PQ 12

Questions and Answers

Q1

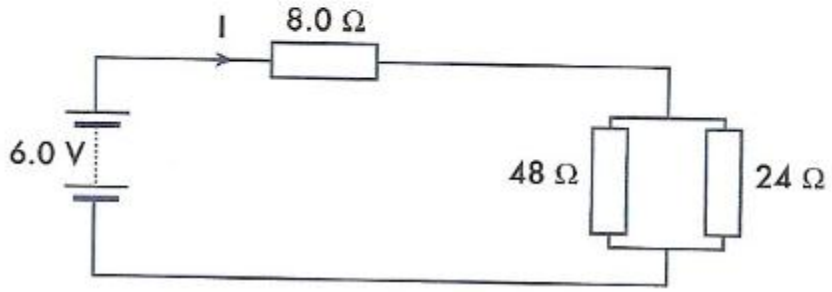
For the circuit drawn below calculate the

(a) total resistance of the circuit,

(b) I,

(c) potential difference across the 24 Ω resistor, and

(d) power dissipated through 8.0 Ω resistor.



(a) *In parallel section:* $\frac{1}{R_T} = \frac{1}{48} + \frac{1}{24}$

$= \frac{1+2}{48} = \frac{3}{48}$

$\therefore R_T = 16\ \Omega$

$\therefore$ *Total resistance of circuit* $= 8.0 + 16$

$= 24\ \Omega$

(b) $V = IR$

$6.0 = I \times 24$

$\therefore I = 0.25\ A$

(c) *P.D. across parallel section* $= IR_T$

$= 0.25 \times 16$

$= 4.0\ V$

$\therefore$ *P.D. across 24 Ω resistor* $= 4.0\ V$

(d) $P = I^2 R$

$= (0.25)^2 \times 8.0$

$= 0.50\ W$

$\therefore$ *Power dissipated through 8.0 Ω resistor*

$= 0.50\ W$

Q2

Kylie made a cup of coffee by boiling 300 mL of water in an electric kettle which had the following written on its base: 240 V, 2400 W

If the kettle took 50.0 seconds to boil the water,

(a) how much electrical energy was used in this time, and

(b) can Kylie expect all of the heat energy transformed from this electrical energy to be absorbed by the water in the kettle and heat it to boiling point?

(a) Electrical energy supplied $= P \times t$

$= 2400 \times 50.0 = 1.20 \times 10^5\ J$

(b) No. Some of the internal energy transformed from the electrical energy in the kettle will be used to heat the kettle and escape to the surroundings.

Q3

A television set owned by Michael is rated at 180 W and is designed to operate on a 240 V supply. If standard values for fuses are 2.00 A, 5.00 A and 10.0 A,

(a) suggest a value for a fuse to be placed in the circuit to which Michael's television is connected, and

(b) if a 10.0 A fuse was inadvertently used instead of the recommended fuse, predict what may happen if fault in the television caused a much larger current to flow in the television set.

(a) $P = VI$

$180 = 240\,I$

$\therefore I = 0.75\,A$

∴ Use a 2.00 A fuse.

(b) Components in the television set may be damaged by the excessive current or a fire may start in the television set before the 10.0 A fuse is made to 'blow' by this larger current.

Q4

List three advantages of using an earth leakage circuit breaker.

(i) switch off an electric current in a very short time,
(ii) quickly stop an electric shock or reduce the chances of an electrocution occurring,
(iii) prevent a fire occurring in an electrical appliance due to a fault causing a current to flow through earth wires.

Q5

The 12.0 V battery in a car supplies a current of 3.50×10^2 A to provide the starter motor with maximum power.

(a) Calculate the maximum power of the starter motor.

(b) Determine the maximum resistance of the starter motor, the battery and the connective wires.

(c) Compare the thickness of the wire connecting the battery to the starter motor with the thickness of the wire used in most other circuits in the car. Give a reason for your answer.

(a) $P = VI = 12.0 \times 3.50 \times 10^2 = 4.20 \times 10^3$ *W*

(b) $R = \frac{V}{I} = \frac{12.0}{3.50 \times 10^2} = 3.43 \times 10^{-2}\ \Omega$

(c) The battery to starter motor wire is much thicker for it to have a small resistance (less than 3.43×10^{-2} *Ω) and to carry a very large current.*