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### Very Short Answer Type Questions

**Q1. By what other name is the unit joule/coulomb called?**

**Answer:**

The other name of the unit joule/coulomb is volt.

Volt is the SI unit of electric potential or of electromotive force. It is represented by the letter V. Volt is a representation of the potential difference between the two points of a current-carrying wire of 1 ampere such that when the power dissipates between these two points, it is equal to 1 watt.

**Q2. Which of the following statements correctly defines a volt?**

**a) A volt is a joule per ampere**

**b) A volt is a joule per coulomb**

**Answer:**

The correct statement that defined a volt is b) A volt is a joule per coulomb

Volt is a joule per coulomb because joule is a unit of work done while coulomb is a unit for the charge. The ratio of work done to the charge is the definition of potential and volt is the unit of potential difference. Therefore, it can be said that one joule per coulomb is equal to the unit of the potential difference which is also equal to one volt.

$(1 \text{ Joule}) / (1 \text{ Coulomb}) = 1 \text{ Volt}$

**Q3. a) What do the letters p.d stand for?**

**b) Which device is used to measure p.d?**

**Answer:**

a) p.d stands for potential difference

Potential difference is defined as the difference between the energy carried by the two points in the circuit. Potential difference is also equal to the product of the amount of current and the resistance. Following is the formula used for calculating potential difference:

$$V = I \times R$$

Where,

- V is the voltage
- I is the current
- R is the resistance

b) Voltmeter is used for measuring p.d

An instrument that is used for measuring the voltage in volts is known as a voltmeter. Letter V is used for representing voltmeter between the two terminals.

**Q4. What is meant by saying that the electric potential at a point is 1 volt?**

**Answer:**

The electric potential at a point is 1 volt means 1 joule of work is done in moving 1 unit of positive charge from infinity to that particular point.

**Q5. How much work is done when one-coulomb charge moves against a potential difference of 1 volt?**

**Answer:**

Given,

Potential difference = 1V

Charge to be moved = 1C

To find,

Work done = ?

We know that the work done is given as:

Work done = Potential difference  $\times$  Charge moved

=  $1 \times 1 = 1\text{J}$

Therefore, 1J of work is done to move 1C charge with 1V potential difference.

**Q6. What is the SI unit of potential difference?**

**Answer:**

The SI unit of potential difference is volt. It is the difference of potential that one ampere of current is carried against one-ohm resistance.

**Q7. How much work is done in moving a charge of 2C across two points having a potential difference of 12V?**

**Answer:**

Given,

Potential difference = 12V

Charge moved = 2C

To find,

Work done = ?

We know that the work done is given as:

Work done = p.d  $\times$  charge moved

=  $12 \times 2 = 24\text{J}$

Therefore, 24J of work is done to move a charge of 2C with a potential difference of 12V.



**Q8. What is the unit of electric charge?**

**Answer:**

Coulomb is the unit of electric charge. Coulomb is defined as the charged that is transferred with the help of a steady current of one ampere in one second.

**Q9. Define one coulomb charge.**

**Answer:**

One coulomb charge is defined as the quantity of charge that exerts a force of  $9 \times 10^9$  Newton on a charge which is placed at a distance of 1m from it.

**Q10. Fill in the following blanks with suitable words:**

a) Potential difference is measured in ..... by using a ..... placed in ..... across a component.

b) Copper is a good ..... plastic is an .....

**Answer:**

a) Volts, voltmeter, parallel

b) Conductor, insulator

### Short Answer Type Questions

**Q11. What is meant by conductors and insulators? Give two examples of conductors and two of insulators.**

**Answer:**

Conductors are defined as the materials through which electric current can flow. Almost all the metals are examples of conductors. Following are the examples of conductors:

Copper, silver

Insulators are defined as the materials through which electric current cannot flow. Non-metals are examples of insulators. Following are the examples of insulators:

Plastic, cotton

**Q12. Which of the following are conductors and which are insulators?**

**Sulphur, silver, copper, cotton, aluminium, air, nichrome, graphite, paper, porcelain, mercury, mica, Bakelite, polythene, manganin**

**Answer:**

Conductor: Silver, copper, aluminium, nichrome, graphite, mercury, manganin

Insulator: Sulphur, cotton, air, paper, porcelain, mica, Bakelite, polythene

**Q13. What do you understand by the term “electric potential” at a point? What is the unit of electric potential?**

**Answer:**

The electric potential at a point is defined as the work done to move a unit positive charge from infinity to a particular point. Volt is the unit of electric potential.

**Q14. a) State the relation between potential difference, work done, and charge moved.**

**b) Calculate the work done in moving a charge of 4 Coulomb from a point at 220 Volts to another point at 230 Volt.**

**Answer:**

a) Potential difference = (Work done)/(Charge moved)

b) Given,

$V_1 = 220\text{V}$

$V_2 = 230\text{V}$

Charge moved = 4C

Potential difference = ?

We know that potential difference is:

Potential difference =  $V_2 - V_1$

=  $230 - 220 = 10$

Work done = Potential difference  $\times$  charge moved

=  $10 \times 4 = 40\text{J}$

Therefore, the work done is 40J to move charges.

**Q15. a) Name a device that helps to measure the potential difference across a conductor.**

**b) How much energy is transferred by a 12V power supply to each coulomb of charge which it moves around a circuit?**

**Answer:**

a) Voltmeter

b) Given,

Potential difference = 12V

Charge moved = 1C

Work done = ?

We know that the work done is given as:

Work done = Potential difference  $\times$  Charge moved

=  $12 \times 1 = 12$  Joules

Therefore, 12J work is done on a 1C charge.

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### Long Answer Type Questions

**Q16. a) What do you understand by the term “potential difference”?**

**b) What is meant by saying that the potential difference between two points is 1 volt?**

**c) What is the potential difference between the terminals of a battery if 250 joules of work is required to transfer 20 coulombs of charge from one terminal of battery to the other?**

**d) What is a voltmeter? How is a voltmeter connected in the circuit to measure the potential difference between two points. Explain with the help of a diagram.**

**e) State whether a voltmeter has a high resistance or a low resistance. Give reason for your answer.**

**Answer:**

a) The amount of work done in moving a unit positive charge from one point to the other is defined as the potential difference between the two points.

b) The potential difference between two points is 1 volt means 1 joule of work is done to move 1 coulomb of electric charge from one point to another.

c) Given,

Work done = 250J

Charge moved = 20C

Potential difference = ?

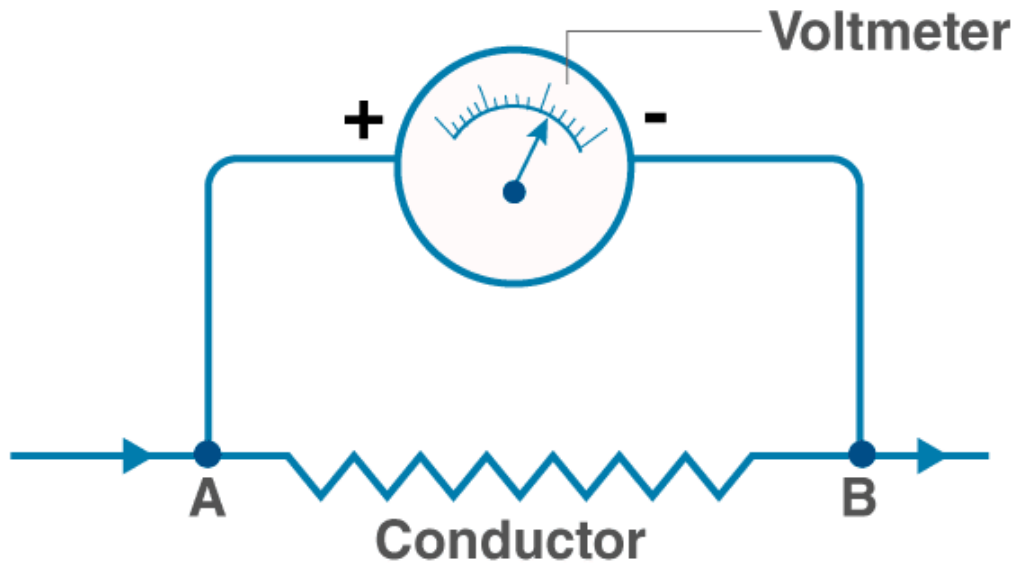
We know that potential difference is given as:

Potential difference = (Work done)/(Charge moved)

=  $(250)/(20) = 12.5$

Therefore, 12.5J of potential difference is required for moving 1 coulomb of charge when the work done is 250J.

d) A voltmeter is defined as the device that is used for measuring the potential difference between the two points in an electric circuit. The voltmeter is usually connected parallel to the two points where the potential difference needs to be measured.



e) The voltmeter has a high resistance because voltmeter needs to take a negligible amount of current from an electric circuit.

### Multiple Choice Questions

Q17. The work done in moving a unit charge across two points in an electric circuit is a measure of:

- a) Current
- b) Potential difference
- c) Resistance
- d) Power

Answer:

The correct option is b) Potential difference.

Potential difference is the measure of the work done in moving a unit charge across two points in an electric circuit.

Q18. The device used for measuring potential difference is known as:

- a) Potentiometer
- b) Ammeter
- c) Galvanometer
- d) Voltmeter

Answer:

The correct option is d) Voltmeter

Voltmeter is the device that is used for measuring potential difference.

Q19. Which of the following units could be used to measure electric charge?

- a) Ampere
- b) Joule
- c) Volt

**d) Coulomb**

**Answer:**

The correct option d) Coulomb

Coulomb is the unit that is used for measuring electric charge.

**Q20. The unit for measuring potential difference is:**

a) Watt

b) Ohm

c) Volt

d) kWh

**Answer:**

The correct option is c) Volt

Volt is the unit used for measuring the potential difference.

**Q21. One coulomb charge is equivalent to the charge obtained in:**

a)  $2.6 \times 10^{19}$  electrons

b)  $6.2 \times 10^{19}$  electrons

c)  $2.65 \times 10^{18}$  electrons

d)  $6.25 \times 10^{18}$  electrons

**Answer:**

The correct option is d)  $6.25 \times 10^{18}$  electrons

There are  $6.25 \times 10^{18}$  electrons in one coulomb charge.

**High Order Thinking Skills**

**Q22. Three 2V cells are connected in series and used as battery in a circuit.**

a) What is the p.d at the terminals of the battery?

b) How many joules of electric energy does 1C gain on passing through one cell and all the three cells?

**Answer:**

a) When three cells with 2 volts respectively are connected in series for the construction of the battery, then the total potential difference between the terminals of the battery will be 6V.

b) For one cell:

Given,

Potential difference = 2V

Charge moved = 1C

Work done = ?

We know that work done is given as:

Work done = potential difference  $\times$  charge moved

=  $2 \times 1 = 2\text{J}$

Therefore, work done to move a charge of 1C with the potential difference of 2V is 2J.

For three cells:

Given,

Potential difference = 6V

Change moved = 1C

Work done = ?

We know that the work done is given as:

Work done = Potential difference  $\times$  charge moved

$$= 6 \times 1 = 6\text{J}$$

Therefore, to move 1C charge with a potential difference of 6V, the work done is 6J.

**Q23. The atoms of copper contain electrons and the atoms of rubber also contain electrons. Then why does copper conduct electricity but the rubber does not conduct electricity?**

**Answer:**

The atoms of copper contain electrons and the atoms of rubber also contain electrons but copper conducts electricity while rubber doesn't conduct electricity because copper has free electrons that are held loosely to each other by the nuclei of the atom. These freely available electrons are responsible for the conduction of electricity in copper.

Whereas in rubber the electrons are under a strong influence of the nuclei of the atoms. There are no much free electrons available for the conduction of electricity in the rubber. Therefore, the rubber doesn't conduct electricity.

### Lakhmir Singh Physics Class 10 Solutions Page No.11

#### Very Short Answer Type Questions

**Q1. By what name is the physical quantity coulomb/second called?**

**Answer:**

Ampere is the name that is used for the physical quantity coulomb/second.

It is defined as the elementary charge  $e$  with a value of  $1.602 \times 10^{-19}$  is expressed in unit C which is equal to A.s

**Q2. What is the flow of charge called?**

**Answer:**

The flow of charge is called as an electric current.

Electric current is defined as the rate of flow of negative charges in the conductor. Or it can also be defined as the continuous flow of electrons in an electric circuit.

**Q3. What actually travels through the wires when you switch on a light?**

**Answer:**

There is a flow of electrons in the wires when the light is switched on.

**Q4. Which particles constitute the electric current in a metallic conductor?**

**Answer:**

Electrons are the particles that constitute the electric current in a metallic conductor.

**Q5. a) In which direction does conventional current flow around a circuit?**

**b) In which direction do electrons flow?**

**Answer:**

a) The flow of conventional current takes place from the positive terminal of the batter to the negative terminal in the outer circuit.

b) The direction in which electrons flow is from the negative terminal to the positive terminal in the battery. The flow of electrons is usually in the opposite direction of the conventional current.

**Q6. Which of the following equations shows the correct relationship between electrical units?**

$$1\text{A} = 1\text{C/sor } 1\text{C} = 1\text{A/s}$$

**Answer:**

The correct is  $1A = 1C/s$

**Q7. What is the unit of electric current?**

**Answer:**

The unit of electric current is ampere.

**Q8. a) How many milliamperes are there in 1 ampere?**

**b) How many microamperes are there in 1 ampere?**

**Answer:**

a) Following is the milliamperes that are there in 1 ampere:

$1 \text{ amp} = 10^3 \text{ milliamp}$

b) Following is the microamperes that are there in 1 ampere:

$1 \text{ amp} = 10^6 \text{ micro amp}$

**Q9. Which of the two is connected in series: ammeter or voltmeter?**

**Answer:**

Out of ammeter and voltmeter, ammeter is connected in series.

**Q10. Compare how an ammeter and a voltmeter are connected in a circuit?**

**Answer:**

In an electric circuit, ammeter is connected in series while the voltmeter is connected in parallel.

**Q11. What do the following symbols mean in circuit diagrams?**



**Answer:**

a) The symbol in the above means variable resistance in the circuit diagram.

b) The symbol in the above means a closed plug key in the circuit diagram.

**Q12. If 20C of charge pass a point in a circuit in 1s, what current is flowing?**

**Answer:**

Given,

Charge moved,  $Q = 20\text{C}$

Time taken,  $t = 1\text{s}$

To find,

Current,  $I = ?$

We know that the current is calculated as follows:

$$I = Q/t$$

Substituting the values, we get

$$I = 20/1 = 20\text{A}$$

Therefore, 20A current is required to move a charge of 20C in 1s time.

**Q13. A current of 4A flows around a circuit for 10s. How much charge flows past a point in the circuit in this time?**

**Answer:**

Given,

Current,  $I = 4\text{A}$

Time taken,  $t = 10\text{s}$

To find,

Charge moved,  $Q = ?$

We know that,

$$I = Q/t$$

Substituting the values in the above equation, we get

$$4 = Q/10$$

$$Q = 4 \times 10 = 40\text{C}$$

Therefore, 40C charge is moved in 10s when the current flowing is 4A.

**Q14. What is the current in a circuit if the charge passing each point is 20C in 40s?**

**Answer:**

Given,

Charge moved,  $Q = 20\text{C}$

Time taken,  $t = 40\text{s}$

To find,

Current,  $I = ?$

We know that,

$$I = Q/t$$

Substituting the values in the above equation we get

$$I = 20/40 = 0.5\text{A}$$

Therefore, 0.5A is required for moving 20C charge in 40s.

**Q15. Fill in the following blanks with suitable words:**

a) A current is a flow of ..... for this to happen there must be a .....

b) Current is measured in ..... using an .....placed in .....in a circuit.

**Answer:**

a) Electrons and closed

b) Amperes, ammeter, and series

### Short Answer Type Questions

**Q16. a) Name a device which helps to maintain potential difference across a conductor (say a bulb).**

**b) If a potential difference of 10V causes a current of 2A to flow for 1 minute, how much energy is transferred?**

**Answer:**

a) The potential difference across a conductor is maintained with the help of a cell or a battery.

b) Given,

Potential difference = 10V,

Current,  $I = 2\text{A}$

Time taken,  $t = 60\text{s}$

We know that:

$$I = Q/t$$

$$\text{So, } Q = I \times t$$

Substituting the values, we get

$$Q = 2 \times 60 = 120$$

Therefore, charge moved is 120C

We also know that,

$$\text{Work done} = \text{Potential difference} \times \text{charge moved}$$

$$= 120 \times 10$$

$$= 1200\text{J}$$

Therefore, work done to move a charge of 120C is 1200J.

**Q17. a) What is an electric current? What makes an electric current flow in a wire?**

**b) Define the unit of electric current.**

**Answer:**

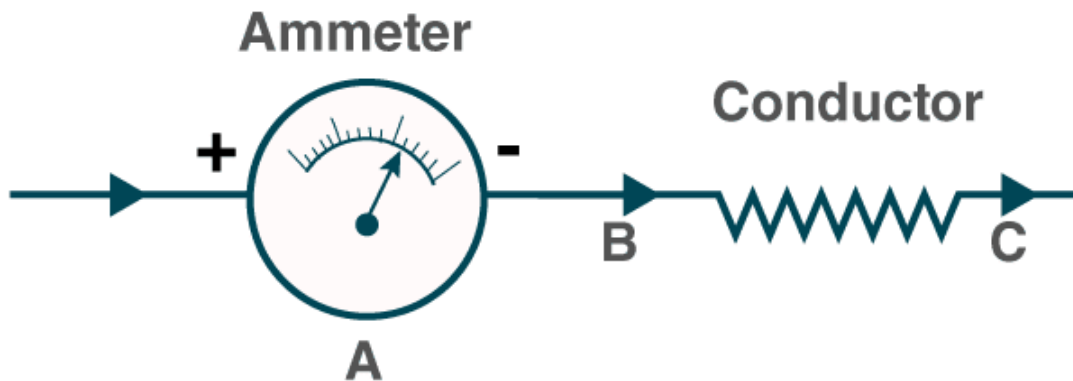
a) An electric current is defined as the flow of electric charges through a conductor such that the potential difference between the two points in the conductor is responsible for the flow of electric current.

b) Ampere is the unit of electric current. It is defined as 1 coulomb of charge flowing through a cross-section of a conductor in 1 second such that the electric current flowing through the conductor is 1 ampere.

**Q18. What is an ammeter? How is it connected in a circuit? Draw a diagram to illustrate your answer.**

**Answer:**

An ammeter is defined as a device that is used for measuring the flow of electric current. An ammeter is always connected in series with the electric current through which the current needs to be measured. Following is the illustration of the connection of ammeter in series with the electric circuit:



**Q19. a) Write down the formula which relates electric charge, time, and electric current.**

**b) A radio set draws a current of 0.36A for 15 minutes. Calculate the amount of electric charge that flows through the circuit.**

**Answer:**

a) The relation between electric charge, time, and electric current is given as:

Current = (charge moved)/(time)

While work done = potential difference  $\times$  charge moved

Therefore, above is the relation between electric, time, and electric current

b) Given,

Current,  $I = 0.36\text{A}$

Time taken,  $t = 15 \text{ min} = 900\text{s}$

We know that,

$Q = I \times t$

$= 0.36 \times 900$

$= 324\text{C}$

Therefore, 324C charge flows through the circuit.

**Q20. Why should the resistance of:**

**a) An ammeter be very small?**

**b) A voltmeter be very large?**

**Answer:**

a) The resistance of an ammeter should be very small because the value of the current flowing through the circuit remains unchanged.

b) The resistance of a voltmeter should be very large because the current that flows through the voltmeter should be of negligible value.

**Q21. Draw circuit symbols for**

**a) fixed resistance**

- b) variable resistance
- c) a cell
- d) a battery of three cells
- e) an open switch
- f) a closed switch

Answer:

(a) Fixed resistance



(b) Variable resistance



(c) Cell



(d) Battery of three cells



(e) Open switch



(f) Closed switch

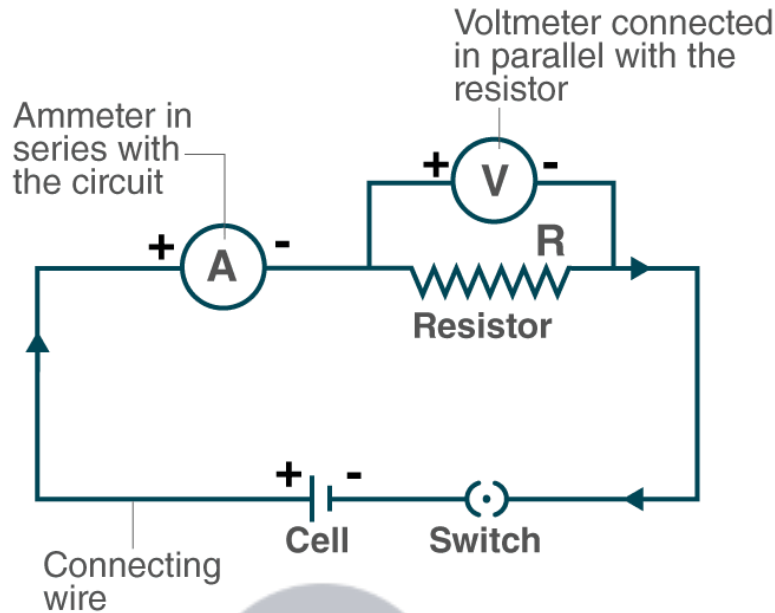


**Q22. What is a circuit diagram? Draw the labelled diagram of an electric circuit comprising of a cell, a resistor, an ammeter, a voltmeter, and a closed switch or closed plug key. Which of the two has a large resistance: an ammeter or a voltmeter?**

**Answer:**

A circuit diagram is defined as a diagram which is used for indicating the different components in an electric circuit and those that are connected with the help of electric symbols.

Also, a voltmeter will have a high resistance than an ammeter.



**Q23.** If the charge on an electron is  $1.6 \times 10^{-19}$  coulombs, how many electrons should pass through a conductor in 1 second to constitute 1 ampere current?

**Answer:**

Given,

Charge moved =  $1.6 \times 10^{-19}$  coulombs

Current,  $I = 1\text{A}$

Time taken,  $t = 1\text{s}$

We know that,

$$I = Q/t$$

$$1 = Q/1$$

$$Q = 1\text{C}$$

We also know that when the charge is  $1.6 \times 10^{-19}$  coulombs, the number of electrons present is 1

Therefore, when a charge of 1 coulomb is present, the number of electrons is given as:

$$(1)/(1.6 \times 10^{-19}) = 0.625 \times 10^{-19} = 6.25 \times 10^8$$

**Q24.** The potential difference across a lamp is 12V. How many joules of electrical energy are changed into heat and light when:

a) a charge of 1C passes through it?

b) a charge of 5C passes through it?

c) a current of 2A flows through it for 10s?

**Answer:**

Given,

Potential difference = 12V

a) Potential difference = (work done)/(charge moved)

Work done = Potential difference  $\times$  charge moved

$$= 12 \times 1 = 12\text{J}$$

Therefore, 12J of electrical energy is converted into heat and light.

b) Work done = potential difference  $\times$  charge moved

$$= 12 \times 5 = 60\text{J}$$

Therefore, 60J of electrical energy is converted into heat and light.

c)  $I = Q/t$

$$Q = I \times t$$

$$= 2 \times 10 = 20\text{C}$$

Work done = potential difference  $\times$  charge moved

$$= 12 \times 20 = 240\text{J}$$

Therefore, 240J of electrical energy is converted into heat and light.

