EXERCISE- 9 (A)

Question 1:

Write an expression for the electrical energy spent in flow of current through an electrical appliance in terms of current, resistance and time.

Solution 1:

Electrical energy, $W = I^2Rt$ joule

Question 2:

Write an expression for the electrical power spent in flow of current through a conductor in terms of

(a) Resistance and potential difference, (b) current and resistance.

Solution 2:

(a) Electrical power, $P = \frac{v^2}{R}$

(b) Electrical power, $P = I^2R$

Question 3:

Electrical power p is given by the expression $P = (Q \times V) \div \text{time}$

(a) What do the symbols Q and V represent?

(b) Express the power P in terms of current and resistance explaining the meaning of symbols used there in.

Solution 3:

(a) Q represents Charge and V represents Voltage.

(b) Electrical Power, $P = I^2R$

Where I : current

And R : Resistance

Question 4:

Name the S.I. unit of electrical energy. How is it related to Wh?

Solution 4:

The S.I. unit of electrical energy is joule.

1Wh = 3600 J

Question 5:
Name the S.I unit of electrical energy. How is it related to Wh?
Solution 5:
The power of an appliance is 100 W. It means that 100 J of electrical energy is consumed by the appliance in 1 second.

Question 6:
State the S.I. unit of electrical power.
Solution 6:
The S.I. unit of electrical power is Watt.

Question 7:
(i) State and define the household unit of electricity.
(ii) What is the voltage of the electricity that is generally supplied to a house?
Solution 7:
(i) The household unit of electricity is kilowatt-hour (kWh).
One kilowatt-hour (kWh) is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for one hour.
(ii) The voltage of the electricity that is generally supplied to a house is 220 Volt.

Question 8:
Name the physical quality which is measured in
(i) Kw (ii) kWh
Solution 8:
(i) Electrical power is measured in kW and
(ii) Electrical energy is measured in kWh.

Question 9:
Define the term kilowatt-hour and state its value in S.I unit
Solution 9:
One kilowatt-hour (kWh) is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for one hour.
Its value in SI unit is $1\text{kWh} = 3.6 \times 10^6$ J

Question 10:
Distinguish between kilowatt and kilowatt-hour.
Solution 10:
Kilowatt is the unit of electrical power whereas kilowatt-hour is the unit of electrical energy.

Question 11:
Complete the following:

(a) $1\text{Kwh} = \dfrac{1\,\text{volt} \times 1\,\text{ampere} \times \text{.............}}{1000}$

(b) 1kWh = …….. J
Solution 11:
(a) $1\text{Kwh} = \dfrac{1\,\text{volt} \times 1\,\text{ampere} \times 1\,\text{hour}}{1000}$

(b) 3.6×10^6J

Question 12:
What do you mean by power rating of an electrical appliance? How do you use it to calculate (a) the resistance of the appliance, and (b) the safe limit of current in it, while in use?
Solution 12:
An electrical appliance such as electric bulb, geyser etc. is rated with power (P) and voltage (V) which is known as its power rating. For example: If an electric bulb is rated as 50W-220V, it means that when the bulb is lighted on a 220 V supply, it consumes 50 W electrical power.

(a) To calculate the resistance of the appliance, the expression is:

$$\text{Resistance, } R = \frac{v^2}{P}$$

(b) The safe limit of current I is : $I = \dfrac{P}{v}$

Question 13:
An electric bulb is rated '100 W, 250 V'. What information does this convey?
Solution 13:
It means that if the bulb is lighted on a 250 V supply, it consumes 100 W electrical power (which means 100J of electrical energy is converted in the filament of bulb into the light and heat energy in 1 second).

Question 14:

List the names of three electrical gadgets used in your house. Write their power, voltage rating and approximate time for which each one is used in a day. Hence find the electrical energy consumed by each in a day.

Solution 14:

Appliance	Power (in watt)	Voltage (in volts)	Time (hours)	Electrical energy ($E = p \times t$)
Fluorescent tube	40	220	12	0.48 kWh
Television set	120	220	4	0.48 KWh
Refrigerator	150	220	24	3.6 kWh

Question 15:

Two lamps, one rated 220 V, 50 W and the other rated 220 V, 100 W, are connected in series with mains of 220 V. Explain why does the 50 W lamp consume more power.

Solution 15:

Resistance of 220 V, 50 w lamp is

$$R_1 = \frac{v^2}{p_1} = \frac{220^2}{50} = 968\ \Omega$$

Resistance of 220 V, 100 lamp is

$$R_2 = \frac{v^2}{p_2} = \frac{220^2}{100} = 484\ \Omega$$

Since the two lamps are connected in series

So same current I passes through each lamp.

Power consumed in 220 v, 50 w lamp is $p_1 = I^2R_1$

Power consumed in 220 v, 100 w lamp is $p_2 = I^2R_2$

Since $R_1 > R_2$, $P_1 > P_2$

i.e. 50 w lamp consumes more power.

Question 16:

Name the factors on which the heat produced in a wire depends when current is passed in it, and state how does it depend on the factors stated by you.

Solution 16:

When current is passed in a wire, the heat produced in it depends on the three factors: (i) on the amount of current passing through the wire, (ii) on the resistance of wire and (iii) on the time for which current is passed in the wire.

(i) Dependence of heat produced on the current in wire: The amount of heat H produced in the wire is directly proportional to the square of current I passing through the wire, i.e., $H \propto I^2$

(ii) Dependence of heat produced on the resistance of wire: The amount of heat H produced in the wire is directly proportional to the resistance R of the wire, i.e., $H \propto R$

(iii) Dependence of heat produced on the time: The amount of heat H produced in the wire is directly proportional to the time t for which current is passed in the wire, i.e., $H \propto t$

MULTIPLE CHOICE TYPE:

Question 1:

When a current *I* flows through a resistance *R* for time *t*, the electrical energy spent is given by:

(a) IRt (b) I^2Rt (c) IR^2t (d) I^2R/t

Solution 1:

I^2Rt

Note: Electrical energy (W) = $I^2Rt = VIt = \frac{v^2t}{R}$

Question 2:

An electrical appliance has a rating 100 W, 120 V. the resistance of element of appliance when in use is:

(a) 1.2Ω (b) 144 Ω (c) 120 Ω (d) 100 Ω

Solution 2:

144Ω

Solution:

Given, power (p) = 100 w

Potential difference, v = 120 volt

$\therefore$ Resistance, r = $\frac{(v)^2}{P} = \frac{(120)^2}{100} = 144\ \Omega$

NUMERICALS:

Question 1:

A current of 2 A is passed through a coil of resistance 75Ω for 2 minutes. (a) How much heat energy is produced? (b) How much charge is passed through the resistance?

