Chapter 9

Current Electricity

Class 9 - Concise Physics Selina Solutions

Exercise 9(A) — Multiple Choice Type

Question 1

A cell is used to :

1. measure current in a circuit
2. provide current in a circuit
3. limit current in a circuit
4. prevent current in a circuit

Answer

provide current in a circuit

Reason — The **cell or a battery** is a source of direct current (d.c.). It provides current as a result of irreversible reaction.

Question 2

During charging of a secondary cell, the ..... energy changes into ..... energy and gets stored in the cell.

1. mechanical, chemical
2. chemical, electrical

3. mechanical, electrical
4. electrical, chemical

Answer

electrical, chemical

Reason — During charging of a secondary cell, the ***electrical*** energy changes into ***chemical*** energy and gets stored in the cell.

Question 3

Primary cells provide current as a result of ..... chemical reaction and secondary cells provide current as a result of ..... reaction.

1. reversible, reversible
2. reversible, irreversible
3. irreversible, reversible
4. irreversible, irreversible

Answer

irreversible, reversible

Reason — Primary cells provide current as a result of ***irreversible*** chemical reaction and secondary cells provide current as a result of ***reversible*** reaction.

Question 4

Identify the correct statement (s)

(i) Primary cell is capable of giving low as well as high current whereas secondary cells provide a weak current only.

(ii) The internal resistance of primary cells is low and that of secondary cells is high.

1. (i)
2. (ii)
3. both (i) and (ii)
4. none of the above

Answer

none of the above

Reason — Primary cell is capable of giving a weak current only and secondary cells provides a low as well as high current.

The internal resistance of primary cells is high and that of secondary cells is low.

Question 5

Current is the rate of flow of charge across a cross-section ..... the flow of current.

1. in any direction of
2. in a parallel direction to
3. in the same direction as
4. normal to the direction of

Answer

normal to the direction of

Reason — Current is the rate of flow of charge across a cross-section normal to the direction of the flow of current.

Question 6

In metals, current flows due to the movement of :

1. protons
2. neutrons
3. electrons
4. electrons and protons

Answer

electrons

Reason — In metals, current flows due to the movement of ***electrons***.

Question 7

The conventional current is in a direction ..... to the direction of motion of electrons.

1. parallel
2. normal
3. opposite
4. none of the above

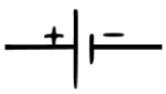
Answer

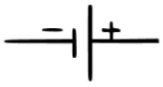
opposite

Reason — Conventionally, the direction of current is taken positive in the direction of flow of positive charge. Therefore, conventionally, the current will be negative in the direction of flow of electrons. Hence, current is in a direction opposite to the direction of motion of electrons.

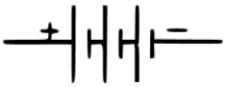
Question 8

A battery is correctly represented by :

(1) 

(2) 

(3) 

(4) 

Answer

Reason — A battery is formed by joining a number of cells together in series (i.e., cathode of one cell connected to the anode of another cell).

Question 9

A ..... is a device by which resistance in a circuit can be varied continuously.

1. key
2. switch
3. rheostat
4. voltmeter

Answer

rheostat

Reason — A rheostat is a device by which resistance in a circuit can be varied continuously. It is used to adjust the magnitude of current in a circuit by changing the length of the resistance wire included in the circuit.

Question 10

Rheostat is used in a circuit to provide :

1. fixed current
2. fixed voltage
3. fixed resistance
4. variable resistance

Answer

variable resistance

Reason — A rheostat is a device by which resistance in a circuit can be varied continuously. It is used to adjust the magnitude of current in a circuit by changing

a

the length of the resistance wire included in the circuit.

Question 11

An instrument used to measure the magnitude of current flowing in a circuit is :

1. voltmeter
2. galvanometer
3. ammeter
4. rheostat

Answer

ammeter

Reason — An ***ammeter*** is an instrument used to measure the magnitude of current flowing in a circuit.

Question 12

A ..... is either used to detect the presence of a weak current or to only know the direction of flow of current in a circuit.

1. ammeter
2. galvanometer
3. voltmeter
4. rheostat

Answer

Reason — A ***galvanometer*** is used to either detect the presence of a weak current or to only know the direction of flow of current in a circuit. It does not measure the magnitude of current in a circuit.

Question 13

Insulators have ..... electrons and conductors have ..... electrons.

1. no free, large number of free
2. large number of free, no free
3. no free, small number of free
4. small number of free, no free

Answer

no free, large number of free

Reason — Insulators have no free electrons and offer very high resistance and conductors have large number of free electrons and they offer very small resistance to the flow of electrons.

Question 14

An insulator of electricity is:

1. copper
2. acidulated water
3. human body
4. silk

Answer

silk

Reason — Silk does not conduct electricity, hence is an insulator.

Question 15

The presence of ..... in the path makes a circuit incomplete and current does not flow.

1. conductor
2. ammeter
3. voltmeter
4. insulator

Answer

insulator

Reason — The presence of insulator in the path makes a circuit incomplete and current does not flow.

Question 16

Select the insulator among the following

1. Pure water
2. Human body
3. Aluminium
4. Mercury

Answer

Pure water

Reason — Pure water is a good insulator as it has a low concentration of ions so it does not conduct electricity very well. On the other hand, the human body, aluminum, and mercury are not good insulators. The human body contains electrolytes and can conduct electricity. Aluminum is a metal and is highly conductive. Mercury is a liquid metal and also conducts electricity well.

Question 17

Connecting wires are made of substances that have :

1. highly conducting material
2. negligible resistance
3. free electrons in a large number
4. all of these

Answer

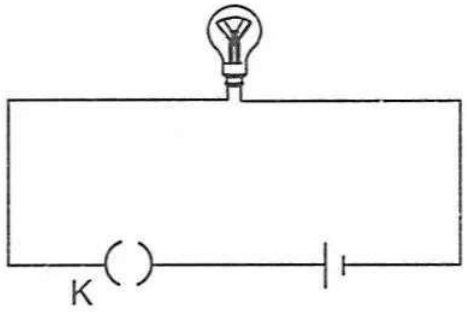
all of these

Reason — Connecting wires are typically made of substances, such as copper or aluminum, that possess highly conducting materials, negligible resistance, and a large number of free electrons. These characteristics allow for efficient flow of electric current through the wires.