### Lakhmir Singh Physics Class 10 Solutions Page No.12

**Q25. In 10s a charge of 25C leaves a battery and 200J of energy are delivered to an outside circuit as a result.**

**a) What is the potential difference across the battery?**

**b) What current flows from the battery?**

**Answer:**

Given,

Time taken,  $t = 10\text{s}$

Charge moved,  $Q = 25\text{C}$

Energy delivered is work done = 200J

a) Potential difference = (work done)/(charge moved) =  $(200)/(25) = 8\text{V}$

b)  $I = Q/t = 25/10 = 2.5\text{A}$

### Long Answer Type Question

**Q26. a) Define electric current. What is the SI unit of electric current.**

**b) One coulomb of charge flows through any cross-section of a conductor in 1 second. What is the current flowing through the conductor?**

**c) Which instrument is used to measure electric current? How should it be connected in a circuit?**

**d) What is the conventional direction of the flow of electric current? How does it differ from the direction of flow of electrons?**

**e) A flash of lightning carries 10C of charge which flows for 0.01s. What is the current? If the voltage is 10MV, what is the energy?**

**Answer:**

a) The flow of electric charges or electrons in a conductor such as a metal wire is known as electric current. Ampere is the SI unit of electric charges.

b) The current flowing through the conductor when one coulomb of charge flows through any cross-section of a conductor in 1 second is 1 ampere.

c) For the measurement of electric current, an ammeter is used which is connected in series in the circuit.

d) The direction of conventional direction of flow of electric current takes place from the positive terminal of a battery to the negative terminal across the outer circuit. It is different from the direction of flow of electrons because the electrons flow from the negative terminal to the positive terminal.

e) Given,

Charge moved,  $Q = 10\text{C}$

Time taken,  $t = 0.01\text{s}$

We know that,

Current,  $I = Q/t = 10/0.01 = 1000\text{A}$

Potential difference = Work done/ charge moved

Work done = potential difference  $\times$  charge moved =  $10 \times 10^6 \times 10 = 100 \times 10^6 = 100\text{MJ}$

Energy = work done =  $100\text{MJ}$

### Multiple Choice Questions

**Q27. The other name of potential difference is**

- a) Ampereage
- b) Waltage
- c) Voltage
- d) Potential energy

**Answer:**

The other name of potential difference is c) Voltage

**Q28. Which statement/statements is/are correct?**

- a) An ammeter is connected in series in a circuit and a voltmeter is connected in parallel
- b) An ammeter has a high resistance
- c) A voltage has a low resistance

**Answer:**

The correct statement is a) An ammeter is connected in series in a circuit and a voltmeter is connected in parallel

**Q29. Which unit could be used to measure current?**

- a) Watt
- b) Coulomb
- c) Volt
- d) Ampere

**Answer:**

The correct option that could be used to measure current unit is d) Ampere

**Q30. If the current through a flood lamp is 5A, what charge passes in 10 seconds?**

- a) 0.5C
- b) 2C
- c) 5C
- d) 50C

**Answer:**

Given,

Current,  $I = 5\text{A}$

Time taken,  $t = 10\text{s}$

Charge moved,  $Q = ?$

$I = Q/t$

$$Q = I \times t$$

$$Q = 50C$$

Therefore, the correct option is d) 50C

**Q31. If the amount of electric charge passing through a conductor in 10 minutes is 300C, the current flowing is:**

a) 30A

b) 0.3A

c) 0.5A

d) 5A

**Answer:**

Given,

Charge moved = 300C

Time taken = 10 mins

Current = ?

$$I = Q/t$$

Substituting, we get  $I = 0.5A$

Therefore, the correct option is c) 0.5A

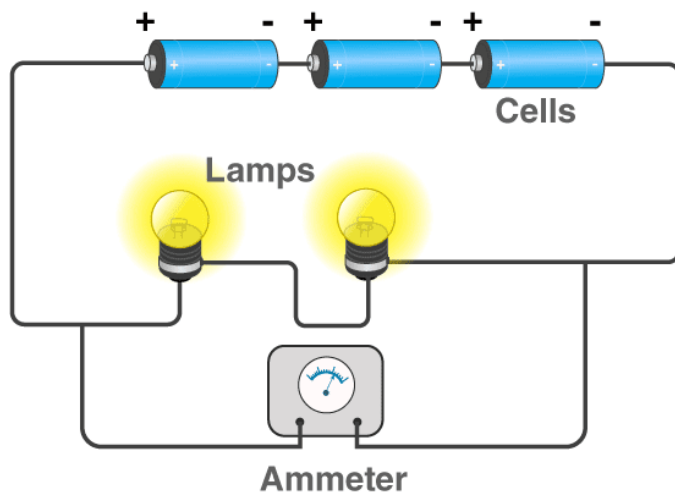
### High Order Thinking Skills

**Q32. A student made an electric circuit shown here to measure the current through two lamps.**

a) Are the lamps in series or parallel?

b) The student has made a mistake in this circuit. What is the mistake?

c) Draw a circuit diagram to show the correct way to connect the circuit. Use the proper circuit symbols in your diagram.

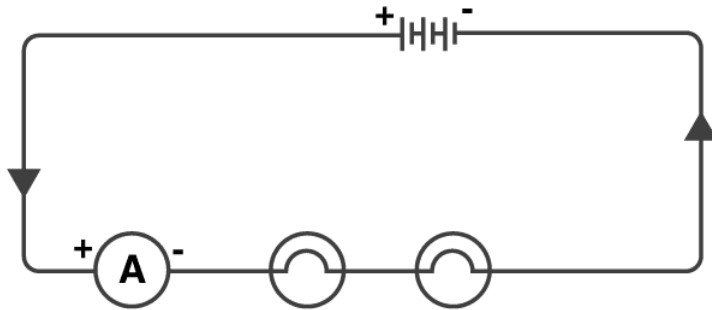


**Answer:**

a) The lamps are arranged in series.

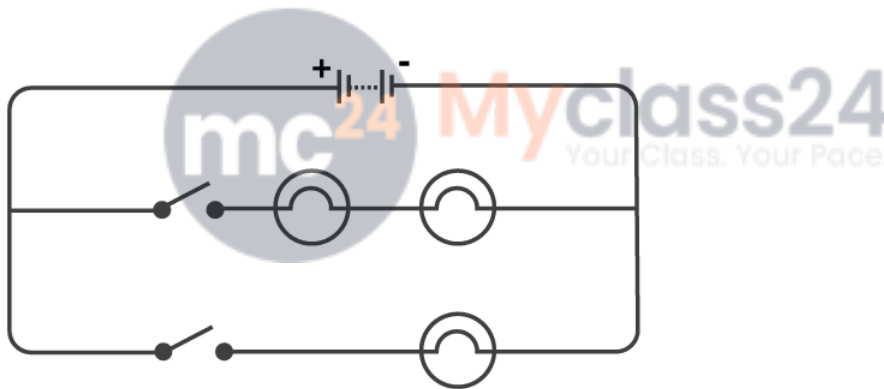
b) The mistake made by the student is that the ammeter is connected in parallel. It should be connected in series.

c)



**Q33. Draw a circuit diagram to show how 3 bulbs can be lit from a battery so that 2 bulbs are controlled by the same switch while the third bulb has its own switch.**

**Answer:**



**Q34. An electric heater is connected to the 230V mains supply. A current of 8A flows through the heater.**

**a) How much charge flows around the circuit each second?**

**b) How much energy is transferred to the heater each second?**

**Answer:**

Given,

Potential difference = 230V

Current,  $I = 8\text{A}$

a)  $I = Q/t$

$8 = Q/1$

$Q = 8 \times 1 = 8\text{C}$

Therefore, the charge flow around the circuit for every second is 8C.

b) We know that energy transferred = work done

Potential difference = work done/charge moved

$230 = \text{work done}/8$

Therefore, work done =  $230 \times 8 = 1840\text{J}$

**Q35. How many electrons are flowing per second past a point in a circuit in which there is a current of 5A?**

**Answer:**

Given,

Current,  $I = 5\text{A}$

Time taken,  $t = 1\text{s}$

We know that,

$I = Q/t$

$Q = I \times t = 5 \times 1 = 5\text{C}$

Number of electrons present in  $1.6 \times 10^{-19}\text{C} = 1$

Number of electrons present in  $5\text{C} = (5)/(1.6 \times 10^{-19}) = 31.25 \times 10^{18}\text{C}$

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### **Very Short Answer Type Questions**

**Q1. Name the law which relates the current in a conductor to the potential difference across its ends.**

**Answer:**

The law that relates the current in a conductor to the potential difference across its ends is Ohm's law.

**Q2. Name the unit of electrical resistance and give its symbol.**

**Answer:**

The unit of electrical resistance is Ohm. Following is the symbol of ohm:  $\Omega$

**Q3. Name the physical quantity whose unit is "ohm".**

**Answer:**

The physical quantity whose unit is "ohm" is electric resistance.

**Q4. What is the general name of the substances having infinitely high electrical resistance?**

**Answer:**

Insulators are the substances that are having infinitely high electrical resistance.

**Q5. Keeping the resistance constant, the potential difference applied across the ends of a component is halved. By how much does the current change?**

**Answer:**

Given,

Resistance = constant

We know that  $V = IR$

When resistance,  $R$  is constant,  $V$  is proportional to  $I$

Therefore, when  $V$  is halved,  $I$  also becomes half.

**Q6. State the factors on which the strength of electric current flowing in a given conductor depends.**

**Answer:**

Following are the factors on which the strength of electric current flowing in a given conductor depends:

a) Voltage (or potential difference) across the ends of the conductor

b) Resistance offered by the conductor

**Q7. Which has less electrical resistance: a thin wire or a thick wire of the same length and same material?**

**Answer:**

A thick wire with the same length and same material as that of a thin wire will have less electrical resistance because the number of electrons present in the thick wire is more than the thin wire.

**Q8. Keeping the potential difference constant, the resistance of a circuit is halved. By how much does the current change?**

**Answer:**

Given,

Potential difference = constant

Also, we know that,

$$V = IR$$

$$I = V/R$$

Given that V is constant, therefore, I will be proportional to  $1/R$ .

Therefore, when R is halved, I also becomes double.

**Q9. A potential difference of 20V is applied across the ends of a resistance of 5 ohms. What current will flow in the resistance?**

**Answer:**

Given,

Potential difference,  $V = 20V$

Resistance,  $R = 5 \text{ Ohms}$

Current,  $I = ?$

We know that,

$$V = IR$$

$$20 = I \times 5$$

$$I = 20/5 = 4A$$

**Q10. A resistance of 20 ohms has a current of 2 amperes flowing in it. What potential difference is there between its ends?**

**Answer:**

Given,

Resistance,  $R = 20 \text{ Ohms}$

Current,  $I = 2 \text{ amp}$

We know that,

$$V = IR$$

$$\text{Therefore, } V = 2 \times 20 = 40V$$

**Q11. A current of 5 amperes flows through a wire whose ends are at a potential difference of 3 volts. Calculate the resistance of the wire.**

**Answer:**

Given,

Current,  $I = 5A$

Potential difference,  $V = 3V$

We know that,  
 $V = IR$   
Therefore,  
 $3 = 5 \times R$   
 $R = 3/5 = 0.6 \text{ Ohms}$

**Q12. Fill in the following blanks with a suitable word:  
Ohm's law states a relation between potential difference and .....**

**Answer:**  
Ohm's law states a relation between potential difference and current.

### Short Answer Type Questions

**Q13. Distinguish between good conductors, resistors, and insulators. Name two conductors, two resistors, and two insulators.**

**Answer:**  
The difference between good conductors, resistors, and insulators are as follows:  
The materials that are having less or low electrical resistance are known as good conductors.  
Copper and iron are the two examples of good conductors.

The materials that are having comparatively high resistance are known as resistors.  
Manganin and nichrome are the two examples of resistors.

The materials that are having infinitely high resistance are known as insulators.  
Wood and rubber are the two examples of insulators.

**Q14. Classify the following into good conductors, resistors, and insulators:  
Rubber, mercury, nichrome, polythene, aluminium, wood, manganin, bakelite, iron, paper, thermocol, metal coin**

**Answer:**  
Conductor: mercury, aluminium, iron, metal coin  
Resistor: manganin, nichrome  
Insulator: rubber, polythene, wood, bakelite, paper, thermocol

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**Q15. What is Ohm's law? Explain how it is used to define the unit of resistance.**

**Answer:**  
Ohm's law helps in understanding the relation between current,  $I$  and potential difference,  $V$ . The law states that at constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends. The mathematical representation of the law is:

Let  $I$  be the current flowing through a conductor and  $V$  be the potential difference across the ends of the conductor. Then from Ohm's law we know that

$$I \propto V$$
$$V \propto I$$
$$V = RI$$

$$R = v/I$$

Where,

R is resistance offered by the conductor which is constant. The unit of resistance is ohm.

If  $V = 1$  volt and  $I = 1$  amp, then  $R = 1/1 = 1$  ohm.

Therefore, 1 ohm is defined as the resistance of a conductor such that when the potential difference of 1 volt is applied to its ends, a current of 1 amp flows through it.

**Q16. a) What is meant by the “resistance of a conductor”? Write the relation between resistance, potential difference, and current.**

**b) When a 12V battery is connected across an unknown resistor, there is a current of 2.5mA in the circuit. Calculate the value of the resistance of the resistor.**

**Answer:**

a) Resistance of a conductor is the property of a conductor. This property helps conductor in opposing the flow of current through it.

Work done = potential difference  $\times$  charge moved

b) Given,

Voltage,  $V = 12$  volt

Current,  $I = 2.5 \times 10^{-3}$  A

We know that,

$$V = IR$$

$$R = V/I$$

$$R = 12/2.5 \times 10^{-3}$$

$$R = 4.8 \times 10^3 \text{ ohm} = 4800 \text{ ohm}$$



**Q17. a) Define the unit of resistance.**

**b) What happens to the resistance as the conductor is made thinner?**

**c) Keeping the potential difference constant, the resistance of a circuit is doubled. By how much does the current change?**

**Answer:**

a) The unit of resistance is ohm. 1 ohm is defined as the resistance offered by the conductor such that when 1 volt potential difference is applied, then 1 ampere current flows through the conductor.

b) As the conductor is made thinner, the resistance of the conductor increases.

c) By keeping the potential difference constant and the resistance is doubled, then

$$V = IR$$

$$I = V/R$$

Then,  $I \propto 1/R$

Therefore, when R is doubled, I becomes half.

**Q18. a) Why do electricians wear rubber hand gloves while working with electricity?**

**b) What potential difference is needed to send a current of 6A through an electrical appliance having a resistance of 40Ω?**

**Answer:**

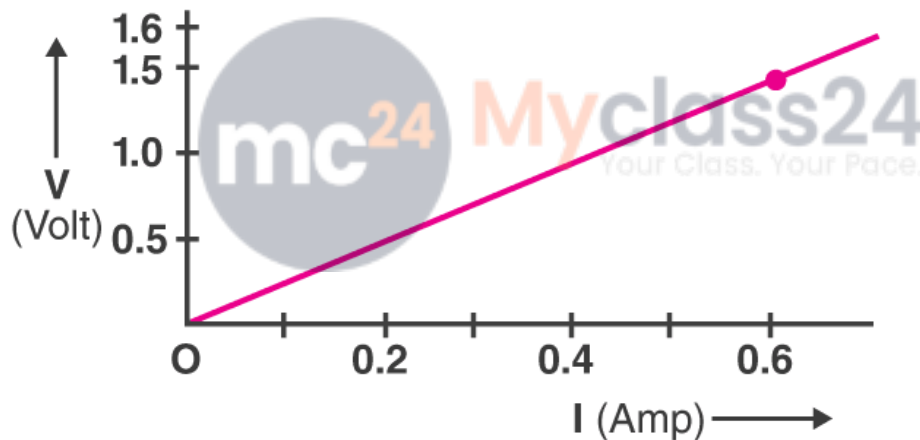
a) We know that rubber is a good insulator or a bad conductor of electricity. This is the reason why electricians wear rubber hand gloves while working with electricity.

b) Given,  
Current,  $I = 6\text{A}$   
Resistance,  $R = 40\Omega$   
We know that,  
 $V = IR$   
 $V = 6 \times 40 = 240\text{V}$

**Q19.** An electric circuit consisting of a 0.5m long nichrome wire XT, an ammeter, a voltmeter, four cells of 1.5V each and a plug key was set up.

a) Draw a diagram of this electric circuit to study the relation between the potential difference maintained between the points 'X' and 'Y' and the electric current flowing through XY.

b) Following graph was plotted between V and I values:



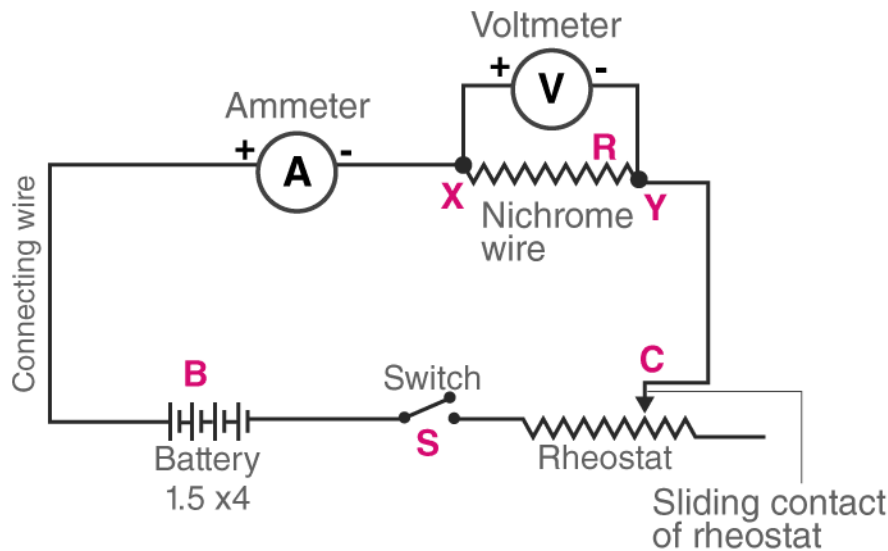
What would be the values of  $1/V$  ratios when the potential difference is 0.8V, 1.2V, and 1.6V respectively?

What conclusion do you draw from these values?

c) What is the resistance of the wire?

Answer:

a)



b) As we see that the graph is a straight line passing through the origin we can say that the current is directly proportional to the potential difference. Therefore, the ratio  $V/I$  remains constant.

From graph,

$$V = 1.5 \text{ volt}$$

$$I = 0.6 \text{ amp}$$

$$\text{Therefore, } V/I = 1.5/0.6 = 2.5\Omega$$

For potential difference of 0.8V, 1.2V, and 1.6V the value of  $V/I$  ratio remains the same that is 2.5 ohm.

c) The resistance of the wire and the ratio of potential difference and the current passing through the wire are equal.

$$R = V/I = 2.5 \Omega$$

### Long Answer Type Questions

Q20. a) What is the ratio of potential difference and current known as?

b) The values of potential difference  $V$  applied across a resistor and the corresponding values of current  $I$  flowing in the resistor are given below:

Potential difference, $V$ in volts	2.5	5.0	10.0	15.0	20.0	25.0
Current, $I$ in amperes	0.1	0.2	0.4	0.6	0.8	1.0

Plot a graph between  $V$  and  $I$  and calculate the resistance of the resistor.

c) Name the law which is illustrated by the above  $V$ - $I$  graph

d) Write down the formula which states the relation between potential difference, current, and resistance

e) The potential difference between the terminals of an electric iron is 240V and the current is 5.0A. What is the resistance of the electric iron?

Answer:

- a) The ratio of potential difference and the current is known as resistance.
- c) The law illustrated by the V-I graph is Ohm's law.
- d) Following is the formula that states the relation between potential difference, current, and resistance:  
Potential difference = Current  $\times$  Resistance
- e) Given,  
Voltage,  $V = 240$  volt  
Current,  $I = 5$  amp  
We know that  
 $V = IR$   
 $240 = 5 \times R$   
 $R = 240/5 = 48$  ohm

### Multiple Choice Questions

**Q21. The potential difference across a  $3\Omega$  resistor is 6V. The current flowing in the resistor will be:**

- a)  $\frac{1}{2}$  A  
b) 1A  
c) 2A  
d) 6A

**Answer:**

The correct option is c) 2A.



**Q22. A car headlight bulb working on a 12V car battery draws a current of 0.5A. The resistance of the light bulb is:**

- a)  $0.5\Omega$   
b)  $6\Omega$   
c)  $12\Omega$   
d)  $24\Omega$

**Answer:**

The correct option is d)  $24\Omega$

**Q23. An electrical appliance has a resistance of  $25\Omega$ . When this electrical appliance is connected to a  $230\Omega$  supply line, the current passing through it will be:**

- a) 0.92A  
b) 2.9A  
c) 9.2A  
d) 92A

**Answer:**

The correct option is c) 9.2A

**Q24. When a  $4\Omega$  resistor is connected across the terminals of a 12V battery, the number of coulombs passing through the resistor per second is:**

- a) 0.3

- b) 3
- c) 4
- d) 12

**Answer:**

The correct option is b) 3

**Q25. Ohm's law gives a relation between:**

- a) Current and resistance
- b) Resistance and potential difference
- c) Potential difference and electric charge
- d) Current and potential difference

**Answer:**

The correct option that gives the relation in Ohm's law is d) current and potential difference.

**Q26. The unit of electrical resistance is:**

- a) Ampere
- b) Volt
- c) Coulomb
- d) Ohm

**Answer:**

The correct option for the unit of electrical resistance is d) Ohm.

**Q27. The substance having infinitely high electrical resistance is called:**

- a) Conductor
- b) Resistor
- c) Superconductor
- d) Insulator

**Answer:**

The correct option for the substance with infinitely high electrical resistance is called d) insulator.

**Q28. Keeping the potential difference constant, the resistance of a circuit is doubled. The current will become:**

- a) Double
- b) Half
- c) One-fourth
- d) Four times

**Answer:**

When the potential difference is constant and the resistance of a circuit is doubled, the current becomes half. Therefore, the correct option is b) half.

**Q29. Keeping the potential difference constant, the resistance of a circuit is halved. The current will become:**

- a) One-fourth
- b) Four times
- c) Half
- d) Double

**Answer:**

When the potential difference is constant and the resistance of a circuit is halved, then the current will be doubled.

Therefore, the correct option is d) doubled.

### High Order Thinking Skills

**Q30. An electric room heater draws a current of 2.4A from the 120V supply line. What current will this room heater draw when connected to 240V supply line?**

**Answer:**

First case:

Given,

Current,  $I = 2.4\text{amp}$

Voltage,  $V = 120\text{V}$

We know that,

$$V = IR$$

$$120 = 2.4 \times R$$

$$R = 120/2.4 = 50 \text{ Ohm}$$

Second case:

Given,

Voltage,  $V = 240 \text{ volt}$

Resistance,  $r = 50 \text{ Ohm}$

We know that,

$$V = IR$$

$$240 = I \times 50$$

$$I = 4.8 \text{ amp}$$



**Q31. Name the electrical property of a material whose symbol is “omega”.**

**Answer:**

The electrical property resistance of the material has the symbol “omega”.

**Q32. The graph between V and I for a conductor is a straight line passing through the origin.**

**a) Which law is illustrated by such a graph?**

**b) What should remain constant in a statement of this law?**

**Answer:**

a) Ohm's law is illustrated by the V-I graph in which the straight line is passing through the origin.

b) For Ohm's law to hold good in the given situation, temperature must remain constant.

