CBSE EXAMINATION PAPER-2022

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 44

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **20 questions.** All questions are **compulsory.**

ii. This question paper is divided into **3 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

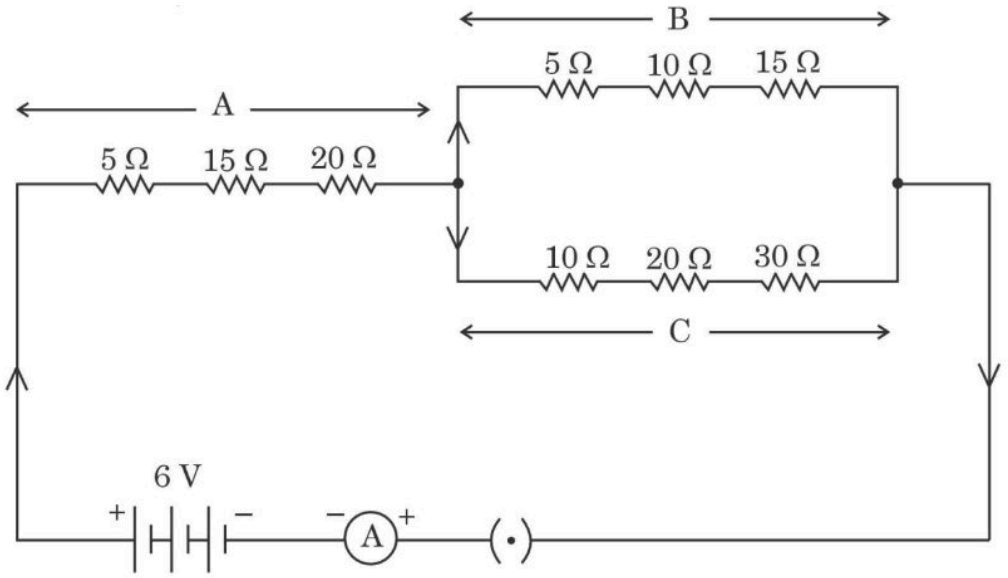
v. **Section C** – questions number **13 to 20** are short answer

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

vii. Use of calculator is NOT allowed.

Section A

Question 1. Study the following electric circuit in which the resistors are arranged in three arms A, B and C:



(1) Find the equivalent resistance of arm A.

[1 Marks]

Answer: The equivalent resistance of arm A, which consists of resistors R1 and R2 in parallel, can be calculated using the formula 1/R' = 1/R1 + 1/R2. Substituting the values, we have 1/R' = 1/10 + 1/40. After calculating, R' equals 8 Ω.

Key Points: Calculate equivalent resistance using parallel formula-Substitute given resistor values-Simplify to find final resistance

(2) Determine the current that flows through the ammeter.

[2 Marks]

Answer: To determine the current flowing through the ammeter, we first apply Ohm's Law. Given the resistors R1, R2, and R3 with values 5 Ω, 10 Ω, and 30 Ω respectively, connected across a 12 V battery, we calculate the current through each resistor. For R1, I1 = V/R1 = 12 V / 5 Ω = 2.4 A; for R2, I2 = 12 V / 10 Ω = 1.2 A; and for R3, I3 = 12 V / 30 Ω = 0.4 A. The total current in the circuit is the sum of these currents, I = I1 + I2 + I3 = 2.4 A + 1.2 A + 0.4 A = 4 A. Therefore, the current flowing through the ammeter is 4 A.

Key Points: Apply Ohm's Law; Calculate individual currents through R1, R2, R3; Sum of individual currents gives total current

(3) Calculate the equivalent resistance of the parallel combination of the arms B and C.

[1 Marks]

Answer: The equivalent resistance of the parallel combination of arms B and C can be calculated using the formula for resistors in parallel. If the resistances of B and C are R2 and R3 respectively, then the equivalent resistance, Rp, is given by 1/Rp = 1/R2 + 1/R3. After substituting the values, for example, if R2 = 10 Ω and R3 = 20 Ω, we have 1/Rp = 1/10 + 1/20 = 3/20, leading to Rp = 20/3 Ω or approximately 6.67 Ω.