Solution 1:

Given, current (I) = 2 A

Resistance, R = 75 Ω

Time, t = 2 min = 120s

(a) Heat produced, H = I^2Rt

Or, H = $(2)^2(75)(120)$ J = 36000 J

(b) Charge passed, Q = It
Or, Q = (2) (120) C = 240 C

Question 2:

Calculate the current through a 60 W lamp rated for 250 V. If the line voltage falls to 200 V, how is the power consumed by the bulb affected?

Solution 2:

Given,
Power, p = 60 w
Voltage, v = 250 v
As power, P = VI

$$I = \frac{60}{250} = 0.24A$$

Resistance of bulb $R = \frac{V^2}{p} = \frac{250^2}{60} = 1041.6\Omega$

Now if voltage falls to 200 v, power consumes will be

$$p = \frac{v^2}{R} = \frac{200^2}{1041.6} = 38.4W$$

Question 3:

An electric bulb is rated '100 W, 250 V'. How much current will the bulb draw if connected to a 250 V supply?

Solution 3:

Given,
Power, P = 100 W
Voltage, V = 250 V
As power, p = VI

$$I = \frac{100}{250} = 0.4A$$

Question 4:

An electric bulb is rated at 220 V, 100 W. (a) what is its resistance? (b) what safe current can be passed through it?

Solution 4:

(a) Given,

Power, p = 100 w
Voltage, v = 220 v

As power, $P = \frac{V^2}{R}$

$$R = \frac{(220)^2}{100} = 484\,\Omega$$

(b) The safe limit of current that can pass through it

$I = \frac{P}{V}$

$I = \frac{100}{220} = 0.45\ A$

Question 5:

A bulb of 40 W is used for 12.5 h each day for 30 days. Calculate the electrical energy consumed.

Solution 5:

Energy consumed per day, E = p × t
= 40 × 12.5
= 500 wh

Energy consumed for 30 days
E = 500 × 30 = 15000 wh = 15 kwh

Question 6:

An electric iron is rated at 750 W, 230 V. Calculate the electrical energy consumed by the iron in 16 hours.

Solution 6:

Energy, E = power × time
= 750 × 16
= 12000 wh
Or E = 12 k wh

Question 7:

An electrical appliance having a resistance of 200Ω is operated at 200 V. Calculate the energy consumed by the appliance in 5 minutes (i) in joules (ii) in kWh.

Solution 7:

Given,
Resistance, R = 200 Ω

Voltage, v = 200 v
Time, t = 5 min = 5 × 60 sec = 300 sec

As, Energy, $E = \frac{v^2 t}{R}$

(i) in joules

$$E = \frac{(200)^2 \times 300}{200}$$

$$E = 60000J$$

(ii) In kwh

As 1 kwh = 3.6×10^6J

$$1\ J = \frac{1}{3.6 \times 10^6}\ kwh$$

$$60000J = \frac{60000}{3.6 \times 10^6} = 0.0167\ kwh$$

Question 8:

A bulb marked 12 V, 24 W operated on a 12 volt battery for 20 minutes. Calculate:
(i) the current flowing through it, and
(ii) the energy consumed

Solution 8:

(a) Given,
Power, p = 24 w
Voltage, v = 12 v
Current, I = ?
As power, p = VI

(i) $I = \frac{24}{12} = 2\,A$

(ii) Energy, E = P × t
E = 24 × 20 × 60 sec
E = 28, 800 J

Question 9:

A current of 0.2 A flows through a wire whose ends are at a potential difference of 15 V. calculate:
(i) the resistance of the wire and
(ii) the heat energy produced in 1 minute.

Solution 9:

Given,

Current, I = 0.2 A
Potential difference, v = 15 v
Time, t = 60 sec
As v = IR

(a) $R = \frac{15}{0.2} = 75\Omega$

(b) Heat energy, H = I^2Rt

$H = (0.2)^2 \times 75 \times 60$

Or $H = 180 \text{ J}$

Question 10:

What is the resistance, under normal working conditions of a 240 V electric lamp rated at 60 W? If two such lamps are connected in series across a 240 V mains supply, explain why each one appears less bright.

Solution 10:

Given,
Voltage, v = 240 v
Power, p = 60 w

As $p = \frac{v^2}{R}$

$\therefore R = \frac{(240)^2}{60} = 960\,\Omega$

$I = \frac{P}{V} = 0.25 \text{ A}$

When one lamp is connected across the mains, it draws 0.25 A current, while if two lamps are connected in series across the mains, current through each bulb becomes $\frac{240\text{v}}{(960+960)\Omega} = 0.125\text{A}$

(i.e., current is halved), hence heating (= I^2Rt) in each bulb becomes one-fourth, so each bulb appears less bright.

Question 11:

Two bulbs are rated 60 W, 220 V and 60 W, 110 V respectively. Calculate the ratio of their resistances.

Solution 11:

Given,
Voltage, V_1 = 220 v
V_2 = 110 v

Power, $P_1 = P_2 = p = 60$ w

As $R = \frac{V^2}{P}$

$$R_1 = \frac{V_1^2}{P} = \frac{(220 \times 220)}{60}$$

$$R_2 = \frac{V_2^2}{P} = \frac{(110 \times 110)}{60}$$

On dividing R_1 and R_2

$$\frac{R_1}{R_2} = \frac{\frac{(220 \times 220)}{60}}{\frac{(110 \times 110)}{60}} = \frac{4}{1}$$

$\therefore \quad R_1 : R_2 = 4 : 1$

Question 12:

An electric bulb is rated 250 W, 230 V calculate:
(i) the energy consumed in one hour
(ii) the time in which the bulb will consume 1.0 kWh energy when connected to 230 V mains.

