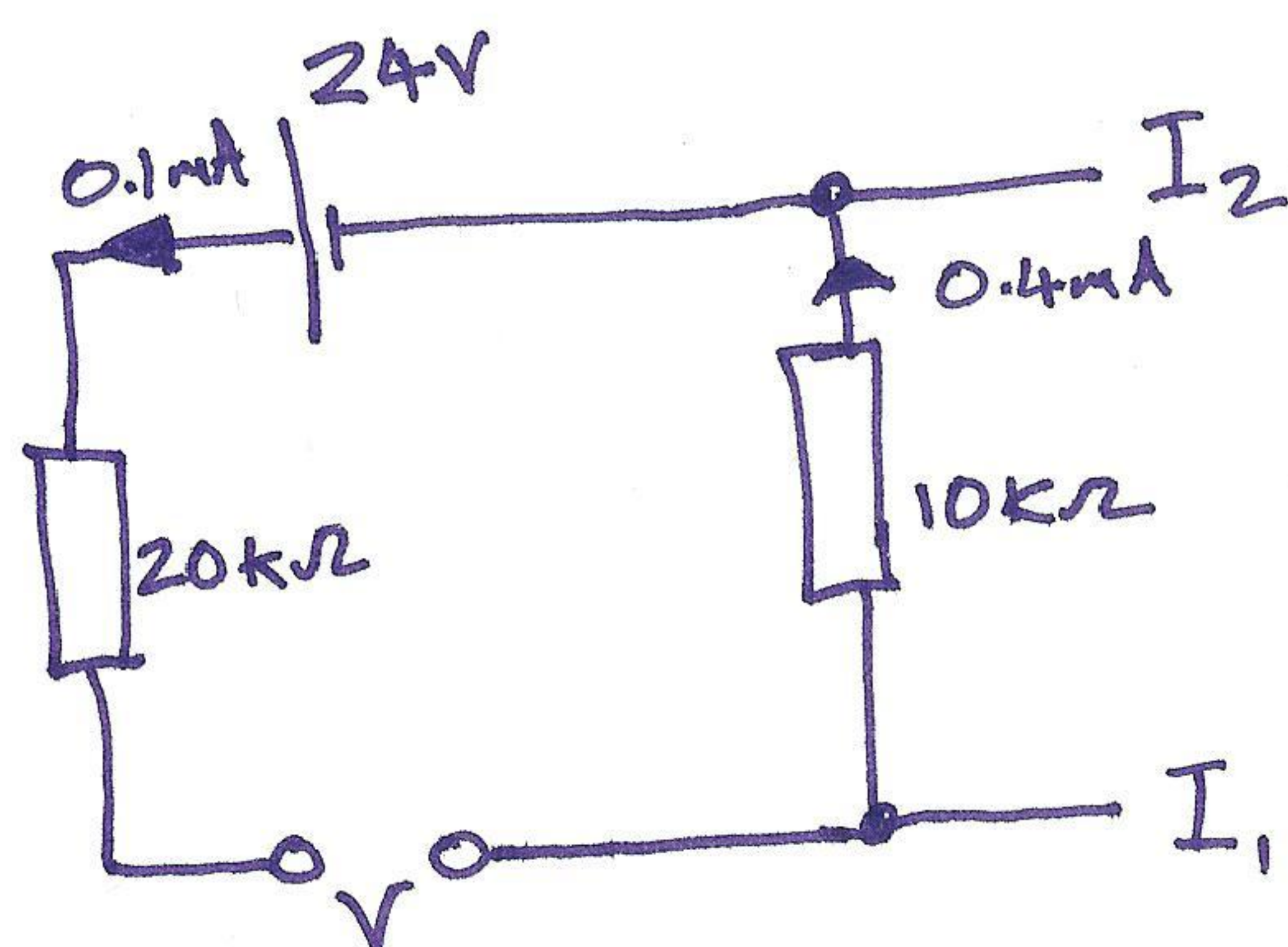
### Question 3



$$I_T = 0.3 \text{ mA}$$

- Calculate  $I_1$  and  $I_2$
- Calculate the magnitude of the unknown voltage  $V$ .
- Draw a battery symbol to indicate the direction of the unknown voltage.