**Q33. A potential difference of 10V is needed to make a current of 0.02A flow through a wire. What potential difference is needed to make a current of 250mA flow through the same wire?**

**Answer:**

First case,

Given,

Current,  $I = 0.02\text{A}$

Voltage,  $V = 10 \text{ volt}$

We know that,

$$V = IR$$

$$10 = 0.02 \times R$$

$$R = 10/0.02 = 500 \text{ Ohms}$$

Second case,

$$\text{Current, } I = 250 \times 10^{-3} \text{ A}$$

$$\text{Resistance, } R = 500 \text{ Ohm}$$

$$V = IR$$

$$V = 250 \times 10^{-3} \times 500 = 125 \text{ volt}$$

**Q34. A current of 200mA flows through a 4kΩ resistor. What is the potential difference across the resistor?**

**Answer:**

Given,

$$\text{Current, } I = 200\text{mA} = 0.2\text{A}$$

$$\text{Resistance, } R = 4\text{k}\Omega = 4 \times 10^3 \text{ Ohm} = 4000 \text{ Ohm}$$

We know that,

$$V = IR$$

$$V = 0.2 \times 4000$$

$$V = 800 \text{ volt}$$



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### **Very Short Answer Type Questions**

**Q1. What happens to the resistance as the conductor is made thicker?**

**Answer:**

As the thickness of the conductor is increased, the resistance of the conductor decreases. This is because:

$$R = (\rho l)/(A)$$

Where,

R is the resistance

l is the length of the conductor

A is the area of cross section of the conductor

And  $\rho$  is the resistivity

Since, area is directly proportional to the radius of the wire, increase in cross-sectional area or the thickness will result in decrease in resistance and current flow will be more.

**Q2. If the length of a wire is doubled by taking more of wire, what happens to its resistance?**

**Answer:**

The resistance of the wire becomes double when the length of the wire is doubled. This is because length is directly proportional to the resistance while area of cross section is inversely proportional to the resistance.

$$\text{Also, we know that } R = (\rho l)/(A)$$

Therefore, if l becomes double, then R becomes 2R.

**Q3. On what factors does the resistance of a conductor depend?**

**Answer:**

Following are the factors on which the resistance of a conductor depends:

- Length of the conductor
- Area of cross-section of the conductor
- Temperature of the conductor
- Nature of the material used in the construction of the conductor

**Q4. Name the material which is the best conductor of electricity.**

**Answer:**

Silver metal is the best conductor of electricity. This is because the electrons of silver metal are available for free movement when compared to the other metals.

**Q5. Which among iron and mercury is a better conductor of electricity?**

**Answer:**

Among iron and mercury, iron is a better conductor of electricity. The resistance of iron is less than mercury and we know that resistance is inversely proportional to the current. Therefore, iron is better as a conductor of electricity when compared to the mercury.

**Q6. Why are copper and aluminum wires usually used for electricity transmission?**

**Answer:**

Copper and aluminum wires are used for electricity transmission because they have low resistivities.

**Q7. Name the material which is used for making the heating element of an electric iron.**

**Answer:**

Nichrome is the material which is used for making the heating element of an electric iron.

**Q8. What is nichrome? State its one use.**

**Answer:**

Nichrome is a alloy material obtained from nickel, chromium, manganese, and iron. The resistivity of nichrome is 60 times more than that of copper. It is used in making of the elements that are used for heating in most of the electrical heating appliances.

**Q9. Give two reasons why nichrome alloy is used for making the heating elements of electrical appliances.**

**Answer:**

Following are the two reasons why nichrome alloy is used for making the heating elements of electrical appliances:

- The resistivity of nichrome is very high.
- Nichrome doesn't undergo oxidation at high temperatures.

**Q10. Why are the coils of electric iron and electric toasters made of an alloy rather than a pure metal?**

**Answer:**

The coils of an electric iron and electric toasters are made of an alloy rather than a pure metal because:

- The resistivity of an alloy is higher when compared to the pure metal
- Alloys don't undergo oxidation at high temperatures

**Q11. Which has more resistance:**

- a) A long piece of nichrome wire or a short one?
- b) A thick piece of nichrome wire or a thin piece?

**Answer:**

Following has more resistance:

- a) A long piece of nichrome wire
- b) A thin piece of nichrome wire

**Q12. a) How does the resistance of a pure metal change if its temperature decreases?  
b) How does the presence of impurities in a metal affect its resistance?**

**Answer:**

- a) As the temperature decreases, the resistance of the material also decreases.
- b) Presence of impurities in a metal increases the resistance of the material.

**Q13. Fill in the following blanks with suitable words:**

Resistance is measured in ..... the resistance of a wire increases as the length..... as the temperature ..... and as the cross-sectional area .....

**Answer:**

Ohm, increases, increases, and decreases.

### Short Answer Type Questions

**Q14. a) What do you understand by the “resistivity” of a substance?**

**b) A wire is 1.0m long, 0.2 mm in a diameter and the has a resistance of 10Ω. Calculate the resistivity of its material?**

**Answer:**

a) Resistivity is defined as the characteristic property of a substance which is dependent on the nature of the substance and the temperature of the substance used in the conductor. It is numerically equal to the resistance between the opposite faces of a cube with sides 1m.

b) Given,

$$l = 1\text{m}$$

$$r = d/2 = 0.2/2 = 0.1\text{mm} = 0.0001\text{m}$$

$$R = 10\text{ohm}$$

We know that,

$$R = \rho l/A$$

$$\rho = RA/l$$

$$= 31.4 \times 10^{-8} \text{ohm}$$

**Q15. a) Write down an expression for the resistance of a metallic wire in terms of the resistivity.**

**b) What will be the resistance of a metal wire of length 2 metres and area of cross-section  $1.55 \times 10^{-6} \text{m}^2$ , if the resistivity of the metal be  $2.8 \times 10^{-8} \Omega \text{m}$ ?**

**Answer:**

a) Following is the expression for the resistance of a metallic wire in terms of the resistivity:

$$R = \rho l/A$$

Where,

R is the resistance of the wire

$\rho$  is the resistivity of the wire

A is the cross-sectional area of the wire  
l is the length of the wire

b) Given,

$$l = 2\text{m}$$

$$A = 1.55 \times 10^{-6}\text{m}^2$$

$$\rho = 2.8 \times 10^{-8}\Omega\text{m}$$

We know that,

$$R = \rho l/A$$

$$= 0.036 \text{ ohm}$$

**Q16. a) Give two examples of substances which are good conductors of electricity. Why do you think they are good conductors of electricity?**

**b) Calculate the resistance of a copper wire 1.0km long and 0.50mm diameter if the resistivity of copper is  $1.7 \times 10^{-8}\Omega\text{m}$ .**

**Answer:**

a) Two examples of substances that are good conductors of electricity are silver and copper. These two metals have free electrons that are available for conduction.

b) Given,

$$l = 1\text{km} = 1000\text{m}$$

$$r = d/2$$

$$= 0.5/2\text{mm}$$

$$= 0.25\text{mm}$$

$$= 0.25 \times 10^{-3}\text{m}$$

$$\rho = 1.7 \times 10^{-8}\Omega\text{m}$$

We know that,

$$R = \rho l/A$$

$$R = 86.6\Omega$$



**Q17. Will current flow more easily through a thick wire or a thin wire of the same material when connected to the same source? Give reason for your answer.**

**Answer:**

The flow of current will be easy in a thick wire than the thin wire because the resistance of the thick wire will be lesser than the thin wire.

**Q18. How does the resistance of a conductor depend on:**

**a) length of the conductor**

**b) area of cross-section of the conductor**

**c) temperature of the conductor**

**Answer:**

a) Resistance of a conductor is dependent on the length of the conductor. As the length of the material increases, the resistance of the material decreases and vice versa.

b) Resistance of a conductor is dependent on the area of cross-section of the conductor. As the cross-section area increases, the resistance of the material decreases and vice versa.

c) As the temperature increases, the resistance of the material also increases.

**Q19. a) Give one example to show how the resistance depends on the nature of material of the conductor**  
**b) Calculate the resistance of an aluminum cable of length 10km and diameter 2.0mm if the resistivity of aluminum is  $2.7 \times 10^{-8} \Omega \text{m}$ .**

**Answer:**

a) Let us consider two wires with same length and diameter. Let these two wires be of copper metal and nichrome alloy. We know that the resistance of nichrome wire is 60 times more than that of the copper wire. Therefore, it is understood that the resistance depends on the nature of the material used in the conductor.

b) Given,

$$l = 10\text{km} = 10000\text{m}$$

$$d = 2\text{mm}$$

$$r = 1\text{mm} = 10^{-3}\text{m}$$

$$\rho = 2.7 \times 10^{-8} \Omega \text{m}$$

We know that,

$$R = \rho l / A$$

Substituting the values we get,

$$R = 86 \Omega$$

**Q20. What would be the effect on the resistance of a metal wire of:**

**a) increasing its length**

**b) increasing its diameter**

**c) increasing its temperature**

**Answer:**

Following are the effects on the resistance of a metal wire when: *Class. Your Pace.*

a) As the length is increased, the resistance will increase

b) As the diameter is increased, the resistance will decrease

c) As the temperature is increased, the resistance will increase

**Q21. How does the resistance of a wire vary with its:**

**a) area of cross-section?**

**b) diameter?**

**Answer:**

a) When the resistance of a wire is varied, the area of cross-section increases, thereby reducing the resistance

b) When the resistance of a wire is varied, the diameter of the material is increased, thereby reducing the resistance

**Q22. How does the resistance of a wire change when:**

**a) its length is tripled?**

**b) its diameter is tripled?**

**c) its material is changed to one whose resistivity is three times?**

**Answer:**

We know that,

$$R = \rho l / A$$

a)  $l$  becomes  $3l$

$$R' = \rho 3l / A$$

$$= 3R$$

Therefore, resistance gets tripled

b)  $d$  becomes  $3d$

$$R = \rho l/A$$

$$R = \rho l/\pi r^2$$

$$= \rho l/\pi (d/2)^2$$

$$R' = R/9$$

Therefore, resistance becomes  $1/9^{\text{th}}$

c)  $\rho = 3\rho$

$$R' = 3\rho l/A$$

$$= 3R$$

Therefore, resistance becomes 3 times.

**Q23.** Calculate the area of cross-section of a wire if its length is 1.0m, its resistance is  $23\Omega$ , and the resistivity of the material of the wire is  $1.84 \times 10^{-8} \Omega\text{m}$ .

**Answer:**

Given,

$$l = 1.0\text{m}$$

$$R = 23 \text{ ohm}$$

$$\rho = 1.84 \times 10^{-8} \Omega\text{m}$$

We have,

$$R = \rho l/A$$

$$23 = 1.84 \times 10^{-8} \times l/A$$

$$A = 8 \times 10^{-8} \text{m}^2$$



### Long Answer Type Questions

**Q24. a)** Define resistivity. Write an expression for the resistivity of a substance. Give the meaning of each symbol.

**b)** State the SI unit of resistivity.

**c)** Distinguish between resistance and resistivity.

**d)** Name two factors on which the resistivity of a substance depends and two factors on which it does not depend.

**e)** The resistance of a metal wire of length 1m is  $26\Omega$  at  $20^\circ\text{C}$ . if the diameter of the wire is  $0.3\text{mm}$ , what will be the resistivity of the metal at that temperature?

**Answer:**

a) Resistivity is defined as:

$$\rho = R \times A/l$$

where,

$R$  is the resistance of the conductor

$A$  is the cross-sectional area of the conductor

$l$  is the length of the conductor

b) The SI unit of resistivity is Ohm-meter

c) Following are the differences between resistance and resistivity:

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Resistance	Resistivity
Resistance is the property of the conductor	Resistivity is the property of the material used in the conductor
In a conductor, resistance is defined as the opposing force to the flow of electric current	Resistivity is the opposing force of the flow of electric current in a rod such that the length of the rod is 1m and the cross-sectional area of the rod is 1m <sup>2</sup>
Parameters such as length, nature of the material used in a conductor, and thickness of the conductor determine the resistance	Parameters such as length and thickness do not determine the resistivity of the conductor

d) Nature of the material and the temperature of the material determine the resistivity of a substance. Resistivity is independent of the length and the thickness of the conductor.

e) Given,

$$l = 1\text{m}$$

$$R = 26\Omega$$

$$r = d/2$$

$$= 0.3/2$$

$$= 0.15\text{mm}$$

$$= 0.15 \times 10^{-3}\text{m}$$

We know that,

$$\rho = R \times A/l$$

$$= 1.83 \times 10^{-6}\Omega\text{m}$$



### Multiple Choice Questions

**Q25. The resistance of a wire of length 300m and cross-section area 1.0mm<sup>2</sup> made of material of resistivity  $1.0 \times 10^{-7} \Omega\text{m}$  is:**

a) 2Ω

b) 3Ω

c) 20Ω

d) 30Ω

**Answer:**

The correct option is d) 30Ω

We know that

$$R = \rho l/A$$

Substituting the values in the above equation we get 30Ω.

**Q26. When the diameter of a wire is doubled, its resistance becomes:**

a) Double

b) Four times

c) One-half

d) One-fourth

**Answer:**

The correct option is d) one-fourth

We know that

$$R = \rho l/A$$

Therefore, when the diameter of the wire is doubled, the resistance becomes one-fourth of the actual value.

**Q27. If the resistance of a certain copper wire is  $1\ \Omega$ , then the resistance of a similar nichrome wire will be about:**

- a)  $25\ \Omega$
- b)  $30\ \Omega$
- c)  $60\ \Omega$
- d)  $45\ \Omega$

**Answer:**

The correct option is c)  $60\ \Omega$ .

The resistance of nichrome is  $60\ \Omega$  when the resistance of a copper wire is  $1\ \Omega$ .

**Q28. If the diameter of a resistance wire is halved, then its resistance becomes:**

- a) Four times
- b) Half
- c) One-fourth
- d) Two times

**Answer:**

The correct option is a) four times.

When the diameter of a resistance wire is halved, the resistance becomes four times.

**Q29. The resistivity of a certain material is  $0.6\ \Omega\text{m}$ . The material is most likely to be:**

- a) An insulator
- b) A superconductor
- c) A conductor
- d) A semiconductor

**Answer:**

The correct option is d) A semiconductor

**Q30. When the area of cross-section of a conductor is doubled, its resistance becomes:**

- a) Double
- b) Half
- c) Four times
- d) One-fourth

**Answer:**

The correct option is b) half

**Q31. The resistivity of copper metal depends on only one of the following factors. This factor is:**

- a) Length
- b) Thickness
- c) Temperature
- d) Area of cross-section

**Answer:**

The correct option is c) Temperature

**Q32. If the area of cross-section of a resistance wire is halved, then its resistance becomes:**

- a) One-half
- b) 2 times
- c) One-fourth
- d) 4 times

**Answer:**

The correct option is b) 2 times.

### High Order Thinking Skills

**Q33. A piece of wire of resistance  $20\Omega$  is drawn out so that its length is increased to twice its original length. Calculate the resistance of the wire in the new situation.**

**Answer:**

We know that,

$$R = \rho l/A$$

Given that,

$$l' = 2l$$

$$A' = A/2$$

And  $\rho' = \rho$  (as the material of the wire is the same)

Therefore,

$$R' = \rho' l'/A'$$

$$= \rho 2l/(A/2)$$

$$= 4\rho l/A$$

$$= 4R$$

Therefore,  $R' = 4 \times 20 = 80\Omega$



**Q34. The electrical resistivities of three materials P, Q, and R are given below:**

$$P = 2.3 \times 10^{-8} \Omega\text{m}$$

$$Q = 2.63 \times 10^{-8} \Omega\text{m}$$

$$R = 1.0 \times 10^{-8} \Omega\text{m}$$

**Which material will you use for making?**

- a) Electric wires
- b) Handle for soldering iron
- c) Solar cells

**Give reasons for your choices.**

**Answer:**

a) For making of the electric wires,  $Q = 2.63 \times 10^{-8} \Omega\text{m}$  can be used as this material has a very low resistivity

b) For making of the handle for soldering iron,  $R = 1.0 \times 10^{-8} \Omega\text{m}$  can be used as this has a very high resistivity

c) For making of the solar cells,  $P = 2.3 \times 10^{-8} \Omega\text{m}$  can be used as this material is a semiconductor

**Q35. The electrical resistivities of four materials A, B, C, and D are given below:**

$$A = 110 \times 10^{-8} \Omega\text{m}$$

$$B = 1.0 \times 10^{-8} \Omega\text{m}$$

$$C = 10.0 \times 10^{-8} \Omega\text{m}$$

$$D = 2.3 \times 10^{-8} \Omega\text{m}$$

**Which material is:**

- a) Good conductor
- b) Resistor
- c) Insulator
- d) Semiconductor

**Answer:**

a) Good conductor is  $C = 10.0 \times 10^{-8} \Omega m$

b) Resistor is  $A = 110 \times 10^{-8} \Omega m$

c) Insulator is  $B = 1.0 \times 10^{10} \Omega m$

d) Semiconductor is  $D = 2.3 \times 10^{-3} \Omega m$

**Q36. The electrical resistivities of five substances A, B, C, S, and E are given below:**

**A =  $5.20 \times 10^{-8} \Omega m$**

**B =  $110 \times 10^{-8} \Omega m$**

**C =  $2.60 \times 10^{-8} \Omega m$**

**D =  $10.0 \times 10^{-8} \Omega m$**

**E =  $1.70 \times 10^{-8} \Omega m$**

- a) Which substance is the best conductor of electricity? Why?
- b) Which one is a better conductor: A or C? Why?
- c) Which substance would you advice to be used for making heating elements of electric irons? Why?
- d) Which two substances should be used for making electric wires? Why?

**Answer:**

a) E is the best conductor of electricity because it has the least resistivity

b) C is a better conductor between A and C because the resistivity of C is lesser than that of A

c) B can be used in the making of the heating elements of an electric iron because the resistivity of B is the highest

d) C and E are the two substances that should be used for making electric wires because they have low electrical resistivities

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### **Very Short Answer Type Questions**

**Q1. Give the law of combination of resistances in series.**

**Answer:**

The law of combination of resistances in series states that the combined resistance of any number of resistance that are connected in series is equal to the individual resistances.

**Q2. If five resistances each of value 0.2 ohm are connected in series, what will be the resultant resistance?**

**Answer:**

According to the law of combination of resistances in series,

$$R = R_1 + R_2 + R_3 + R_4 + R_5$$

$$R = 0.2 + 0.2 + 0.2 + 0.2 + 0.2 = 1 \text{ ohm}$$

**Q3. State the law of combination of resistance in parallel.**

**Answer:**

According to the law of combination of resistance in parallel, the reciprocal of the combined resistance of a number of resistances connected in parallel is equal to the sum of the reciprocals of all the individual resistances.

**Q4. If 3 resistances of 3 ohm each are connected in parallel, what will be their total resistance?**

**Answer:**

$$R_1 = R_2 = R_3 = 3\Omega$$

$$1/R = 1/R_1 + 1/R_2 + 1/R_3$$

$$= 1/3 + 1/3 + 1/3$$

$$= 3/3$$

$$= 1$$

Therefore,  $R = 1\Omega$

**Q5. How should the two resistances of 2 ohms each be connected so as to produce an equivalent resistance of 1 ohm?**

**Answer:**

To produce an equivalent resistance of 1 ohm, the two resistances of 2 ohms must be connected in parallel.

**Q6. Two resistances X and Y are connected turn by turn: a) in parallel b) in series. In which case the resultant resistance will be less than either of the individual resistances?**

**Answer:**

When the two resistances X and Y are connected in parallel, the resultant resistance will be less than either of the individual resistances.

**Q7. What possible values of resultant resistance one can get by combining two resistances, one of value 2 ohm and the other 6 ohm?**

**Answer:**

$$R_1 = 2 \text{ Ohm}$$

$$R_2 = 6 \text{ Ohm}$$

Let case 1 be parallel combination

$$1/R = 1/R_1 + 1/R_2$$

$$1/R = 1/2 + 1/6 = 4/6$$

$$R = 6/4 = 1.5 \text{ ohm}$$

Let case 2 be series combination

$$R = R_1 + R_2$$

$$= 2 + 6 = 8 \text{ ohm}$$

**Q8. Show how you would connect two 4 ohm resistors to produce a combined resistance of**

**a) 2 ohms**

**b) 8 ohms**

**Answer:**

a) By connecting in parallel, then

$$1/R = 1/4 + 1/4 = 2/4 = 1/2$$

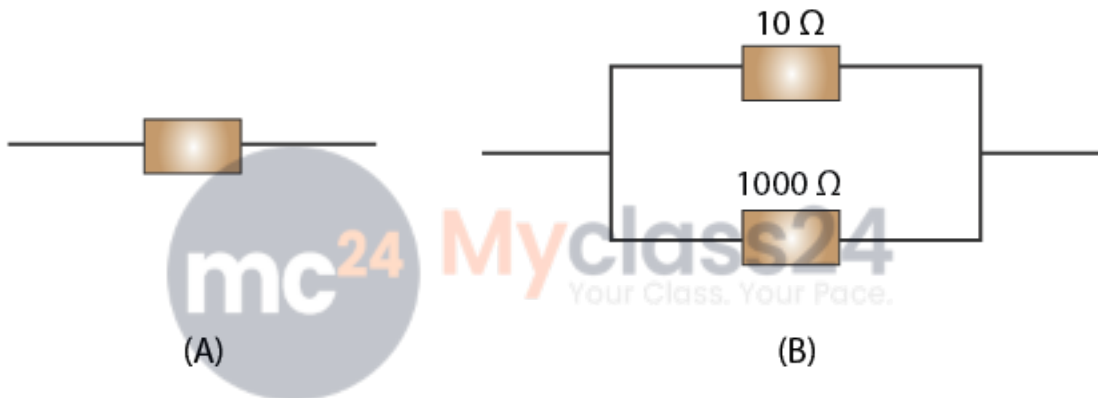
Therefore,  $R = 2$  ohm

b) By connecting in series, then

$$R = 4 + 4 = 8$$

Therefore,  $R = 8$  ohm

**Q9. Which of the following resistor arrangement, A or B, has the lower combined resistance?**



**Answer:**

When the resistance arrangement from A is combined with the resistance arrangement B, following is calculated:

$$1/R = 1/10 + 1/1000$$

$$= (100+1)/1000$$

$$R = 1000/101$$

$$R = 9.9 \text{ Ohm}$$

Therefore, the arrangement B has a lower combined resistance.