> **Key Points: Use the formula for parallel resistors; Substitute values for R2 and R3; Calculate equivalent resistance Rp.**

(4)

Determine the current that flows in the ammeter when the arm B is withdrawn from the circuit.

[2 Marks]

Answer: When arm B is withdrawn from the circuit, the resistors A and C remain connected in series. The total resistance of the circuit can be recalculated using the resistances of arms A and C. If we assume arm A has a resistance of 5 Ω and arm C has a resistance of 30 Ω, the total resistance of the circuit, R = R_A + R_C = 5 Ω + 30 Ω = 35 Ω. Given a voltage of 12 V across the circuit, applying Ohm's Law (I = V/R), we find that the current I = 12 V / 35 Ω = 0.34 A. Therefore, 0.34 A flows through the ammeter when arm B is withdrawn.

> **Key Points: 1. Identify the resistances of arms A and C. 2. Calculate total resistance when arm B is withdrawn. 3. Apply Ohm's Law to find the current.**

Question 2.

The modes by which various organisms reproduce depend on the body design of the organisms. In asexual reproduction , a single individual parent produces offsprings without the involvement of gametes. This method is a common means of increasing the offsprings rapidly under favorable conditions. Asexual reproduction occurs mostly in unicellular organisms, some plants and certain simple multicellular animals.

(1)

State the name of the organism in which binary fission takes place in a definite orientation. Also name the disease caused by this organism.

[1 Marks]

Answer: The organism in which binary fission takes place in a definite orientation is 'Euglena'. The disease caused by this organism is 'Euglena-associated infections'.

Key Points: Euglena-binary fission-disease

(2)

List any two advantages of producing plants through vegetative propagation.

[1 Marks]

Answer: Two advantages of producing plants through vegetative propagation are: 1. They take less time to grow and bear flowers and fruits earlier than those produced from seeds. 2. The new plants are exact copies of the parent plant, ensuring that desired traits are maintained.

Key Points: Faster growth and flowering-Exact copies of parent

(3)

Explain the process of budding in Hydra.

[2 Marks]

Answer: Budding in Hydra is a form of asexual reproduction where new individuals develop from outgrowths called buds. These buds form on the body of the parent hydra and grow as small bulges. As the buds mature, they develop tissues and eventually detach from the parent hydra to become independent organisms. This process allows Hydra to rapidly increase their population under favorable conditions.

Key Points: Budding is asexual reproduction- New individuals develop from buds- Buds form on the parent hydra- Buds detach to become independent

(4)

What happens when

(i) a spirogyra filament matures and attains a considerable length, and

(ii) a spirogyra in Rhizopus bursts on maturation ?

[2 Marks]

Answer: When a spirogyra filament matures and attains a considerable length, it typically reproduces asexually by fragmentation, leading to the formation of new filaments. In contrast, when a spirogyra in Rhizopus bursts upon maturation, it releases spores that can germinate and grow into new individuals under favorable conditions.

Key Points: Spirogyra filament matures; undergoes asexual reproduction by fragmentation - New filaments formed; Spirogyra in Rhizopus bursts - Releases spores for new growth

Section B

Question 3.

Kulhads (disposable cups made of clay) and disposable paper cups both are used as an alternative for disposable plastic cups. Which one of these two can be considered as a better alternative to plastic cups and why ?

[2 Marks]

Answer: Kulhads, made from clay, can be considered a better alternative to disposable paper cups. They are biodegradable and do not cause long-term environmental harm like plastic. Additionally, kulhads have natural insulating properties that keep beverages cooler. Unlike paper cups, which may require trees for production and can add to waste if not recycled correctly, kulhads utilize locally sourced natural materials and are entirely eco-friendly. This makes them a sustainable choice overall.

Key Points: biodegradable-non-toxic-use of local materials-sustainable alternative

Question 4.

Human beings are most adversely affected by the Biological Magnification. State the reason. Why can ordinary washing of the edibles (fruits and vegetables) not reduce the effect of biological magnification ?

