CBSE EXAMINATION PAPER-2022

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 53

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **23 questions.** All questions are **compulsory.**

ii. This question paper is divided into **4 sections.**

iii. **Section A** – questions number **1 to 2** are case based questions

iv. **Section B** – questions number **3 to 12** are very short answer

v. **Section C** – questions number **13 to 15** are long answer

vi. **Section D** – questions number **16 to 23** are short answer

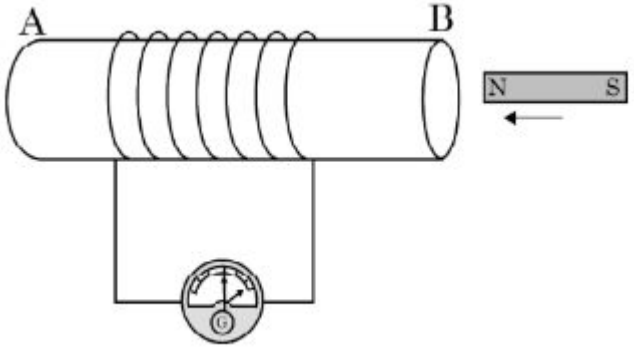
vii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

viii. Use of calculator is NOT allowed.

Section A

Question 1.

AB coil of copper wire having an ample number of turns. The ends of the coil are connected with a galvanometer as shown. When the north pole of a strong bar magnet is moved towards the end B of the coil, a deflection is observed in the galvanometer.



(1)

State the reason for using a galvanometer in the activity and why does its needle deflects momentarily when magnet is moved towards the coil.

[1 Marks]

Answer: A galvanometer is used in this activity to measure the electric current induced in the coil due to the movement of the magnet. When the north pole of the magnet is moved towards the coil, it causes a change in the magnetic field around the coil, inducing an electromotive force (EMF) and causing a current to flow through the coil. This induced current makes the galvanometer needle deflect momentarily.

Key Points: Galvanometer measures induced current-Induced current is generated by changing magnetic field-Galvanometer needle deflects due to induced EMF

(2)

What would be observed in the galvanometer in a situation when the coil and the bar magnet both move with the same speed in the same direction ? Justify your answer.

[1 Marks]

Answer: When the coil and the bar magnet move with the same speed in the same direction, no deflection will be observed in the galvanometer. This is because electromagnetic induction only occurs when there is relative motion between the magnet and the coil. Since both are moving together at the same speed, there is no change in the magnetic field experienced by the coil, and hence no induced current is generated.

Key Points: relative motion needed for induction-no change in magnetic field-explains lack of galvanometer deflection

(3)

State the conclusion that can be drawn from this activity.

Will there be any change in the momentary deflection in the galvanometer if number of turns in the coil is increased and a more stronger magnet is moved towards the coil ?

[2 Marks]

Answer: The conclusion that can be drawn from the activity is that moving a magnet near the coil induces an electric current, which causes a deflection in the galvanometer. If the number of turns in the coil is increased and a stronger magnet is used, the momentary deflection in the galvanometer will also increase. This is because a greater number of turns increases the induced current, and a stronger magnet enhances the rate of change of magnetic flux.

Key Points: Induction of current occurs when magnet moves near coil - More turns = stronger deflection - Stronger magnet increases deflection due to greater magnetic flux change

(4)

What is electromagnetic induction ? What is observed in the galvanometer when a strong bar magnet is held stationary near one end of a coil of large number of turns ? Justify your answer.

[2 Marks]

Answer: Electromagnetic induction is the process by which a changing magnetic field can induce an electromotive force (EMF) in a coil of wire. When the north pole of a strong bar magnet is held stationary near the end B of the coil, there is no relative motion between the magnet and the coil; thus, no change in the magnetic field through the coil occurs. As a result, the galvanometer shows no deflection because induced EMF is generated only when there is relative motion, or a change in magnetic flux through the coil.

Key Points: Definition of electromagnetic induction; stationary magnet does not produce a changing magnetic field; galvanometer shows no deflection when magnet is stationary.

Question 2.

Sex of an individual is determined by different factors in various species. Some animals rely entirely on the environmental cues, while in some other animals the individuals can change their sex during their life time indicating that sex of some species is not genetically determined. However, in human beings, the sex of an individual is largely determined genetically.

(1)

In what way are the sex chromosomes 'X' and 'Y' different in size? Name the mismatched pair of sex chromosomes in humans.