**Q10. A wire that has resistance R is cut into two equal pieces. The two parts are joined in parallel. What is the resistance of the combination?**

**Answer:**

Given that the resistance of each part is:  $R/2$

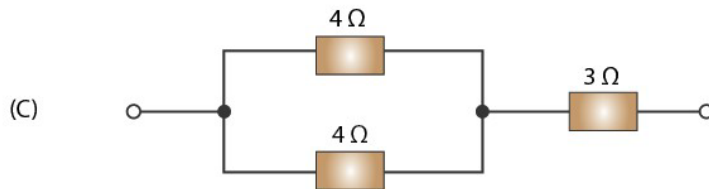
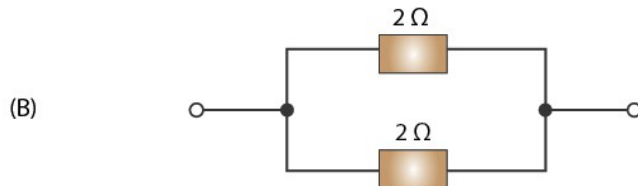
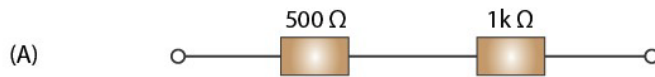
Let resultant resistance be  $R'$

$$1/R' = 2/R + 2/R$$

$$R' = R/4$$

**Q11. Calculate the combined resistance in each case:**

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**Answer:**

a) Given,  
 $R_1 = 500\Omega$   
 $R_2 = 1000\Omega$   
From the above circuit diagram,  
 $R = R_1 + R_2$   
 $= 500 + 1000$   
 $= 1500\Omega$

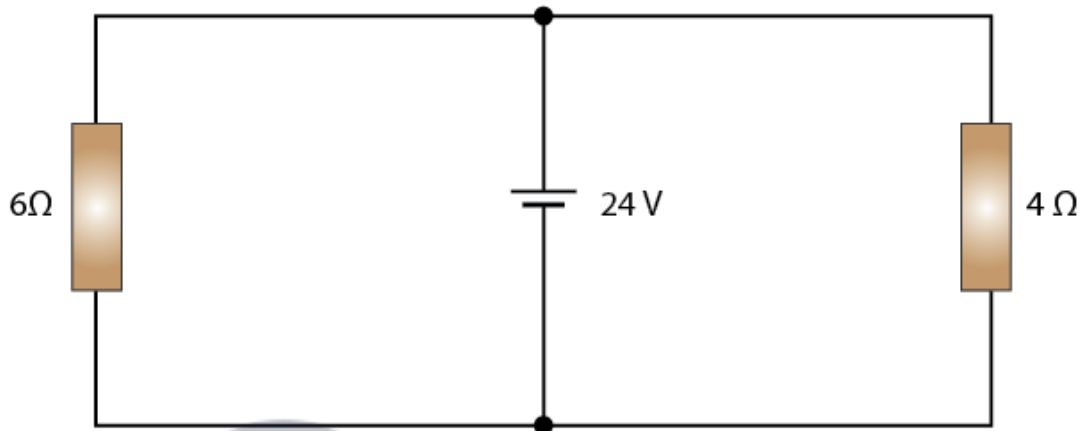
b) Given,  
 $R_1 = 2\Omega$   
 $R_2 = 2\Omega$   
From the given circuit diagram,  
 $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$   
 $\frac{1}{R} = \frac{1}{2} + \frac{1}{2}$   
 $R = 1\Omega$

c) Given,  
 $R_1 = 4\Omega$   
 $R_2 = 4\Omega$   
 $R_3 = 3\Omega$   
From the given circuit diagram,  
 $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$   
 $\frac{1}{R} = \frac{1}{4} + \frac{1}{4}$   
 $R = 2\Omega$   
Total resistance =  $R + R_3$   
 $= 2 + 3$



= 5  $\Omega$

**Q12. Find the current in each resistor in the circuit shown below:**



**Answer:**

Given,

$R_1 = 6\Omega$

$R_2 = 4\Omega$

$V = 24V$

From the given circuit diagram we know that the two resistances are connected in parallel

Therefore,

Current across  $R_1 = I_1 = V/R_1 = 24/6 = 4\text{amp}$

Current across  $R_2 = I_2 = V/R_2 = 24/4 = 6\text{amp}$

### Short Answer Type Questions

**Q13. Explain with diagrams what is meant by the “series combination” and “parallel combination” of resistance. In which case the resultant resistance is:**

a) less

b) more than either of the individual resistance?

**Answer:**

Series combination: When two or more resistances are connected end to end, these resistances are said to be connected in series combination. The sum of all the individual resistances is equal to the any number of resistances that are connected in series.

The resultant resistance is usually more than either of the individual resistances.

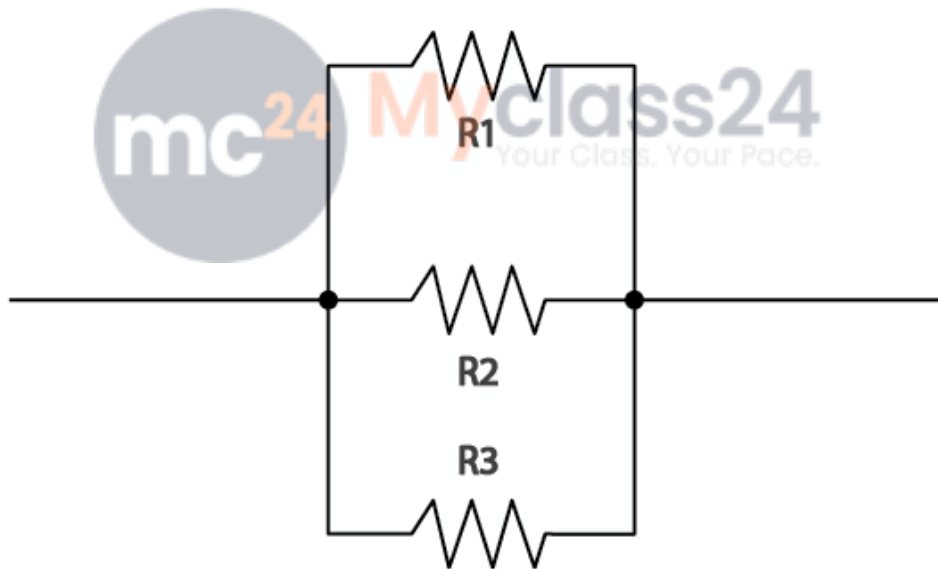
$R = R_1 + R_2 + \dots$



Parallel combination: When two or more resistances are connected between the same two points, these resistances are said to be connected in parallel combination. The sum of all the individual resistances is equal to the reciprocal of the resistances that are connected in parallel.

The resultant resistance is usually less than either of the individual resistances.

$$1/R = 1/R_1 + 1/R_2 + \dots$$



**Q14. A battery of 9V is connected in series with resistors of 0.2Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω, and 12 Ω. How much current would flow through the 12 Ω resistor?**

**Answer:**

Given,

$$R_1 = 0.2 \Omega$$

$$R_2 = 0.3 \Omega$$

$$R_3 = 0.4 \Omega$$

$$R_4 = 0.5 \Omega$$

$$R_5 = 12 \Omega$$

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$$V = 9V$$

Therefore, the resultant resistance is given as:

$$\begin{aligned} R &= R_1 + R_2 + R_3 + R_4 + R_5 \\ &= 0.2 + 0.3 + 0.4 + 0.5 + 12 \\ &= 13.4 \Omega \end{aligned}$$

The current flow through  $12 \Omega$  resistance is given as:  $V/R$

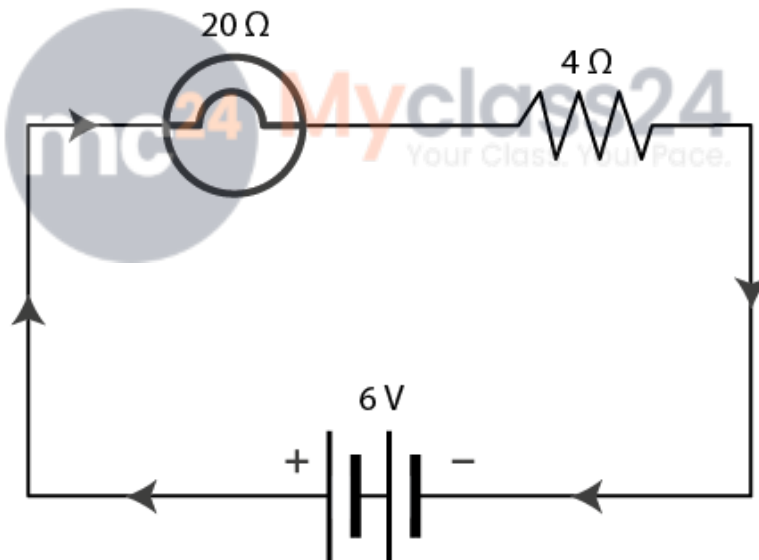
$$\text{Therefore, } I = 9/13.4$$

$$I = 0.67\text{amp}$$

**Q15. An electric bulb of resistance  $20 \Omega$  and a resistance wire of  $4 \Omega$  are connected in series with a  $6V$  battery. Draw the circuit diagram and calculate:**

- total resistance of the circuit**
- current through the circuit**
- potential difference across the electric bulb**
- potential difference across the resistance wire**

**Answer:**



a) Total resistance of the circuit is given as:

$$R = R_1 + R_2 = 20 + 4 = 24\Omega$$

b) We know that,

$$V = IR$$

Therefore,

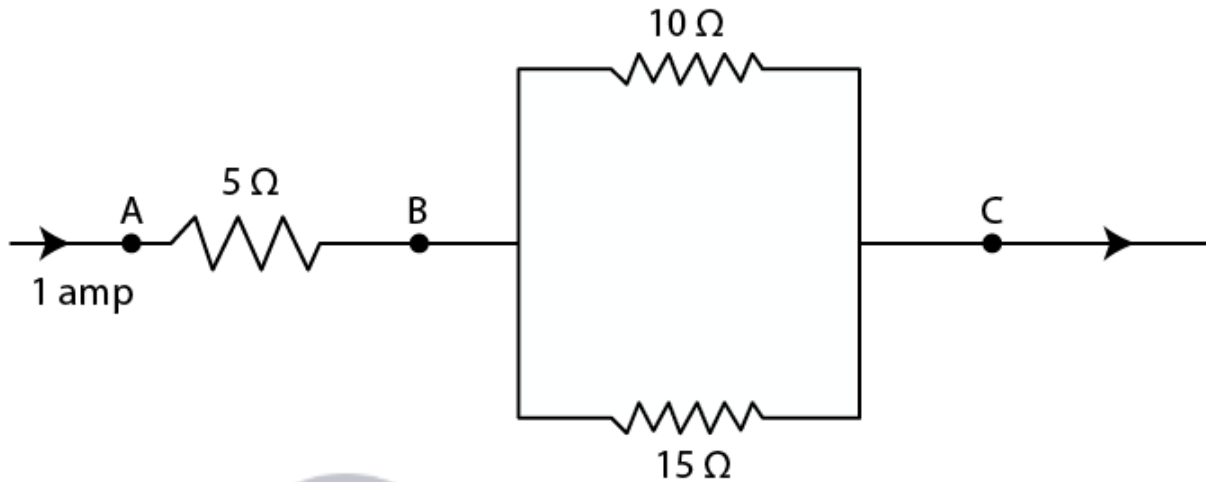
$$6 = 24I$$

$$I = 6/24 = 0.25\text{amp}$$

c) Potential difference across the bulb =  $IR_1 = 0.25 \times 20 = 5V$

d) Potential difference across the resistance wire =  $IR_2 = 0.25 \times 4 = 1V$

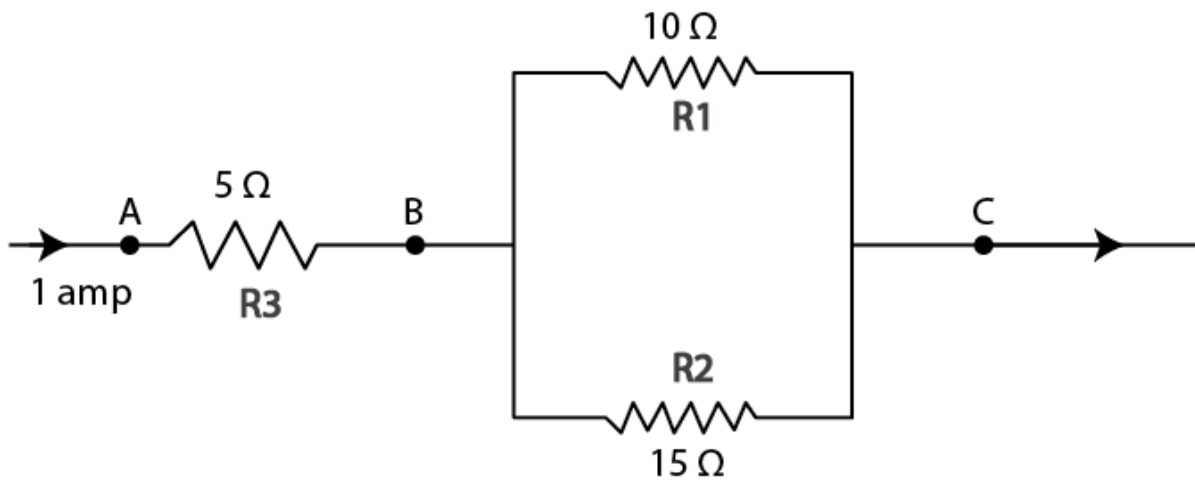
Q16. Three resistors are connected as shown in the diagram:



Through the resistor  $5\Omega$  a current of 1 ampere is flowing.

- What is the current through the other two resistors?
- What is the potential difference across AB and across AC?
- What is the total resistance?

Answer:



From the above circuit diagram;

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a) Total current,  $I$  entering the resistances  $R_1$  and  $R_2$  that are arranged in parallel combination is 1 amp. Let  $I_1$  be the current flow through  $R_1$  and  $I_2$  be the current flow through  $R_2$ .

$$\begin{aligned} I_1 &= (IR_2)/(R_1 + R_2) \\ &= (1 \times 15)/(10 + 15) \\ &= 0.6A \end{aligned}$$

$$\begin{aligned} I_2 &= (IR_1)/(R_1 + R_2) \\ &= (1 \times 10)/(10 + 15) \\ &= 0.4A \end{aligned}$$

b) Potential difference across  $AB = IR_3 = 1 \times 5 = 5V$

Equivalent resistance between  $B$  and  $C$  is

$$\begin{aligned} 1/R' &= 1/R_1 + 1/R_2 \\ &= 1/10 + 1/15 \\ &= 5/30 \end{aligned}$$

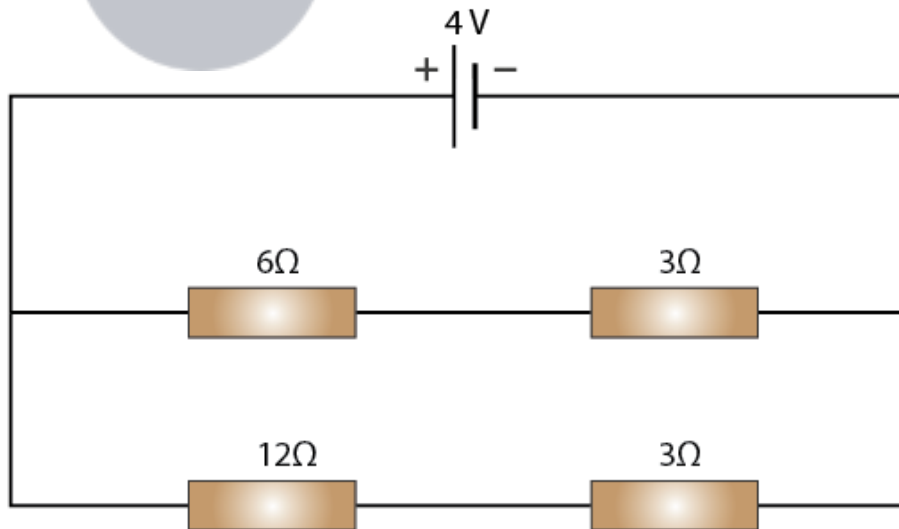
$$R' = 6\Omega$$

Total resistance between  $A$  and  $C$  is  $R = 5 + 6 = 11\Omega$

Potential difference across  $AC = IR = 1 \times 11 = 11V$

c) Total resistance =  $R_3 + R' = 5 + 6 = 11\Omega$

**Q17. For the circuit shown in the diagram below:**



**What is the value of:**

**a) Current through 6Ω resistor?**

**b) Potential difference across 12 Ω resistor?**

**Answer:**

From the given circuit:

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$$V = 4V$$

$$\text{Total resistance in line 1} = R_1 = 6 + 3 = 9 \Omega$$

$$\text{Total resistance in line 2} = R_2 = 12 + 3 = 15 \Omega$$

a) Current through  $6 \Omega$  resistor is same as the current through line 1 =  $V/R_1 = 4/9 = 0.44 \Omega$

b) Potential difference across line 2 is 4V

$$\text{Current through line 2} = V/R_2 = 4/15 \Omega$$

$$\text{Potential difference across } 12 \Omega \text{ resistor} = (4/15) \times 12 = 3.2V$$

**Q18. Two resistors with resistances  $5 \Omega$  and  $10 \Omega$  respectively are to be connected to a battery of emf 6V so as to obtain minimum and maximum current flowing**

**a) How will you connect the resistances in each case?**

**b) Calculate the strength of the total current in the circuit in the two cases.**

**Answer:**

Given,

$$R_1 = 5 \Omega$$

$$R_2 = 10 \Omega$$

$$V = 6V$$

a) When the two resistors are connected in series, minimum current flows through the resistors. When the resistors are connected in parallel, the current flow will be maximum.

b) When the resistors are in series,

$$\text{Total resistance} = 5 + 10 = 15\Omega$$

$$1/R = 1/R_1 + 1/R_2$$

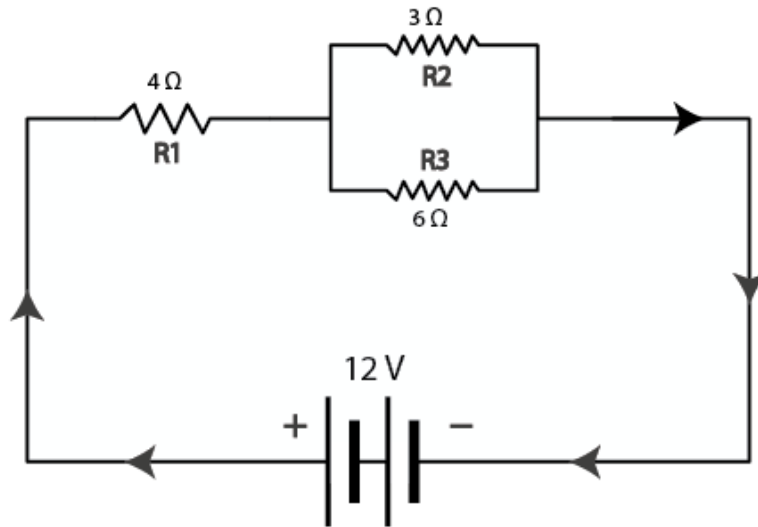
$$1/R = 1/5 + 1/10$$

$$1/R = 3/10$$

$$R = 10/3 \Omega$$

$$\text{Therefore, the total current drawn by the circuit} = V/R = 6/(10/3) = 1.8\text{amps}$$

**Q19. The circuit diagram given below shows the combination of three resistors  $R_1$ ,  $R_2$ , and  $R_3$ :**



**Find:**

- a) total resistance of the circuit
- b) total current flowing in the circuit
- c) the potential difference across R1

**Answer:**

a) Total resistance of two resistors that are connected in parallel is

$$1/R' = 1/3 + 1/6$$

$$1/R' = 3/6$$

$$R' = 2 \text{ ohms}$$

$$\text{Total resistance of the circuit} = 2 + 4 = 6 \text{ ohms}$$

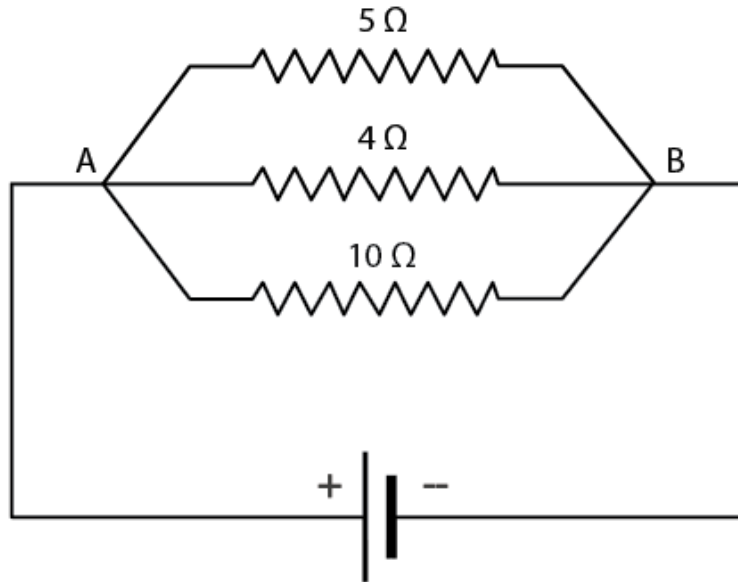
b) Total current flowing through the circuit =  $V/R$

Where R = total resistance

$$I = 12/6 = 2 \text{ amp}$$

c) Potential difference across R1 =  $R_1 I = 8V$

**Q20. In the circuit diagram given below, the current flowing across 5 ohm resistor is 1 amp. Find the current flowing through the other two resistors.**



**Answer:**

Given,

$$I = 1 \text{ amp}$$

$$R = 5 \text{ ohm}$$

The potential difference across each resistor is same as the resistors are connected in parallel and the voltage across these resistors are the same.