Question 18

Out of the following circuits shown, the bulb glows in which one?

1.



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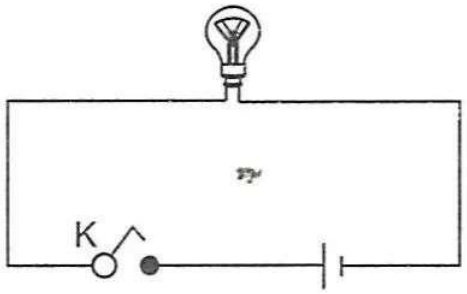
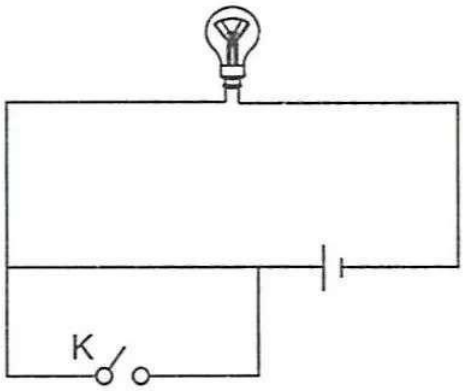
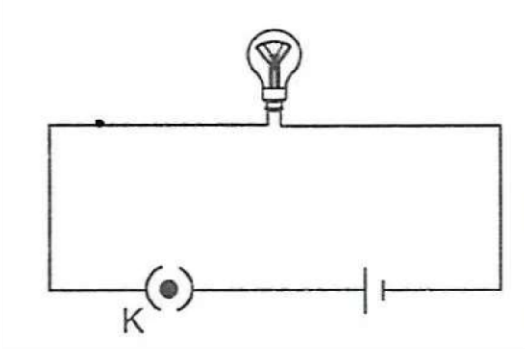


3.

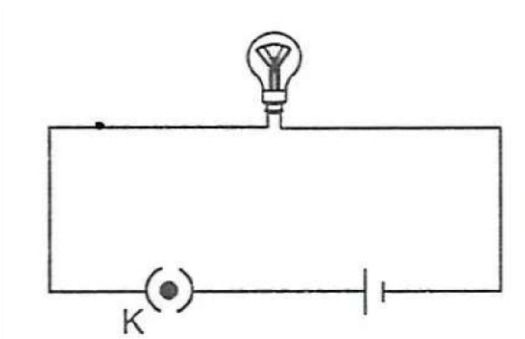


4.

a



Answer



option 4

Reason — In circuit 4, the key is closed, completing the circuit. In the other circuits the key (K) is left open, so the circuits are incomplete. For an electric circuit to function, every component must conduct current. If the circuit is broken at any point, the circuit remains open and no current flows.

Exercise 9(A) — Very Short Answer Type

Question 1

Name one d.c. source and one a.c. source.

Answer

The **cell or a battery** is a source of direct current (d.c.).

The **mains in our house or an a.c. generator** are the source of alternating current (a.c.).

Question 2

What is an electric cell?

Answer

An electric cell is a device that converts chemical energy into electrical energy when it sends current in a circuit. It consists of a vessel containing two conducting rods, called the electrodes, at some separation, placed or immersed in a solution (or jelly), called the electrolyte.

Question 3

What transformation of energy takes place when current is drawn from a cell?

Answer

When current is drawn from a cell, **chemical energy changes to electrical energy**.

Question 4

Name the constituents of a cell.

Answer

A cell consists of two electrodes and an electrolyte placed in a vessel.

Question 5

State the two kinds of cell. Give one example of each.

Answer

The two kinds of cells with examples are —

1. Primary cell
   Example — Daniel cell
2. Secondary cells or accumulators
   Example — Ni-Fe (or alkali) accumulator

Question 6

How much is the charge on an electron?

Answer

Current in conductor $I = \frac{Q}{t} = \frac{ne}{t}$

The charge on an electron is -1.6×10^{-19} coulomb.

Question 7

n electrons flow through a cross section of a conductor in time t. If charge on an electron is e, write an expression for the current in the conductor.

Answer

Question 8

Name the instrument used to control current in an electric circuit.

Answer

Rheostat.

Question 9

What is the function of a key (or switch) in an electric circuit?

Answer

A key is used to put the current on or off in a circuit.

Question 10

Select conductors of electricity from the following — Copper wire, silk thread, pure water, acidulated water, human body, glass, mercury.

Answer

The conductors of electricity are — copper wire, acidulated water, human body and mercury.

Exercise 9(A) — Short Answer Type

Question 1

What is a primary cell? Name two such cells.

Answer

Primary cell — These cells **provide current as a result of irreversible chemical reaction**. The cells are discarded after use when the entire chemical energy in them has been converted into electrical energy. Thus, these are **'use and throw'** types of cells and cannot be recharged.

Depending upon the material of electrodes and electrolyte, we have different types of primary cells e.g., **simple voltaic cell, dry cell, etc.**

Question 2

What is a secondary cell? Name one such cell.

Answer

Secondary cells or accumulators also provide current as a result of a chemical reaction. In these cells, the **chemical reaction is reversible and so they can be recharged after use.** e.g., Lead accumulator.

Question 3

What do you understand by the term current? State and define it's S.I. unit.

Answer

Current is the **rate of flow of charge across a cross-section normal to the direction of flow of current**.

The S.I. unit of current is **coulomb per second** which is called ampere. It is denoted by the symbol **A**.

Question 4

What are conductors and insulators of electricity? Give two examples of each.

Answer

Conductors — The substances which **allow the current to flow through them easily** are called conductors. They have large number of free electrons and they offer a very small resistance to the flow of current.

Examples — impure water (or acidulated water) and mercury are conductors of electricity.

Insulators — The substances which **do not allow current to flow through them** are called insulators. They have almost no electrons and offer a very high resistance to the flow of current.

Example — cotton, rubber.

Question 5

State two differences between a conductor and an insulator of electricity.

Answer

The differences between a conductor and an insulator of electricity are as follows —

Conductor	Insulator
Allow the current to flow through them easily	Do not allow current to flow through them.
They have large number of free electrons and they offer a very small resistance to the flow of current.	They have almost no electrons and offer a very high resistance to the flow of current.

