# Modelling and control summaries

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## Modelling principles and analogies 8:

## Tutorial sheet on electrical circuits

1. State Kirchhoff's Current and Voltage Laws. Use simple examples to illustrate how the laws are used in practice.

2. State Ohm's Law. Values of current are measured when different voltages are applied to a resistor. Calculate the resistance in each case and report whether Ohm's Law is obeyed.

| | | | |
|---|---|---|---|
| *v* voltage (volts) | 20 | 70 | 105 |
| *i* current (amps) | 6 | 21 | 31.5 |

3. What current is produced when 240 V is applied to a resistance of 60 Ω ?

4. What voltage applied to a resistor of 40 Ω will produce 2.8 A?

5. Calculate the combined resistance of $R_1$, $R_2$ and $R_3$ in Figure E1 where:

(a) $R_1 = 2\ \Omega$, $R_2 = 4\ \Omega$ and $R_3 = 6\ \Omega$
(b) $R_1 = 5\ \Omega$, $R_2 = 20\ \Omega$ and $R_3 = 25\ \Omega$
(c) $R_1 = 1\ \Omega$, $R_2 = 6\ \Omega$ and $R_3 = 8\ \Omega$

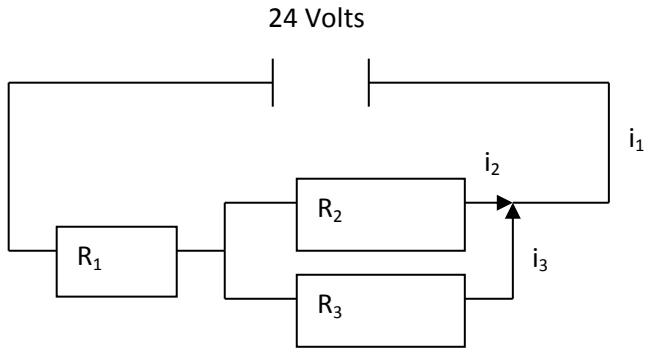



***Figure E1 Series and Parallel Circuit***

6. When a potential difference of 1.5 V is supplied by the battery, calculate the voltage across $R_1$ in Figure E1 for cases (a), (b) and (c).

7. For the same potential difference as in E5, calculate the voltage across $R_2$ in Figure E1 and hence determine the current in $R_2$ for cases (a), (b) and (c).

8. Find the potential $v_3$ across the component $Z_3$ for the circuit given in Figure E2 when $Z_1 = 2\ \Omega$, $Z_2 = 4\ \Omega$, $Z_3 = 5\ \Omega$ and $Z_4 = 6\ \Omega$.

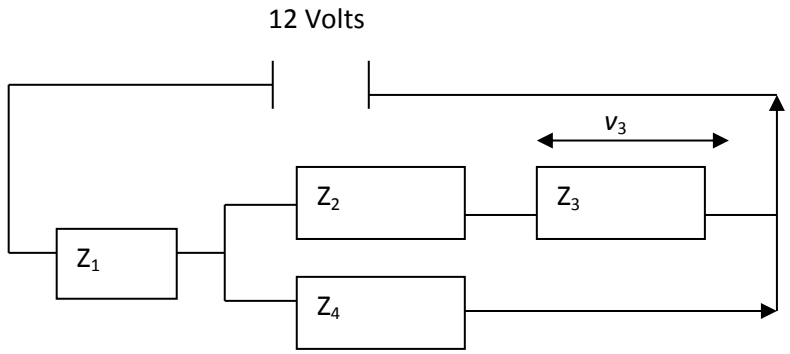
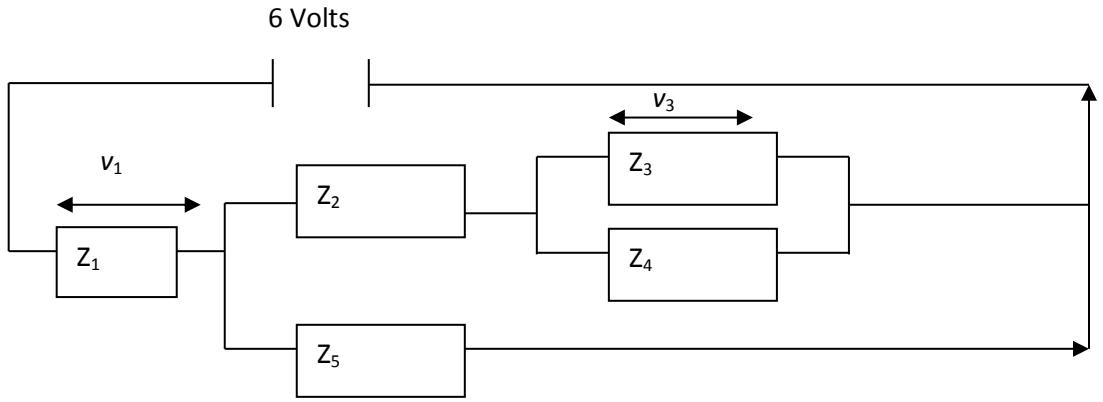



***Figure E2 Electrical Circuit with Impedances***

9. Find the potential $v_1$ across the component $Z_1$ and the potential $v_3$ across the component $Z_3$ for the circuit given in Figure E3 when $Z_1 = 1\ \Omega$, $Z_2 = 2\ \Omega$, $Z_3 = 3\ \Omega$, $Z_4 = 4\ \Omega$ and $Z_5 = 5\ \Omega$.




**CONCISE ANSWERS**

1. Bookwork.

2. 3.3 Ω, Ohm's Law is obeyed since the resistance is constant as the voltage varies

3. 4.0 A

4. 112 V

5. (a) 4.4 Ω (b) 16 Ω (c) 4.4 Ω

6. (a) 0.68 V (b) 0.47 V (c) 0.34 V

7. (a) 0.82 V, 205 mA (b) 1.03 V, 52 mA (c) 1.16 V, 193 mA

8. $v_3$ = 30/84 v = 0.357*12 Volts = 4.286Volts

9. $v_1$ = 366/191 = 1.92 V, $v_3$ = (130/191)*(12/26)*6 V