

2. Effects of electric current

Let us Assess

1. Question

What are the reasons of using nichrome as a heating coil? What are the component elements of nichrome?

Answer

Nichrome is used as a heating coil because:

i. It has a high resistance and so a large amount of heat is produced on passing current through it.

(heat generated per second = $\text{current}^2 \times \text{resistance}$)

ii. It has a high melting point and thus it can achieve a high temperature without getting destroyed (melting or getting burnt).

iii. It can remain in red hot condition for a long time without getting oxidised.

2. Question

What are the points of be remembered when fuse wire is connected in a circuit? Explain.

Answer

i. The ends of the fuse wire must be connected firmly.

ii. The fuse wire shouldn't project out of the carrier base.

iii. The fuse wire should be of appropriate amperage, else it will not serve the purpose of protecting the user and the appliance from damage due to excessive flow of current.

3. Question

An electric heater of power 920 W is working on a 230 V supply. If current flows for 5 minutes through it, calculate the heat generated.

Answer

Given:

Power = 920 W = 920 J/s

($\because$ 1 Watt = 1Joule/sec)

Time = 5 mins = 5 $\times$ 60 seconds = 300 seconds.

Formula used:

Heat, H = Power $\times$ time

$\Rightarrow H = 920 \text{ J-sec}^{-1} \times 300 \text{ sec}$

= 276000 J

= $276 \times 10^3 \text{ J}$

$\therefore$ 276 kilo joules energy will be generated in the heater when the current flows for 5 mins.

4. Question

How do discharge lamps produce light?

Answer

i. When the discharge lamp is connected to a source of electricity, the gas in between the electrodes gets ionized due to the applied potential difference.

ii. Ionised atoms move at high speed and hit unionized atoms among them and excite them to higher energy states.

iii. Excited atoms come back to their original states for attaining stability and emit light in the process.

5 A. Question

The marking on an electrical appliance is 800 W, 200 V.

If it works on 100 V, what is the power consumed?

Answer

Given:

Power = 800W

Voltage = 200V

For the rating given above, we will find resistance of the electric appliance.

Formula used: Power, $P = \frac{V^2}{R}$

$$\Rightarrow \text{Resistance} = \frac{(\text{Voltage rating})^2}{\text{Power Rating}} = \frac{200^2}{800} = 50 \Omega$$

Now, it will offer a resistance of 50 Ω

If it works on 100V, then power consumed, will be given as:

$$\text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{100 \text{ V}^2}{50 \Omega} = 200 \text{ W}$$

$\therefore$ it will consume 200 W of power, if it gets 100V.

5 B. Question

The marking on an electrical appliance is 800 W, 200 V.

What is the power when it works on 50 V?

Answer

$$\text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{50 \text{ V}^2}{50 \Omega} = 50 \text{ W}$$

5 C. Question

The marking on an electrical appliance is 800 W, 200 V.

What happens if 500 V is applied to it?

Answer

Since this is beyond the rating of the device, chances are it will burn out, but first we need to check the power generated as well.

$$\text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{500 \text{ V}^2}{50 \Omega} = 5000 \text{ W}$$

which is beyond the rating. So, the appliance will be destroyed.

6 A. Question

A potential difference of 200 V is applied at a 200 Ω resistor for 5 minutes.

Calculate the amount of heat generated.

Answer

Given:

Voltage = 200V

Resistance = 200 Ω

Heat generated = ?

Now, formula used:

Heat generated = Power × time

$$\text{Power, } P = \frac{V^2}{R}$$

$$\Rightarrow \text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{200V^2}{200\Omega} = 200\text{ W}$$

Heat generated in 5 minutes i.e. 5×60 s i.e. 300 s

$\Rightarrow \text{Heat} = \text{Power} \times \text{time}$

$$= 200 \times 300 = 60000\text{ J}$$

$$= 60\text{ kJ}$$

6 B. Question

A potential difference of 200 V is applied at a 200Ω resistor for 5 minutes.

If 200Ω is replaced by 100Ω , how much heat will be generated in 5 minutes?

Answer

$$\text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{200^2}{100} = 400\text{ W}$$

Heat generated in 5 minutes i.e. 5×60 s i.e. 300 s

= Power × time

$$= 400 \times 300$$

$$= 120000\text{ J}$$

$$= 120\text{ kJ}$$

6 C. Question

A potential difference of 200 V is applied at a 200Ω resistor for 5 minutes.

If 400Ω resistance is used in this place for 5 minutes, how much heat is generated?

Answer

$$\text{Power} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{200^2}{400} = 100\text{ W}$$

Heat generated in 5 minutes i.e. 5×60 s i.e. 300 s

= Power × time

$$= 100 \times 300$$

$$= 30000\text{ J}$$

$$= 30\text{ kJ}$$

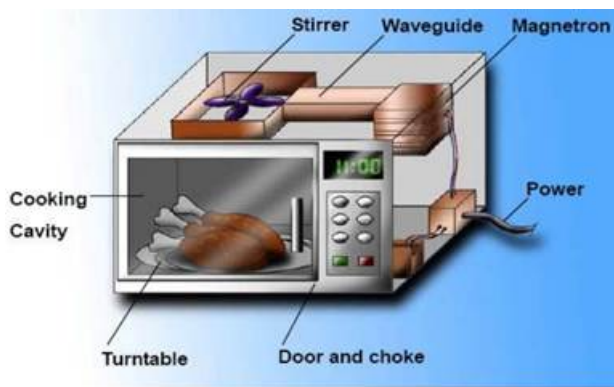
Extended Activities

1. Question

Explain the working of a microwave oven.

Answer

The diagram of microwave is given below:



Working of Microwave oven

- i. Microwave is used to cook the food. In it, microwaves, are passed through the molecules of the food.
- ii. These microwaves are produced by a device called a magnetron within the microwave oven.
- iii. All food items contain water. The frequency of microwaves, causes the water molecules to vibrate, as a result, this movement generates heat.
- iv. When the temperature rises, the molecules of water travel or vibrate or rotate with higher energies. The frequency of rotation of water molecules is about 3 gigahertz (300 crore hertz).
- v. If water receives microwaves of this frequency, its molecules absorb this radiation and water gets heated up. In this way the food gets heated up in a microwave oven.

2. Question

Explain the instances when arc lamps are used in rescue operations.

Answer

- i. Arc lamps are used in rescue operations as searchlights in areas where electrification has been disrupted.
- ii. They are kind of super shot lights which can light a large area. Hence, preferred in rescue operations.
- iii. Also, these are much cheaper as compared to any other light source.