Question 6

Write the condition required for a circuit to be a closed circuit.

Answer

For an electric circuit to be closed, each component of it must pass current through it, i.e., it should be conducting

Question 7

How will you obtain a source of large direct current ? Show it with the help of a diagram.

Answer

When a strong direct current is needed, either we join a number of cells together in series (cathode of one cell connected to the anode of another cell), to form a battery or we use a storage cell.

Question 8

Which material is used to make wires for a resistance box ? Why is this particular material used ?

Answer

Manganin is an alloy which is used for preparing wires in a resistance box. It is used because of its property that its resistance does not vary much with temperature.

Question 9

A galvanometer has an 'O' mark at the middle, while a voltmeter and ammeter has the mark at the left hand corner of the dial. Explain.

Answer

A galvanometer is used to know the direction of flow of current in a circuit. Current can enter or leave through any of its terminals, therefore it has just an 'O' mark at the middle and no +/- signs at its terminals.
On the other hand, Ammeter and Voltmeter measure the current and voltage in the circuit, respectively. Therefore, the + sign marked at the left hand corner indicates that current must enter through this terminal.

Question 10

What is meant by load in an electrical circuit ? Give some examples.

Answer

An appliance which is connected in a circuit is called a load. It may be just a resistance or a combinations of different electrical components. Examples : bulb, refrigerator, microwave etc.

Exercise 9(A) — Long Answer Type

Question 1

Distinguish between d.c. and a.c.

Answer

The differences between d.c. and a.c are as follows —

Direct current (d.c.)	Alternating current (a.c.)
Direct current (d.c) is a current of constant magnitude flowing in one direction	Alternating current (a.c.) is the current for which both the magnitude and direction change with time.
The **cell or a battery** is a source of d.c. current.	The **mains in our house or an a.c. generator** are the source of alternating current (a.c.).

Question 2

Distinguish between a closed circuit and an open circuit, with the use of suitable labelled diagram.

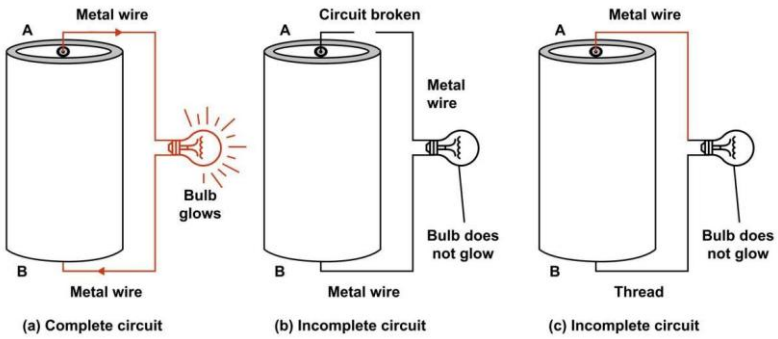
Answer

The differences are —

Closed circuit	Open circuit

Current flows only in a closed circuit	Current does not flow in an open circuit.
For an electric circuit to be	If there is an insulator in the path
Closed circuit	**Open circuit**
closed, each component of it must pass current through it, i.e., it should be conducting	(or the circuit is broken), the circuit is incomplete (or open) and the current will not flow through it.

The diagram below shows closed and open circuits:



Question 3

State three differences between primary and secondary cells.

Answer

The differences between a primary and a secondary cell are —

Primary cell	Secondary cell
Chemical reactions are **irreversible**.	Chemical reactions are **reversible**.

Primary cell	Secondary cell
Chemical energy is converted into electrical energy when current is drawn from it.	Electrical energy converts into chemical energy when current is passed in it (i.e., during charging), while chemical energy converts into electrical energy when current is drawn from it (i.e., during discharging).
It can not be **recharged.**	It can be **recharged**.

Question 4

Write symbols and state functions of each of the following components in an electric circuit —

(i) key

(ii) cell

(iii) rheostat

(iv) ammeter

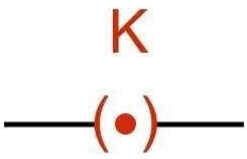
(v) voltmeter

Answer

The symbol and function of the components are as follows —

(i) Key

Symbol:

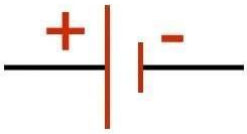


Function:

A key is used to put the current on and off in a circuit.

(ii) Cell

Symbol:

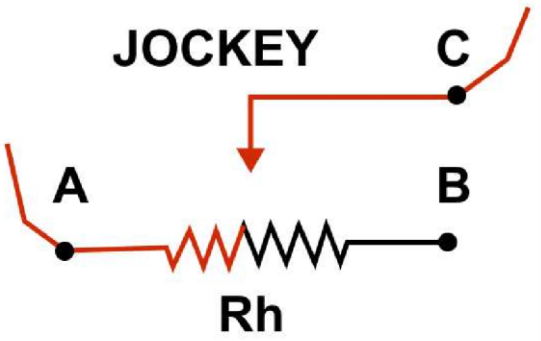


Function:

A cell acts as a source of direct current for the circuit.

(iii) Rheostat

Symbol:

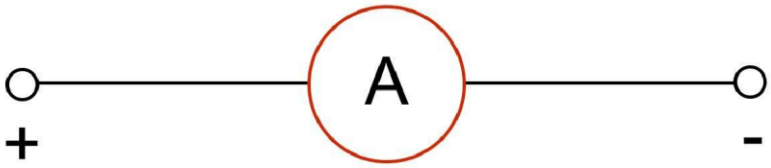


Function:

It controls the flow of current in a circuit.

(iv) Ammeter

Symbol:

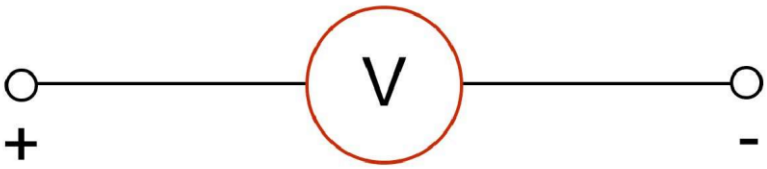


Function:

An ammeter is an instrument used to measures the magnitude of current flowing in a circuit.