Solution 12:

Given,
Power, p = 250 w
Voltage, v = 230 v
(i) Energy, E = p × t
Time, t = 1 × 60 × 66 = 3600 sec
As, energy, E = 250 × 3600 = 9×10^5 J
(ii) 1000 wh = 250 × t

Time, t = $\frac{1000}{250}$ = 4 hours

If it consumes 1kwh of energy then it requires 4 hours.

Question 13:

Three heaters each rated 250 W, 100 V are connected in parallel to a 100 V supply. Calculate:
(i) the total current taken from the supply
(ii) the resistance of each heater and
(iii) the energy supplied in kWh to the three heaters in 5 hours.

Solution 13:

Given,

Power, p = 250 w
Voltage, v = 100 v
(i) current through each heater, I = ?
As p = VI

$\Rightarrow I = \frac{P}{V}$

$= \frac{250}{100} = 2.5A$

∴ Current taken for the three heaters = 3 × 2.5 = 7.5 A

(ii) resistance for each heater, $R = \frac{V}{I}$

$= \frac{100}{2.5} = 40\ \Omega$

(iii) Time for which energy is supplied, t = 5h
As, Energy, E = p × t
E = 250 × 5 = 1250 wh
Or E = 1.25 kwh
Energy for three heaters = 3 × 1.25 = 3. 75 kwh

Question 14:

A bulb is connected to a battery of p.d 4 V and internal resistance 2.5 Ω A steady current of 0.5 A flows through the circuit calculate:
(i) the total energy supplied by the battery in 10 minutes
(ii) the resistance of the bub and
(iii) the energy dissipated in the bulb in 10 minutes.

Solution 14:

Given,
Voltage, v = 4 v
Resistance of the battery, R_B = 2.5 Ω
Current, I = 0.5 A

(i) Energy supplied by the battery, $E = \frac{v^2 t}{R}$

T = 10 × 60 = 600 sec

$R = \frac{V}{I} = \frac{4}{0.5} = 8\Omega$

$E = \frac{(4)^2 \times 600}{8} = 1200J$

(ii) Total resistance, R = 8 Ω
Resistance of the battery, R_B = 2.5 Ω
Resistance of the bulb, R_b = 8 – 2.5 Ω = 5.5 Ω

(iii) Energy dissipated in the bulb in 10 min, $E = I^2Rt$

$$E = (0.5)^2 \times 5.5 \times 600 = 825\ J$$

Question 15:

Two resistors A and B of resistance 4 Ω and 6 Ω respectively are connected in parallel. The combination is connected across a 6 volt battery of negligible resistance. Calculate: (i) the power supplied by the battery, (ii) the power dissipated in each resistor.

Solution 15:

Given,

Resistance, $R_A = 4\Omega$

Resistance, $R_B = 6\Omega$

Voltage, V = 6V

(i) As resistance are connected in parallel

Equivalent Resistance = $\frac{1}{R} = \frac{1}{R_A} + \frac{1}{R_B}$

$$\frac{1}{R} = \frac{1}{4} + \frac{1}{6} = \frac{10}{24}$$

$$R = 2.4\ \Omega$$

As power, $P = \frac{V^2}{R}$

$$= \frac{(6)^2}{2.4} = 15\,\text{w}$$

(ii) Power dissipation across each resistor, p = VI

Current across resistor $R_A, I_A = \frac{V}{R_A}$

$$I_A = \frac{6}{4} = 1.5\text{A}$$

Power dissipation across resistor R_A,

$P = VI_A = 6 \times 1.5 = 9\text{w}$

(ii) Current across resistor $R_B, I_B = \frac{V}{R_B}$

$$I_B = \frac{6}{6} = 1\text{A}$$

Power dissipation across resistor R_B,

$$P = VI_B = 6 \times 1 = 6\text{w}$$

Question 16:

A battery of e.m.f 15 V and internal resistance 2 Ω is connected to two resistors of resistance 4 ohm and 6 ohm joined in series. Find the electrical energy spent per minute in 6 ohm resistor.

Solution 16:

Given,

E.m.f. of battery, v = 15 v

Internal resistance of battery, $R_B = 2\ \Omega$

Resistance given in circuit, $R_1 = 4\Omega$

$R_2 = 6\Omega$

(i) When resistors are connected in series

Equivalent resistance, $R = R_B + R_1 + R_2 = 12\ \Omega$

Current the circuit, $I = \frac{15}{12} = 1.25A$

Now voltage across resistor R_2, $V_2 = IR = 1.25 \times 6$

$V_2 = 7.50$ V

Time, t = 1min = 60 sec

Energy across R_2, $E = \frac{V^2 t}{R} = \frac{(7.5)^2 \times 60}{6}$

E = 562.5 J

Question 17:

Water in an electric kettle connected to a 220 V supply took 5 minutes to reach its boiling point. How long would it have taken if the supply voltage had fallen to 200 V?

Solution 17:

$$P = \frac{V^2}{R}$$

Heated gained $= \left(\frac{V^2}{R}\right) \times t$

$$\left(\frac{V_1^2}{R}\right) \times t_1 = \left(\frac{V_2^2}{R}\right) \times t_2$$

$$t_2 = \left(\frac{V_1}{V_2}\right)^2 \times t_1$$

$$= \left(\frac{220}{200}\right)^2 \times 300 = 363s = 6.05 \text{ min}$$

Question 18:

An electric toaster draws 8 A current in a 220 V circuit. It is used for 2 h. Find the cost of operating the toaster if the cost of electrical energy is Rs. 4.50 per kWh.

Solution 18:

Given,
Voltage, v = 220 v
Current, I = 8 A
Time, t = 2 h
Energy, E = VIt
$E = 220 \times 8 \times 2 = 3520$ Wh
$\Rightarrow$ E = 3.52 kwh
Cost of energy = Rs. 4.50 / kwh
$\therefore$ Cost of 3.52 kwh of energy = Rs. 4.50 × 3.52 kwh
= 15.84

Question 19:

An electric kettle is rated 2.5 kW, 250 V. Find the cost of running the kettle for two hours at Rs. 5.40 per unit.