Therefore, applied voltage,  $V = IR = 5\text{V}$

Current through 4 ohm resistor =  $V/R = 5/4 = 1.25 \text{ amp}$

Current through 10 ohm resistor =  $V/R = 5/10 = 0.5 \text{ amp}$

**Q21. A resistor has a resistance of 176 ohms. How many of these resistors should be connected in parallel so that their combination draws a current of 5 ampere from a 220 volt supply volt line?**

**Answer:**

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

$$V = 220 \text{ V}$$

$$R = V/I = 220/5 = 44 \text{ ohm}$$

The resultant resistance must be less than 176 ohm. Therefore, the resistors are connected in parallel

Let the required no be n

$$R_{re} = 176/n = 44$$

$$N = 176/44 = 4$$

**Q22. An electric heater which is connected to a 220V supply line has two resistance coils A and B of 24 ohm resistance each. These coils can be used separately in series or in parallel. Calculate the current drawn when:**

a) only one coil A is used

b) coils A and B are used in series

c) coils A and B are used in parallel

**Answer:**

Given,

$$V = 220V$$

$$R_a = R_b = 24 \text{ ohm}$$

a) Current drawn when only coil A is used:

$$I = V/R_a = 220/24 = 9.16 \text{ amps}$$

b) Current drawn when the coils A and B are used in series:

$$\text{Total resistance, } R = R_a + R_b = 24 + 24 = 48 \text{ ohms}$$

$$I = V/R = 220/48 = 4.58 \text{ amps}$$

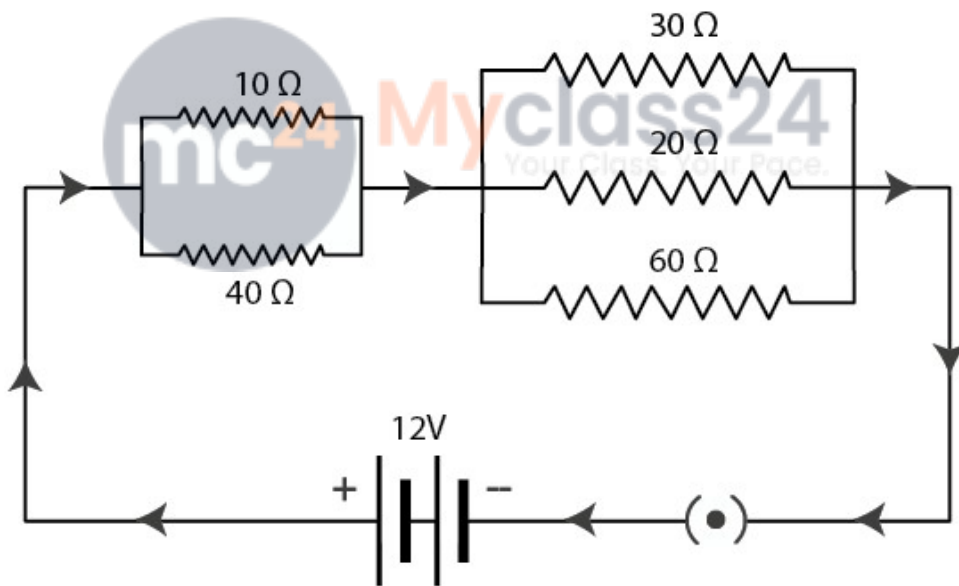
c) Current drawn when coils A and B are used in parallel:

$$\text{Total resistance is } 1/R = 1/R_a + 1/R_b = 1/24 + 1/24 = 2/24 = 1/12$$

$$R = 12 \text{ ohms}$$

$$I = V/R = 220/12 = 18.33 \text{ amps}$$

**Q23. In the circuit diagram given below five resistance of  $10\Omega$ ,  $40\Omega$ ,  $30\Omega$ ,  $20\Omega$ , and  $60\Omega$  are connected as shown to a  $12V$  battery.**



**Calculate:**

**a) total resistance in the circuit**

**b) total current flowing in the circuit**

**Answer:**

a) Equivalent resistance of  $10\Omega$  and  $40\Omega$  resistances is  $R_1$  is given as:

$$1/R_1 = 1/10 + 1/40 = 5/40$$

$$R_1 = 8 \Omega$$

Equivalent resistance of  $30\Omega$ ,  $20\Omega$ , and  $60\Omega$  resistance is  $R_2$  is given as:

$$1/R_2 = 1/30 + 1/20 + 1/60 = 6/60$$

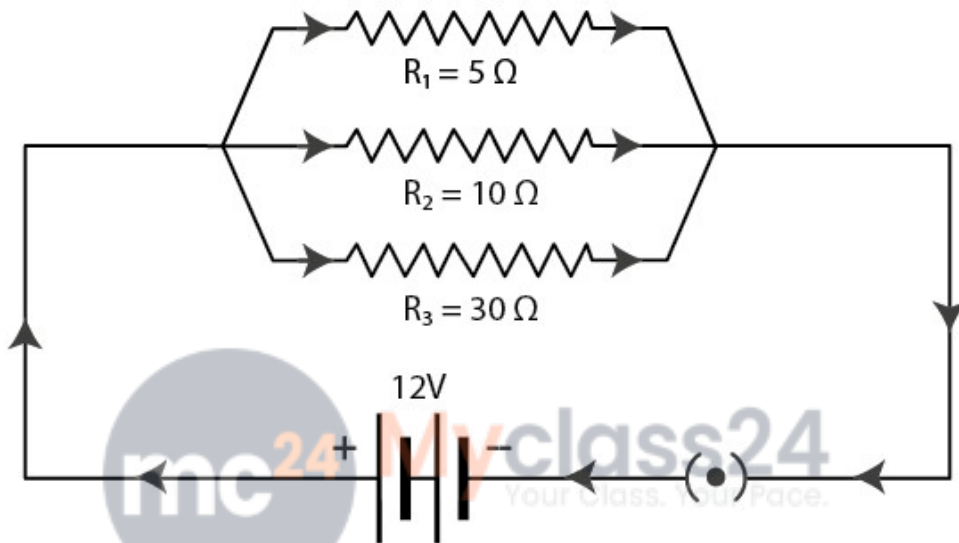
$$R_2 = 10 \Omega$$

$R_1$  and  $R_2$  are connected in series

Therefore, total resistance in the circuit,  $R = R_1 + R_2 = 8 + 10 = 18 \Omega$

b) Total current flowing in the circuit,  $I = V/R = 12/18 = 0.67\text{amp}$

**Q24. In the circuit diagram given below, three resistors  $R_1$ ,  $R_2$ , and  $R_3$  of  $5 \Omega$ ,  $10 \Omega$ , and  $30 \Omega$  respectively are connected as shown:**



**Calculate:**

a) current through each resistor

b) total current in the circuit

c) total resistance in the circuit

**Answer:**

Given,

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

$R_1$ ,  $R_2$ , and  $R_3$  are connected in parallel

$$\text{a) Current through } R_1 = V/R_1 = 12/5 = 2.4 \text{ A}$$

$$\text{Current through } R_2 = V/R_2 = 12/10 = 1.2 \text{ A}$$

$$\text{Current through } R_3 = V/R_3 = 12/30 = 0.4\text{A}$$

$$\text{b) Total current in the circuit} = 2.4 + 1.2 + 0.4 = 4\text{A}$$

c) Total resistance in the circuit =  $R$

$$1/R = 1/R_1 + 1/R_2 + 1/R_3$$

$$1/R = 1/5 + 1/10 + 1/30$$

$$1/R = 10/30$$

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

**Q25. A potential difference of 4V is applied to two resistors of 6Ω and 2 Ω connected in series. Calculate:**

- a) the combined resistance
- b) the current flowing
- c) the potential difference across the 6 Ω resistor

**Answer:**

Given,

$$V = 4V$$

$$R_1 = 6 \Omega$$

$$R_2 = 2 \Omega$$

a) Combined resistance,  $R = R_1 + R_2 = 8 \text{ ohm}$

b) Current flowing,  $I = V/R = 4/8 = 0.5 \text{ amp}$

c) Potential difference across 6 ohm resistor =  $IR_1 = 3V$

**Q26. A potential difference 6V is applied to two resistors of 3 Ω and 6 Ω connected in parallel. Calculate:**

- a) the combined resistance
- b) the current flowing in the main circuit
- c) the current flowing in the 3 Ω resistor

**Answer:**

Given,

$$V = 6V$$

$$R_1 = 3 \Omega$$

$$R_2 = 6 \Omega$$

a) Combined resistance,

$$1/R = 1/R_1 + 1/R_2 = 1/3 + 1/6 = 1/2$$

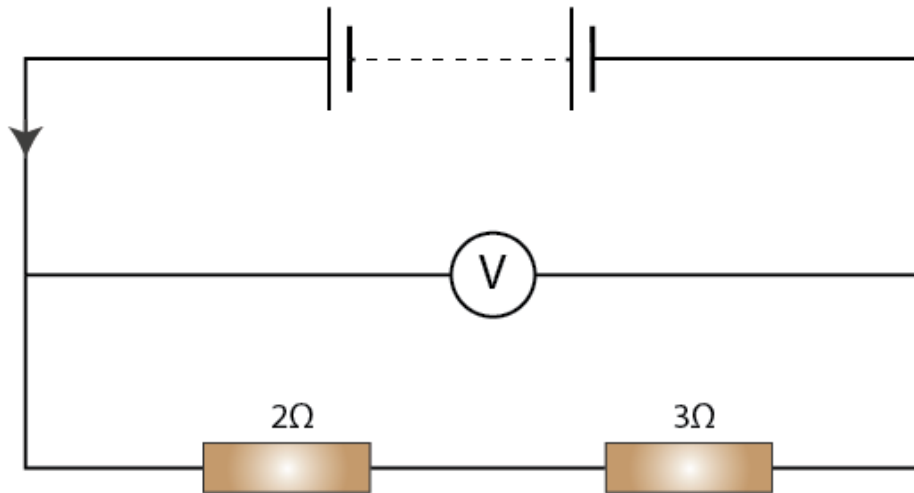
$$R = 2 \Omega$$

b) Current flowing in the main circuit,  $I = V/R = 6/2 = 3A$

c) Current flowing in 3 Ω resistor =  $V/R_1 = 6/3 = 2A$

**Q27. In the circuit shown below, the voltmeter reads 10V.**





- a) What is the combined resistance?  
b) What current flows?  
c) What is the potential difference across 2Ω resistor?  
d) What is the potential difference across 3 Ω resistor?

**Answer:**

Given,

$$V = 6V$$

$$R_1 = 2 \Omega$$

$$R_2 = 3 \Omega$$

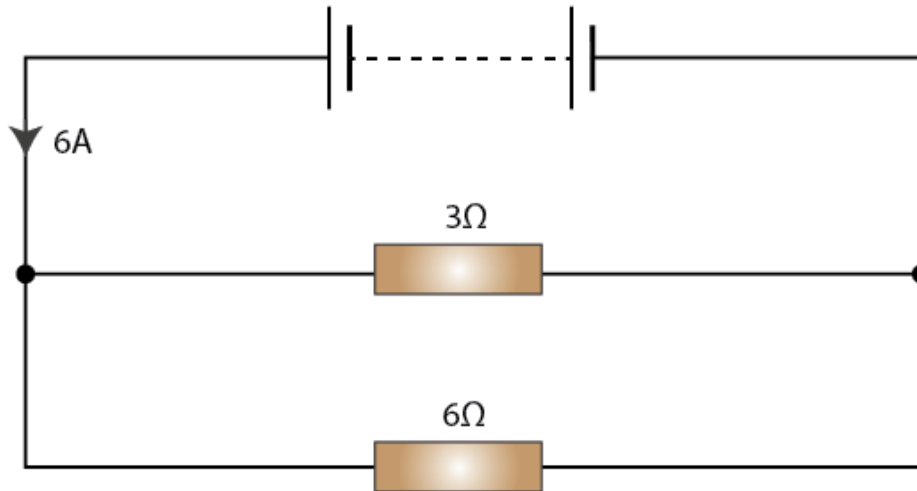
a) Combined resistance,  $R_t = 2+3 = 5 \Omega$

b)  $I = V/R_t = 10/5 = 2A$

c) Potential difference across 2 Ω resistor =  $IR_1 = 4V$

d) Potential difference across 3 Ω resistor =  $IR_2 = 6V$

**Q28. In the circuit given below:**



- What is the combined resistance?
- What is the potential difference across the combined resistance?
- What is the potential difference across the 3Ω resistor?
- What is the current in the 3Ω resistor?
- What is the current in the 6Ω resistor?

**Answer:**

Total current flowing through circuit,  $I = 6A$

$R_1 = 3\ \Omega$

$R_2 = 6\ \Omega$

a) Combined resistance  $R$  is

$$1/R = 1/3 + 1/6 = 3/6$$

$$R = 2\ \Omega$$

b) Potential difference across the combined resistance =  $IR = 12V$

c) Potential difference across the 3Ω resistor = Potential difference across the combined resistance = 12V

d) Current flowing through the 3Ω resistor =  $V/R_1 = 12/3 = 4A$

e) Current flowing through the 6Ω resistor =  $V/R_2 = 12/6 = 2A$

**Q29. A 5V battery is connected to two 20Ω resistors which are joined together in series.**

a) Draw a circuit diagram to represent this. Add an arrow to indicate the direction of conventional current flow in the circuit.

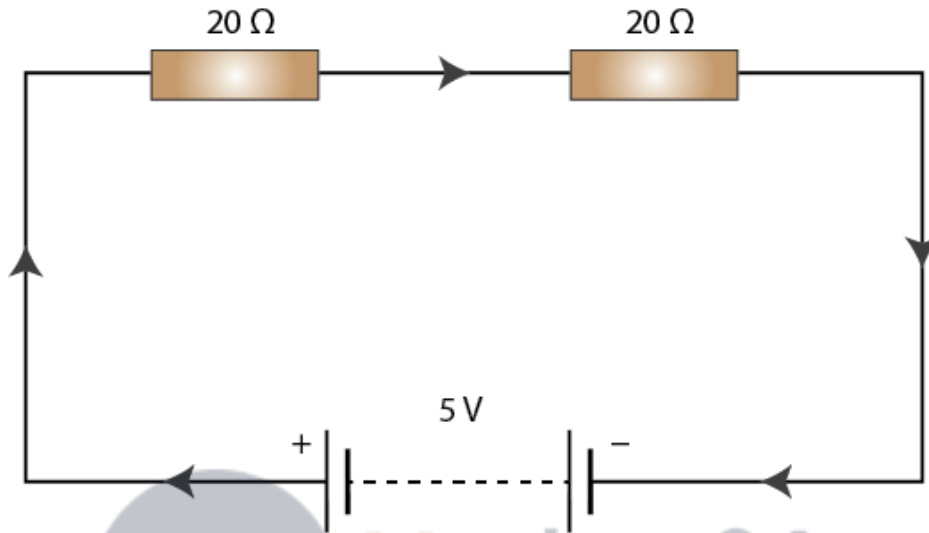
b) What is the effective resistance of the two resistors?

c) Calculate the current that flows from the battery

d) What is the potential difference across each resistor?

Answer:

a)



b) Effective resistance =  $20 + 20 = 40$  ohms

c) Current flowing through the circuit =  $I = V/R = 5/40 = 0.125$ amp

d) Potential difference across each resistance =  $IR = 2.5$ V

**Q30.** The figure given below shows an electric circuit in which current flows from a 6V battery through two resistors.

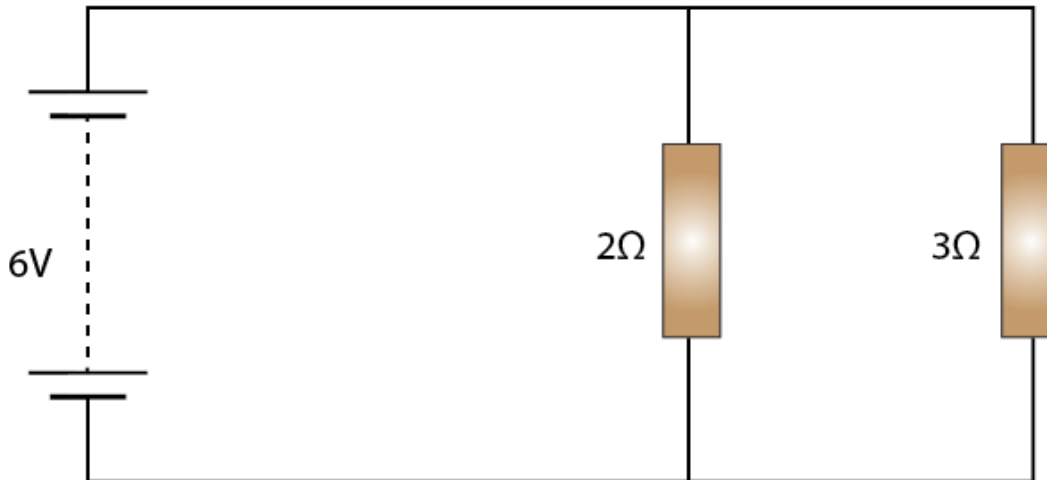
a) Are the resistors connected in series with each other or in parallel?

b) For each resistor, state the potential difference across it.

c) The current flowing from the battery is shared between the two resistors. Which resistor will have bigger share of the current?

d) Calculate the effective resistance of the two resistors.

e) Calculate the current that flows from the battery.



**Answer:**

Given,

$$V = 6V$$

$$R_1 = 2\Omega$$

$$R_2 = 3\Omega$$

a) Resistors are connected in parallel

b) Potential difference across each resistor is the same and is equal to 6V

c) 2  $\Omega$  resistance have bigger share of current because of its lower resistance

d) Effective resistance = R

$$1/R = 1/2 + 1/3$$

$$1/R = 5/6$$

$$R = 1.2\Omega$$

e) Current flowing through battery,  $I = V/R = 6/1.2 = 5A$

**Q31. A 4  $\Omega$  coil and a 2  $\Omega$  coil are connected in parallel. What is their combined resistance? A total current of 3A passes through the coils. What current passes through the 2  $\Omega$  coil?**

**Answer:**

4  $\Omega$  and 2  $\Omega$  coils are connected in parallel.

Therefore, the combined resistance, R

$$1/R = 1/4 + 1/2 = 3/4$$

$$R = 4/3\Omega$$

Total current,  $I = V/R = 3A$

$$V/(4/3) = 3$$

$$V = 4V$$

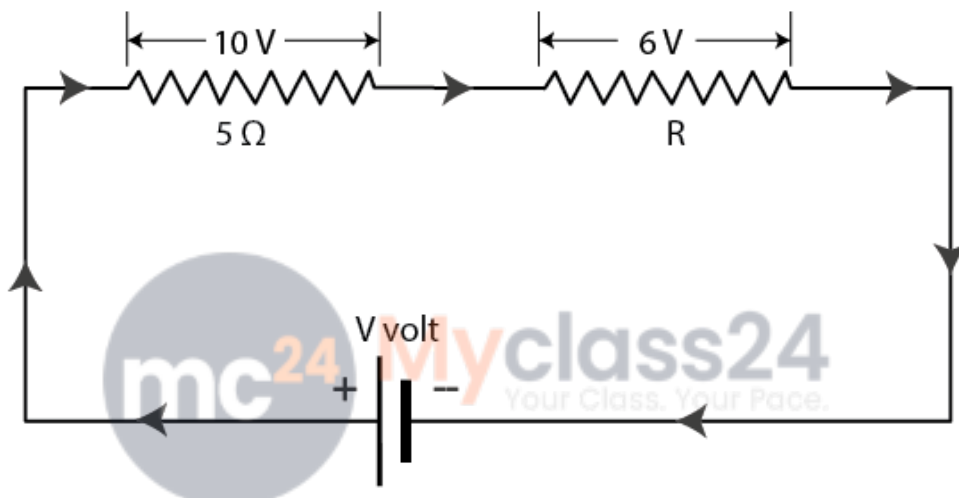


Current through  $2\ \Omega$  coil =  $V/2 = 4/2 = 2\ \text{A}$

### Long Answer Type Questions

Q32. a) With the help of a circuit diagram, deduce the equivalent resistance of two resistances connected in series.

b) Two resistances are connected in series as shown in the diagram:



i) What is the current through the  $5\ \text{ohm}$  resistance?

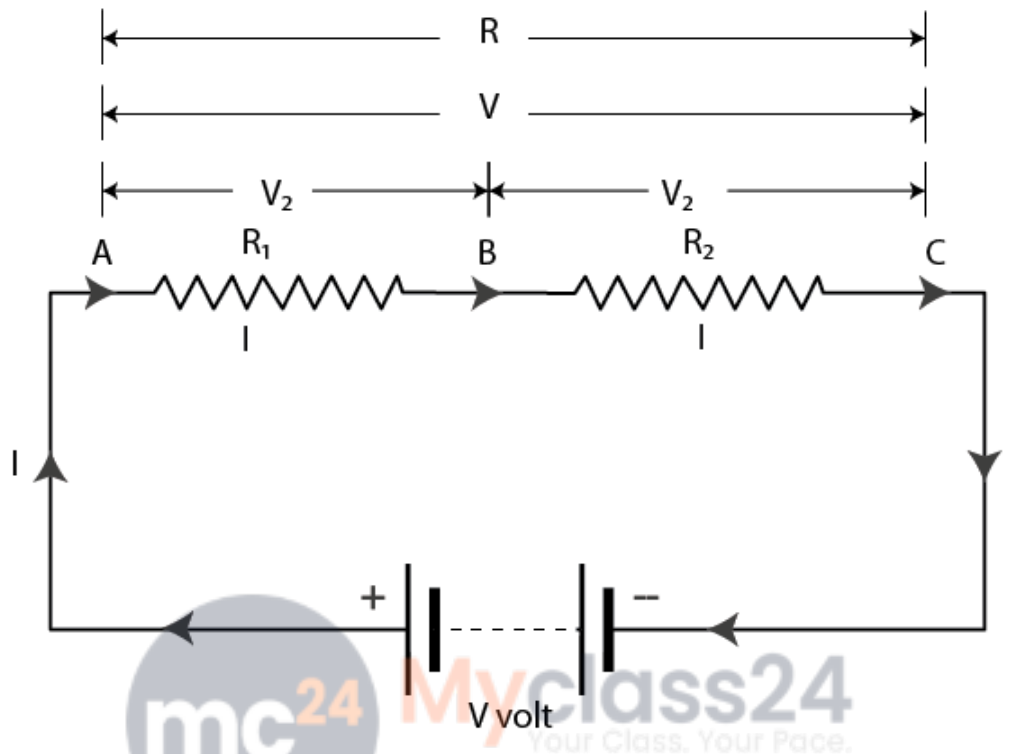
ii) What is the current through  $R$ ?

iii) What is the value of  $R$ ?

iv) What is the value of  $V$ ?