(v) Voltmeter

Symbol:

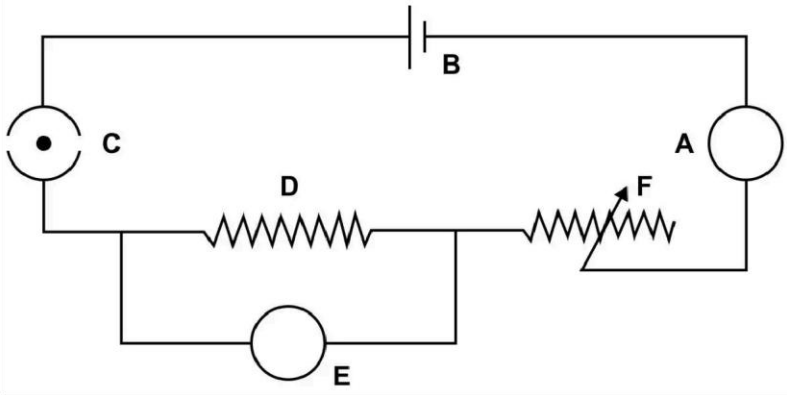


Function:

A voltmeter is used to measure the potential difference between two points of a circuit.

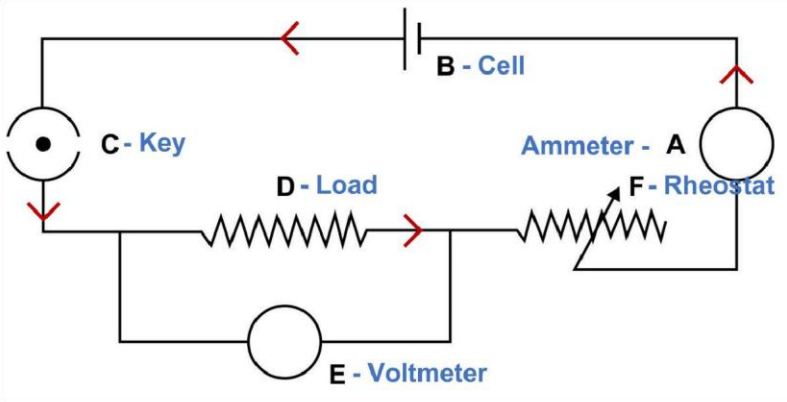
Question 5

In the electric circuit shown in the figure below, label the parts A, B, C, D, E, and F. State the function of each part. Show in the diagram the direction of flow of current.



Answer

The diagram below shows the direction of flow of current marked by red arrows and the labelled parts — A, B, C, D, E, and F



The name and function of each part is as follows —

A → Ammeter.

An ammeter is an instrument used to measure the magnitude of current flowing in a circuit.

B → Cell.

It acts as a source of direct current for the circuit.

C → key.

It is used to put the current on and off in the circuit.

D → Load.

An appliance which is connected in a circuit. It may be a resistance (e.g., bulb, heater etc.) or a combination of different electrical components.

E → Voltmeter.

A voltmeter is used to measure the potential difference between two points of a circuit.

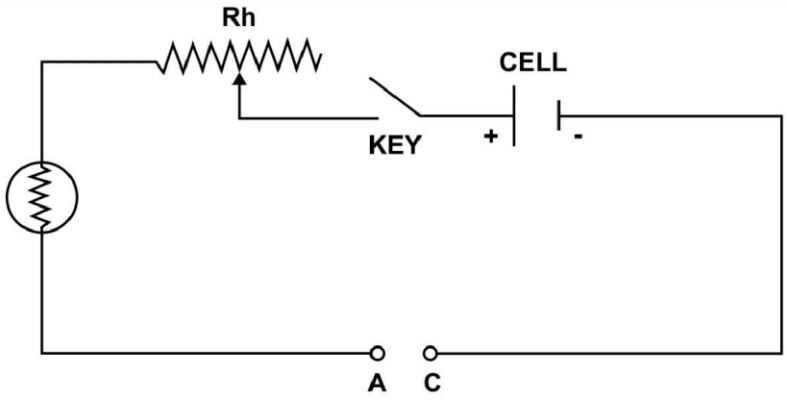
F → Rheostat.

A rheostat is a device by which resistance in a circuit can be varied continuously.

Question 6

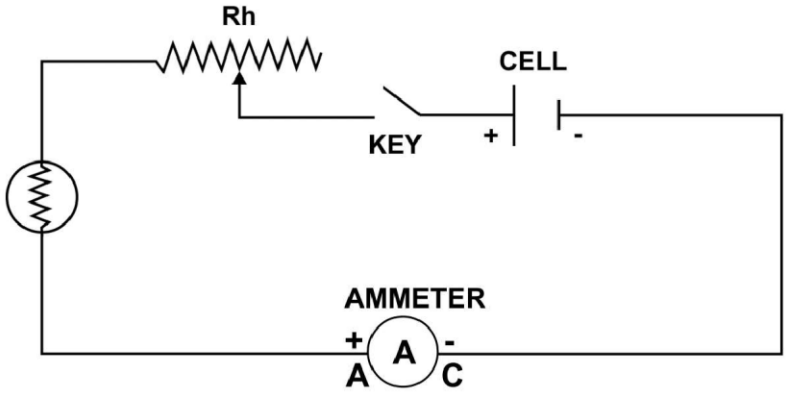
(a) Complete the circuit given in figure by inserting between the terminals A and C, an ammeter. (b) In the diagram mark the polarity

at the terminals of ammeter and indicate clearly the direction of flow of current in the circuit, when the circuit is complete. (c) Name and state the purpose of Rh in the circuit.

