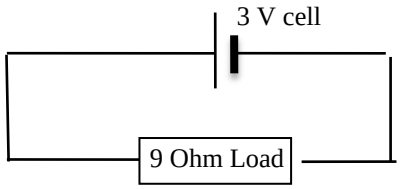
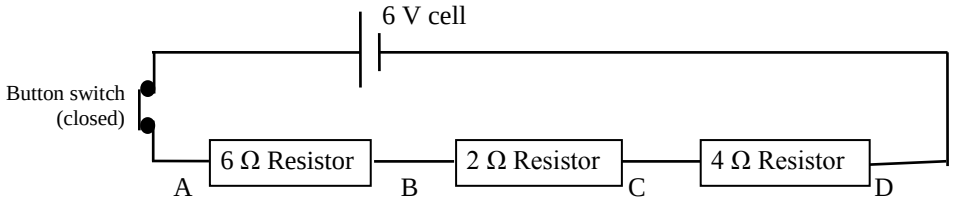
05 Electric currents review questions

1. Simple circuit.



(a) Draw the circuit.
(b) Draw arrows showing the direction of the current flow and the direction of the electron flow.
(c) State the value of the potential difference across the 9 Ohm load.
(d) Calculate the current flowing through the circuit.
(e) By considering the definition of potential difference and that current is a flow rate of charge explain why the power dissipated in the resistor is equal to **1** Watt.
(f) Derive a formula for power dissipated based on the values of current and resistance only.
(g) How long would it take before 60 Joules of energy had been transferred to the load from the cell?
(h) How much energy does each individual electron supply to the load?
i) in eV
ii) in Joules
(g) How many electrons will have flowed through the resistor to transfer the 60 Joules of energy?

2. In line (series) circuit.



(a) Calculate the total resistance of the circuit.
(b) Calculate the current flowing around the circuit.
(c) Calculate the potential differences between:
(i) A and B (ii) B and C (iii) C and D (iv) A and C (v) A and D
(d) Calculate the power being dissipated at each of the loads

3. Parallel circuit

(a) Redraw the circuit as a parallel circuit with a button switch for each load. Explain what the advantages of parallel circuits are.
(b) Calculate the combined resistance of the three parallel loads and hence the total current.
(c) Show that this total current is consistent with calculating the current though each of the three resistors independently and adding the result.

4. Additional observations.

(a) In questions 2 which resistor has the most power dissipated across it and in questions 3 which resistor has the most power dissipated across it.
(b) Measuring the values of current and resistance will affect the values. Explain this statement.
(c) The 6V cell in questions 3 and 4 will in reality have internal resistance. Will this affect the answers to question 3 or 4 the most?

5. Resistivity and Ohms law

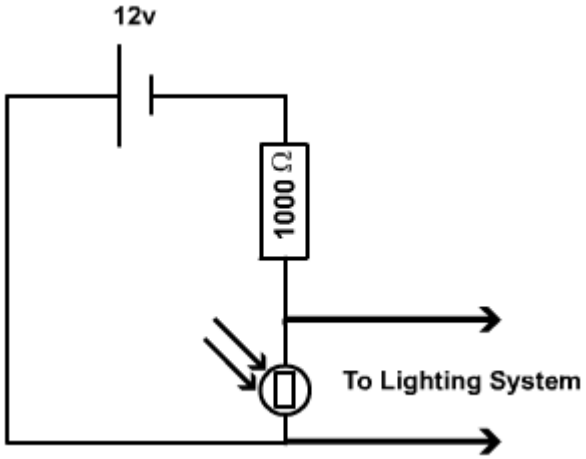
(a) A wire of diameter 0.5mm and length 0.8m has a resistance of 8 Ohms. Calculate the resistivity of the wire.
(b) Potential difference does not affect resistivity but if the temperature of the wire increases the resistivity of the wire increases. Explain whether or not the wire obeys Ohm's law.
(c) Sketch a graph of Current against voltage for a perfect resistor, this wire and a filament lamp.

6. Specialized circuits

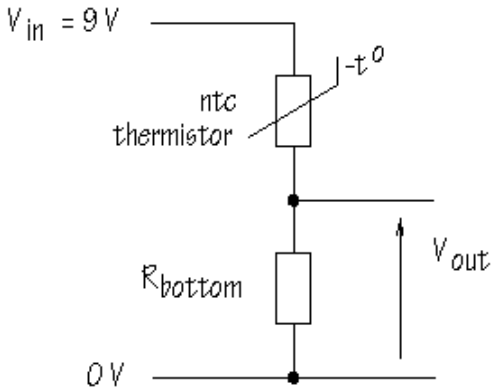
(a) The circuit opposite is used to control a lighting circuit.

In the day time the LDR has a resistance of 200Ω. At night the LDR has a resistance of 5000Ω. The lighting system needs at least 8 V to operate.

Show that the lighting circuit will be activated in the night but not in the day.



(b) A similar circuit shown below can be used to control a heating system using a NTC thermistor.



The system should activate when it is cold.

(i) Explain whether the heating system will be activated by a low or high potential difference at V_{out}.

(ii) Calculate V_{out} if R_{bottom} = 100kΩ and thermistor resistance = 120kΩ.

(c) In the strain gauge circuit below R1, R2, R3 and the strain gauge all have the same resistance when the gauge is not under strain. A very sensitive Voltmeter can therefore be used as the voltage measured is always small. If the strain guage resistance increases slightly which side of the voltmeter will have a positive voltage compared to the other side?

Quarter-bridge strain gauge circuit