Answer:

a)



Above circuit shows resistances  $R_1$  and  $R_2$  connected in series with a battery of  $V$  volts  
Let the potential difference across  $R_1$  be  $V_1$  and the potential difference across  $R_2$  be  $V_2$

$$V = V_1 + V_2 \quad (1)$$

By Ohm's law

$$R = V/I$$

$$V = IR \quad (2)$$

Applying Ohm's law

$$V_1 = IR_1 \quad (3)$$

$$V_2 = IR_2 \quad (4)$$

From (1), (2), (3), and (4)

$$R = R_1 + R_2$$

b) i) Current through 5 ohm resistor = 2A

ii) Current through  $R = 2A$  because 5 ohm resistor and  $R$  are connected in series

iii)  $V = IR$

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

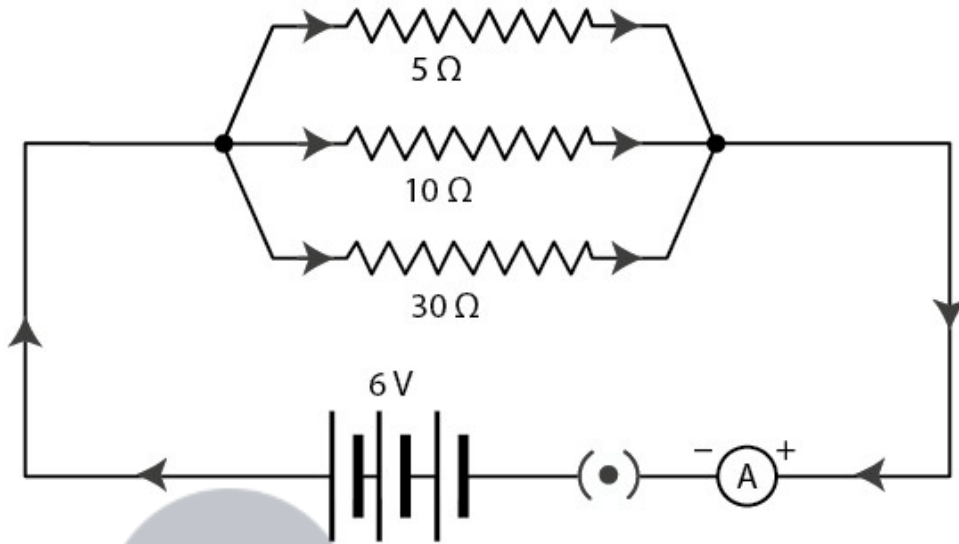
$$\text{iv) } V = 10 + 6 = 16V$$

**Q33. a) With the help of a diagram, derive the formula for the resultant resistance of three resistors connected in series.**

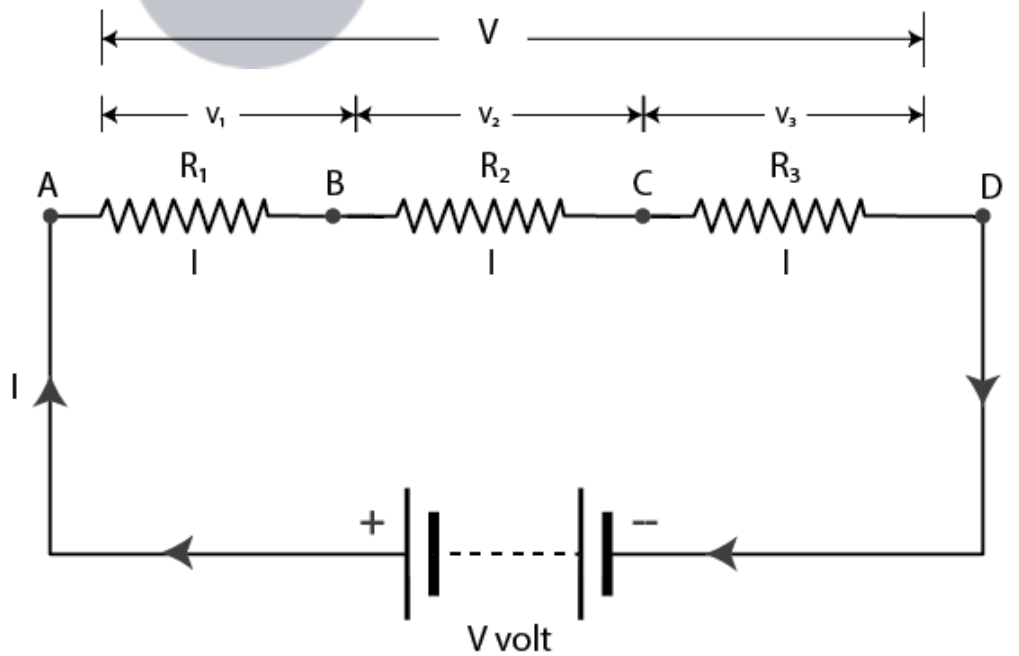
**b) For the circuit shown in the diagram given below, calculate**

**i) Value of current through each resistor**

- ii) total current in the circuit
- iii) total effective resistance of the circuit



Answer:  
a)



We know that  $V = V_1 + V_2 + V_3$   
 $R = V/I$

$$V_1 = IR_1$$

$$V_2 = IR_2$$

$$V_3 = IR_3$$

Using above equations,

$$IR = IR_1 + IR_2 + IR_3$$

$$R = R_1 + R_2 + R_2$$

b) i) Current through  $R_1 = 1.2A$

Current through  $R_2 = 0.6A$

Current through  $R_3 = 0.2A$

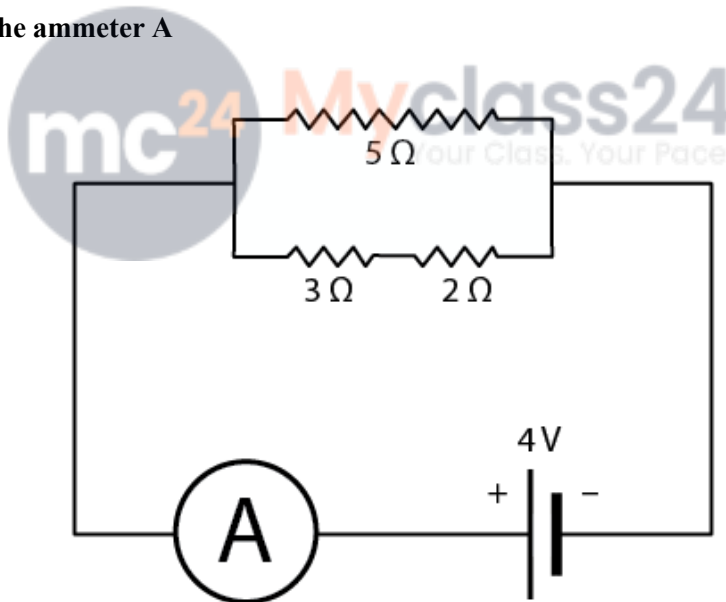
ii) Total current in the circuit =  $2A$

iii) Effective resistance =  $3 \text{ ohm}$

**Q34. a) With the help of a circuit diagram, obtain the relation for the equivalent resistance of two resistance connected in parallel. Find**

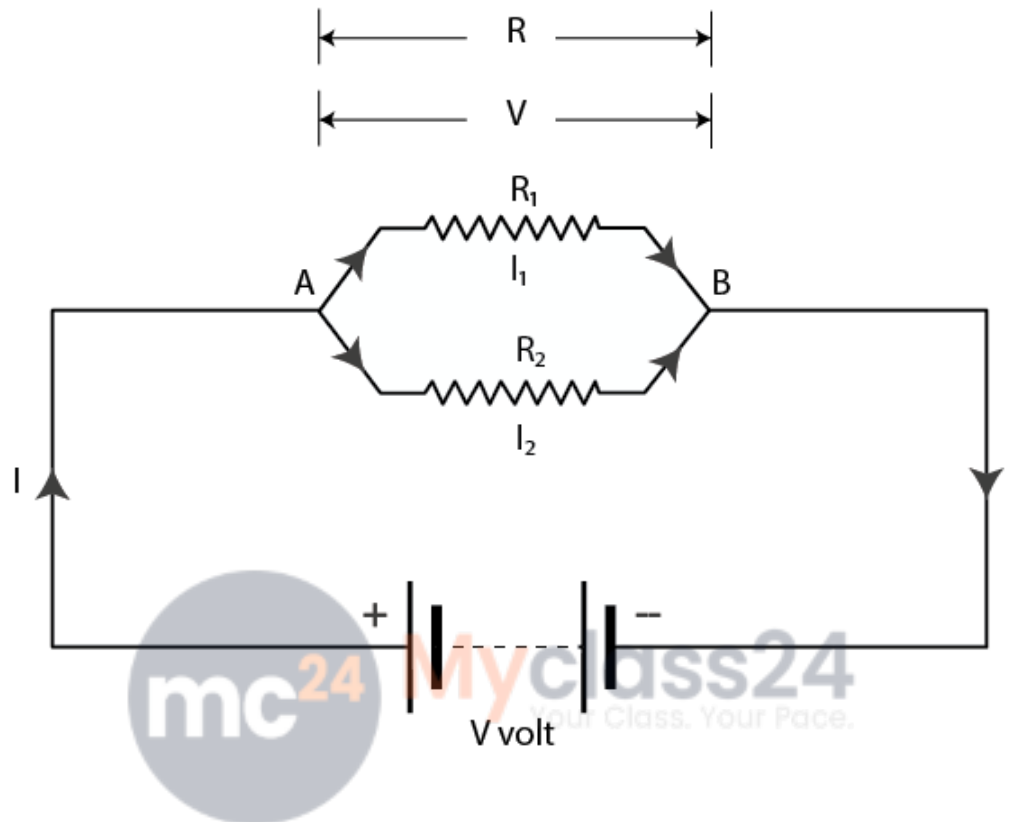
**i) Total resistance**

**ii) Current shown by the ammeter A**



**Answer:**

a)



$$\text{Total current} = I = I_1 + I_2$$

$$I_1 = V/R_1$$

$$I_2 = V/R_2$$

$$V/R = V/R_1 + V/R_2$$

$$1/R = 1/R_1 + 1/R_2$$

b) i) Total resistance =  $R$

$$R_1 = 5 \text{ ohms}$$

$$R_2 = 3+2 = 5 \text{ ohms}$$

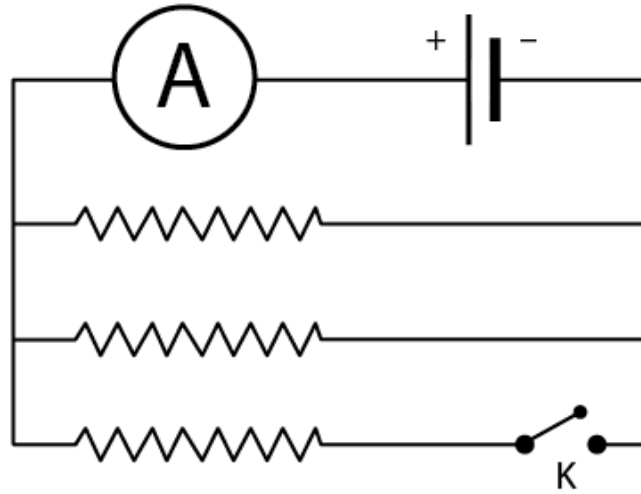
$$R = 2.5 \text{ ohms}$$

ii) Current flowing through the circuit,  $I = V/R = 1.6 \text{ amps}$

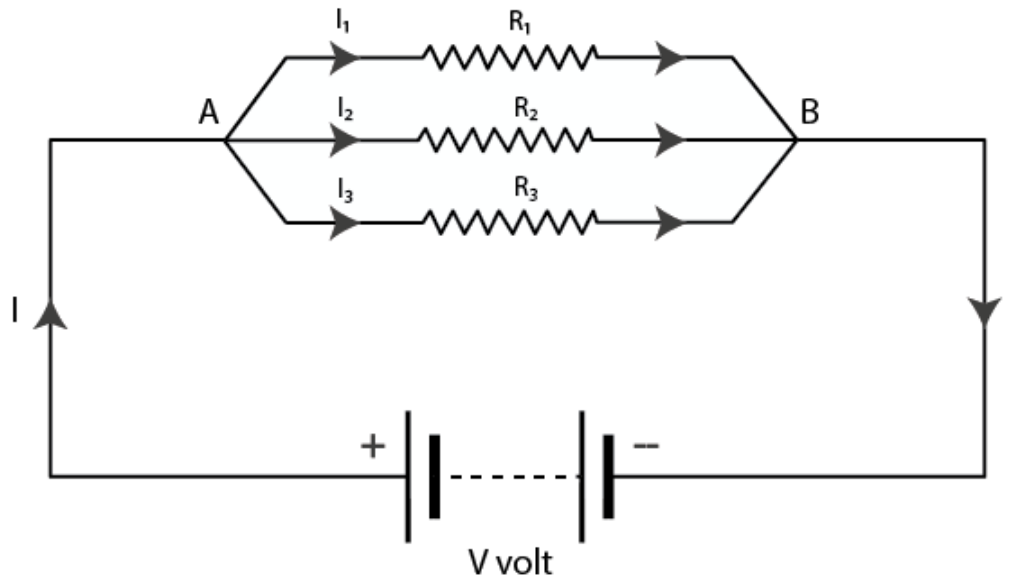
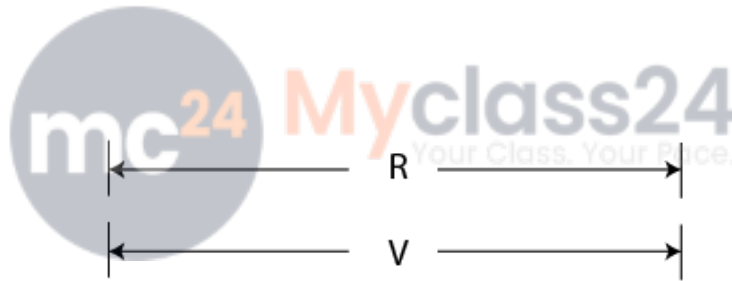
**Q35. a) Explain with the help of a labelled circuit diagram, how you will find the resistance of a combination of three resistors of resistance  $R_1$ ,  $R_2$ , and  $R_3$  joined in parallel**

**b) In the diagram shown below, the cell and the ammeter both have negligible resistance. The resistors are identical.**

**With the switch  $K$  open, the ammeter reads  $0.6\text{A}$ . what will be the ammeter reading when the switch is closed?**



Answer:  
a)



$$I = V/R$$

$$I_1 = V/R_1$$
$$I_2 = V/R_2$$
$$I_3 = V/R_3$$
$$1/R = 1/R_1 + 1/R_2 + 1/R_3$$

b) Effective resistance =  $1/R + 1/R = 2/R$

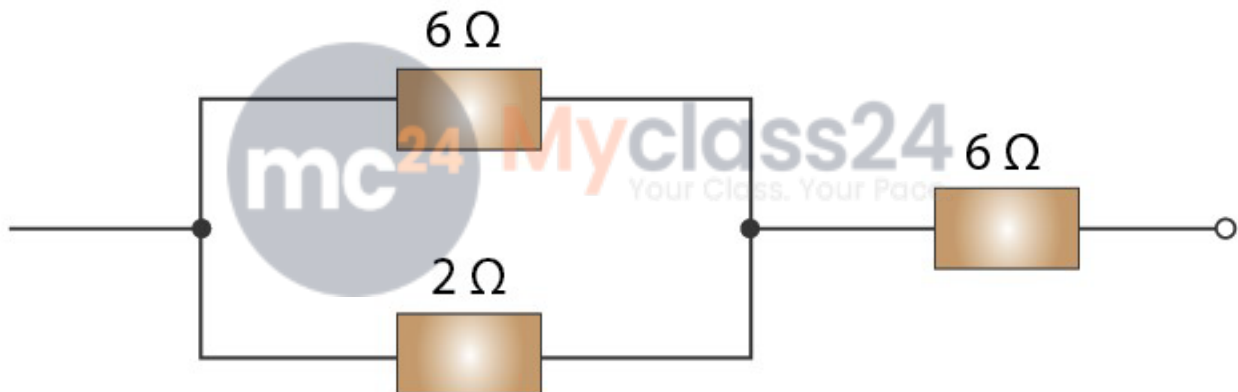
Current,  $I = V/(R/2) = 0.6A$

$V/R = 0.3A$

Therefore, final current,  $I = V/(R/3) = 0.9A$

### Multiple Choice Questions

Q36. The figure given below shows three resistors:



Their combined resistance is:

- a)  $1 \frac{5}{7} \Omega$
- b)  $14 \Omega$
- c)  $6 \frac{2}{3} \Omega$
- d)  $7 \frac{1}{2} \Omega$

Answer:

The correct option is d)  $7 \frac{1}{2} \Omega$

When the resistors are in combination, series and parallel combination formula needs to be used. Resistors with  $6 \Omega$  and  $2 \Omega$  are in parallel combination. Their resultant resistance is then added with  $6 \Omega$  resistor to obtain the total resistance of the circuit.

Q37. If two resistors of  $25 \Omega$  and  $15 \Omega$  are joined together in series and then placed in parallel with a  $40 \Omega$  resistor, the effective resistance of the combination is:

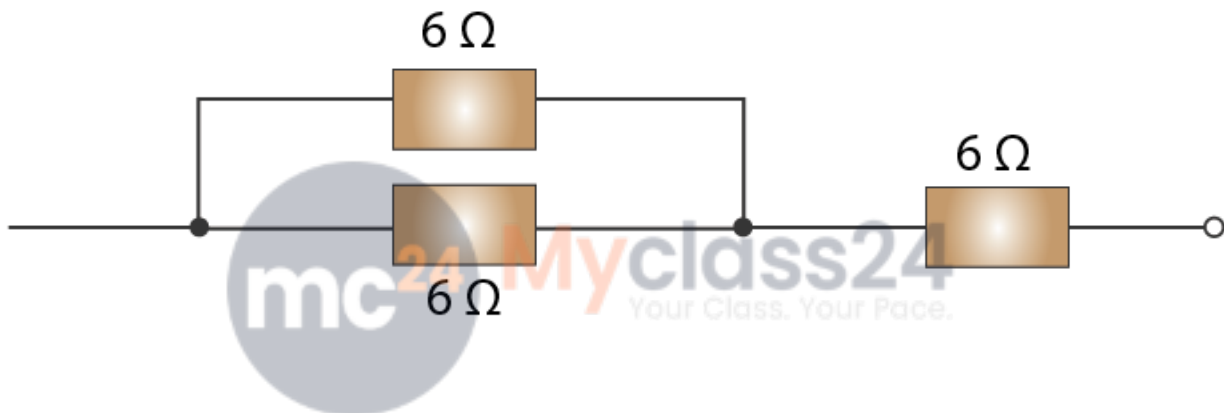
- a)  $0.1 \Omega$
- b)  $10 \Omega$
- c)  $20 \Omega$
- d)  $40 \Omega$

**Answer:**

The correct option is c)  $20 \Omega$

The resultant resistance obtained from the resistors that are placed in series combination is connected with  $40 \Omega$  in parallel such that the overall resistance obtained is equal to  $20 \Omega$ .

**Q38. The diagram below shows part of a circuit:**



**If this arrangement of three resistors was to be replaced by a single resistor, its resistance should be:**

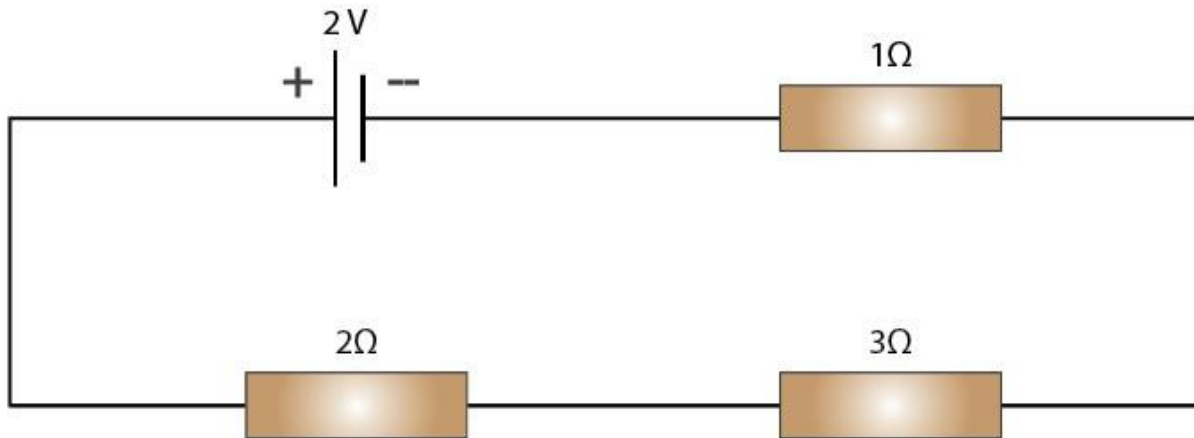
- a)  $9 \Omega$
- b)  $4 \Omega$
- c)  $6 \Omega$
- d)  $18 \Omega$

**Answer:**

The correct option is a)  $9 \Omega$

Again series and parallel combination is used for the calculation of overall resistance of the given circuit.

**Q39. In the circuit shown below:**



The potential difference across the  $3\Omega$  resistor is:

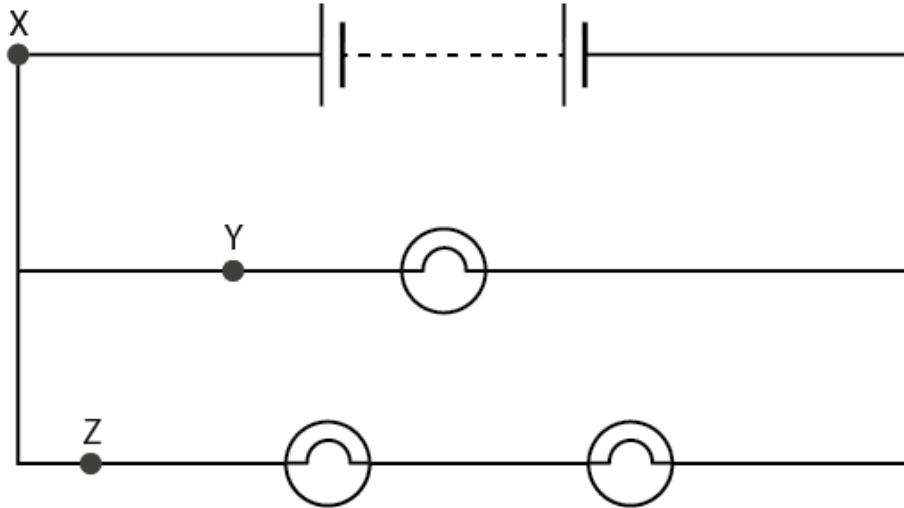
- a)  $1/9$  V
- b)  $1/2$  V
- c) 1V
- d) 2V

**Answer:**

The correct option is c) 1V

We know that the potential difference across a resistor is calculated as  $V = IR$ . Therefore, substituting the values we get potential difference across the resistor of  $3\Omega$  as 1V.

**Q40. A battery and three lamps are connected as shown:**



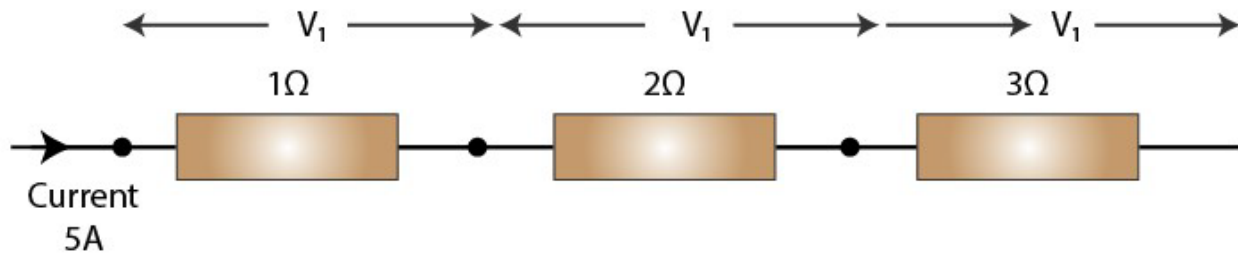
Which of the following statements about the currents at X, Y, and Z is correct?

- a) The current at Z is greater than that at Y
- b) The current at Y is greater than that at Z
- c) The current at X equals the current at Y
- d) The current at X equal the current at Z

Answer:

The correct option is b) The current at Y is greater than that at Z

Q41.  $V_1$ ,  $V_2$ , and  $V_3$  are the potential difference across the  $1\ \Omega$ ,  $2\ \Omega$ , and  $3\ \Omega$  resistors in the following diagram, the current is 5A.



Which one of the columns (a) to (d) shows the correct values of  $V_1$ ,  $V_2$ , and  $V_3$  measured in volts?

	$V_1$	$V_2$	$V_3$
a)	1.0	2.0	3.0
b)	5.0	10.0	15.0
c)	5.0	2.5	1.6
d)	4.0	3.0	2.0

**Answer:**

The correct option is b) Where  $V_1 = 5.0$ ,  $V_2 = 10.0$ , and  $V_3 = 15.0$

Using the formula,  $V = IR$ , substituting the values in the formula, we get the correct values for  $V_1$ ,  $V_2$ , and  $V_3$ .

**Q42. A wire of resistance  $R_1$  is cut into five equal pieces. These five pieces of wire are then connected in parallel. If the resultant resistance of this combination be  $R_2$ , then the ratio  $R_1/R_2$  is:**

- a)  $1/25$
- b)  $1/5$
- c) 5
- d) 25

**Answer:**

The correct option is d) 25.

When a resistance wire is cut into five pieces, the ratio of the resistance and the resultant resistance obtained when the pieces are connected in parallel is 25.

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### Very Short Answer Type Questions

**Q1. Are the lights in your house wires in series?**

**Answer:**

The light in our houses are not connected in series. They are connected in parallel.

**Q2. What happens to the other bulbs in a series circuit if one bulb blows off?**

**Answer:**

When the bulbs are connected in series, all the other bulbs stop glowing.

**Q3. What happens to the other bulbs in a parallel circuit if one bulb blows off?**

**Answer:**

When the bulbs are in parallel, they continue to glow.