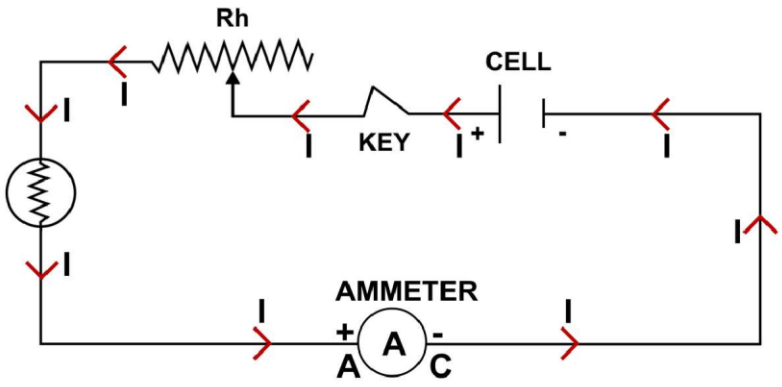


Answer

(a) The circuit with ammeter between the terminals A and C with polarity marked is shown below:



(b) The direction of flow of current in the completed circuit with ammeter (polarity marked) is shown below:



(c) Rh is the rheostat. It controls the flow of current in a circuit.

Exercise 9(A) — Numericals

Question 1

A charge 0.5 C passes through a cross section of a conductor in 5 s. Find the current.

Answer

Given,

charge (Q) = 0.5 C,

time (t) = 5 s

current (I) = ?

$$I = \frac{Q}{t}$$

Substituting the values we get,

$$I = \frac{0.5}{5}$$

$$\Rightarrow I = 0.1\ A$$

Hence, **current = 0.1 A**

Question 2

A current of 1.5 A flows through a conductor for 2.0 s. What amount of charge passes through the conductor?

Answer

Given,

current (I) = 1.5 A

time (t) = 2 s

charge (Q) = ?

$$I = \frac{Q}{t}$$

Substituting the values we get,

$$1.5 = \frac{Q}{2}$$

$$\Rightarrow Q = 1.5 \times 2$$

$$\Rightarrow Q = 3\ C$$

Hence, **amount of charge that passes through the conductor = 3 C**

Question 3

When starter motor of a car is switched on for 0.8 s, a charge 24 C passes through the coil of the motor. Calculate the current in the coil.

Answer

Given,

Time = 0.8 s

charge = 24 C

current = ?

$$I = \frac{Q}{t}$$

Substituting the values we get,

$$I = \frac{24}{0.8}$$

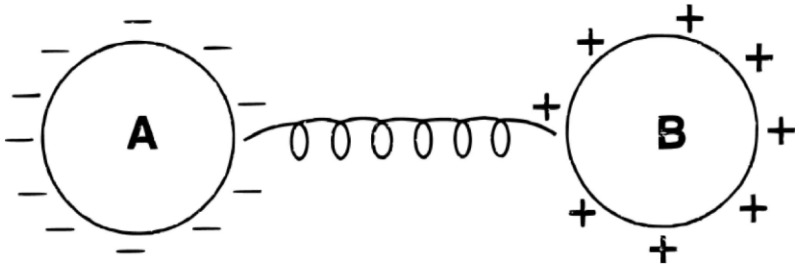
$$\Rightarrow I = 30\ A$$

Hence, **the current in the coil = 30 A**

Exercise 9(B) — Multiple Choice Type

Question 1

In the given figure, the flow of electrons would be :



1. B to A
2. A to B
3. both A to B and B to A
4. none of the above

Answer

A to B

Reason — Conductor A is negatively charged while conductor B is positively charged. Electrons flow from the negatively charged conductor A to positively charged conductor B.

Question 2

A conductor having an excess of electrons is said to be at ..... potential while a conductor having a deficit of electrons is at ..... potential.

1. lower, lower
2. lower, higher
3. higher, lower
4. higher, higher

Answer

lower, higher

Reason — A conductor having an excess of electrons is said to be at ***negative (lower)*** potential while a conductor having a deficit of electrons is at ***positive (higher)*** potential.

Question 3

The force between the two charges is ..... when they are at an infinite separation.

1. finite
2. infinite
3. zero
4. none of the above

Answer

zero

Reason — The force between the two charges is zero when they are at an infinite separation.

Question 4

The unit of potential difference is:

1. ampere
2. volt
3. ohm
4. coulomb

Answer

volt

Reason — Potential difference is measured in joule per coulomb which is named as volt (V).

Question 5

The S.I. unit of potential is :

1. Joule/coulomb

2. Volt

3. Ampere

4 Both (a) and (b)

Answer

Both (a) and (b)

Reason — The S.I. unit of potential is joule/coulomb or volt (symbol V).

Question 6

On increasing the resistance in a circuit, the current in it:

1. decreases
2. increases
3. remains unchanged
4. nothing can be said

Answer

decreases

Reason — Current (I) is inversely proportional to the resistance (R) hence it decreases.

Question 7

A larger wire offers ..... resistance than a shorter wire.

1. less

2. equal

3. more

4 none of the above

Answer

more

Reason — The resistance of a wire increases with its length because the moving electrons experience more collisions when traveling a longer distance. Hence, resistance of a wire is directly proportional to the length of the wire.

Question 8

A thicker wire offers ..... resistance than a thin wire.

1. less
2. equal
3. more
4. none of the above

Answer

less

Reason — In a thick wire, electrons get a larger area of cross section to flow as compared to a thin wire, therefore, a thick wire offers less resistance (i.e., **resistance of**

wire is inversely proportional to the area of cross section of the wire).

Question 9

Upon increasing the temperature, the resistance of a wire :

1. decreases
2. does not change
3. increases
4. first increases then decreases

Answer

increases

Reason — If the temperature of the wire increases, ions in it vibrate more violently. As a result, the number of collisions increases and hence the resistance of wire increases (i.e., the **resistance of the wire increases with the increase in it's temperature)**.

Question 10

The resistance of a conductor would be ..... if a current of 2 A flows through it when the potential difference across its ends is 2 volt.