[2 Marks]

Answer: Human beings are adversely affected by biological magnification because they occupy the top trophic level in the food chain, leading to higher accumulation of harmful chemicals. These chemicals enter the food chain through pesticides and pollutants, accumulating in plants, animals, and ultimately humans. Ordinary washing of fruits and vegetables cannot eliminate these substances, as they are often taken up by the plants directly from the soil and water, making them integrated into the plant tissue.

> **Key Points: Humans at top of food chain - High accumulation of chemicals - Chemicals from pesticides enter food chain - Washing doesn't remove them - Chemicals absorbed into plant tissue**

Question 5.

Draw the electron dot structure of the following:

(a) Cyclohexane

(b) Butane

[2 Marks]

Answer: (a) The electron dot structure of cyclohexane, C_6H_{12}, shows six carbon atoms arranged in a ring, each carbon bonded to two neighboring carbons and two hydrogens. Each bond is represented by a pair of dots indicating shared electron pairs. (b) For butane, C_4H_{10}, the electron dot structure is a straight chain of four carbon atoms, each bonded to neighboring carbons with single bonds, and remaining valencies satisfied by hydrogen atoms. Each bond is shown as a pair of dots representing two shared electrons.

> **Key Points: Electron dot structure shows valence electrons-Electrons are shared in pairs to form bonds-Cyclohexane is cyclic with six carbons-Butane is a straight chain with four carbons**

Question 6.

State the criteria used by Mendeleev for creating his Periodic Table. Compare the position of isotopes of elements in the Mendeleev's Periodic Table and in the Modern Periodic Table.

[2 Marks]

Answer: Mendeleev's criteria for creating the Periodic Table included the arrangement of elements based on increasing atomic mass and grouping them by similar chemical properties. He left gaps for undetected elements. In comparison, isotopes, which are variants of elements with the same atomic number but different masses, were not specifically positioned in Mendeleev's table. In the Modern Periodic Table, isotopes are not directly separated but are incorporated based on their atomic number, enhancing clarity in atomic structure.

Key Points: Criteria: Increasing atomic mass, similar properties, gaps for undiscovered elements; Mendeleev vs Modern: Isotopes in Modern Table based on atomic number not mass.

Question 7.

An electric heater rated 1100 W operates at 220 V. Calculate

(i) its resistance, and (ii) the current drawn by it.

[2 Marks]

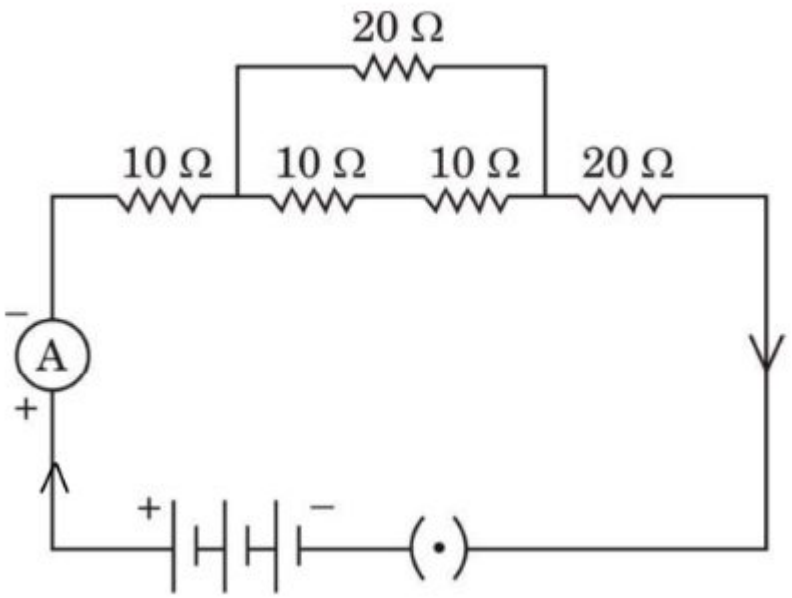
Answer: To calculate the resistance of the electric heater, we can use the formula $R = V^2/P$, where V is the voltage (220 V) and P is the power (1100 W). Thus, $R = (220\ V)^2 / 1100\ W = 44\ \Omega$. The current drawn by the heater can be calculated using $I = P/V$. Therefore, $I = 1100\ W / 220\ V = 5\ A$.