Solution 19:

Given,
Power of kettle, p = 2.5 kw
Voltage, V = 250 v
Time, t = 2 h
As, Energy, $E = P \times t$
$= 2.5 \times 2 = 5$ kwh
Cost per unit of energy = Rs. 5.40
Cost for 5 kwh of energy = 5.40 × 5 = Rs. 27

Question 20:

A geyser is rated 1500 W, 250 V. This geyer is connected to 250 V mains. Calculate:
(i) the current drawn
(ii) the energy consumed in 50 hours, and
(iii) the cost of energy consumed at Rs. 4.20 per kWh

Solution 20:

Given,
Power of geyser, p = 1500 w
Voltage, v = 250 v

(i) Current, $I = \frac{P}{V}$

$$I = \frac{1500}{250} = 6A$$

(ii) Time, t = 50 h

Energy, E = p × t

= 1500 × 50 = 75000wh = 75kwh

(iii) Cost per unit of energy = Rs. 4.20

Cost for 75 kwh of energy = 4.20 × 75 = Rs. 315

EXERCISE. 9 B

Question 1:

At what voltage and frequency is the electric power generated at the power generating station?

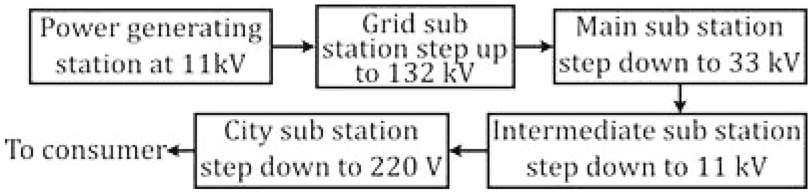
Solution 1:

The electric power is generated at 11 KV, 50Hz at the power generating station.

Question 2:

Explain with the aid of a simple diagram, the transmission of electric power from the generating station to your house.

Solution 2:



At a power generating station, the electric power is generated at 11 kV. From here, the alternating voltage is transmitted to the grid sub-station and stepped up to 132 kV using a step-up transformer. It is then transmitted to the main sub-station where the voltage is stepped down to 33 kV using a step-down transformer and is then transmitted to the intermediate sub-station. At the intermediate sub-station, the voltage is stepped down to 11 kV using a step-down transformer and is transmitted to the city sub-station, where the voltage is further stepped down to 220 V and is supplied to our houses.

Question 3:

At what voltage is the electric power from the generating station transmitted? Give reason to your answer.

Solution 3:

Electric power from the generating station is transmitted at 11 kV because voltage higher than this causes insulation difficulties, while the voltage lower than this involves high current and loss of energy in form of heat (I^2Rt).

Question 4:
At what voltage and frequency is the a.c. supplied to our houses?

Solution 4:
At 220 V of voltage and 50 Hz of frequency, the a.c. is supplied to our houses.

Question 5:
Name the device used to (a) increase the voltage at the generating station (b) decrease the voltage at the substation for its supply.

Solution 5:
(a) Step-up transformer
(b) Step-down transformer

Question 6:
(a) Name the three connecting wires used in a household circuit
(b) Which of the two wires mentioned in part (a) are at the same potential?
(c) In which of the wire stated in part (a) the switch is connected?

Solution 6:
(a) The three connecting wires used in a household circuit are:
  (i) Live (or phase) wire (L),
  (ii) Neutral wire (N), and
  (iii) Earth wire (E).
(b) Among them neutral and earth wires are at the same potential.
(c) The switch is connected in the live wire.

Question 7:
What is the pole fuse? Write down its current rating.

Solution 7:
Before the electric line is connected to the meter in a house, a fuse of rating ($\approx$ 50 A) is connected in the live wire at the pole or just before the meter. This fuse is called the pole fuse. Its current rating is $\approx$ 50 A

Question 8:

State the function of each of the following in a house circuiting?
(a) kWh meter (b) main fuse, and (c) main switch

Solution 8:

(a) After the company fuse, the cable is connected to a kWh meter and from this meter; connections are made to the distribution board through a main fuse and a main switch.
(b) Main fuse is connected in the live wire and in case of high current it gets burnt and cut the connections to save appliances.
(c) Main switch is connected in the live and neutral wires. It is used to cut the connections of the live as well as the neutral wires simultaneously from the main supply.

Question 9:

In what unit does the electric meter in a house measure the electrical energy consumed? What is its value in S.I unit?

Solution 9:

The electric meter in a house measures the electrical energy consumed in kWh.
Its value in S.I. unit is 1kwh = 3.6×10^6J

Question 10:

Where is the main fuse in a house circuit connected?

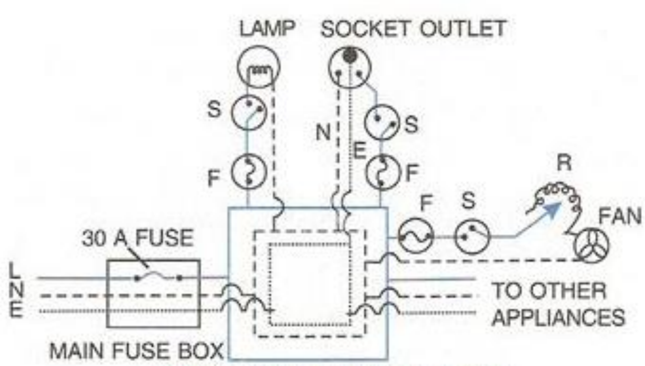
Solution 10:

The main fuse in a house circuit is connected on the distribution board, in live wire before the main switch.

Question 11:

Draw a circuit diagram to expain the ring system of house wiring. State two advantage of it.