[1 Marks]

Answer: The X chromosome is larger in size compared to the Y chromosome, which is shorter. In humans, the mismatched pair of sex chromosomes consists of one X chromosome and one Y chromosome, resulting in males being XY.

Key Points: X chromosome is larger-Y chromosome is smaller-mismatched pair is XY

(2)

Write the number of pairs of sex chromosomes present in human beings. In which one of the parent (male/female) perfect pair / pairs of sex chromosomes are present?

[1 Marks]

Answer: Human beings have 1 pair of sex chromosomes. Females have a perfect pair of sex chromosomes (XX), while males have one X and one Y chromosome (XY).

Key Points: 1 pair of sex chromosomes - Females have a perfect pair (XX) - Males have XY chromosomes

(3)

Citing two examples to justify the statement 'Sex of an individual is not always determined genetically.

[2 Marks]

Answer: One example is found in some reptiles, where the temperature at which the fertilized eggs are incubated can determine whether the offspring will be male or female. This indicates that environmental factors play a crucial role in sex determination. Another example is seen in certain species of snails that can change their sex during their lifetime, demonstrating that sex is not fixed or solely determined by genetics.

> **Key Points: Example of reptiles where temperature determines sex-Example of snails that change sex**

(4)

Draw a flowchart to show that sex is determined genetically in human beings.

[2 Marks]

Answer: Start -> Chromosomes from parents -> XX (female) or XY (male) -> Newborn individual -> End. This flowchart illustrates that the sex of a human being is determined by the combination of sex chromosomes inherited from the parents, specifically the presence of X and Y chromosomes.

> **Key Points: Chromosomes determined by parents - Sex chromosomes - XX (girl) or XY (boy) - Genetic determination of sex.**

Section B

Question 3.

Explain giving reason why although the nuclear charge in atoms increases in moving from left to right in a period as well as in moving from top to bottom in a group in the Modern periodic table, but the size of the atoms does not vary similarly in both situations.

[2 Marks]

Answer: As we move left to right across a period, the nuclear charge increases due to higher proton numbers, which attracts electrons more strongly, thus reducing atomic size. However, when moving

down a group, although nuclear charge also increases, additional electron shells are added, which outweighs the effect of the increased nuclear charge. Thus, atom size increases down a group due to increased distance and electron shielding, resulting in a larger atomic radius.

Key Points: Nuclear charge increases left to right; atomic size decreases; nuclear charge increases top to bottom; additional shells increase electron shielding; atoms size increases down a group

Question 4.

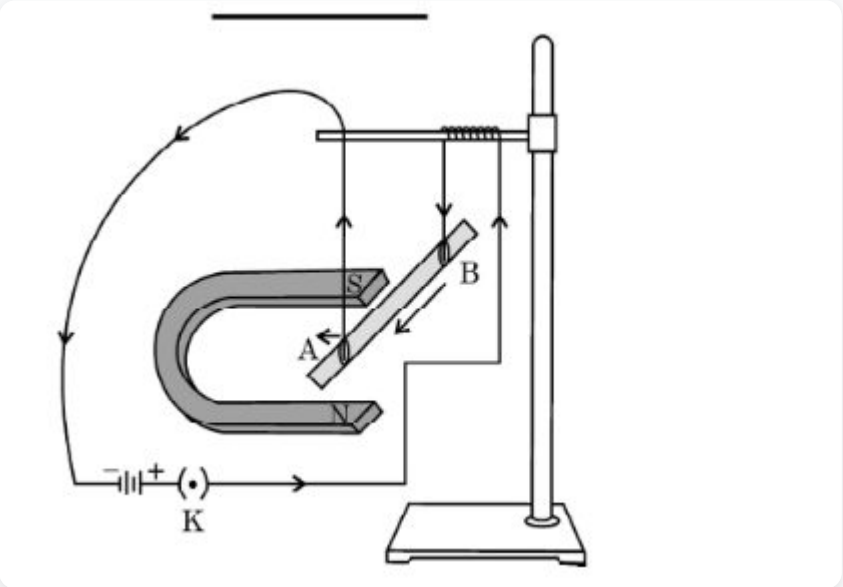
As shown in the diagram an aluminium rod 'AB' is suspended horizontally between the two poles of a strong horse shoe magent in such a way that the axis of rod is horizontal and the direction of the magnetic field is vertically upward. The rod is connected in series with a battery and a key.

