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Q1.

Heat produced is directly proportional to the square of current.

Q2.

Heat produced is directly proportional to the square of current.

If current I is doubled, heat H will be four times.

Q3.

Two effects of produced by electric current are:

(a) Heating effect

(b) Magnetic effect

Q4.

Heating effect

Q5.

Heating effect

Q6.

Electric heater and electric fuse.

Q7.

Argon and nitrogen.

Q8.

Filament type electric bulbs are not power efficient because most of the electric power consumed by the filament of a bulb appears as heat and only a small amount of electric power is converted into light.

Q9.

The connecting cord of the heater made of copper does not glow because negligible heat is produced in it by passing current (because of its extremely low resistance); but the heating element made of nichrome glows because it becomes red-hot due to the large amount of heat produced on passing current (because of its high resistance).

Q10.

(a) Heat produced, $H = I^2 R t$

(b) Given: $R = 20 \Omega$, $I = 5 \text{ amp}$, $t = 30 \text{ s}$

We know that $H = I^2 R t$

$$H = 5^2 \times 20 \times 30$$

$$H = 15000 \text{ J}$$

Q11.

Heat produced by an electric current depends on the following factors:

(i) Heat produced is directly proportional to square of current.

(ii) Heat produced is directly proportional to resistance.

(iii) Heat produced is directly proportional to the time for which current flows.

Q12.

(a) Joule's law of heating states that heat produced in joules when a current of I amperes flows in a wire of resistance R ohms for time t seconds is given by $H = I^2Rt$.

Thus the heat produced in a wire is directly proportional to:

(i) Square of current

(ii) Resistance of wire

(iii) Time for which current is passed

(b) Given: $R_1 = 40\text{ohms}$, $R_2 = 60\text{ohms}$ (in series), $V = 220\text{V}$, $t = 30\text{sec}$
We know that

Total resistance, $R = 40 + 60 = 100\text{ohms}$

By Ohm's law,

$$V = IR$$

$$I = V/R$$

$$I = 220/100 = 2.2\text{amp}$$

Putting the values of I, R and t in eq. $H = I^2RT$

$$H = 2.2^2 \times 100 \times 30$$

$$H = 14520 \text{ J}$$

Q13.

If air is filled in an electric bulb, then the extremely hot tungsten filament would burn up quickly in the oxygen of air. So, the electric bulb is filled with a chemically unreactive gas like argon or nitrogen. These gases do not react with the hot tungsten filament and hence prolong the life of the filament of the bulb.

Q14.

Tungsten is used for making the filaments of electric bulbs because it has a very high melting point. Due to its very high melting point, the tungsten filament can be kept white hot without melting away. Also, tungsten has high flexibility and low rate of evaporation at high temperature.

Q15.

The connecting wires of the heater get only slightly warm because they have extremely low resistance due to which negligible heat is produced in them by passing current.

Q16.

Given: $I = 4\text{amp}$, $t = 10\text{min} = 10 \times 60 = 600\text{sec}$, $H = 2.88 \times 10^4 \text{ J}$

(a) We have

$$H = I^2RT$$

$$28800 = 4^2 \times R \times 600$$

$$R = 3\text{ohms}$$

We know that

$$P = I^2 \times R$$

$$= 4^2 \times 3$$

$$P = 48\text{W}$$

(b) $V = ?$

We know that

$$V = IR$$

$$V = 4 \times 3$$

$$V = 12\text{V}$$

Q17.

Given: $R = 200\text{ohms}$, $I = 2.5\text{amp}$, $t = 1\text{sec}$

We know that

$$H = I^2RT$$

$$H = 2.5^2 \times 200 \times 1$$

$$H = 1250 \text{ J/s}$$

Q18.

Given: $R=8\text{ohms}$, $I=15\text{amp}$, $t=1\text{sec}$

We know that

$$H=I^2RT$$

$$H=15^2 \times 8 \times 1$$

$$H=1800\text{J/s}$$

Q19.

Given: $R=25\text{ohms}$, $V=12\text{V}$, $H=?$, $t=60\text{sec}$

$$V=IR$$

$$12=25I$$

$$I=0.48\text{amp}$$

We have

$$H=I^2RT$$

$$H=0.48^2 \times 25 \times 60$$

$$H=345.6\text{J}$$

Q20.

Given: $H=100\text{J}$, $t=1\text{sec}$, $R=4\text{ohms}$,

We know that

$$H=I^2RT$$

$$100=I^2 \times 4 \times 1$$

$$100/4=I^2$$

$$I=5\text{amp}$$

$$V=IR$$

$$V=5 \times 4$$

$$=20\text{V}$$

Q21.

(a) When an electric charge Q moves against a p.d. V , the amount of work done is given by

$$W=Q \times V \text{ -----(1)}$$

We know, current, $I = \frac{Q}{t}$

$$Q = I \times t \text{ -----(2)}$$

By Ohm's law, $\frac{V}{I} = R$

$$V = I \times R \text{ -----(3)}$$

Putting eqs. (2) and (3) in eq. (1),

$$W = I \times I \times t \times R$$

$$W = I^2 R t$$

Assuming that all the electrical work done is converted into heat energy, we get

Heat produced, $H = I^2 R t$ joules

This relation is known as Joule's law of heating.

(b) Given: $P=12\text{W}$, $V=12\text{V}$, $t=60\text{sec}$

$$P=VI$$

$$I=P/V=12/12=1\text{A}$$

$$V=IR$$

$$R=V/I=12/1=12\text{ohm}$$

$$H=I^2 R t$$

$$H=1^2 \times 12 \times 60$$

$$H=720\text{J}$$

(c) The heat produced by the heater will become one-fourth because heat produced is directly proportional to the square of the current.

(d) When an electric current is passed through a high resistance wire, the wire becomes very hot and produces heat. This effect is known as heating effect of current. This effect is used in room heaters and electric ovens.

(e) Tungsten is used for making the filaments of an electric bulb.

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Q31.

(a) S; because it has high resistivity of $11/100000000$ ohm-m (it is actually nichrome).

(b) Q; because it has very low resistivity of $1.7/1000000000$ ohm-m (it is actually copper).

(c) R; because it has very very high resistivity of $1.0 \times 1000000000000000$ ohm-m (it is actually rubber).

Q32.

(a) The filament wire becomes white hot where as other wires in the circuit do not get heated much.

(b) High resistance of filament wire accounts for this difference.

Q33.

In series, because total resistance in series connection is more than that in parallel connection.

Q34

Given: $V=220V$, $P_{\min}=360W$, $P_{\max}=840W$

For minimum heating case:

We know that

$$P_{\min}=VI$$

$$360=220 \times I$$

$$I=1.63\text{amp}$$

$$R=V/I$$

$$R=220/1.63$$

$$R=134.96\text{ohms}$$

For maximum heating case:

We know that

$$P_{\max}=VI$$

$$840=220 \times I$$

$$I=3.81\text{amp}$$

$$R=V/I$$

$$R=220/3.81$$

$$R=57.74\text{ohms}$$

Q35.

Electric iron , electric oven, water heater, room heater.

***** END *****