1. 2Ω
2. 0Ω
3. 1Ω

4. 4Ω

Answer

1Ω

Reason — As, $R = \frac{V}{I}$

I = 2A

V = 2 volt

Hence, $R = \frac{2}{2} = 1\Omega$

Question 11

While performing an experiment, a student reduces the resistance to one half keeping the potential difference same. New reading of the current will be :

1. half
2. double
3. four times
4. one fourth

Answer

double

Reason — Let initial and final current be I and I_{new}, initial and final resistance is R and R_{new} and initial and final potential be V and V_{new}

From Ohm's law,

Case 1 :

$$\mathrm{V} = \mathrm{IR}$$

Case 2 :

$$\mathrm{V_{new}} = \mathrm{I_{new}R_{new}}$$

According to question,

$$\mathrm{V_{new}} = \mathrm{V} \text{ and } \mathrm{R} < em > \mathrm{new} = \frac{1}{2}\mathrm{R}$$

$$\Rightarrow \mathrm{I} < /em > \mathrm{newR_{new}} = \mathrm{IR}$$

$$\Rightarrow \mathrm{I_{new}} \times \frac{1}{2}\mathrm{R} = \mathrm{IR}$$

$$\Rightarrow \frac{\mathrm{I_{new}}}{2} = \mathrm{I}$$

$$\Rightarrow \mathrm{I_{new}} = 2\mathrm{I}$$

Exercise 9(B) — Very Short Answer Type

Question 1

What is the other name for the unit :

(a) Joule per Coulomb

(b) Coulomb per second

Answer

(a) Volt (V)

(b) Ampere (A)

Question 2

For what purpose is a battery connected in a circuit?

Answer

A battery is connected in a circuit when a strong current is needed.

Question 3

How will the resistance of a wire change if it is stretched ?

Answer

The resistance of a wire will increase when it is stretched due to increase in length and decrease in area of cross section.

Question 4

How does current change with voltage when it is altered across a given resistance ?

Answer

On increasing the voltage, the current increases and vice versa because voltage (potential difference) is directly proportional to current.

Question 5

Name the physical quantities whose units are —

(a) Coulomb and ampere

(b) Volt and ohm

Answer

The physical quantities are —

(a) Charge and Current

(b) Potential difference and Resistance

Question 6

How is the direction of flow of current between two charged conductors determined by their potentials?

Answer

The direction of flow of current is from a body at a **higher potential to the one at a lower potential** i.e., in direction opposite to the direction of flow of electrons.

Question 7

Define the term potential difference.

Answer

Potential difference between two conductors is equal to the work done in transferring a unit

positive charge from one conductor to the other conductor.

If work W is done in transferring a test charge q from one conductor to the other, the potential difference between them is

$$V_1 - V_2 = \frac{W}{q}$$

Potential difference is a **scalar quantity**.

Question 8

State and define the S.I. unit of potential difference.

Answer

The S.I. unit of potential difference is Volt (V) or joule per coulomb.

The potential difference between two points is said to be 1 volt if work done in transferring 1 coulomb of charge from one point to the other point is 1 joule.

Question 9

State and define the S.I. unit of resistance.

Answer

S.I. unit of resistance is Ohm (Ω) or volt per ampere.

The resistance of a conductor is said to be 1 ohm if a current of 1 ampere flows through it when the potential difference across it's ends is 1 volt.

Question 10

State Ohm's law.

Answer

Ohm's law states that current flowing through a conductor is directly proportional to the potential difference applied across it's ends provided it's temperature is constant. i.e., $I \propto V$ or $V \propto I$ or $V = IR$ where R is the resistance of the conductor.

Question 11

How are the potential difference (V), current (I) and resistance (R) related?

Answer

$V = IR$

Question 12

State whether the resistance of filament of a bulb will decrease, remain unchanged or increase when it glows.

Answer

The resistance of the filament increases, when a bulb glows as the temperature of the filament increases.

Exercise 9(B) — Short Answer Type

Question 1

What do you understand by the term resistance?

Answer

The obstruction offered to the flow of current by a conductor is called it's electrical resistance.

Question 2

How is the current flowing in a conductor changed if the resistance of conductor is doubled keeping the potential difference across it the same?

Answer

According to Ohm's law,

$$V = IR$$

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

Let the doubled resistance be 2R. Potential difference remains the same

$$I_{new} = \frac{V}{2R}$$

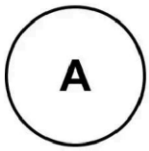
a

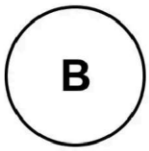
$$\Rightarrow \mathrm{I} < /em > \mathrm{new} = \frac{\mathrm{I}}{2}$$

∴ If the resistance of conductor is doubled keeping the potential difference across it the same then **current flowing in a conductor will be halved**.

Question 3

Figure below shows two conductors A and B. Their charges and potentials are given in the diagram. State the direction of (i) flow of electrons, and (ii) flow of current, when both the conductors are joined by a metal wire.





Q = -10 coulomb
V = 5 volt

Q = 5 coulomb
V = 10 volt

Answer

(a) The direction of flow of electrons is from **A to B** (i.e., from a low potential to a high potential)

(b) The direction of flow of current when both the conductors are joined by a metal wire is from **B to A**. (i.e., from a high potential to a low potential)

Question 4

How is the resistance of a wire affected if it's (a) length is doubled, (b) radius is doubled?

Answer

(a) If the length is doubled, the resistance of the wire doubles as resistance of a wire is directly proportional to the length of the wire.

(b) The resistance of a wire becomes less or one-fourth when the radius of the wire is doubled as resistance of a wire is inversely proportional to the area of cross section of the wire.

Question 5

'The potential difference between two conductors is 1 volt'. Explain the meaning of this statement.

Answer

The statement 'potential difference between two conductors is 1 volt' means that **1 joule of work is done in transferring 1 coulomb of charge from one conductor to the other.**

Question 6

'The resistance of wire is 1 ohm'. Explain the meaning of this statement.

Answer

'The resistance of wire is 1 ohm' means that current of 1 ampere flows through it when the potential difference across it's ends is 1 volt.

Exercise 9(B) — Long Answer Type

Question 1

Explain the concept of electric potential difference in terms of work done in transferring the charge.

Answer

We know that, like charges repel and unlike charges attract, therefore to create an excess or deficit of electrons at a point, some work is to be done in moving the charges (or electrons) against the forces between them. The force between the two charges is zero when they are at infinite separation.

Hence, quantitatively, potential at a point is measured in terms of work done in bringing a charge q from infinity to that point. If work W' is done in bringing a charge q from infinity to a point, then potential at that point is:

$$V = \frac{W'}{q}$$

Hence, the potential difference between two conductors is measured in terms of work done in transferring the charge from one

conductor to the other, through a metallic wire.

Potential difference is a **scalar quantity.**

Question 2

Explain why does a metal wire when connected to a cell offer resistance to the flow of current.

Answer

A metal wire has free electrons which move in a random manner in the absence of any cell connected across it.