Solution 11:



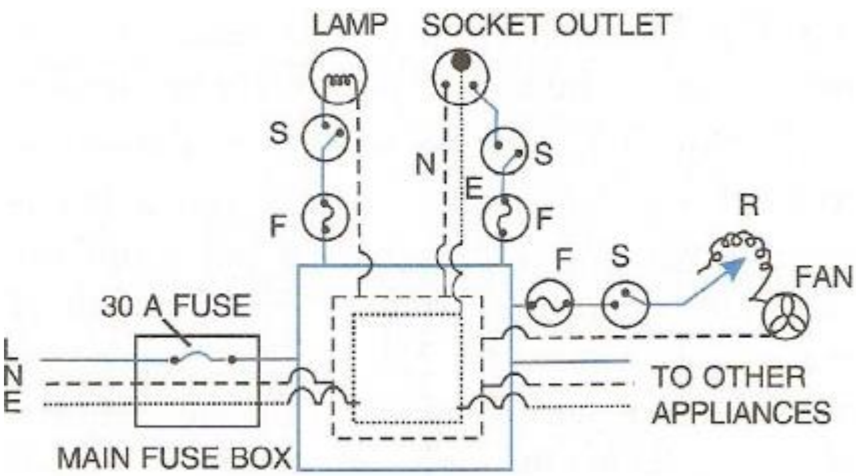
Ring system of house wiring

Advantages of ring system over tree system
(i) In a ring system the wiring is cheaper than tree system.
(ii) In ring system the sockets and plugs of same size can be used while in a tree system sockets and plugs are of different size.
(iii) In ring system, each appliance has a separate fuse due to which if there is a fault and the fuse of one appliance burns it does not affect other appliances; while in a tree system when fuse in one distribution line blows, it disconnects all the appliances connected to that distribution circuit.

Question 12:

Draw a labelled diagram with necessary switch, regulator, etc. to connect a bulb and a fan with the mains. In what arrangement are they connected to the mains : series or parallel?

Solution 12:



These appliances are connected to the mains in a parallel arrangement.

Question 13:

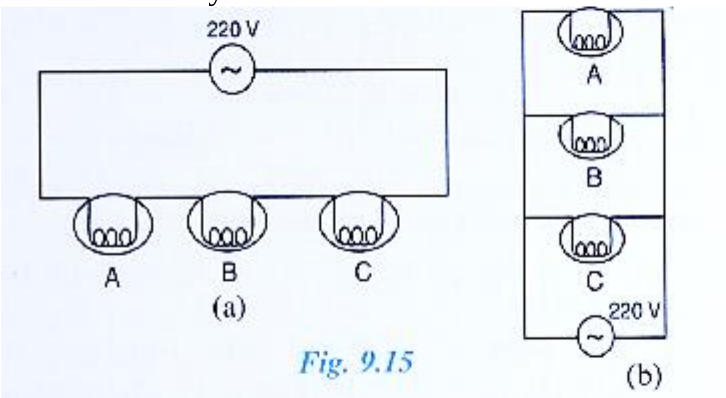
How should the electric lamps be connected with the mains so that the switching on or off a lamp has no effect on other lamps?

Solution 13:

All the electrical appliances in a building should be connected in parallel at the mains, each with a separate switch and a separate fuse connected in the live wire so that the switching on or off in a room has no effect on other lamps in the same building.

Question 14:

Fig 9.15 shows two ways (a) and (b) of connecting the three lamps A, B and C to a.c. supply of 220 V. Name the two arrangements. Which of them would you prefer in a household circuit? Give reason for your answer.



Solution 14:

The two arrangements are (a) series arrangement, and (b) parallel arrangement.
In a household circuit we will prefer the second circuit i.e., (b).
In circuit (b) each appliance has same voltage of 220 V. Since all the appliances that we use have voltage rating of 220 V in our country, so each bulb works normally.

Question 15:

Two sets A and B of four bulbs each are glowing in two separate rooms. When one of the bulbs in set A is fused, the other three bulbs also cease to glow. But in set B, when one bulb fuses the other bulbs continue to glow. Explain the difference.

Solution 15:

In set A, the bulbs are connected in series. Thus, when the fuse of one bulb blows off, the circuit gets broken and current does not flow through the other bulbs also.
In set B, the bulbs are connected in parallel. Thus, each bulb gets connected to its voltage rating (= 220 V) and even when the fuse of one bulb blows off, others remain unaffected and continue to glow.

MULTIPLE CHOICE TYPE:

Question 1:

The main fuse is connected in:
(a) live wire
(b) neutral wire
(c) both the live and earth wires
(d) both earth and the neutral wire

Solution 1:

The main fuse is connected in live wire.
Hint: The main fuse is connected in live wire so that if the current exceeds its rating, the fuse melts and breaks the circuit; thus, preventing the excessive current from flowing into the circuit.

Question 2:

The electrical appliances in a house are connected in:
(a) series
(b) parallel
(c) either in series or parallel
(d) both in series and parallel

Solution 2:

Electrical appliances in a house are connected in parallel.
Hint: On connecting the electrical appliances in parallel, each appliance works independently without being affected whether the other appliance is switched on or off.

Question 3:

The electric meter in a house records:
(a) charge (b) current
(c) energy (d) power

Solution 3:

Energy
Hint: The electric meter in a house records the amount of electrical energy consumed in a house.

EXERCISE. 9 (C)

Question 1:

What is a fuse? Name the material of fuse. State on characteristic of material used for fuse.

Solution 1:

An electric fuse is a safety device, which is used to limit the current in an electric circuit. The use of fuse safeguards the circuit and appliances connected in that circuit from being damaged. An alloy of lead and tin is used as a material of fuse because it has low melting point and high resistivity.

Question 2:
Name the device used to protect the electric circuits from over loading and short circuit. On what effect of current does it work?

Solution 2:
An electric fuse is a safety device, which is used to limit the current in an electric circuit. The use of fuse safeguards the circuit and appliances connected in that circuit from being damaged. An alloy of lead and tin is used as a material of fuse because it has low melting point and high resistivity.

Question 3:
Complete the following sentences:
(a) A fuse is a short piece of wire of material of high …………and low ………..
(b) A fuse wire is made of an alloy of ………. and …..If the current in a circuit rises too high, the fuse wire ……….
(c) A fuse is connected in …… with the ………..wire.