### Question 4



- Calculate the unknown currents  $I_1$  and  $I_2$
- Calculate the voltage  $V$  and indicate its direction.

### Question 5

A wire has a diameter of  $0.16 \text{ mm}$  and is made from a material with a resistivity of  $2.65 \times 10^{-8} \Omega \cdot \text{m}$ . Calculate the maximum length of the wire if the resistance is to be less than  $0.5 \Omega$ .

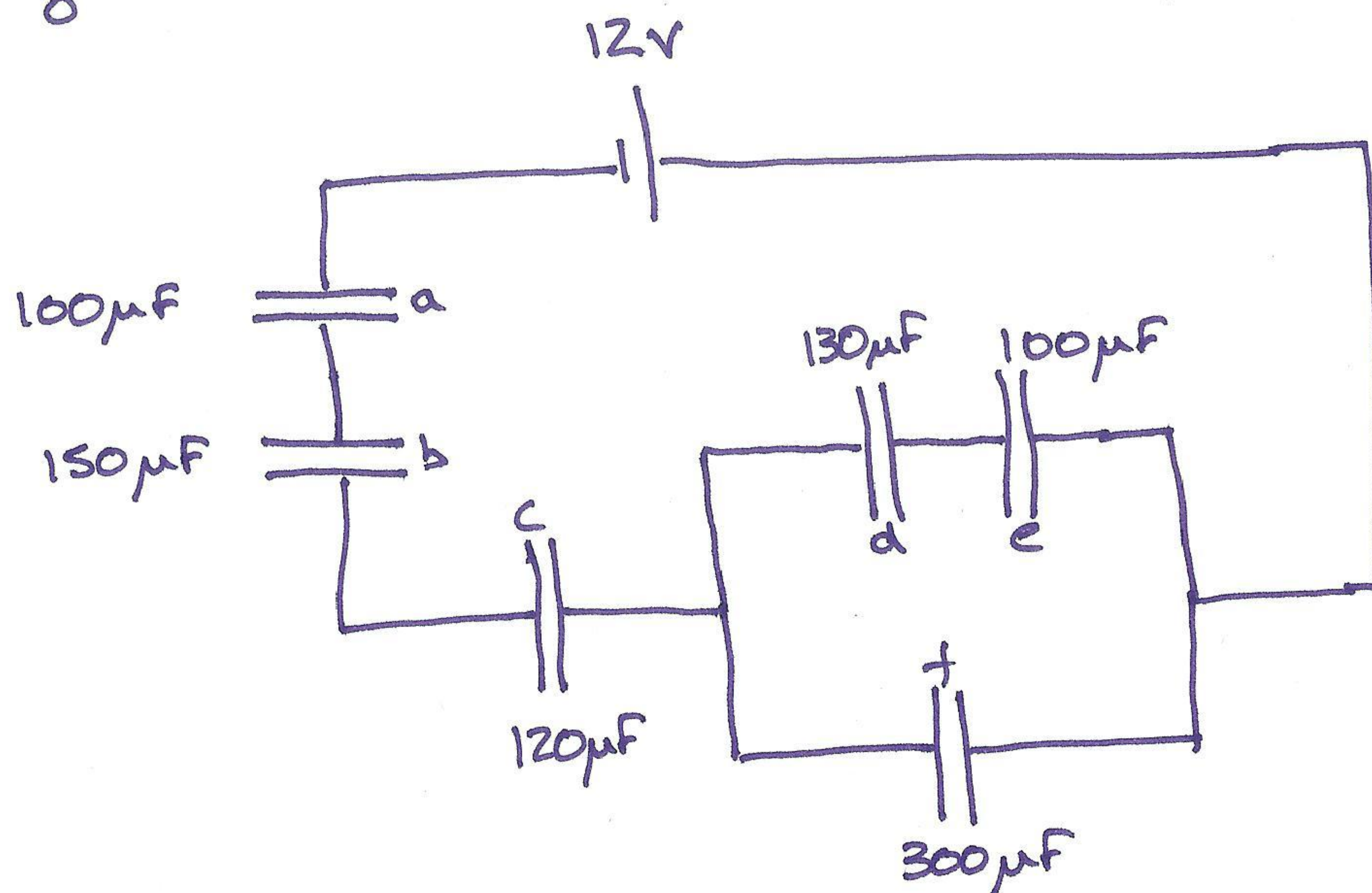
### Question 6

Calculate the EMF of a battery if its terminal voltage measures  $10.8 \text{ V}$  when a current of  $0.4 \text{ A}$  is drawn through an internal resistance of  $10 \Omega$ .

### Question 7

If a wire has a resistance of  $0.12$  at  $0^{\circ}\text{C}$ , a temperature co-efficient of  $4 \times 10^{-3}$  and is measured to have a resistance of  $0.162$  in its working environment, calculate the temperature of this environment.

