O Level Physics Tutorial 15: DC Circuits

Syllabus :
(a) draw circuit diagrams with power sources (cell, battery, d.c. supply or a.c. supply), switches, lamps, resistors (fixed and variable), variable potential divider (potentiometer), fuses, ammeters and voltmeters, bells, light-dependent resistors, thermistors and light-emitting diodes

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1. State the name of the circuit component represented by each of the symbols below.

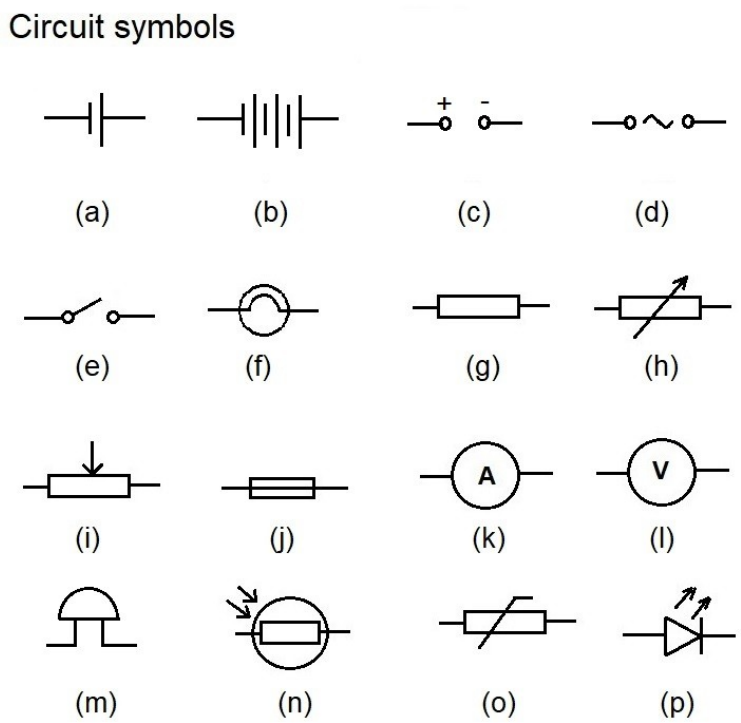

Figure 15-1

(b) state that the current at every point in a series circuit is the same and apply the principle to new situations or to solve related problems

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2. The current at point A in the circuit below is 0.1 A.

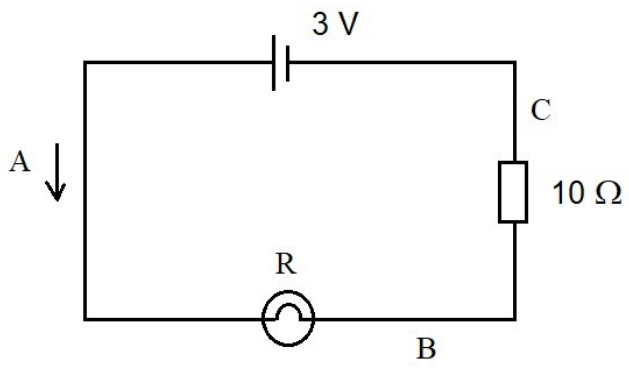

Figure 15-2

State the currents at B and C.

(c) state that the sum of the potential differences in a series circuit is equal to the potential difference across the whole circuit and apply the principle to new situations or to solve related problems

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3. The voltage between A and B is 2 V, between B and C is 1 V.

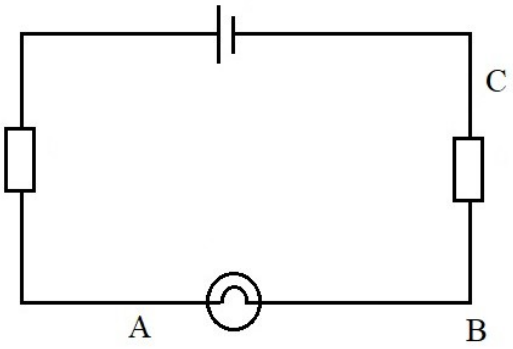

Figure 15-3

Find the voltage between A and C.

(d) state that the sum of the currents in the separate branches of a parallel circuit is equal to the current from the source and apply the principle to new situations or to solve related problems

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(e) state that the potential difference across the separate branches of a parallel circuit is the same and apply the principle to new situations or to solve related problems

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4. In the circuit below, the current I from the cell is 0.3 A.

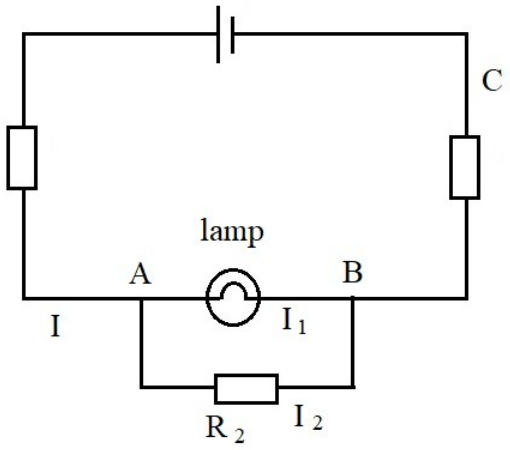

Figure 15-4

At A, it splits into two parts. The part that goes through the lamp is 0.2 A. What is the current through resistor R_2.