State giving reason:

(a) What is observed when a current is passed through the aluminum rod from end B to end A?

(b) What change is observed in a situation in which the axis of the rod 'AB' is moved and aligned parallel to the magnetic field and current is passed in the rod in the same direction ?

[2 Marks]



Answer: When a current flows from end B to end A through the aluminum rod placed in an upward magnetic field, the rod experiences a force and is displaced towards the left due to the interaction between the magnetic field and the current. If the rod is aligned parallel to the magnetic field while maintaining the same current direction, no force is exerted, and thus no movement occurs as the current's direction is parallel to the field lines. This shows that magnetic fields have both magnitude and direction.

Key Points: Current from B to A causes leftward movement; no movement when rod is parallel to field; proof of direction and magnitude of magnetic field.

Question 5.

Using height (tallness/ dwarfness) of a plant as an example , show that genes control the characteristics or traits in an organism.

[2 Marks]

Answer: Height in plants is strongly influenced by genes. The tallness trait (T) is dominant, meaning a plant needs only one copy to be tall, while two copies of the dwarf trait (t) are needed for a short plant. This dominance explains why variations occur in height based on genetic makeup. Additionally, genes regulate enzymes that produce growth hormones. Hence, if genes make these enzymes less efficient, the plant will not produce enough hormone and will be short.

Key Points: Genes control traits- Tallness is dominant (T)- Dwarfness is recessive (t)- One T makes tall plant- Two tt makes short plant- Genes regulate enzyme efficiency- Enzyme efficiency affects hormone levels

Question 6.

Mention the function of (a) Placenta (b) Fallopian tubes (c) Uterus and (d) Ovary in the human female reproductive system.

[2 Marks]

Answer: The placenta functions as a lifeline between the mother and fetus, supplying nutrients and oxygen while removing waste. The fallopian tubes transport the egg from the ovary to the uterus and are the site of fertilization. The uterus houses and nurtures the developing fetus during pregnancy. The ovaries produce female gametes called ova and also secrete hormones essential for the menstrual cycle and pregnancy.

Key Points: Function of placenta- nutrient and waste exchange;Function of fallopian tubes- egg transport and fertilization;Function of uterus- fetal development;Function of ovary- ova production and hormone secretion

Question 7.

" The improvement in our lifestyle has led to the generation of large amount of waste material." List two reasons to justify this statement.

[2 Marks]

Answer: The improvement in our lifestyle has led to increased waste generation primarily due to two reasons: First, the rising trend of disposable products contributes significantly to waste. Many items we use daily, such as cutlery, packaging, and personal care products, are designed for single use and discarded immediately. Second, changes in packaging materials, particularly the widespread use of non-biodegradable plastics, result in increased environmental pollution as they take hundreds of years to decompose.

> **Key Points: disposable products increase waste-non-biodegradable plastics pollution**

Question 8.

(a) Differentiate between binary fission in Amoeba and binary fission in Leishmania.

(b) How does reproduction take place in malarial parasite ?

[2 Marks]

Answer: Binary fission in Amoeba occurs without a definitive orientation, allowing division to take place in any plane. In contrast, Leishmania exhibits more cellular organization; the fission occurs in a specific orientation due to the presence of a whip-like structure at one end. Regarding malarial parasites, they reproduce both sexually and asexually. The asexual stage occurs in the human host, while sexual reproduction happens in the Anopheles mosquito, making the life cycle complex and well-adapted for survival.

> **Key Points: Binary fission in Amoeba is non-oriented; Leishmania shows oriented division; Malarial parasite has a complex reproduction involving both hosts.**

Question 9.

Consider the carbon compounds having following molecular formula :

(i) C_3H_6 (ii) C_3H_8 (iii) C_4H_6 (iv) C_6H_6 (v) C_6H_{12}

(a) State the number of double covalent bonds present in C_3H_6 .

(b) Write the formula of first member of the homologous series to which the carbon compound C_4H_6 belongs.

(c) which one of the above compounds forms ring structure of carbon atoms ?

(d) Identify, which of the above compounds, is a member of alkane series.

[2 Marks]

Answer: (a) The molecular formula C_3H_6 corresponds to an alkene with one double covalent bond because the general formula for alkenes is C_nH_{2n}. Hence, C_3H_6 has one double bond.