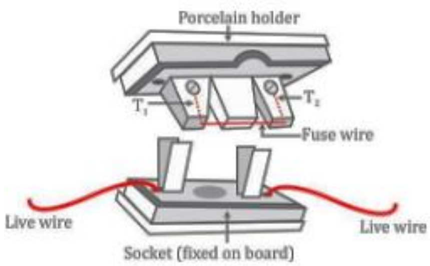
Solution 3:
(a) A fuse is a short piece of wire of material of high **resistivity** and low **melting point.**
(b) A fuse wire is made of an alloy of **lead** and **tin.** If the current in a circuit rises too high, the fuse wire **melts**
(c) A fuse is connected in **series** with the **live** wire.

Question 4:
Why is the fuse wire fitted in a porcelain casing?

Solution 4:
The fuse wire is fitted in a porcelain casing because porcelain is an insulator of electricity.

Question 5:
How is a fuse put in an electric circuit? State the purpose of using a fuse in a circuit.

Solution 5:
The fuse wire is stretched between the two metallic terminals T_1 and T_2 in a porcelain holder (since porcelain is an insulator of electricity). This holder fits into a porcelain socket having two metallic terminals to which the live wires of the circuit are connected. The figure below is showing the fuse arrangement.

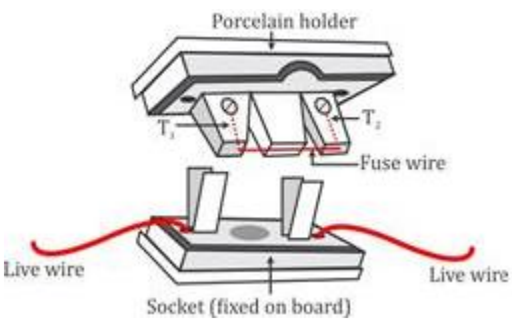


A fuse is connected with each electrical appliance to safeguard it from the flow of excessive current through it.

Question 6:

Describe with the aid of a diagram some form of a fuse which is used in the electric lighting circuit of a house. Give two reasons why a fuse must not be replaced by an ordinary copper wire.

Solution 6:



The figure above shows the most common fuse arrangement in which the fuse wire is stretched between the two metallic terminals T_1 and T_2 in a porcelain holder. This holder fits into a porcelain socket having two metallic terminals to each of which the live wire of the circuit is connected.

A fuse must not be replaced with a copper wire because copper has very low resistivity and high melting point.

Question 7:

A fuse is always connected to the live wire of the circuit. Explain the reason.

Solution 7:

The fuse wire is always connected in the live wire of the circuit because if the fuse is put in the neutral wire, then due to excessive flow of current when the fuse burns, current stops flowing in the circuit, but the appliance remains connected to the high potential point of the supply through the live wire. Now if a person touches the appliance, he may get a shock as the person will come in contact with the live wire through the appliance.

Question 8:

Two fuse wire of same length are rated 5 A and 20 A. Which of the two is thicker and why?

Solution 8:

The 20 A fuse wire will be thicker so that its resistance be low.

Question 9:

Explain the meaning of the statement 'the current rating of a fuse is 5 A'.

Solution 9:

It means that the line to which this fuse is connected has a current carrying capacity of 5 A.

Question 10:

'A fuse is rated 8 A'. can it be used with an electrical appliance of rating 5kW, 200V?

Solution 10:

The safe limit of current which can flow through the electrical appliance is I = P/V = 5000/200 = 25 A; which is greater than 8 A. So, such fuse cannot be used.

Question 11:

An electric kettle is rated 3 kW, 250 V. give reason whether this kettle can be used in a circuit which contains a 13 A fuse.

Solution 11:

Yes, this kettle can be used in a circuit which contains a 13 A fuse because safe limit of current for kettle is,

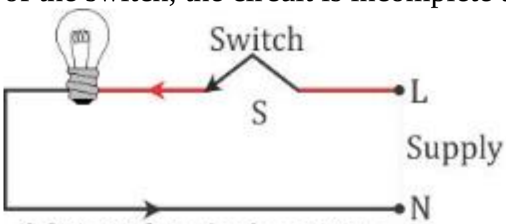
$$I = \frac{3000\text{W}}{250\text{V}} = 12\,\text{A}$$

Question 12:

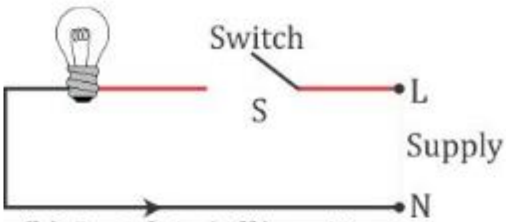
What is the purpose of a switch in a circuit? Why is the switch put in the live wire? What precaution do you take while handling a switch?

Solution 12:

A switch is an on-off device for current in a circuit (or in an appliance). The switch should always be connected in the live wire so that the appliance could be connected to the high potential point through the live wire. In this position the circuit is complete as the neutral wire provides the return path for the current. When the appliance does not work i.e., in off position of the switch, the circuit is incomplete and no current reaches the appliance.

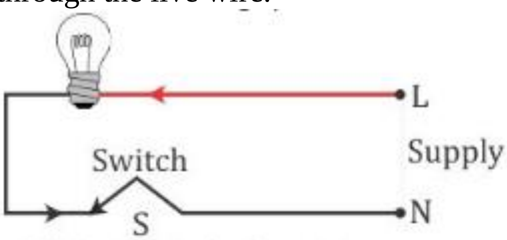


(a) Switch in 'on' position.

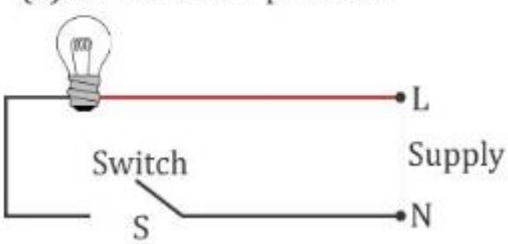


(b) Switch in 'off' position.

On the other hand, if switch is connected in the neutral wire, then in 'off' position, no current passes through the bulb. But the appliance remains connected to the high potential terminal through the live wire.



(a) Switch in 'on' position.



(b) Switch in 'off' position.