When the ends of the wire are connected to a cell, the electrons start moving from the negative terminal of cell to it's positive terminal through the metal wire.

During their movement, they collide with the fixed positive ions and other free electrons of the wire due to which their speed decreases and direction of motion changes.

After each collision, they again accelerate towards the positive terminal and suffer collision with other positive ions and free electrons again. This process continues.

As a result, the electrons do not move in bulk with increasing speeds from one end to the other but they drift towards the positive

terminal. This is how a wire offers resistance to the flow of electrons (or current) through it.

Question 3

State three factors on which the resistance of a wire depends. Explain how does the resistance depend on the factors stated by you.

Answer

The factors on which the resistance of a wire depend are —

1. **The length of the wire** — The number of collisions suffered by the moving electrons will be more if they have to travel a longer distance in a wire, therefore a long wire offers more resistance than a short wire (i.e., **resistance of a wire is directly proportional to the length of the wire**).
2. **The area of cross section of wire** — In a thick wire, electrons get a larger area of cross section to flow as compared to a thin wire, therefore, a thick wire offers less resistance (i.e., **resistance of wire is inversely proportional to the area of cross section of the wire**).
3. **The temperature of the wire** — If the temperature of the wire increases, ions in

it vibrate more violently. As a result, the number of collisions increases and hence the resistance of wire increases (i.e., the **resistance of the wire increases with the increase in it's temperature**.

Exercise 9(B) — Numericals

Question 1

In transferring 1.5 C charge through a wire, 9 J of work is done. Find the potential difference across the wire.

Answer

Given,

charge (q) = 1.5 C

work = 9 J

potential difference across the wire

$$V = \frac{W}{q}$$

Substituting the values in the formula, we get,

$$V = \frac{9}{1.5}$$
$$\Rightarrow V = 6\ V$$

Hence, the **potential difference across the wire = 6 V.**

Question 2

A cell of potential difference 12V is connected to a bulb. The resistance of filament of bulb when it glows, is 24Ω. Find the current drawn from the cell.

Answer

Given,

V = 12 V

R = 24 ?

I = ?

From Ohm's Law,

V = IR

Substituting the values in the formula, we get,

$$12 = \mathrm{I} \times 24$$

$$\Rightarrow \mathrm{I} = \frac{12}{24}$$

$$\Rightarrow \mathrm{I} = 0.5\ \mathrm{A}$$

Hence, **the current drawn from the cell = 0.5 A**

Question 3

A bulb draws current 1.5 A at 6.0 V. Find the resistance of filament of bulb while glowing.

Answer

Given,

I = 1.5 A

Potential difference = 6 V

R = ?

From Ohm's Law,

V = IR

Substituting the values in the formula, we get,

$$6 = 1.5 \times \mathrm{R}$$
$$\Rightarrow \mathrm{R} = \frac{6}{1.5}$$
$$\Rightarrow \mathrm{R} = 4\Omega$$

Hence, the resistance of filament of bulb while glowing = 4Ω

Question 4

A current 0.2 A flows in a wire of resistance 15Ω. Find the potential difference across the ends of the wire.

Answer

Given,

I = 0.2 A

R = 15Ω

Potential difference = ?

From Ohm's Law,

V = IR

Substituting the values in the formula, we get,

V = 0.2 x 15 = 3 V

Hence, **the potential difference across the ends of the wire = 3 V**

Exercise 9(C) — Multiple Choice Type

Question 1(i)

An efficient use of energy results in :

1. increase in the emission of greenhouse gases
2. a reduction in the cost of energy
3. a reduction in the emission of green house gases
4. both (b) and (c)

Answer

both (b) and (c)

Reason — An efficient use of energy results in reduction of (i) the cost of energy and, (ii) the emission of greenhouse gases.

Question 1(ii)

The most non-polluting and efficient lighting device is —

1. CFL

2. Fluorescent light
3. LED
4. Electric bulb

Answer

LED

Reason — The use of **LED (light emitting diode) bulbs** for lighting reduces the consumption of energy drastically. It is also helpful in reducing global warming and the harmful effects of mercury used in fluorescent lights.

Question 1(iii)

IEA is the short form of —

1. Indian Energy Association
2. Indian Eco Academy
3. International Energy Agency
4. International Eco Academy

Answer

International Energy Agency

Reason — According to the International Energy Agency (IEA), the improved energy efficiency in buildings, industries and transportation could reduce the world's energy need in 2050 by one-third and thus it

can help to control global emission of greenhouse gases.

Question 1(iv)

LED stands for :

1. Long lasting electric device
2. Least efficient diode
3. Light emitting diode
4. Laser emission device

Answer

Light emitting diode

Reason — LED stands for Light emitting diode.

Exercise 9(C) — Assertion Reason Type

Question 2(i)

Assertion (A) : Primary cells are use and throw types.

Reason (R) : Primary cells provide current as a result of irreversible chemical reaction.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true

4. assertion is true but reason is false

Answer

both A and R are true and R is the correct explanation of A

Explanation

Assertion (A) is true because primary cells (like dry cells, alkaline batteries) are non-rechargeable. Once their chemical reaction is completed, they cannot be reused, so they are discarded after use.

Reason (R) is true because in primary cells, the chemical reaction is irreversible, which means the chemicals cannot be restored to their original form by passing a current therefore, the cell cannot be recharged. Hence, reason correctly explains assertion.

Question 2(ii)

Assertion (A) : The rate of flow of electrons in a direction is called electronic current in that direction.

Reason (R) : The conventional current is in a direction opposite to direction of motion of electrons.

1. both A and R are true and R is the correct explanation of A

2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

both A and R are true and R is the correct explanation of A

Explanation

Assertion (A) is true because electronic current refers to the actual flow of electrons, which move from the negative terminal to the positive terminal of a power source and the rate at which electrons flow defines the magnitude of current.

Reason (R) is true because conventional current is defined as the flow of positive charge, which is taken to be from positive to negative terminal of a cell opposite to the direction of electron flow.

The reason correctly explains the difference between electronic current (actual flow of electrons) and conventional current (assumed flow of positive charge).

Question 2(iii)

Assertion (A) : An ammeter is used to measure potential difference between two

points of circuit.