(b) The compound C_4H_6 belongs to the alkyne series which has the general formula C_nH_{2n-2}. The first member of this series is ethyne with formula C_2H_2.
(c) The compound that forms a ring structure is C_6H_{12}, which is cyclohexane. It is a cycloalkane having six carbon atoms arranged in a ring with only single bonds.
(d) The compound which is a member of alkane series is C_3H_8 because alkanes have the general formula C_nH_{2n+2}. C_3H_8 fits this formula, so it is an alkane (propane).

> **Key Points: C_3H_6 has one double bond - C_4H_6 belongs to alkynes, first member is C_2H_2 - C_6H_{12} forms ring structure (cyclohexane) - C_3H_8 is an alkane**

Question 10.

" Magnetic field is a physical quantity that has both direction and magnitude". How can this statement be proved with the help of magnetic field lines of a bar magnet ?

[2 Marks]

Answer: The statement is proved by observing the magnetic field lines around a bar magnet using a compass needle. When the compass needle is placed near the magnet, its direction aligns with the magnetic field, indicating that the field has a specific direction. The density of the lines shows the strength of the magnetic field, demonstrating magnitude. Field lines emerge from the north pole and converge at the south pole, proving both attributes.

> **Key Points: Direction shown by compass alignment-Density of lines indicates strength-Magnetic field lines emerge from north, converge at south**

Question 11.

In a cross between red coloured and white coloured flowers, when plants with red coloured flowers of F1 generation were self pollinated, plants of F2 generation were obtained in which 75% of plants were with red flowers and 25% plants were with white flowers.

Explain the inheritance of traits in the above cross with the help of a flow chart only along with the ratio of plants obtained.

[2 Marks]

Answer: Flow chart showing inheritance of flower colour:
P generation: Red flower (RR) × White flower (rr)
↓
F1 generation: All plants Red flower (Rr)
(Red is dominant, white is recessive)
↓
Self pollination of F1: Rr × Rr

↓

F2 generation: Genotype ratio: 1 RR : 2 Rr : 1 rr

Phenotype ratio: 3 Red : 1 White

Thus, 75% plants have red flowers and 25% plants have white flowers in F2 generation.

> **Key Points: Red is dominant - White is recessive - F2 ratio is 3 red : 1 white**

Question 12.

" The change in packaging has resulted in waste becoming non-biodegradable."

Giving two examples from daily life, justify this statement.

[2 Marks]

Answer: The shift to non-biodegradable packaging materials is evident in daily products. For instance, the use of plastic bags for groceries, which take years to decompose, contributes significantly to landfill waste. Another example is packaging for ready-to-eat meals, often consisting of plastic and styrofoam. These materials persist in the environment and can lead to pollution and harmful impacts on wildlife as they do not break down easily, affecting ecosystems.

> **Key Points: Plastic bags take years to decompose - ready-to-eat meal packaging often made of plastic and styrofoam - persistent waste causes pollution - impacts on wildlife and ecosystems**

Section C

Question 13. Mention the functions of (i) Placenta (ii) Fallopian tubes (iii) Uterus and (iv) Ovary in the human female reproductive system.

[2.5 Marks]

Answer: The human female reproductive system consists of several key organs, each with specific functions. Firstly, the ovary produces female gametes known as ova or eggs, and it also secretes hormones like estrogen and progesterone, which regulate the menstrual cycle and facilitate reproduction. Secondly, the fallopian tubes, also known as oviducts, transport the released egg from the ovary to the uterus and are the site where fertilization typically occurs when sperm meets the egg. Thirdly, the uterus is a muscular organ that supports the developing embryo after fertilization. Its lining thickens to nourish the embryo; if implantation does not occur, this lining sheds during menstruation. Lastly, the placenta forms after implantation and connects the developing fetus to the mother’s blood supply, facilitating the exchange of nutrients, gases, and waste products, thus playing a crucial role in fetal development and sustaining pregnancy.

Key Points: Ovary produces ova and hormones; Fallopian tubes transport eggs and site of fertilization; Uterus supports embryo development and menstrual cycle; Placenta nourishes fetus and connects to mother's blood supply.

Question 14. The improvement in our lifestyle has led to the generation of large amounts of waste material. List two reasons to justify this statement.