**Q4. Which type of circuit, series or parallel, is preferred while connecting a large number of bulbs:**

**a) for decorating a hotel building from outside?**

**b) for lighting inside the rooms of the hotel?**

**Answer:**

Following type of circuit is used when:

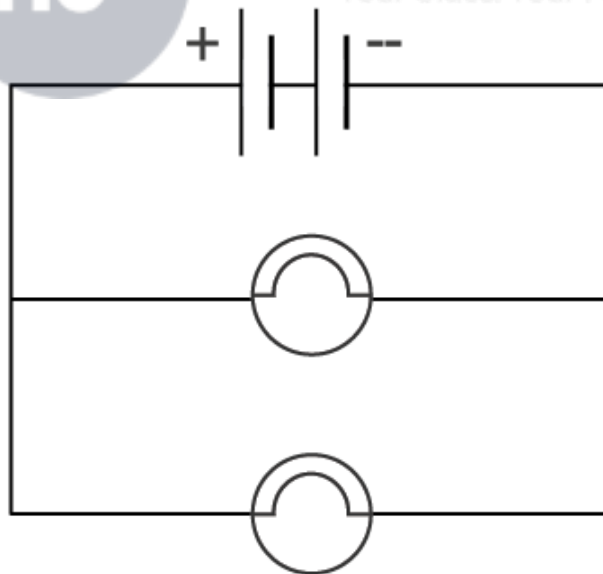
a) hotel building is to be decorated from outside: series

b) lighting the rooms inside the hotel: parallel

**Q5. Draw a circuit diagram to show how two 4V electric lamps can be lit brightly from two 2V cells.**

**Answer:**

Following is the circuit diagram of two lamps with 4V each and is arranged in parallel with 2V cells:



### Short Answer Type Questions

**Q6. Why is a series arrangement not used for connecting domestic electrical appliances in a circuit?**

**Answer:**

A series arrangement is not used for connecting domestic electrical appliances in a circuit because if any of the electrical appliance stops working, it affects all the other appliances.

**Q7. Given three reasons why different electrical appliances in a domestic circuit are connected in parallel.**

**Answer:**

Different electrical appliances in a domestic circuit are connected in parallel because:

- the voltage distribution to each appliance is the same from the power supply line
- the working of the appliance can be controlled using individual switch
- the working of the appliances are not dependent on each other

**Q8. Ten bulbs are connected in a series circuit to a power supply line. Ten identical bulbs are connected in**

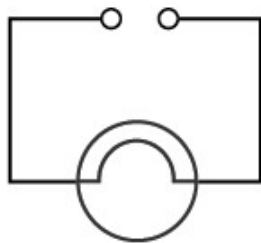
**a:**

- an identical power supply line
- which circuit would have the highest voltage across each bulb?
- in which circuit would the bulbs be brighter?
- in which circuit, if one bulb blows out, all others will stop glowing?
- which circuit would have less current in it?

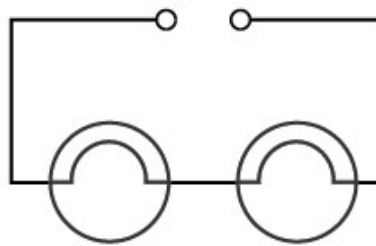
**Answer:**

- To have an identical power supply line, the circuit must be parallel
- When the circuit is parallel, each bulb will have highest voltage
- The working of the appliance can be controlled using individual switch when a parallel circuit is used
- The working of the appliances are not dependent on each other when they are connected in parallel

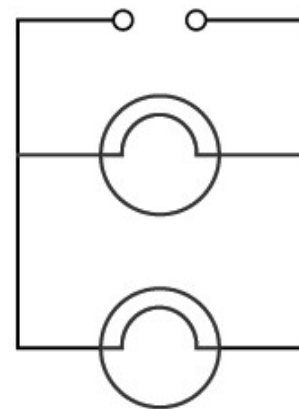
**Q9. Consider the circuits given below:**



(i)



(ii)



(iii)

- In which circuit are the lamps dimmest?
- In which circuit or circuits are the lamps of equal brightness to the lamps in circuit?
- Which circuit gives out the maximum light?

**Answer:**

- a) In circuit (ii) the lamps are the dimmest
- b) In circuit (iii) the lamps are of equal brightness
- c) In circuit (i) the maximum light is obtained

**Q10. If you were going to connect two light bulbs to one battery, would you use a series or a parallel arrangement? Why? Which arrangement takes more current from the battery?**

**Answer:**

When the arrangement is in parallel the consumption of current from the battery is more. The defect in any of the bulb won't affect the working of the other bulbs.

### Long Answer Type Questions

**Q11. a) Which is the better way to connect lights and other electrical appliances in domestic wiring: series circuits or parallel circuit? Why?**

**b) Christmas tree lamps are usually wired in series. What happens if one lamp breaks?**

**c) An electrician has wired a house in such a way that if a lamp gets fused in one room of the house, all the lamps in other rooms of the house stop working. What is the defect in the wiring?**

**d) Draw a circuit diagram showing two electric lamps connected in parallel together with a cell and a switch that works both lamps. Mark an A enclosed in a circle on your diagram to show where an ammeter should be placed to measure the current.**

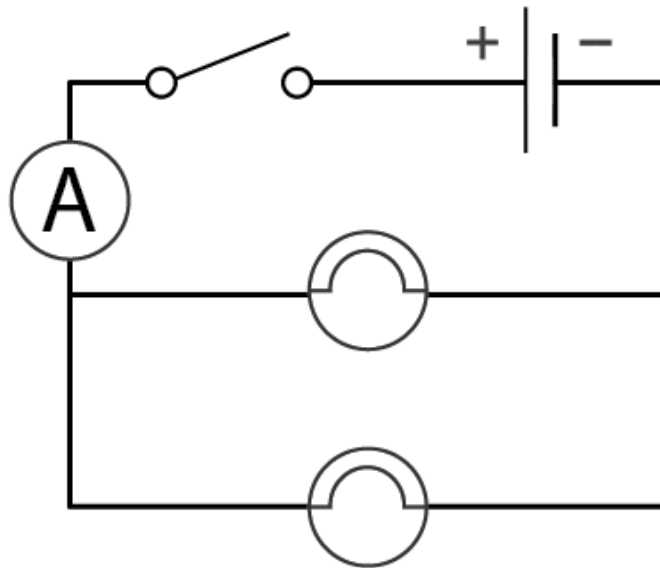
**Answer:**

a) When domestic wiring is to be done, parallel circuits are better than series. This is because when one of the electrical appliance stops working, others are affected.

b) When the lamps are connected in series, the lamps stop glowing.

c) All the lamps are connected in series.

d)



### Multiple Choice Questions

Q12. The lamps in a household circuit are connected in parallel because:

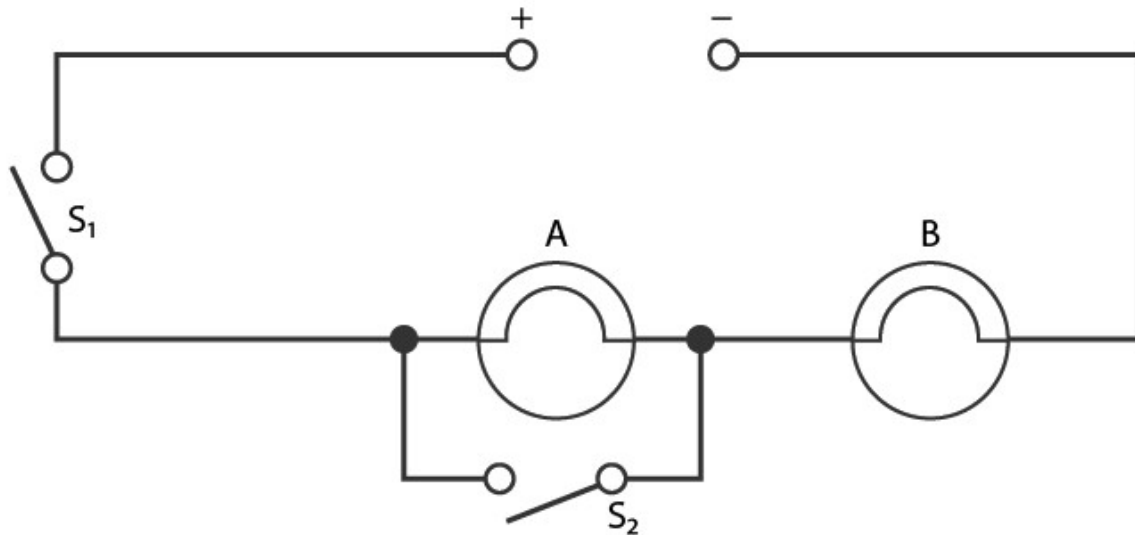
- a) this way they required less current
- b) if one lamp fails the others remain lit
- c) this way they require less power
- d) if one lamp fails the others also fail

**Answer:**

The correct option is b) if one lamp fails, the others remain lit.

When the lamps are arranged in parallel connection, the current flowing through them are different. Therefore, if one lamp fails, the others remain lit.

Q13. Using the circuit given below, state which of the following statement is correct?



- a) When S<sub>1</sub> and S<sub>2</sub> are closed, lamps A and B are lit
- b) With S<sub>1</sub> open and S<sub>2</sub> closed, A is lit and B is not lit
- c) With S<sub>2</sub> open and S<sub>1</sub> closed A and B are lit
- d) With S<sub>1</sub> closed and S<sub>2</sub> open, lamp A remains lit even if lamp B gets fused

Answer:

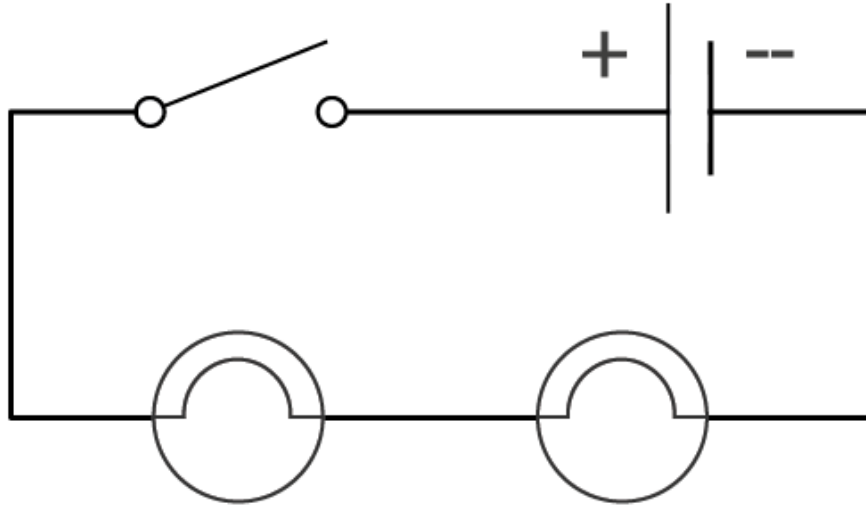
The correct option is c) With S<sub>2</sub> open and S<sub>1</sub> closed A and B are lit.

### High Order Thinking Skills

- Q14. a) Draw a circuit diagram showing two lamps, one cell, and a switch connected in series.  
b) How can you change the brightness of the lamps?

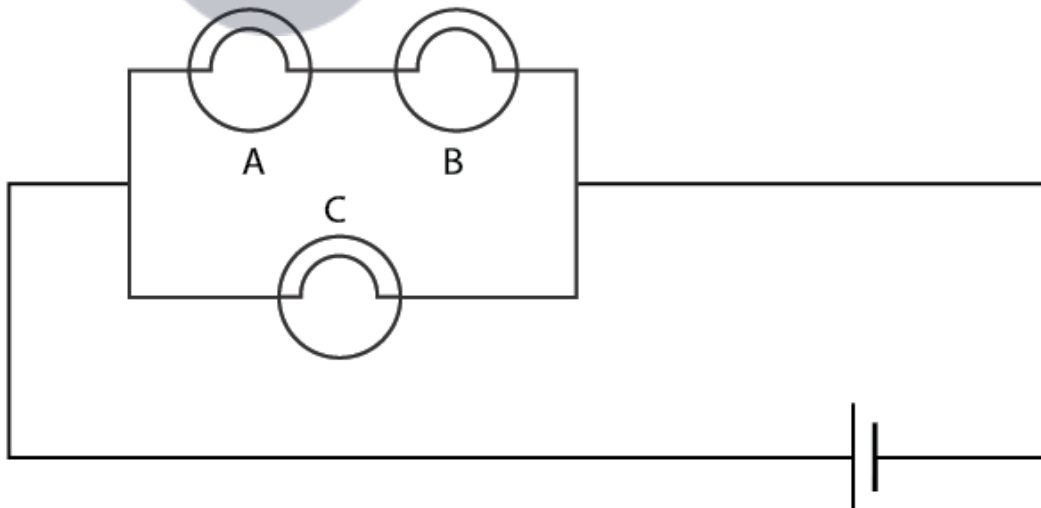
Answer:

a)



b) The brightness of the lamp can be changed by connecting the lamps in parallel.

**Q15.** Consider the circuit given below where A, B, and C are three identical light bulbs of constant resistance.



- a) List the bulbs in order of increasing brightness
- b) If C burns out, what will be the brightness of A now compared with before?
- c) If B burns out instead, what will be the brightness of A and C compared with before?

**Answer:**

- a) The brightest among the three is C while A and B will have equal brightness.
- b) The brightness of A will remain unchanged if C burns out as the voltage of A remains unaltered.
- c) If B burns out, then A will also burn out as they are connected in series with each other. However, C remains to be the brightest.

**Q16. How do you think the brightness of two lamps arranged in parallel compares with the brightness of two lamps arranged in series?**

**Answer:**

When the two lamps are arranged in parallel, the lamps will have more brightness than when they are arranged in series.

**Q17. If current flows through two lamps arranged in:**

a) series

b) parallel

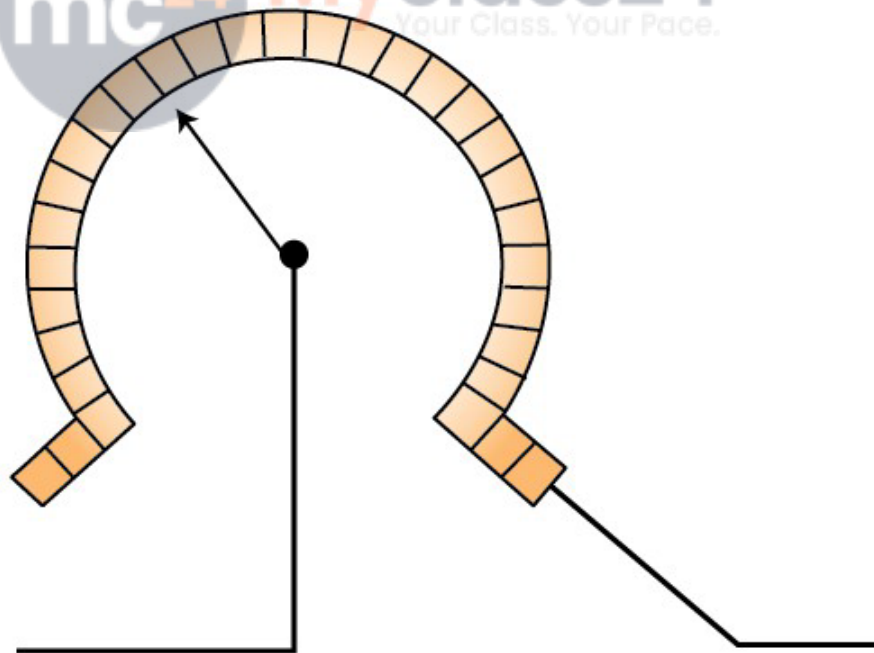
**and the filament of one lamp breaks, what happens to the other lamp? Explain**

**Answer:**

a) When the lamps are arranged in series, the lamps stop glowing when the filament of one of the lamps breaks.

b) When the lamps are arranged in parallel, the lamps continue to glow even if one of the lamps breaks.

**Q18. The figure below shows a variable resistor in a dimmer switch**



**How would you turn the switch to make the lights**

a) brighter

b) dimmer

**Answer:**

- a) To make the lights brighter, the switch has to be turned to the right as the resistance decreases when turned to the right.
- b) To make the lights dimmer, the switch has to be turned to the left as the resistance increases when turned to the left.

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**Very Short Answer Type Questions**

**Q1. State two factors on which the electrical energy consumed by an electrical appliance depends.**

**Answer:**

Following are the two factors on which the electrical energy consumed by an electrical appliance depends:

- a) Usage time of the appliance
- b) Power rating of the appliance

**Q2. Which one has a higher electrical resistance: a 100 watt bulb or a 60 watt bulb?**

**Answer:**

60 watt bulb has a higher electrical resistance than a 100 watt bulb because we know that power is inversely proportional to the resistance.

**Q3. Name the commercial unit of electric energy.**

**Answer:**

The commercial unit of electric energy is kilowatt-hour.

**Q4. An electric bulb is rated at 220V, 100W. What is its resistance?**

**Answer:**

Given,

$$V = 220V$$

$$P = 100W$$

$$R = ?$$

We know that,

$$R = V^2/P$$

$$R = 484 \text{ ohm}$$

**Q5. What is the SI unit of electric energy and electric power?**

**Answer:**

The SI unit of electric energy is joule and the SI unit of electric power is watt.

**Q6. Name the quantity whose unit is kilowatt and kilowatt-hour.**

**Answer:**

Kilowatt is the unit of electric power and kilowatt-hour is the unit of electric energy.

**Q7. Which quantity has the unit of watt?**

**Answer:**

Watt is the unit of electric power.

**Q8. What is the meaning of the symbol kWh? Which quantity does it represent?**

**Answer:**

kWh is the commercial unit of electrical energy and it stands for kilowatt-hour.

**Q9. If the potential difference between the end of a wire of fixed resistance is doubled, by how much does the electric power increase?**

**Answer:**

We know that,

$$P = V^2/R$$

R is constant

V is doubled

$$\text{Therefore, } P = 2(V^2)/R$$

$$P = 4V/R$$

Therefore, when the resistance is doubled, power becomes four times the actual value.

**Q10. An electric lamp is labelled 12V, 36W. This indicates that it should be used with a 12V supply. What other information does the label provide?**

**Answer:**

The other information provided by the label is that the rate of consumption of energy takes place at 36J/s.

**Q11. What current will be taken by a 920W appliance if the supply voltage is 230V?**

**Answer:**

Given,

$$P = 920W$$

$$V = 230V$$

$$I = ?$$

We know that,

$$P = VI$$

$$920 = 230I$$

$$I = 920/230$$

$$I = 4A$$

### Short Answer Type Questions

**Q12. Define watt. Write down an equation linking watts, volts, and ampere.**

**Answer:**

Following is the equation that relates watts, volts, and ampere:

$$1 \text{ watt} = 1 \text{ volt} \times 1 \text{ ampere}$$

**Q13. Define watt-hour. How many joules are equal to 1 watt-hour?**

**Answer:**

Watt-hour is defined as the amount of electrical energy that is consumed when an electrical appliance of 1 watt power is used for 1 hour.

1 watt-hour = 3600 joules.

**Q14. How much energy is consumed when a current of 5 ampere flows through the filament of a heater having resistance of 100 ohms for two hours? Express it in joules.**

**Answer:**

Given,

$$I = 5A$$

$$R = 100 \text{ ohm}$$

$$T = 2 \text{ hours}$$

We know that,

$$\text{Energy consumed} = P \times T = I^2RT$$

Substituting the values,

$$\text{Energy consumed} = 5kWh$$

$$1kWh = 3.6 \times 10^6 J$$

$$\text{Therefore, } 5kWh = 5 \times 3.6 \times 10^6 J = 18 \times 10^6 J$$

**Q15. An electric bulb is connected to a 220V power supply line, if the bulb draws a current of 0.5A, calculate the power of the bulb.**

**Answer:**

Given,

$$V = 220V$$

$$I = 0.5A$$

$$P = ?$$

We know that,

$$P = VI$$

$$P = 110 \text{ watt}$$



**Q16. In which of the following cases more electrical energy is consumed per hour?**

**a) A current of 1 ampere passed through a resistance of 300 ohms**

**b) A current of 2 amperes passed through a resistance of 100 ohms**

**Answer:**

a) Given,

$$R = 300 \text{ ohm}$$

$$I = 1 \text{ amp}$$

$$T = 1 \text{ hour}$$

$$P = I^2R = 300W$$

$$E = PT = 300 \text{ watt-hour}$$

b) Given,

$$R = 100 \text{ ohm}$$

$$I = 2 \text{ amp}$$

$$T = 1 \text{ hour}$$

$$P = I^2R = 400W$$

$$E = PT = 400 \text{ watt-hour}$$

Therefore, in second case the consumption of electrical energy per hour is more.

**Q17. An electric kettle rated at 220V, 2.2kW works for 3 hours. Find the energy consumed and the current drawn.**

**Answer:**

Given,

$$V = 220V$$

$$P = 2.2kW = 2200 \text{ watt}$$

$$T = 3 \text{ hours}$$

We know that

$$\text{Energy consumed} = PT = 6.6kWh$$

We also know that,

$$P = VI$$

$$\text{Therefore, } I = 10 \text{ amp}$$

**Q18. In a house two 60W electric bulbs are lighted for 4 hours and three 100W bulbs for 5 hour everyday. Calculate the electric energy consumed in 30 days.**

**Answer:**

Case 1

$$\text{Power, } P_1 = 60W$$

$$\text{Number, } n_1 = 2$$

$$\text{Time for use, } T_1 = 4 \text{ hours everyday}$$

$$\text{Energy consumed, } E_1 = n_1 \times P_1 \times T_1$$

$$E_1 = 2 \times 60 \times 4 = 480 \text{ watt-hour} = 0.48kWh$$

$$\text{Therefore, energy consumed for 30 days} = 30 \times 0.48 = 14.4 \text{ watt-hour}$$

Case 2

$$\text{Power, } P_2 = 100W$$

$$\text{Number, } n_2 = 3$$

$$\text{Time for use } T_2 = 5 \text{ hours everyday}$$

$$\text{Energy consumed, } E_2 = n_2 \times P_2 \times T_2$$

$$E_2 = 3 \times 100 \times 5 = 1500 = 1.5kWh$$

$$\text{Therefore, energy consumed for 30 days} = 30 \times 1.5 = 45kWh$$

$$\text{Therefore, overall energy consumed} = 14.4 + 45 = 59.4kWh$$

**Q19. A bulb is rated as 250V, 0.4A. Find**

**a) Power**

**b) Resistance**

**Answer:**

Given,

$$V = 250V$$

$$I = 0.4 \text{ amp}$$

a)  $P = ?$

$$P = VI$$

$$P = 100 \text{ watt}$$

b)  $R = ?$   
 $P = IR$   
 $R = 625 \text{ ohm}$

**Q20. For a heater rated at 4kW and 220V, calculate:**

- a) the current
- b) the resistance of the heater
- c) the energy consumed in 2 hours
- d) the cost if 1 kWh is priced at Rupees 60

**Answer:**

Given,  
 $P = 4\text{kW}$   
 $V = 220\text{V}$

a)  $I = ?$   
 $P = VI$   
 $I = 16\text{amp}$

b)  $R = ?$   
 $P = IR$   
 $R = 15.25 \text{ ohm}$

c) Energy consumed in two hours =  $PT$   
 $E = 8\text{kWh}$

d) If  $1\text{kWh} = \text{Rupees } 4.6$   
Total cost = Rupees 36.8



**Q21. An electric motor takes 5 ampere current from a 220 volt supply line. Calculate the power of the motor and electric energy consumed by it in 2.**

**Answer:**

Given,  
 $I = 5\text{amp}$   
 $V = 220\text{V}$   
 $T = 2 \text{ hours}$   
 $P = ?$   
 $E = ?$   
 $P = VI$   
 $P = 1.1\text{kW}$   
Energy consumed  $E = PT$   
 $E = 2.2\text{kWh}$

**Q22. Which uses more energy: a 250W TV set in 1 hour or a 1200W toaster in 10 minutes?**

**Answer:**

Case 1: TV set

$$P = 250W = 0.25kWh$$

$$T = 1 \text{ hour}$$

$$\text{Energy consumed, } E = PT = 0.25kWh$$

Case 2: Toaster

$$P = 1200W = 1.2kW$$

$$T = 10 \text{ min} = 1/6 \text{ hour}$$

$$\text{Energy consumed, } E = PT = 0.2kWh$$

Therefore, it can be concluded that TV uses more power.