Key Points: Use power formula P = VI-Use resistance formula $R = V^2/P$-Calculate current using I = P/V

Question 8.

Calculate the equivalent resistance of the following electric circuit:

[2 Marks]



Answer: Solution:

To find the equivalent resistance, first calculate the combined resistance of R1 and R2 which are in parallel using the formula 1/R_{12} = 1/R_1 + 1/R_2.

Next, calculate the combined resistance of R3, R4, and R5 which are also in parallel: 1/R_{345} = 1/R_3 + 1/R_4 + 1/R_5.

Finally, since R_{12} and R_{345} are in series, add their resistance values: R_{total} = R_{12} + R_{345}. This gives the equivalent resistance of the entire circuit.

Key Points: Calculate parallel resistance for R1 and R2 - Calculate parallel resistance for R3, R4, and R5 - Add series resistances R_{12} and R_{345} to find total resistance

Question 9.

Suggest any two contraceptive methods to control the size of human population and explain them.

[2 Marks]

Answer: Two effective contraceptive methods are condoms and hormonal pills. Condoms create a mechanical barrier which prevents sperm from reaching the egg, reducing the chance of pregnancy and also preventing sexually transmitted infections. Hormonal pills, on the other hand, alter the body's hormonal balance to prevent ovulation, meaning no eggs are released for fertilization. Both methods play a crucial role in family planning and controlling population growth.

Key Points: Contraceptive methods-Mechanical barrier-Prevents sperm from reaching egg-Reduces chance of pregnancy-Also reduces STIs-Hormonal pills alter hormonal balance-Prevents ovulation-Important for family planning-Population control

Question 10.

Mendel crossed two pea plants with visible contrasting characteristics and found that there were no half-way characteristics in the plants of F_1 progeny. Explain the reason for this observation of Mendel.

[2 Marks]

Answer: Mendel observed that in the F_1 progeny of pea plants, only one trait appeared, and there were no intermediate or 'half-way' characteristics. This happened because one character was dominant and the other was recessive. The dominant trait masked the effect of the recessive trait in the hybrid plants, so all F_1 plants showed the dominant trait only. This led to the discovery of the Law of Dominance, which states that in a hybrid, one trait can dominate over the other.

> **Key Points: No intermediate traits in F1 - Dominant trait masks recessive trait - Mendel's Law of Dominance**

Question 11.

Justify the statement "Sex of the children will be determined by what they inherit from their father".

[2 Marks]

Answer: The sex of a child depends on the chromosomes inherited from the parents. Women have two X chromosomes (XX), and men have one X and one Y chromosome (XY). The mother always passes an X chromosome to the child. The father can pass either an X or a Y chromosome. If the father passes an X chromosome, the child will be a girl (XX). If the father passes a Y chromosome, the child will be a boy (XY). Therefore, the father's chromosome determines the sex of the child.

> **Key Points: Men have XY chromosomes - Women have XX chromosomes - Father determines sex by passing X or Y chromosome**

Question 12.

Name the part/organ of the human female reproductive system

(a) where contraceptive devices such as loop or copper-T are placed to prevent pregnancy.

(b) which is blocked to prevent the transfer of eggs.

(c) where formation of green cells as ova takes place.

(d) from where the embryo gets nutrition from the mother's blood.

[2 Marks]

Answer: (a) The uterus is where contraceptive devices like the loop or copper-T are placed to prevent pregnancy. (b) The fallopian tubes can be blocked to prevent the transfer of eggs. (c) The ovaries are

responsible for the formation of ova. (d) The placenta is where the embryo gets nutrition from the mother's blood.