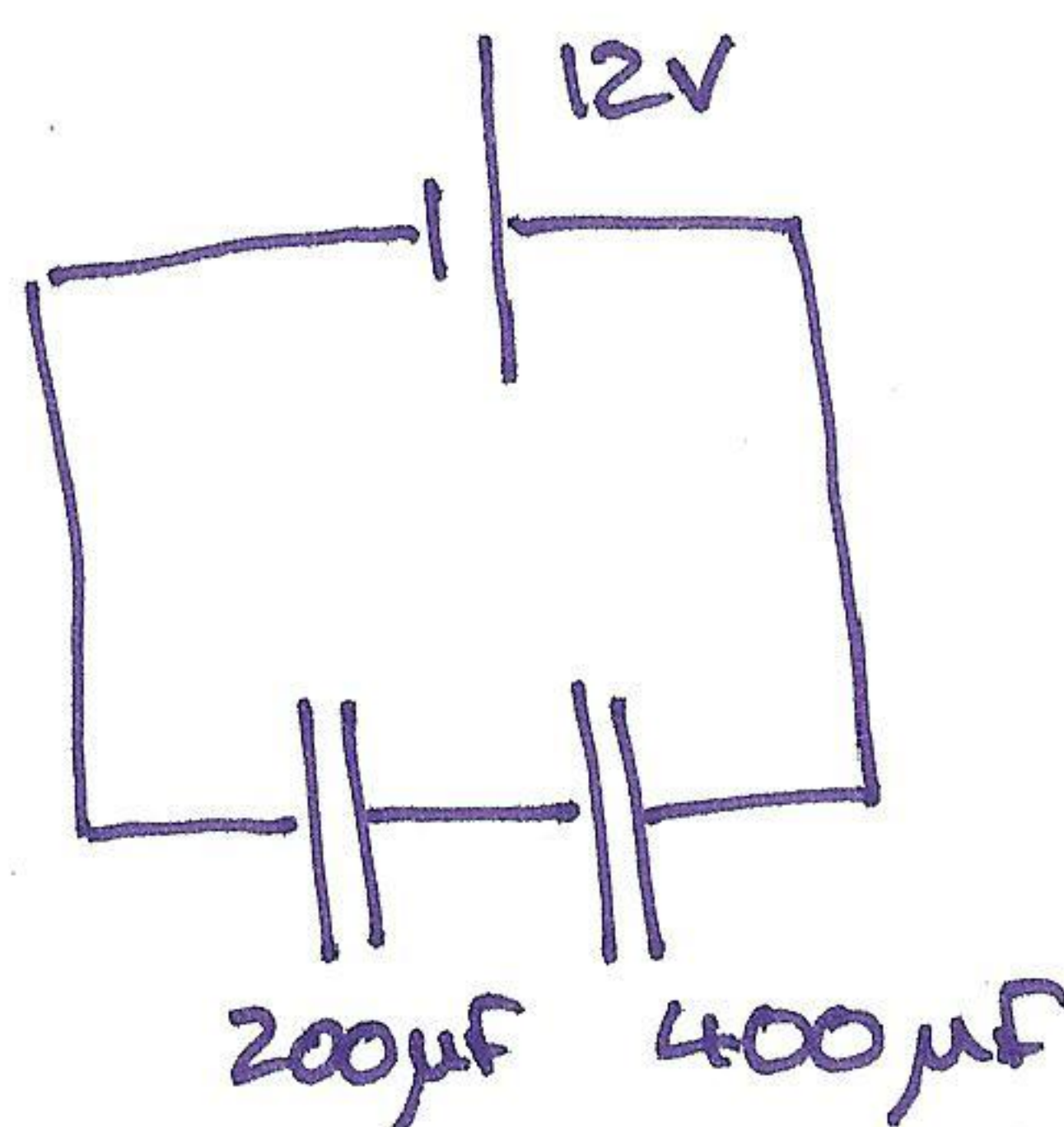
### Question 8



Calculate the total capacitance of the circuit above.

### Question 9.

Calculate the energy stored by the circuit below.



### Question 10

- Explain what is meant by the term electromagnetic induction
- What is the advantage over 3 phase electricity in terms of an alternator output?
- Explain how an AC transformer steps up or steps down voltage