Thus, if the switch is connected in the neutral wire, it can be quite deceptive and even dangerous for the user.
Precaution while handling a switch: A switch should not be touched with wet hands.

Question 13:

A switch is not touched with wet hands while putting it on or off. Give a reason for your answer.

Solution 13:

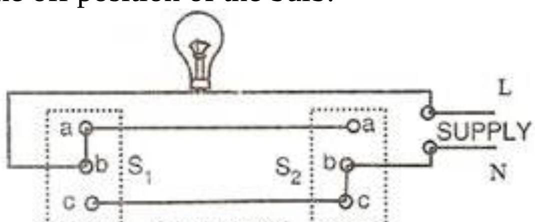
A switch should not be touched with wet hands. If water reaches the live wire, it forms a conducting layer between the hand and the live wire of the switch through which the current passes to the hand and the person may get a fatal shock.

Question 14:

Draw a circuit diagram using the dual control switches to light a staircase electric light and explain its working.

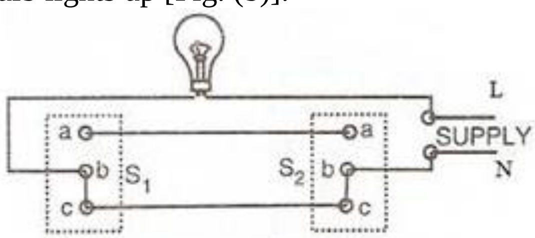
Solution 14:

Let a switch S_1 be fitted at the bottom and a switch S_2 at the top of the staircase. Fig. (a) shows the off position of the bulb.



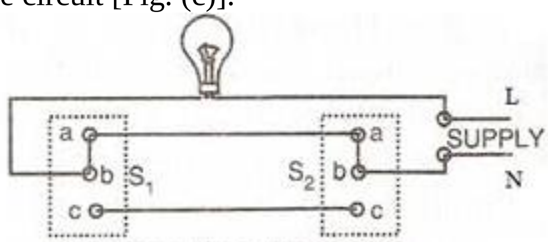
(a) Bulb off

The bulb can now be switched on independently by either the switch S_1 or the switch S_2. If the switch S_1 is operated, the connection 'ab' is changed to 'bc', which completes the circuit and the bulb lights up [Fig. (b)].



(b) Bulb on through switch S_1

Similarly, on operating the switch S_2, the connection 'bc' changes to 'ba', which again completes the circuit [Fig. (c)].



(c) Bulb on through switch S_2

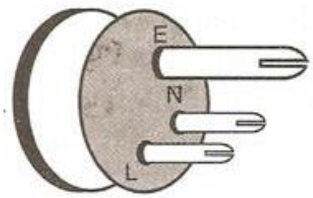
Similarly if the bulb is in on position as shown in Fig. (b) or (c), one can switch off the bulb either from the switch S_1 or the switch S_2.

Question 15:

The diagram in Fig. 9.27 shows a three pin plug. Label the three pins.
(a) why if the top pin thicker and longer than the other two?
(b) why are the pins splitted at the ends?

Solution 15:

The three pins in the plug are labelled as



Here E signifies the earth pin,
L is for live wire, and
N is for neutral wire.

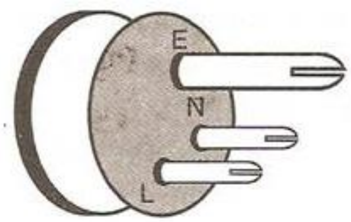
(a) The earth pin is made long so that the earth connection is made first. This ensures the safety of the user because if the appliance is defective, the fuse will blow off. The earth pin is thicker so that even by mistake it cannot be inserted into the hole for the live or neutral connection of the socket.
(b) The pins are splitted at the end to provide spring action so that they fit in the socket holes tightly.

Question 16:

What purpose is served by the terminals of a three way pin plug? Draw a diagram and name the pins.

Solution 16:

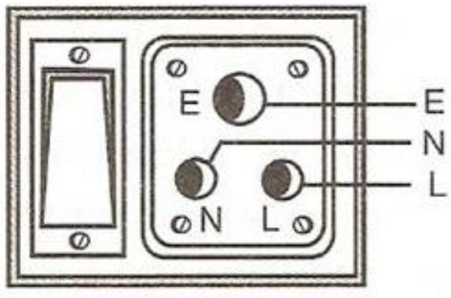
All electrical appliances are provided with a cable having a plug at one end to connect the appliance to the electric supply.
In this three way pin plug, the top pin is for earthing (E), the live pin (L) in on the left and the neutral pin (N) is on the right.



Question 17:

Draw a labelled diagram of a three pin socket.

Solution 17:



E: for earth pin
N: for neutral wire pin
L: for live wire pin.

Question 18:

The diagram in Fig. 9.28 shows a three pin socket marked as 1, 2 and 3.
(a) Identify and write live (L) neutral (N) and earth (E) against the correct number
(b) To which part of the appliance is the terminal 1 connected?
(c) To which wire joined to 2 or 3, is the fuse connected and why?

Solution 18:

(a) 1 – Earth, 2 – Neutral, 3 – Live
(b) Terminal 1 is connected to the outer metallic case of the appliance.
(c) The fuse is connected to live wire joined to 3 so that in case of excessive flow of current fuse melts first and breaks down the circuit to protect appliances.

Question 19:

What do you mean by the term local earthing? Explain how it is done.

Solution 19:

Local earthing is made near kWh meter. In this process a 2 - 3 metre deep hole is dug in the ground. A copper rod placed inside a hollow insulating pipe, is put in the hole. A thick copper plate of dimensions 50 cm × 50 cm is welded to the lower end of the copper rod and it is buried in the ground. The plate is surrounded by a mixture of charcoal and salt to make a good earth connection.
To keep the ground damp, water is poured through the pipe from time to time. This forms a conducting layer between the plate and the ground. The upper end of the copper rod is joined to the earth connection at the kWh meter.

Question 20:

The metal case of an electric appliance is earthed explain the reason.