[2.5 Marks]

Answer: The improvement in our lifestyle has significantly contributed to the generation of large amounts of waste material for various reasons. Firstly, the shift towards a more consumerist culture has led to an increased demand for products made with non-biodegradable materials, such as plastics. Many of these products, including single-use bags, containers, and packaging, contribute to substantial waste that does not decompose easily in the environment. Secondly, changes in our attitudes towards convenience have accelerated the use of disposable items. Items such as plates, cutlery, and even clothing are often designed for one-time use, leading to higher waste generation. This change has not only increased the volume of waste but has also affected the natural environment, as large quantities of waste accumulate in landfills and in oceans, adversely impacting ecosystems and water sources. Consequently, the need for effective waste management practices becomes critical to mitigate these environmental issues.

Key Points: Shift towards consumerism resulting in increased demand for non-biodegradable products; Increased reliance on convenience leading to the popularity of disposable items; Accumulation of waste adversely affecting ecosystems and water sources.

Question 15.

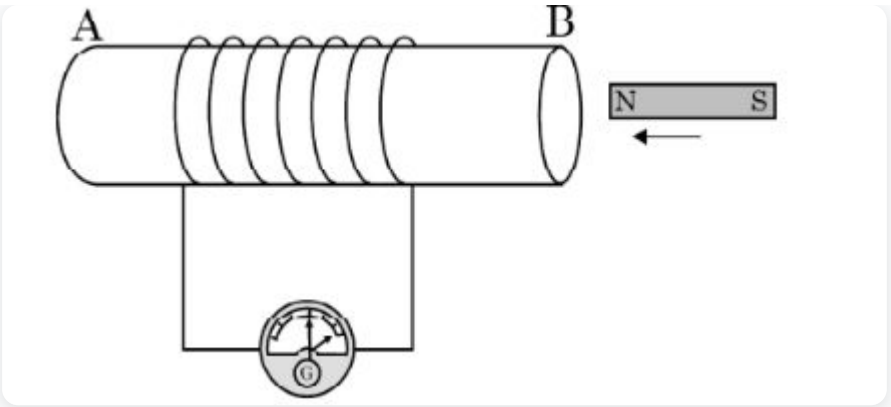
AB is coil of copper wire having a large number of turns. The Ends of the coil are connected with a galvanometer as shown. When the north pole of a strong bar magnet is moved towards the end B of the coil, a deflection is observed in the galvanometer.

(a) State the reason for using galvanometer in the activity and why does its needle deflects momentarily when magnet is moved towards the coil.

(b) What would be observed in the galvanometer in a situation when the coil and the bar magnet both move with the same speed in the same direction ? Justify your answer.

(c) State the conclusion that can be drawn from this activity.

[4 Marks]



Answer: The galvanometer is used to measure the deflection caused by induced electromotive force (EMF) generated in the coil. When the north pole of the magnet approaches the coil, the changing magnetic field induces an electric current in the coil, momentarily causing the galvanometer needle to deflect. If both the coil and the magnet move together at the same speed and direction, there would be no change in magnetic flux through the coil, resulting in no induced current and thus no deflection in the galvanometer. This indicates that relative motion between the magnet and the coil is necessary for inducing EMF. The conclusion from this activity is that a change in magnetic field around a coil induces electric current, demonstrating Faraday's law of electromagnetic induction, which is fundamental in electromagnetic applications, including electromagnets.

Key Points: Purpose of galvanometer; Induced current due to changing magnetic field; No deflection at constant relative speed; Importance of relative motion; Conclusion on electromagnetic induction

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Section D

Question 16.

Name the elements whose compounds formed the basis of classification in Mendeleeve's periodic table. Why did Mendeleev choose these elements ? How the formulae of these compounds had helped Mendeleev in deciding the position of an elements in his periodic table ?

[3 Marks]

Answer: Mendeleev primarily used the compounds of elements such as hydrogen, oxygen, carbon, and nitrogen for classification in his periodic table. He chose these elements because they form a variety of binary compounds, which demonstrated different chemical properties and behaviors. The chemical formulae derived from these compounds, based on the valencies of the participating elements, allowed Mendeleev to determine relationships between elements. The consistent patterns in the properties and formulae of these compounds helped him position elements according to their similar characteristics.

Key Points: Mendeleev's basis: hydrogen, oxygen, carbon, nitrogen; reasons for choice: diverse binary compounds; role of formulae: revealed relationships and properties; aided classification.

Question 17.