Key Points: uterus|copper-T and loop|fallopian tubes|blocked to prevent transfer of eggs|ovaries produce ova|placenta provides nutrition

---

Section C

Question 13.

What are human-made ecosystems ? Give an example. Can a human-made ecosystem become a self-sustaining ecosystem ? Give reason to justify your answer.

[3 Marks]

Answer: Human-made ecosystems, also known as artificial ecosystems, are created and maintained by human activities. Examples include gardens, crop-fields, and aquariums. These ecosystems mimic natural environments but are designed for specific purposes. For instance, an aquarium can include aquatic plants and animals, providing a controlled habitat. A human-made ecosystem can become self-sustaining if the right components are included, such as a balanced food chain and proper abiotic factors like water and oxygen. This self-sustainability occurs as interactions among flora and fauna create a balance, reducing the need for continuous human intervention.

Key Points: Definition of human-made ecosystems; Examples: gardens, aquariums; Explanation of self-sustainability; Importance of balanced interactions; Role of abiotic factors.

Question 14.

State the reason why

(i) carbon compounds have low melting and boiling points.

(ii) carbon compounds do not conduct electricity.

(iii) carbon can form only covalent compounds.

[3 Marks]

Answer: Carbon compounds have low melting and boiling points primarily due to the weak intermolecular forces between molecules. Unlike ionic compounds, which possess strong ionic bonds that require significant energy to break, carbon compounds' covalent bonds are strong within the molecule but the interactions between the molecules themselves are weak. This leads to lower melting and boiling points. Furthermore, carbon compounds typically do not conduct electricity

because they do not contain freely moving charged particles like ions; instead, the shared electrons exist in covalent bonds without forming ions. Finally, carbon can only form covalent compounds because it has four valence electrons, allowing it to form stable covalent bonds with other nonmetals.

Key Points: Low melting and boiling points due to weak intermolecular forces-Non-conductors of electricity as they lack free ions-Covalent bonding exists due to carbon's four valence electrons

Question 15.

What is a homologous series ? Find the difference in molecular mass between the two consecutive members of a homologous series. State how in a homologous series of carbon compounds the following properties vary with increase in molecular mass:

(i) Melting and boiling points

(ii) Chemical properties

[3 Marks]

Answer: Definition: A homologous series is a group of compounds having the same functional group and similar chemical properties, where each successive member differs by a CH_2 unit.

Difference in molecular mass: The difference between two consecutive members of a homologous series is the molecular mass of one CH_2 group, which is (12 u for C + 2*1 u for H) = 14 u.

(i) Variation in melting and boiling points: As molecular mass increases in a homologous series, the melting and boiling points increase due to stronger van der Waals forces.

(ii) Variation in chemical properties: Chemical properties remain similar in the series since they depend on the functional group which remains the same.

Thus, homologous series show a gradual change in physical properties but similar chemical properties.

Key Points: Definition of homologous series - Difference in molecular mass is 14 u - Melting and boiling points increase with molecular mass - Chemical properties remain similar due to same functional group

Question 16.

In the following table, some elements have been arranged in a certain pattern :

Identify the periodic law with which the given table is associated. List two important features and two anomalies of the above periodic law.

[3 Marks]

pattern :

sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	–	–

Answer: The periodic law associated with the given table is the Periodic Law, which states that the properties of elements are a periodic function of their atomic numbers. Two important features of this law include the arrangement of elements in increasing order of atomic number, showcasing periodicity in properties like ionization energy and electronegativity. Additionally, elements with similar valence electron configurations are placed in the same group. However, two notable anomalies are the placement of hydrogen in Group 1 despite being a non-metal and the transitional metals that do not follow the expected trends in reactivity and atomic radii. These deviations arise because the electron configurations of some elements can lead to unexpected chemical behavior.

Key Points: Periodic Law-Arrangement by atomic number-Similar properties in groups-Anomalies: Hydrogen placement-Transitional metals' reactivity

Question 17.

What is a Solenoid ? Draw the pattern of the magnetic field lines around a current carrying solenoid. Mark on the pattern the region where the magnetic field is uniform.