Solution 20:

If the live wire of a faulty appliance comes in to direct contact with the metallic case due to some reason then the appliance acquires the high potential of live wire. This may results in shock if any person touches the body of appliance. But if the appliance is earthed then as soon as the live wire comes in to contact with the metallic case, high current flows through the case to the earth. The fuse connected to the appliance will also blows off, so the appliance get disconnected.

Question 21:

(a) the earthing of an electric appliance is useful only if the fuse is in the love wire. Explain the reason.
(b) Name the part of the appliance which is earthed.

Solution 21:

(a) The fuse must be connected in the live wire only. If the fuse is in the neutral wire, then although the fuse burns due to the flow of heavy current, but the appliance remains at the supply voltage so that on touching the appliance current flows through the appliance to the person touching it.
(b) Metallic case of the appliance should be earthed.

Question 22:

For earthing an electrical appliance, one has to remove the paint from the metal body of the appliance where the electrical contact is made. Explain the reason.

Solution 22:

The paint provides an insulating layer on the metal body of the appliance. To make earth connection therefore, the paint must be removed from the body part where connection is to be made.

Question 23:

What is the colour code for the insulation on the (a) live (b) neutral and (c) earth wire?

Solution 23:

According to new international convention
(a) Live wire is brown in colour.
(b) Neutral is light blue and
(c) Earth wire is yellow or green in colour.

Question 24:

A power circuit uses a cable having three different wires.
(a) Name the three wires of the cable.
(b) to which of the two wires should the heating element of an electric geyser be connected?
(c) To which wire should the metal case of the geyser be connected?
(d) to which wire should the switch and fuse be connected?

Solution 24:

(a) The three wires are: Live wire, Earth wire and Neutral wire.
(b) The heating element of geyser should be connected to live wire and neutral wire.
(c) The metal case should be connected to earth wire.
(d) The switch and fuse should be connected to live wire.

Question 25:

State two circumstances when one may get an electric shock from an electrical gadget. What preventive measure must be provided with the gadget to avoid it?

Solution 25:

One may get an electric shock from an electrical gadget in the following two cases:

(i) If the fuse is put in the neutral wire instead of live wire and due to fault, if an excessive current flows in the circuit, the fuse burns, current stops flowing in the circuit but the appliance remains connected to the high potential point of the supply through the live wire. In this situation, if a person touches the faulty appliance, he may get an electric shock as the person will come in contact with the live wire through the appliance.

Preventive measure: The fuse must always be connected in the live wire.

(ii) When the live wire of a faulty appliance comes in direct contact with its metallic case due to break of insulation after constant use (or otherwise), the appliance acquires the high potential of the live wire. A person touching it will get a shock because current flows through his body to earth.

Preventive measure: Proper *'earthing'* of the electric appliance should be done.

Question 26:

Why is it necessary to have an earth wire installed in a power circuit, but not in a lighting circuit?

Solution 26:

Power circuit carries high power and costly devices. If there is some unwanted power signal (noise) in the wire it can damage the device. To reduce this effect earth is necessary.
Lighting circuit carries low power (current). So, we ignore the earth terminal.

Question 27:
Give two characteristic of a high tension wire.

Solution 27:
A high tension wire has a low resistance and large surface area.

Question 28:
Which of the cables, one rated 5 A and the other 15 A will be of thicker wire? Give a reason for your answer.

Solution 28:
To carry larger current, the resistance of the wire should be low, so its area of cross section should be large. Therefore 15 A current rated wire will be thicker.

Question 29:
The diagram in Fig. 9.29 shows three lamps and three switches 1, 2 and 3
(a) Name the switch / switches to be closed so as to light all the three lamps.
(b) How are the lamps connected: in series or in parallel?

Solution 29:
(a) Switches 2 and 3.
(b) The lamps are connected in series.

Question 30:
Fig 9.30 below shows two bulbs with switches and fuse connected to mains through a socket.
(a) label each component
(b) Name and state the colour of insulation of each wire 1, 2 and 3
(c) How are the two bulbs joined : in series or in parallel?

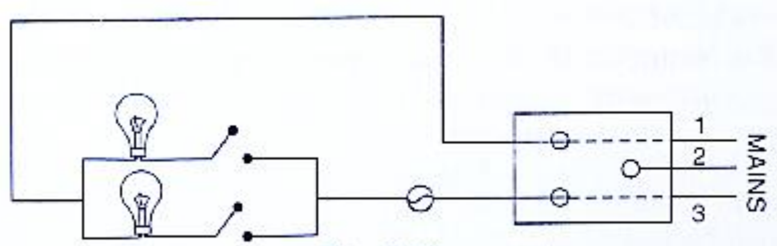
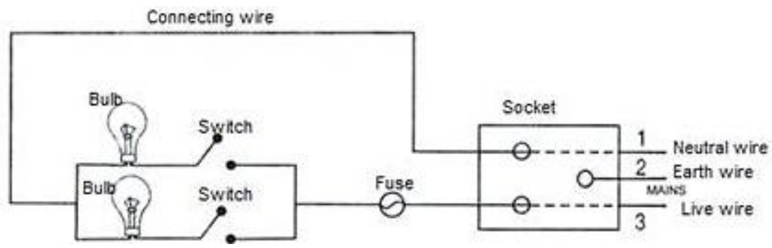


Fig. 9.30

Solution 30:
(a)



(b)

Wire no.	Wire name	Colour (Old convention)	Colour (New convention)
1	Neutral wire	Black	Light blue
2	Earth wire	Green	Green or yellow
3	Live wire	Red	Brown

(c) The bulbs are joined in parallel.

MULTIPLE CHOICE TYPE:

Question 1:

The rating of a fuse connected in the lighting circuit is:

(a) 15 A (b) 5 A (c) 10 A (d) Zero

Solution 1:

5 A

Hint: The electric wiring for light and fan circuit uses a thin fuse of low current rating (= 5 A) because the line wire has a current carrying capacity of 5 A.

Question 2:

A switch must be connected in:

(a) Live wire (b) neutral wire

(c) earth wire (d) either earth or neutral wire

Solution 2:

A switch must be connected in live wire.

Explanation: A switch must be connected in live wire, so that when it is in 'off' position, the circuit is incomplete and no current reaches the appliance through the live wire.