Reason (R) : An ammeter must have a very low resistance.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

assertion is false but reason is true

Explanation

Assertion (A) is false because an ammeter is used to measure current, not potential difference and to measure potential difference, voltmeter is used.

Reason (R) is true because an ammeter is connected in series in a circuit and to not affect the current it is measuring, its resistance should be as low as possible.

Question 2(iv)

Assertion (A) : Cotton and rubber are examples of insulators.

Reason (R) : These materials have a large number of free electrons and they offer less

resistance to flow of current.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

assertion is true but reason is false

Explanation

Assertion (A) is true because both cotton and rubber do not conduct electricity under normal conditions since they have almost no free electrons and offer a very high resistance to the flow of current so they are commonly used as insulating materials in electrical applications.

Reason (R) is false because they have almost no free electrons and offer a very high resistance to the flow of current.

Question 2(v)

Assertion (A) : A thick wire offers less resistance in comparison to a thin wire.

Reason (R) : Resistance of wire is directly proportional to its area of cross-section.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

assertion is true but reason is false

Explanation

Assertion (A) is true because in a thick wire, electrons get a larger area of cross-section to flow as compared to a thin wire, therefore, a thick wire offers less resistance.

Reason (R) is false because resistance is inversely proportional to the area of cross-section, not directly proportional since flow of electrons (i.e., current) depends upon the area of cross-section through which they flow so more area implies high current as number of collisions between electrons decreases and vice versa.

Question 2(vi)

Assertion (A) : Current flows from body at higher potential to a body at lower potential.

Reason (R) : The direction of flow of electrons is from low potential body to a body

at a higher potential.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

both A and R are true and R is the correct explanation of A

Explanation

Assertion (A) is true because conventional current is defined to flow from higher potential to lower potential, even though actual charge carriers (electrons) move in the opposite direction.

Reason (R) is true because electrons are negatively charged, so they move from lower potential to higher potential opposite to the direction of conventional current.

The reason correctly explains why current flows from high to low potential because electrons, which actually move, go the opposite way.

Question 2(vii)

Assertion (A) : Longer wires have greater resistance and the smaller wires have lesser resistance.

Reason (R) : Resistance of a wire increases with increase in temperature.

1. both A and R are true and R is the correct explanation of A
2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

both A and R are true and R is not the correct explanation of A

Explanation

Assertion (A) is true because the number of collisions suffered by the moving electrons will be more if they have to travel a longer distance in a wire, therefore, a long wire offers more resistance than a short wire (i.e., resistance of a wire $\propto$ length of wire).

Reason (R) is true because if the temperature of wire increases, electrons in it vibrate more violently. As a result, the number of collisions increases and hence the resistance of wire increases (i.e., the resistance of a wire

e

increas s with the increase in its temperature).

The assertion talks about wire length, but the reason explains the effect of temperature. So, although both statements are true, the reason does not explain the assertion.

Exercise 9(C) — Very Short Answer Type

Question 1

State the first traditional electric device to be used for home lighting.

Answer

The traditional incandescent light bulbs were the first electric device to be used for home lighting.

Question 2

Which of the following device is most efficient for lighting purpose :

LED, CFL, Fluorescent tube light, Electric bulb.

Answer

LED (**L**ight **E**mitting **D**iode)

Exercise 9(C) — Short Answer Type

Question 1

a

State two ways to save energy.

Answer

The ways to save energy are —

1. By properly insulating a home, it is possible to maintain a comfortable temperature inside. It will reduce the cost of heating devices in winter and cooling devices in summer.
2. The use of fluorescent and LED lights or natural sky light instead of traditional incandescent light bulbs, reduces the amount of energy required to attain the same level of illumination.

Question 2

How does proper insulation of home save energy?

Answer

By properly insulating a home, it is possible to maintain a comfortable temperature inside. It will reduce the cost of heating devices in winter and cooling devices in summer.

Question 3

How is CFL better than a usual bulb ?

Answer

e

The us of compact fluorescent lights (CFL) saves 67% energy and they may last 6 to 10 times longer than the usual bulb.

Question 4

What is indicated by the different number of stars on an electric appliance?

Answer

Appliances are star rated according to their efficient use of electricity.

Exercise 9(C) — Long Answer Answer Type

Question 1

What is meant by efficient use of energy?

Answer

The meaning of efficient use of energy is to reduce the cost and amount of energy used to provide us the various products and services. This results in reduction of (i) cost of energy and (ii) the emission of green house gases.

Example — By properly insulating a home, it is possible to maintain a comfortable temperature inside. It will reduce the cost of heating devices in winter and cooling devices in summer.

Question 2

Explain the role of geographical location and architectural features in reducing the artificial lighting inside a building

Answer

A building's location and its surrounding play a key role in regulating its temperature and illumination. Proper placement of windows and skylights and the use of architectural features that reflect light into the building can reduce the need of artificial lighting. White roof systems can save more energy in summers.

Question 3

Give an example to explain that the use of modern eco-friendly technologies is more efficient and less polluting.

Answer

Modern energy efficient appliances such as refrigerators, ovens, freezers, dishwashers, dryers etc. make use of significantly less energy than the older appliances. Nowadays appliances are star rated according to their efficient use of electricity.

Hence, modern eco-friendly technologies are more efficient and less polluting.

Question 4

e

Describ three ways for the efficient use of energy.

Answer

Listed below are ways for the efficient use of energy —

1. The use of LED (light emitting diode) bulbs for lighting reduces the consumption of energy drastically. It is also helpful in reducing global warming and the harmful effects of mercury used in fluorescent lights.
2. Fuel efficiency in vehicles can be increased by reducing the weight of the vehicle using advanced tyres and computer controlled engines.
3. Modern energy efficient appliances such as refrigerators, ovens, freezers, dishwashers, dryers etc. make use of significantly less energy than the older appliances. Nowadays appliances are star rated according to their efficient use of electricity.

Question 5

What social initiatives must be taken for the sensitive use of energy?

Answer

Social initiatives taken to sensitise use of energy are as follows —

1. Public awareness can be improved through mass-media and children's participation in campaigns and eco-club activities.
2. Community involvement will surely be effective in reducing the misuse of electricity.
3. The non-government organizations (NGOs) can be used to create social awareness about the sensitive use of resources.

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