[3 Marks]

Answer: A solenoid is a coil of many circular turns of insulated wire wrapped closely in the shape of a cylinder. When an electric current passes through the solenoid, it generates a magnetic field. The field lines around a current-carrying solenoid resemble those of a bar magnet, indicating that one end behaves like a north pole and the other as a south pole. Inside the solenoid, the magnetic field lines are parallel and evenly spaced, showing that the magnetic field is uniform in that region. Outside the solenoid, the field lines spread out and are weaker. This is essential for applications such as electromagnets, where a strong, uniform magnetic field is desired.

Key Points: Definition of solenoid - Structure and function - Uniform magnetic field inside - Comparison with bar magnet - Practical applications of solenoids

Question 18.

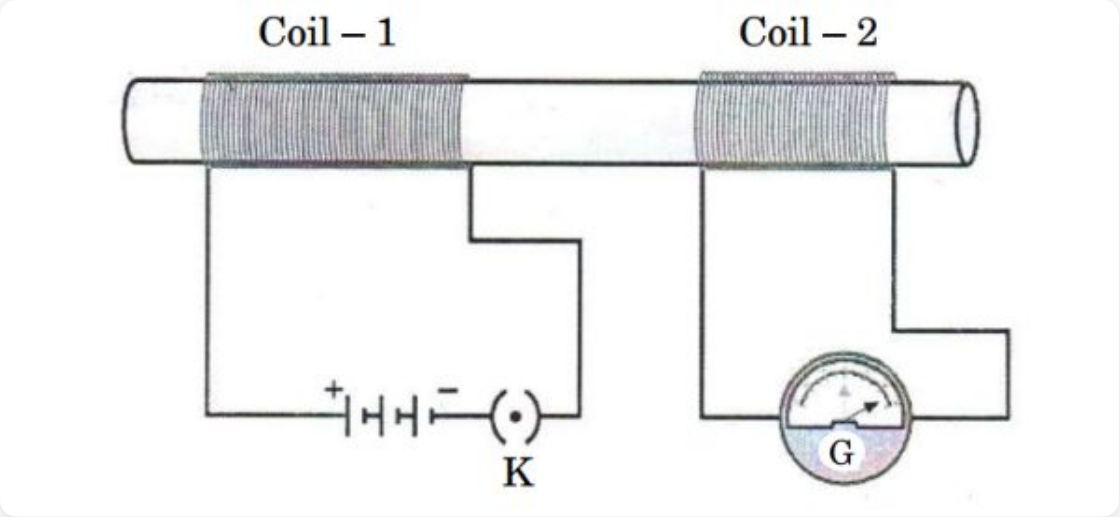
In the diagram given below, Coil 1 is connected in series with a battery and a plug key while Coil 2 is connected with a galvanometer.

(i) Why does the galvanometer show deflection only when the key (K) is plugged in and not when a steady current starts flowing in the circuit ?

(ii) What is observed in the galvanometer, when the key is plugged out ?

(iii) State the conclusion based on the observation of this activity.

[3 Marks]



Answer: The galvanometer shows deflection only when the key (K) is plugged in because the deflection indicates a change in magnetic field due to the variation of current, triggering the electromagnetic effect. When the key is plugged in, a current begins to flow, creating a dynamic magnetic field that influences the galvanometer. When the key is unplugged, the current ceases, leading to no deflection, as there's no changing magnetic field. This illustrates that a changing current produces a magnetic effect, essential for electromagnetism and inductive behavior.

Key Points: Deflection occurs due to changing current-Magnetic field influences galvanometer-Cutting off current stops deflection-Conclusion: Changing current is necessary for magnetic effects.

Question 19.

In the figure given below, a simple electric motor is shown :

As shown in the figure, the current in the coil ABCD flows from A to B in the arm AB and C to D in the arm CD.