**Q23. Calculate the power used in the  $2\Omega$  resistor in each of the following circuits:**

**a) a 6V battery in series with  $1\Omega$  and  $2\Omega$  resistors**

**b) a 4V battery in parallel with  $12\Omega$  and  $2\Omega$  resistors**

**Answer:**

a) Given,

$$V = 6V$$

$$R_1 = 1 \text{ ohm}$$

$$R_2 = 2 \text{ ohm}$$

$$\text{Equivalent resistance, } R = R_1 + R_2 = 3 \text{ ohm}$$

$$\text{Total current, } I = V/R = 6/3 = 2\text{amp}$$

$$\text{Current through } R_2 = I_2 = I = 2\text{amp}$$

$$\text{Voltage across } R_2 = V_2 = I_2 R_2 = 4 \text{ ohm}$$

$$\text{Power used in } R_2 = I_2 V_2 = 8W$$

b)  $V = 4V$

$$R_1 = 12 \text{ ohm}$$

$$R_2 = 2 \text{ ohm}$$

$$\text{Voltage across } R_2 = V_2 = V = 4V$$

$$\text{Current across } R_2 = I_2 = V_2/R_2 = 2 \text{ amp}$$

$$\text{Power used in } R_2 = I_2 V_2 = 8W$$

**Q24. Two lamps one rated 40 watt at 220V and the other 60 watt at 220V are connected in parallel to the electric supply at 220V.**

**a) Draw a circuit diagram to show the connections**

**b) Calculate the current drawn from the electric supply**

**c) Calculate the total energy consumed by the two lamps together when they operate for one hour**

**Answer:**

Given,

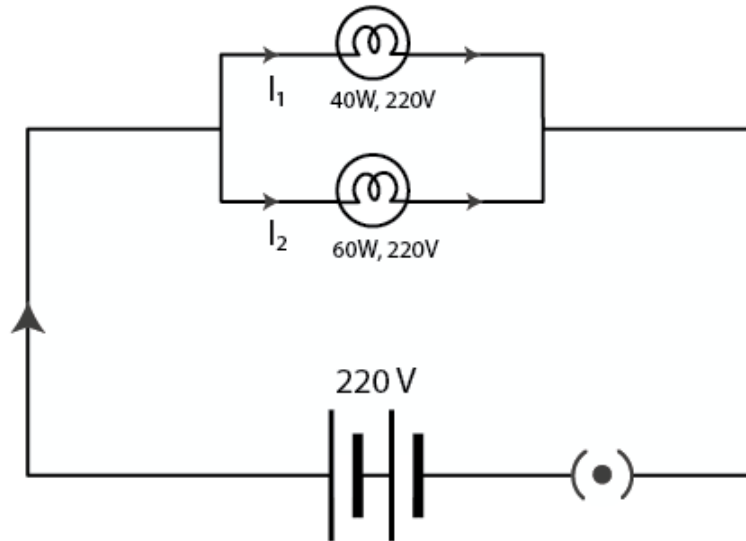
$$\text{No. of lamps} = 2$$

$$P_1 = 40W$$

$$P_2 = 60W$$

$$V = 220V$$

a)



b) Voltage across both the bulbs is the same and is equal to 220V

Current through 40W lamp =  $I_1 = P_1/V = 40/220$  amp

Current through 60W lamp =  $I_2 = P_2/V = 60/220$  amp

Total current drawn from the electric supply =  $40/220 + 60/220 = 0.45$  amp

c) Energy consumed by 40W lamp in 1 hour,  $E_1 = PT = 40$  watt-hour

1 watt-hour = 3.6kJ

$E_1 = 144$ kJ

Energy consumed by 60 watt lamp in 1 hour,  $E_2 = PT = 216$ kJ

Total energy consumed =  $144 + 216 = 360$ kJ

**Q25. An electric kettle connected to the 230V mains supply draws a current of 10A. Calculate:**

**a) the power of the kettle**

**b) the energy transferred in 1 minute**

**Answer:**

Given,

$V = 230$ V

$I = 10$ amp

a)  $P = VI$

$P = 2300$  watt =  $2300$  J/s

b) Energy consumed in one minute =  $PT$

=  $138000$  J

**Q26. A 2kW heater, a 200 watt TV and three 100 watt lamps are all switched on from 6-10PM. What is the total cost at Rupees 5.50 per kWh?**

**Answer:**

For heater,

$$P = 2\text{kWh}$$

$$T = 4 \text{ hours}$$

$$\text{Energy consumed} = PT = 8\text{kWh}$$

For TV,

$$P = 200 \text{ watt} = 0.2\text{kW}$$

$$T = 4 \text{ hours}$$

$$\text{Energy consumed} = PT = 0.8\text{kWh}$$

For lamps,

$$P = 100 \text{ watt} = 0.1\text{kW}$$

$$T = 4 \text{ hours}$$

$$n = 3$$

$$\text{Energy consumed} = PTn = 1.2\text{kWh}$$

$$\text{Total energy consumed} = 8 + 0.8 + 1.2 = 10\text{kWh}$$

$$\text{Cost of 1kWh} = \text{Rupees } 5.50$$

$$\text{Total cost} = \text{Rupees } 55.$$



**Q27. What is the maximum power in kilowatts of the appliance that can be connected safely to a 13A, 230V mains socket?**

**Answer:**

Given,

$$I = 13\text{amp}$$

$$V = 230\text{V}$$

$$P = VI$$

$$P = 2.99\text{kW}$$

**Q28. An electric fan runs from the 230V mains. The current flowing through it is 0.4A. At what rate is electrical energy transferred by the fan?**

**Answer:**

Given,

$$V = 230\text{V}$$

$$I = 0.4\text{amp} \text{Rate at which electrical energy is transferred} = \text{Power}$$

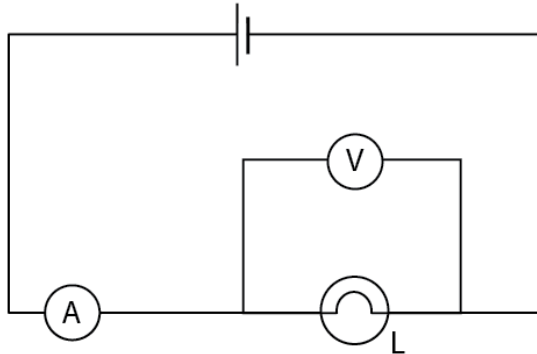
$$P = VI$$

$$P = 92\text{watt} = 92\text{J/s}$$

### Long Answer Type Questions

**Q29. a) What is meant by “electric power”? Write the formula for electric power in terms of potential difference and current.**

**b) The diagram below shows a circuit containing a lamp L, a voltmeter, and an ammeter. The voltmeter reading is 3V and the ammeter reading is 0.5A.**



**What is the resistance and power of the lamp?**

**c) Define kilowatt-hour. How many joules are there in one kilowatt-hour?**

**d) Calculate the cost of operating a heater of 500W for 20 hours at the rate of? Rupees 3.90 per unit.**

**Answer:**

a) Electric power is defined as the rate at which the consumption of electric energy takes place. It is given as:  
 $P = VI = \text{watt}$

b) Given,  
 $V = 3V$   
 $I = 0.5 \text{ amp}$   
 $R = ?$   
 $P = ?$   
 $V = IR$   
 $R = 6 \text{ ohms}$   
 $P = VI$   
 $P = 1.5 \text{ watt}$



c) The energy consumed when an electrical appliance with power 1 kilowatt is used for 1 hour, that is known as one kilowatt hour.

d) Given,  
 $P = 500W = 0.5kW$   
 $T = 20 \text{ hour}$   
Energy consumed =  $PT = 10kWh$   
Total cost = ?  
Cost per unit = Rupees 3.9  
Therefore, total cost = Rupees 39

### **Multiple Choice Questions**

**Q30. When an electric lamp is connected to 12V battery, it draws a current of 0.5A. The power of the lamp is:**

- a) 0.5W
- b) 6W
- c) 12W
- d) 24W

**Answer:**

The correct option is b) 6W

We know that power is calculated as  $P = VI$ . Substituting the values of V and I we get  $P = 6W$ .

**Q31. The unit for expressing electric power is:**

- a) Volt
- b) Joule
- c) Coulomb
- d) Watt

**Answer:**

The correct option is d) Watt

Watt is the unit that is used for expressing the electric power.

**Q32. Which of the following is likely to be the correct wattage for an electric iron used in our homes?**

- a) 60W
- b) 250 W
- c) 850W
- d) 2000W

**Answer:**

The correct option is c) 850W

The electric iron that is used in our homes have 850W power.

**Q33. An electric heater is rated at 2kW. Electrical energy costs rupees 4 per kWh. What is the cost of using the heater for 3 hours?**

- a) Rupees 12
- b) Rupees 24
- c) Rupees 36
- d) Rupees 48

**Answer:**

The correct option is b) Rupees 24.

It is given that the electrical energy cost is Rupees 4/kWh

Time duration is 3 hours

The power of the electric heater is 2kW

Using the given information we can calculate the amount for 3 hours as Rupees 24.

**Q34. The SI unit of energy is:**

- a) Joule
- b) Coulomb
- c) Watt
- d) Ohm-meter

**Answer:**

The correct answer is a) Joule

The SI unit of energy is joule.

**Q35. The commercial unit of energy is:**

- a) Watt

- b) Watt-hour
- c) Kilowatt-hour
- d) Kilo-joule

**Answer:**

The correct option is c) Kilowatt-hour  
Kilowatt hour is the commercial unit of energy.

**Q36. How much energy is does a 100W electric bulb transfer in 1 minutes?**

- a) 100J
- b) 600J
- c) 3600J
- d) 6000J

**Answer:**

The correct option is d) 6000J  
6000J of energy is transferred in an electric bulb with a power of 100W in 1 minute.

**Q37. An electric kettle for use on a 230V supply is rated at 3000W. For safe working, the cable connected to it should be able to carry at least:**

- a) 2A
- b) 5A
- c) 10A
- d) 15A

**Answer:**

The correct option is d) 15A  
15A current is required for the safe working of an electric kettle that has a supply of 230V.

**Q38. How many joules of electrical energy are transferred per second by a 6V, 0.5A lamp?**

- a) 30 J/s
- b) 12 J/s
- c) 0.83 J/s
- d) 3 J/s

**Answer:**

The correct option is d) 3 J/s  
When 6V and 0.5A lamp is used, 3 J/s electrical energy is required.

**Q39. At a given time, a house is supplied with 100A at 220V. How many 75W, 220V light bulbs could be switched on in the house at the same times if they are all connected in parallel?**

- a) 93
- b) 193
- c) 293
- d) 393

**Answer:**

The correct option is c) 293  
A total of 293 bulbs can be used when they are all connected in parallel and have 75W and 220V.

**Q40. If the potential difference between the ends of a fixed resistor is halved, the electric power will become:**

- a) double
- b) half
- c) four times
- d) one-fourth

**Answer:**

The correct option is d) one-fourth

When the potential difference between the ends of a fixed resistor is halved, the electric power becomes one-fourth of the actual value.

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### **Very Short Answer Type Questions**

**Q1. How does the heat  $H$  produced by a current passing through a fixed resistance wire depend on the magnitude of current  $I$ ?**

**Answer:**

The heat  $H$  produced by a current passing through a fixed resistance wire is directly proportional to the magnitude of the current  $I$ .

**Q2. If the current passing through a conductor is doubled, what will be the change in heat produced?**

**Answer:**

When the current passing through a conductor is doubled, the heat produced will increase by four times. This is because the heat produced is directly proportional to the square of current.

**Q3. Name two effects produced by electric current.**

**Answer:**

Following are the two effects produced by electric current:

- a) Heating effect
- b) Magnetic effect

**Q4. Which effect of current is utilized in an electric light bulb?**

**Answer:**

The heating effect of current is utilized in an electric light bulb.

**Q5. Which effect of current is utilized in the working of an electric fuse?**

**Answer:**

The heating effect of current is utilized in the working of an electric fuse.

**Q6. Name two devices which work on the heating effect of electric current.**

**Answer:**

Following are the two devices that work on the heating effect of an electric current:

- a) Electric heater
- b) Electric fuse

**Q7. Name two gases which are filled in filament type electric light bulbs.**

**Answer:**

Following are the two gases that are filled in filament type electric light bulbs:

- a) Argon
- b) Nitrogen

**Q8. Explain why, filament type electric bulbs are not power efficient.**

**Answer:**

Filament type electric bulbs are not power efficient because they consume most of the electric power as heat and a very small amount of electric power is converted into light.

**Q9. Why does the connecting cord of an electric heater not glow hot while the heating element does?**

**Answer:**

The connecting cord of an electric heater does not glow hot while the heating element does because the connecting cord is made from copper which does not glow as the heat produced is negligible. Whereas in a heating element is made from the nichrome glows because a large amount of heat is produced when the current is passed through it.

### Short Answer Type Questions

**Q10. a) Write down the formula for the heat produced when a current I is passed through a resistor R for time t.**

**b) An electric iron of resistance 20 ohms draws a current of 5 amperes. Calculate the heat produced in 30 seconds.**

**Answer:**

a) Following is the formula for the heat produced:

$$H = I^2Rt$$

b) Given,

$$R = 20\Omega$$

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

$$t = 30\text{s}$$

We know that,

$$H = I^2Rt$$

Substituting the values we get,

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

**Q11. State three factors on which the heat produced by an electric current depends. How does it depend on these factors?**

**Answer:**

Following are the three factors on which the heat produced by an electric current depend:

- a) Heat produced is directly proportional to the square of current
- b) Heat produced is directly proportional to resistance
- c) Heat produced is directly proportional to the time for which the current flows

**Q13. Why is an electric bulb not filled with air? Explain why argon or nitrogen is filled in an electric bulb.**

**Answer:**

An electric bulb is not filled with air because the filament in an electric bulb is made using tungsten which would burn quickly when it comes in contact with the oxygen in the air. This is the reason why unreactive gases such as argon and nitrogen is used for filling an electric bulb. These gases are chemically unreactive.

**Q14. Explain why, tungsten is used for making the filaments of an electric bulb.**

**Answer:**

Tungsten is used for the making of the filaments of an electric bulb because the melting point of the tungsten is very high. This means that the filament remains burning hot but won't melt. The other reason for using tungsten is that it is flexible and the rate of evaporation is low at high temperatures.

**Q15. Explain why, the current that makes the heater element very hot, only slightly warms the connecting wires leading to the heater.**

**Answer:**

The connecting wires leading to the heater are slightly warmer than the wires that makes the heater element hot because they have low resistance which results in flow of negligible heat production in them.

**Q16. When a current of 4amp passes through a certain resistor for 10 minutes,  $2.88 \times 10^4$  J of heat are produced. Calculate**

**a) the power of the resistor**

**b) the voltage across the resistor**

**Answer:**

Given,

$$I = 4\text{amp}$$

$$T = 10\text{min} = 600\text{s}$$

$$H = 2.88 \times 10^4 \text{ J}$$

a) We know that,

$$H = I^2RT$$

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

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

We know that,

$$P = I^2R$$

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

b) We know that,

$$V = IR$$

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

**Q17. A heating coil has a resistance of  $200\Omega$ . At what rate will heat be produced in it when a current of  $2.5\text{A}$  flows through it?**

**Answer:**

Given,

$$R = 200 \text{ ohms}$$

$$I = 2.5\text{amp}$$

$$T = 1\text{s}$$

We know that,

$$H = I^2RT$$

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



**Q18.** An electric heater of resistance  $8\Omega$  takes a current of  $15\text{A}$  from the mains supply line. Calculate the rate at which heat is developed in the heater.

**Answer:**

Given,

$$R = 8\text{ohm}$$

$$I = 15\text{amp}$$

$$T = 1\text{s}$$

We know that,

$$H = I^2RT$$

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

**Q19.** A resistance of  $25\Omega$  is connected to a  $12\text{V}$  battery. Calculate the heat energy in joules generated per minute.

**Answer:**

Given,

$$R = 25\Omega$$

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

$$T = 60\text{s}$$

$$H = ?$$

$$V = IR$$

$$12 = 25I$$

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

We know that,

$$H = I^2RT$$

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



**Q20.**  $100$  joules of heat is produced per second in a  $4\text{ohm}$  resistor. What is the potential difference across the resistor?

**Answer:**

Given,

$$H = 100\text{J}$$

$$T = 1\text{s}$$

$$R = 4\text{ohms}$$

We know that,

$$H = I^2RT$$

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

$$100/4 = I^2$$

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

$$V = IR$$

$$V = 5 \times 4$$

$$V = 20\text{V}$$

### Long Answer Type Questions

**Q21. a)** Derive the expression for the heat produced due to a current  $I$  flowing for a time interval  $t$  through a resistor  $R$  having a potential difference  $V$  across its ends. With which name is this relation known?

**b)** How much heat will an instrument of  $12\text{W}$  produce in one minute if it is connected to a battery of  $12\text{V}$ ?

- c) The current passing through a room heater has been halved. What will happen to the heat produced by it?
- d) What is meant by the heating effect of current? Give two applications of the heating effect of current.
- e) Name the material which is used for making the filaments of an electric bulb.

**Answer:**

a) When an electric charge  $Q$  moves against the potential difference  $V$  then the amount of work done is given as:

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

We know, current  $I = Q/T$

$$Q = IT \text{ (2)}$$

By Ohm's law,

$$V/I = R$$

$$V = IR \text{ (3)}$$

Substituting the equation (2) and (3) in (1), we get

$$W = I^2RT$$

Assumption:

The electrical work done is converted into heat energy

Therefore, heat produced is  $H = I^2RT$

The above equation is known as Joule's law of heating

b) Given,

$$P = 12W$$

$$V = 12V$$

$$T = 60s$$

We know that,

$$P = VI$$

$$I = P/V$$

$$= 12/12$$

$$= 1 \text{ amp}$$

$$V = IR$$

$$R = V/I$$

$$= 12/1$$

$$= 12 \text{ ohm}$$

$$H = I^2RT$$

$$H = 720J$$

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

d) The heating effect of current is the production of heat when an electric current is passed through the wire that has a high resistance. This effect is used in electric oven and electric heaters.

e) For the making of an electric bulb, tungsten is used.

### Multiple Choice Questions

**Q22. The heat produced by passing an electric current through a fixed resistor is proportional to the square of:**

- a) magnitude of resistance of the resistor
- b) temperature of the resistor
- c) magnitude of current
- d) time for which current is passed

**Answer:**

The correct option is c) magnitude of current

The heat produced by passing an electric current through a fixed resistor is proportional to the square of the magnitude of current.

**Q23. The current passing through an electric kettle has been doubled. The heat produced will become:**

- a) half
- b) double
- c) four times
- d) one-fourth

**Answer:**

The correct option is c) four times

The heat produced in an electric kettle becomes four times the actual value when the current is doubled.

**Q24. An electric fuse works on the:**

- a) chemical effect of current
- b) magnetic effect of current
- c) lighting effect of current
- d) heating effect of current

**Answer:**

The correct option is d) heating effect of current

Heating effect of current is the working principle for an electric fuse.

**Q25. The elements of electric heating devices are usually made of:**

- a) tungsten
- b) bronze
- c) nichrome
- d) argon

**Answer:**

The correct option is c) nichrome

The elements of an electric heating devices are made using nichrome.

**Q26. The heat produced in a wire of resistance 'x' when a current 'y' flows through it in time 'z' is given by:**

- a)  $x^2 \times y \times z$
- b)  $x \times z \times y^2$
- c)  $y \times z^2 \times x$
- d)  $y \times z \times x$

**Answer:**

The correct option is b)  $x \times z \times y^2$

**Q27. Which of the following characteristics is not suitable for a fuse wire?**

- a) thin and short
- b) thick and short
- c) low melting point
- d) higher resistance than rest of wiring

**Answer:**

The correct option is b) thick and short

When a fuse wire is thick the electrons available are more which is not a suitable characteristic of a fuse wire.

**Q28. In a filament types light bulb, most of the electric power consumed appears as:**

- a) visible light
- b) infrared rays
- c) ultraviolet rays
- d) fluorescent light

**Answer:**

The correct option is b) infrared rays

The electric power consumed in a filament type light bulb is an infrared rays.

**Q29. Which of the following is the most likely temperature of the filament of an electric light bulb when it is working on the normal 220V supply line?**

- a) 500°C
- b) 1500°C
- c) 2500°C
- d) 4500°C

**Answer:**

The correct option is c) 2500°C



**Q30. If the current flowing through a fixed resistor is halved, the heat produced in it will becomes:**

- a) double
- b) one-half
- c) one-fourth
- d) four times

**Answer:**

The correct option is: c) four times

When the current flowing through a fixed resistor is halved, then the heat produced in the resistor will becomes four times the actual value.

### **High Order Thinking Skills**

**Q31. The electrical resistivities of four materials P, Q, R, and S are given below:**

**P:  $6.84 \times 10^{-8} \Omega\text{m}$**

**Q:  $1.70 \times 10^{-8} \Omega\text{m}$**

**R:  $1.0 \times 10^{-8} \Omega\text{m}$**

**S:  $11.0 \times 10^{-8} \Omega\text{m}$**

**Which material will you use for making:**

- a) heating element of electric iron
- b) connecting wires of electric iron
- c) covering of connecting wires

**Give reason for your choice in each case.**

**Answer:**

- a) The heating element of an electric iron is S because the resistivity of S is high. This material is nichrome.
- b) The connecting wires of an electric iron is Q as it has low resistivity. This material is copper.
- c) The covering of connecting wires is R as the resistivity of R is very high and the material is rubber.

**Q32. a) How does the wire in the filament of a light bulb behave differently to the other wires in the circuit when the current flows?**

**b) What property of the filament wire accounts for this difference?**

**Answer:**

- a) The behavior of the wire in the filament of a light bulb is different from the other wires of the circuit as the wire used in the filament becomes white hot while the other wires do not heat much.
- b) The high resistance of the filament wire is responsible for the difference seen between the filament wire and the other wires of the circuit.

**Q33. Two exactly similar heating resistances are connected in series and in parallel in two different circuits one by one. If the same current is passed through both the combinations, is more heat obtained per minute when they are connected in series or when they are connected in parallel? Give reason for your answer.**

**Answer:**

When the heating resistances are connected in series more heat is obtained per minute. This is because the total resistance in series combination is more when compared to the total resistance in parallel combination.

**Q34. An electric iron is connected to the mains power supply of 220V. When the electric iron is adjusted at 'minimum heating' it consumes a power of 360W but at 'maximum heating' it takes a power of 840W.**

**Calculate the current and resistance in each case.**

**Answer:**

Given,

$$V = 220V$$

$$P_{\min} = 360W$$

$$P_{\max} = 840 W$$

When the heating is minimum,

$$P_{\min} = VI$$

$$360 = I220$$

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

$$R = V/I$$

$$R = 220/1.63$$

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

When the heating is maximum,

$$P_{\max} = VI$$

$$840 = 220I$$

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

$$R = V/I$$

$$R = 220/3.81$$

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

**Q35. Which electric heating devices in your home do you think have resistors which control the flow of electricity?**

**Answer:**

Following are the electric heating devices that have resistors that control the flow of electricity:

- a) Electric iron
- b) Room heater
- c) Water heater
- d) Electric oven