What are trophic levels ? Why re autotrophs considered to be at the first trophic level of all food chains ? State the reason for limited number of trophic levels in nature.

[3 Marks]

Answer: Trophic levels are the hierarchical stages in a food chain through which energy passes in an ecosystem. Autotrophs, also known as producers, occupy the first trophic level because they capture solar energy through the process of photosynthesis, converting it into chemical energy stored in organic matter. As energy moves up the trophic levels from autotrophs to herbivores and then to carnivores, a significant amount is lost at each stage, primarily through metabolic processes and heat. This energy loss limits the number of trophic levels—typically, food chains consist of only three or four levels. Beyond that, insufficient energy remains to support additional levels, leading to an upper limit on ecosystem complexity.

Key Points: Trophic levels define energy stages in an ecosystem - Autotrophs are first trophic level as they capture solar energy - Energy loss limits number of trophic levels

Question 18.

In flowering plants, the pollen grains are transferred to stigma by pollination but the female germ cells are present in the ovary. Explain with the help of a labelled diagram (only concerned parts), how the male germ cell reaches the ovary.

[3 Marks]

Answer: In flowering plants, the process of pollination leads to the male germ cell reaching the ovary. Initially, pollen grains from the stamen are transferred to the stigma, the sticky part of the pistil. Once on the stigma, the pollen germinates and forms a pollen tube. This tube grows down through the style, a connecting structure between the stigma and ovary. The pollen tube carries two male gametes to the ovary where the ovules are located. The male gametes then fuse with the female gametes in the ovules, leading to fertilization to form a zygote, which can develop into a new plant. A labelled diagram showing the stigma, style, and ovary is essential to illustrate this process clearly.

Key Points: Pollen transfer occurs from stamen to stigma; pollen tube forms from the pollen grain; pollen tube travels through the style to ovary; fusion of male and female gametes occurs in ovule; fertilization leads to zygote formation.

Question 19.

"Two different forms of carbon - diamond and graphite have different structures and very different physical properties even though their chemical properties are same." Explain why.

[3 Marks]

Answer: Diamond and graphite are both allotropes of carbon, meaning they are different structural forms of the same element. In diamond, each carbon atom is covalently bonded to four other carbon atoms in a tetrahedral structure, resulting in a rigid, three-dimensional lattice. This structure gives diamond its exceptional hardness and high melting and boiling points. In contrast, graphite consists of layers of carbon atoms bonded in a hexagonal arrangement, with weaker van der Waals forces between layers. This structure allows layers to slide over each other, making graphite soft and an excellent conductor of electricity. Thus, despite having the same chemical properties, their distinct structures lead to vastly different physical properties.

Key Points: Allotropes of carbon; diamond's tetrahedral structure; rigid and hard; graphite's layered structure; soft and conductive; different physical properties despite similar chemical properties.

Question 20.

State the reasons, why carbon cannot

(i) Lose four electrons to form C^{4+} cation and

(ii) Grain four electrons to form C^{4-} anion.

How does carbon overcome this problem to form compounds?

[3 Marks]

Answer: (a) Carbon cannot lose four electrons to form C^{4+} cation because it requires a very large amount of energy to remove four electrons from carbon. Removing these electrons leaves carbon with only two electrons while still having six protons, which is highly unstable.

(b) Carbon cannot gain four electrons to form C^{4-} anion because it would be difficult for the nucleus with six protons to hold on to ten electrons (six original plus four extra). The repulsion among the increased number of electrons also makes the anion unstable.

(c) To overcome this problem, carbon shares its four valence electrons with other atoms through covalent bonding rather than completely losing or gaining electrons. This way, carbon forms stable molecules by sharing electrons and achieving a noble gas configuration, as seen in compounds like methane (CH_4).

Key Points: Large energy required to remove 4 electrons - Unstable to hold 10 electrons due to nuclear charge and electron repulsion - Carbon forms covalent bonds by sharing

electrons to attain stability

Question 21.

(a) A student wants to use an electric heater, an electric bulb an electric fan simultaneously.

How should these gadgets be connected with the mains ? Justify your answer giving three reasons.

(b) What is an electric fuse ? How is it connected in a circuit ?