(f) recall and apply the formulae for the effective resistance of a number of resistors in series and in parallel to new situations or to solve related problems

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5. (a)

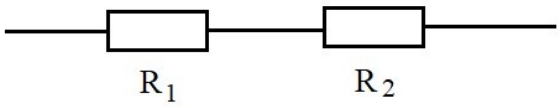

Figure 15-5(a)

The combined resistance R of two resistors R_1 and R_2 in series is given by

$$R = R_1 + R_2$$

Find the combined resistance of a 2 Ω and a 3 Ω resistors in series.

(b)

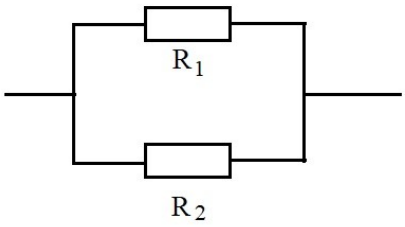

Figure 15-5(b)

The combined resistance R of two resistors R_1 and R_2 in parallel is given by

$$1/R = 1/R_1 + 1/R_2$$

Find the combined resistance of a 2 Ω and a 3 Ω resistors in series.

(g) recall and apply the relevant relationships, including R = V / I and those for current, potential differences and resistors in series and in parallel circuits, in calculations involving a whole circuit

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6.

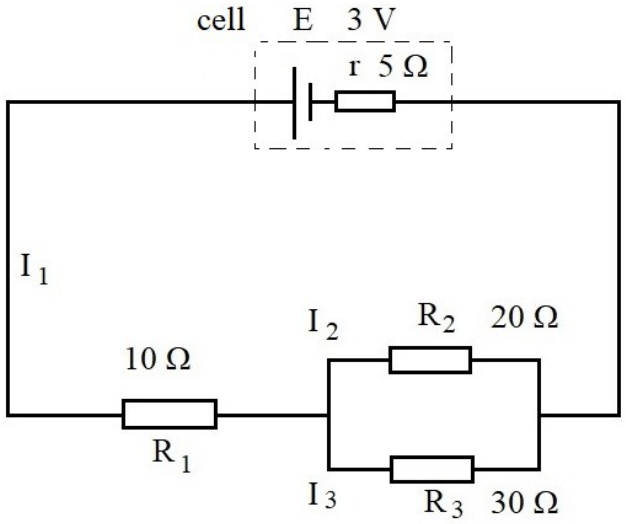

Figure 15-6

(i) Find the combined resistance of R_2 and R_3.

(ii) Find the current I_1.

(iii) Find the voltage across R_2.

(iv) Find the currents I_2 and I_3.

(v) Find the voltage across the cell.

(vi) What is the decrease in voltage across the cell due to the internal resistance r.

(h) describe the action of a variable potential divider (potentiometer)

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7. In this circuit, AB is a 1 m long wire with resistance 10 kΩ.. It has uniform cross-section, so the resistance of any part of the wire (like x) is proportional to the length of that part. The idea is to provide an adjustable voltage between 0 and 2 V.

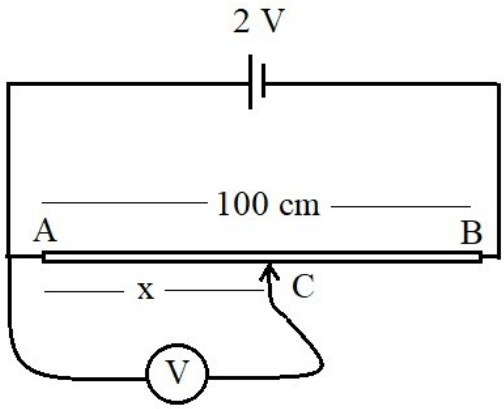

Figure 15-7

A voltmeter is connected between point A and C, where C can be moved to any part of the wire. Find the voltmeter readings for these values of x:

(i) 0 cm
(ii) 20 cm
(iii) 60 cm
(iv) 100 cm

(i) describe the action of negative temperature coefficient (NTC) thermistors and light-dependent resistors and explain their use as input transducers in potential dividers

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8. (a) Describe how a thermistor works and explain how it can be used in a potential divider.

(b) Describe how a light-dependent resistors works and explain how it can be used in a potential divider.

(j) solve simple circuit problems involving NTC thermistors and light-dependent resistors.

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7. The resistance of a thermistor decreases when it gets hot, like if there is a fire.

Assume that the resistance-temperature R-θ graph is a straight line.

θ / deg C	R / kΩ
20	6
100	0.3

This figure shows a simple fire alarm circuit.

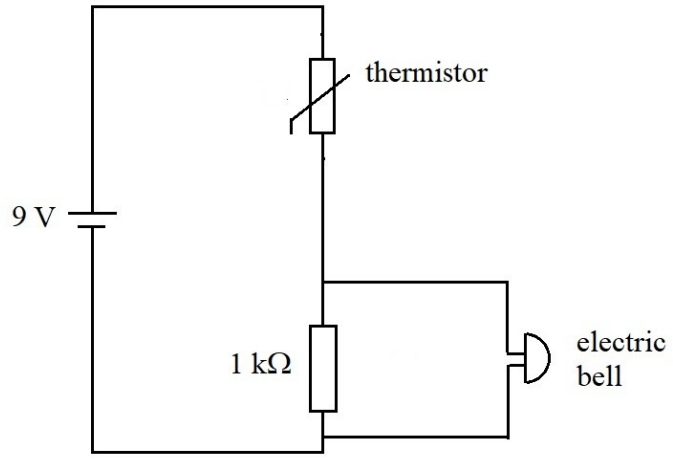

Figure 15-8

The electric bell rings when its voltage is over 5 V.

Estimate the temperature when it rings.

Updated 6 March 2025