# Answers

$$Q1 \ a) \ R_T = 50 + 20 + \frac{1}{\frac{1}{30} + \frac{1}{10+40}}$$

$$R_T = 70 + \frac{1}{\frac{1}{30} + \frac{1}{50}}$$

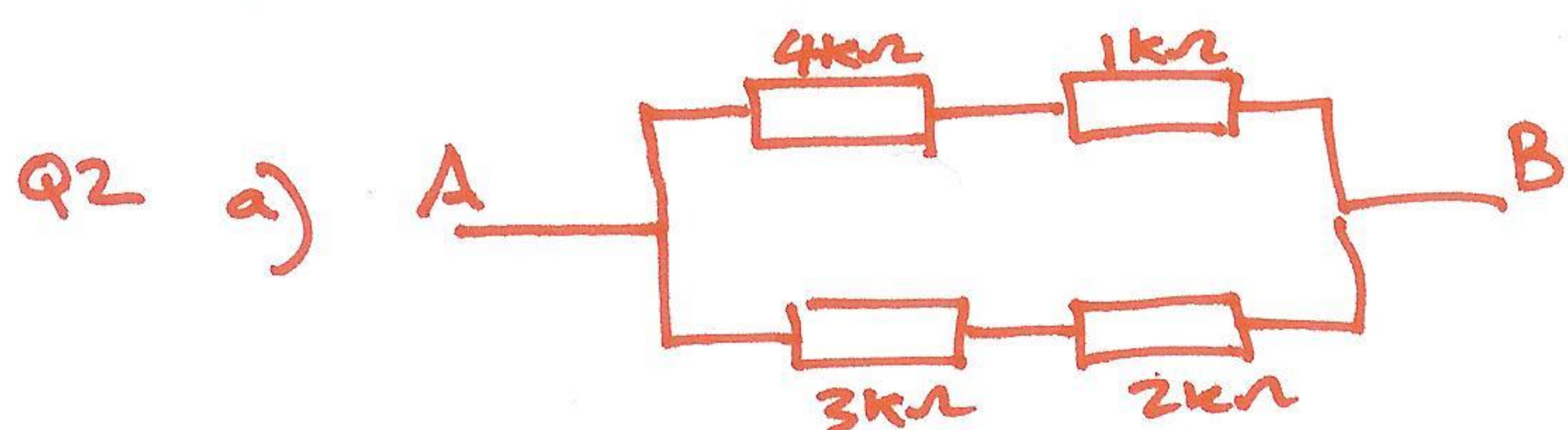
$$R_T = 88.75 \ \Omega$$

$$b) \ V = IR$$

$$I = \frac{V}{R} = \frac{24}{88.75} = 0.27 \text{ A.}$$

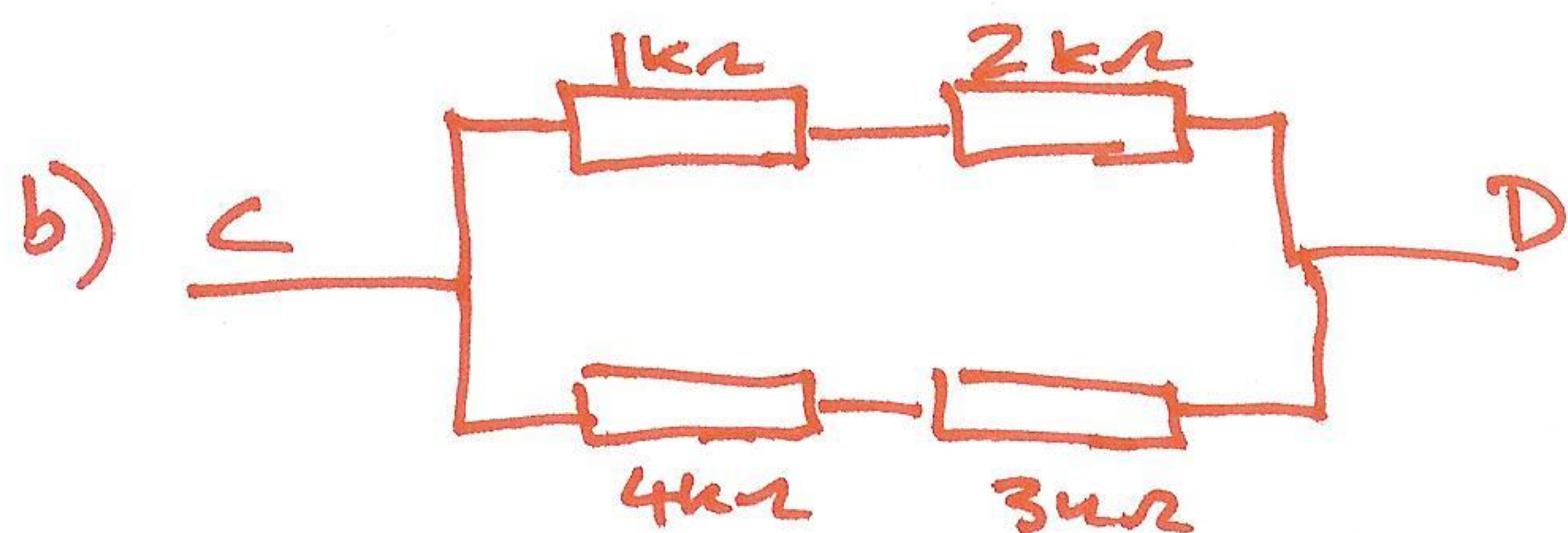
$$c) \ P = I^2 R = 0.27^2 \times 20 = 1.458 \text{ W}$$

$$d) \ P = I^2 R = 0.27^2 \times 88.75 = 6.47 \text{ W.}$$



$$R_{AB} = \frac{1}{\frac{1}{4+1} + \frac{1}{3+2}} = \frac{1}{\frac{1}{5} + \frac{1}{5}} = 2.5 \text{ k}\Omega.$$

N.B as all resistors are in  $\text{k}\Omega$  we can maintain units in calcs.



$$R_{CD} = \frac{1}{\frac{1}{1+2} + \frac{1}{4+3}} = \frac{1}{\frac{1}{3} + \frac{1}{7}} = 2.1 \text{ k}\Omega.$$

Q3 a) Kirchhoff's 1<sup>st</sup> law on node A:

$$0.3 \times 10^{-3} + 0.4 \times 10^{-3} + I_1 = 0$$

$$I_1 = -0.4 \times 10^{-3} - 0.3 \times 10^{-3} = -0.7 \times 10^{-3} \text{ A}$$

= -0.7 mA.  
(away from A)

Kirchhoff's 1<sup>st</sup> law on node B:

$$0.7 \times 10^{-3} + I_2 - 0.6 \times 10^{-3} = 0$$

$$I_2 = 0.6 \times 10^{-3} - 0.7 \times 10^{-3} = -0.1 \times 10^{-3} \text{ A}$$