[3 Marks]

Answer: To use an electric heater, an electric bulb, and an electric fan simultaneously, all these gadgets should be connected in parallel to the mains. This connection allows each device to operate independently, ensuring they can function at their required voltage levels without affecting each other. If one device fails, the others remain operational, preventing complete circuit disruption. Additionally, a parallel circuit distributes current evenly, ensuring all devices receive the power they need for optimal performance. An electric fuse is a safety device that prevents excess current from damaging electrical appliances and reducing the risk of fire. It is connected in series with the circuit so that all the current passes through it, allowing it to blow and break the circuit if the current exceeds a safe level.

Key Points: Connected in parallel allows independent operation; devices maintain required voltage levels; prevents total circuit failure.

Question 22.

An electric motor rated 1100 W is connected to 220 V mains. Find :

(i) the current drawn from the mains,

(ii) Electric energy consumed if the motor is used for 5 hours daily for 6 days.

(iii) Total cost of energy consumed if the rate of one unit is Rs.5

[3 Marks]

Answer: To find the current drawn from the mains, we can use the formula P = VI, where P is the power (1100 W) and V is the voltage (220 V). Rearranging gives I = P/V = 1100 W / 220 V = 5 A. The electric energy consumed by the motor when used for 5 hours daily over 6 days is calculated as Energy = Power × Time = 1100 W × (5 hours/day × 6 days) = 1100 W × 30 hours = 33,000 Wh or 33 kWh. The total cost of energy consumed at Rs. 5 per unit (kWh) is 33 kWh × Rs. 5/unit = Rs. 165.

Key Points: Use P = VI to find current; Calculate electric energy consumed using Energy = Power × Time; Determine cost by multiplying total consumed energy with unit rate

Question 23.

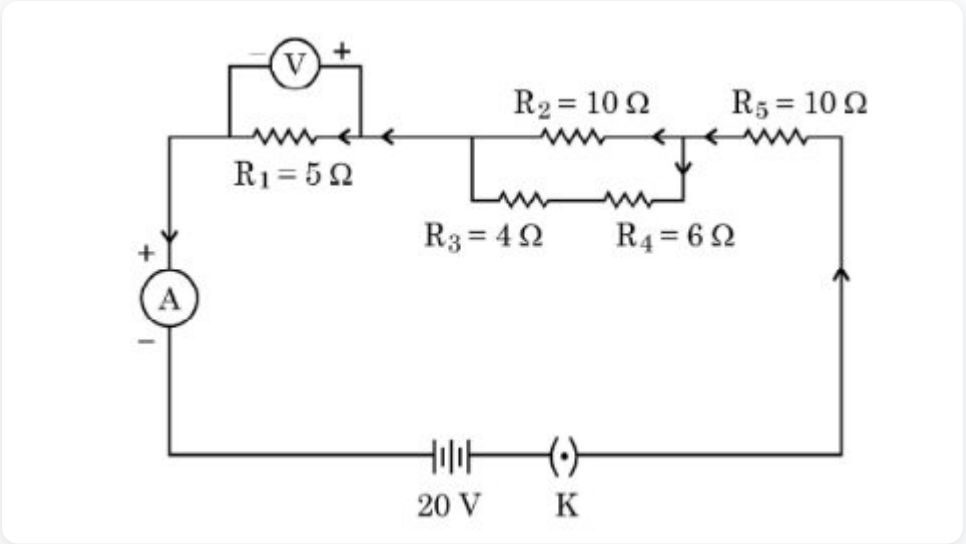
Study the following circuit and find:

(i) Effective resistance of the circuit

(ii) Current drawn from the battery

(iii) Potential difference across the 5Ω resistor

[3 Marks]



Answer: To find the effective resistance (Rp) of the circuit with R1 = 5Ω, R2 = 10Ω, and R3 = 30Ω, we use the formula for resistors in parallel: 1/Rp = 1/R1 + 1/R2 + 1/R3. Substituting the values, we get 1/Rp = 1/5 + 1/10 + 1/30, which simplifies to Rp = 3Ω. The total current drawn from the battery (I) can be calculated using Ohm's law (I = V/Rp). With a battery voltage V = 12V, I = 12V / 3Ω = 4A. The potential difference across the 5Ω resistor (V1) can be determined using Ohm's law (V1 = I1 * R1), where I1 = 2.4A, yielding V1 = 2.4A * 5Ω = 12V.

Key Points: Effective resistance calculated using 1/Rp = 1/R1 + 1/R2 + 1/R3; Total current I derived from I = V/Rp; Potential difference V1 across 5Ω resistor determined through V1 = I1 * R1.