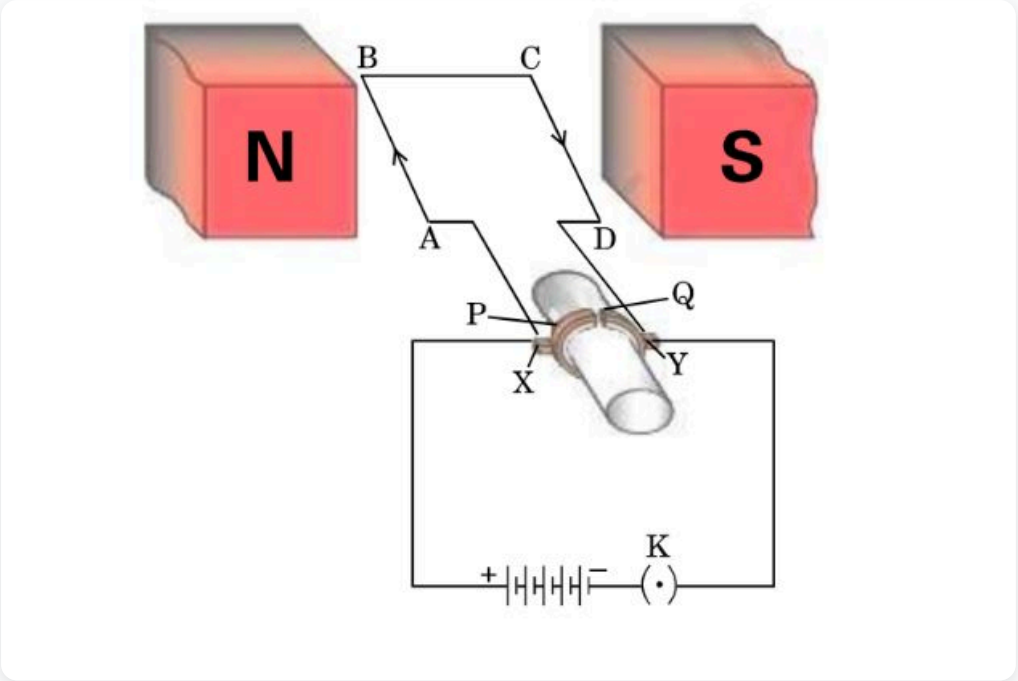
(i) State the directions in which the arms AB and CD will experience a force.

(ii) Identify the part of the electric motor that reverses the flow of current in the coil ABCD and write its name.

(iii) After the reversal of flow of current in the coil ABCD, state the directions in which the arms AB and CD will experience a force.

(iv) Name the rule which is applied to determine the direction of force on a current carrying conductor placed in a magnetic field.

[3 Marks]



Answer: (a) The arm AB will experience a force acting in the upward direction, while the arm CD will experience a force acting downward. This is because the direction of force on a current carrying conductor in a magnetic field depends on both the direction of current and magnetic field.
(b) The part of the electric motor that reverses the flow of current in the coil ABCD is called the **commutator**.
(c) After the reversal of current in the coil ABCD by the commutator, the direction of forces on arms AB and CD also reverses. Now, AB will experience force downward and CD will experience force upward, causing continuous rotational motion.
(d) The rule used to determine the direction of force on a current carrying conductor placed in a magnetic field is called **Fleming's Left-Hand Rule**.

Key Points: Force direction depends on current and magnetic field-Fleming's Left-Hand Rule-Commutator reverses current direction

Question 20.

How do Mendel's experiments show that the traits are inherited independently ? Explain.

[3 Marks]

Answer: Mendel's experiments and independent inheritance of traits:
Mendel performed dihybrid crosses where he studied two traits at the same time, like seed shape (round or wrinkled) and seed colour (yellow or green) in pea plants. He crossed plants heterozygous for both traits and observed the offspring.
He found that traits were inherited independently, shown by the 9:3:3:1 ratio in the F2 generation. This

means the alleles for one trait separate independently of the alleles for another trait during gamete formation.
This principle is called the Law of Independent Assortment.
It shows that the inheritance of one trait does not affect the inheritance of another, so traits are inherited independently.

> **Key Points: Mendel's dihybrid cross - 9:3:3:1 ratio in F2 generation - Law of Independent Assortment**