= -0.1 mA.  
(away from B)

b) Apply Kirchhoff's second law to loop

$$V_1 + V_2 + V_3 + V_4 + V_5 + V_6 = 0$$

$$12 - (1 \times 10^3 \times 0.3 \times 10^{-3}) - (2 \times 10^3 \times 0.3 \times 10^{-3}) - (1 \times 10^3 \times 0.7 \times 10^{-3}) + V - (2 \times 10^3 \times 0.1 \times 10^{-3}) = 0$$

$$12 - 0.3 - 0.6 - 0.7 - 0.2 + V = 0$$

$$V = 0.3 + 0.6 + 0.7 + 0.2 - 12 = -10.2 \text{ V.}$$

(anti clockwise).

Q4

a) Apply Kirchhoff's 1<sup>st</sup> law at node A.

$$0.1 + I_1 - 0.4 = 0$$

$$I_1 = 0.4 - 0.1 = 0.3 \text{ mA}$$

(toward A)

Apply Kirchhoff's 1<sup>st</sup> law at node B

$$0.4 - 0.1 + I_2 = 0$$

$$I_2 = 0.1 - 0.4 = -0.3 \text{ mA}$$

(away from B)

b) Apply Kirchhoff's 2<sup>nd</sup> law to loop.

$$V_1 + V_2 + V_3 + V_4 = 0$$

$$24 - (0.1 \times 10^{-3} \times 20 \times 10^3) + V - (10 \times 10^3 \times 0.4 \times 10^{-3}) = 0$$

$$V = 4 + 2 - 24 = -18 \text{ V}$$

(clockwise)

Q5

$$d = 0.16 \text{ mm}$$

$$\rho = 2.65 \times 10^{-8} \text{ }\Omega\text{m}$$

$$R_{\text{max}} = 0.5 \text{ }\Omega$$

$$L = ?$$

$$R = \frac{\rho L}{A}$$

$$L = \frac{RA}{\rho} = \frac{R \pi d^2}{4\rho} = \frac{0.5 \times \pi \times (0.16 \times 10^{-3})^2}{4 \times 2.65 \times 10^{-8}}$$

$$L = 0.379 \text{ m.}$$

Q6

$$V = 10.8$$

$$R_x = 10 \text{ }\Omega$$

$$I = 0.4 \text{ A.}$$

$$E = V + IR_x$$

$$E = 10.8 + (0.4 \times 10)$$

$$E = 14.8 \text{ V.}$$

Q7

$$R_0 = 0.1 \Omega$$

$$\alpha = 4 \times 10^{-3} \text{ K}^{-1}$$

$$R_1 = 0.16 \Omega$$

$$R_1 = R_0 + R_0 \alpha \Delta T$$

$$\Delta T = \frac{R_1 - R_0}{R_0 \alpha} = \frac{0.16 - 0.1}{0.1 \times 4 \times 10^{-3}} = 150^\circ \text{C}$$

Q8

$$C_{de} = \frac{1}{\frac{1}{130} + \frac{1}{100}} = 56.52 \mu\text{F}$$

$$C_{def} = 56.52 + 300 = 356.52 \mu\text{F}$$

$$C_{abcdef} = \frac{1}{\frac{1}{100} + \frac{1}{150} + \frac{1}{120} + \frac{1}{356.52}} = C_T = 35.96 \mu\text{F}$$

Q9

$$C_T = \frac{1}{\frac{1}{200} + \frac{1}{400}} = 133.33 \mu\text{F}$$

$$E = \frac{C V^2}{2} = \frac{133.33 \times 12^2}{2} = 960 \text{ J}$$

Q10

a) Electro magnetic induction is where a current is induced in a conductor as it cuts through a magnetic field. The direction of the induced current depends on the direction of movement and direction of magnetic field.

b) When a 3 phase output is rectified (turned from a.c to d.c) the current output is smoother than that of a single phase rectified output.

c) An alternating current is passed through a primary coil which produces an alternating magnetic field. As this field cuts a secondary coil, a voltage is induced. The induced voltage depends on the number of coils on the primary relative to the secondary.