Sample Question Paper - 39
Science (086)
Class- X, Session: 2021-22
TERM II

Time allowed : 2 hours ***Maximum marks : 40***

General Instructions :

(i) All questions are compulsory.

(ii) The question paper has three sections and 15 questions. All questions are compulsory.

(iii) Section–A has 7 questions of 2 marks each; Section–B has 6 questions of 3 marks each; and Section–C has 2 case based questions of 4 marks each.

(iv) Internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

SECTION - A

1. (a) Arrange the ions Na^+, O^{2-} and F^- in the decreasing order of their ionic radii.
(b) Arrange I^-, I and I^+ in the decreasing order of their radii. (atomic no. of I = 53)

2. While moving down in a group of non-metals, the chemical reactivity decreases. Explain with an example.

OR

How can the valency of an element be determined if its electronic configuration is known? What will be the valency of an element of atomic number 9(nine)?

3. A spore is a single or several celled reproductive structure that detaches from the parent and gives rise to a new individual. List two advantages for organisms to reproduce themselves through spores.

4. (a) How many contrasting characters are chosen by Mendel in pea plant?
(b) Define test cross.
(c) When a tall (T) and red-flowered (R) plant is crossed with a dwarf (t) and white-flowered (r) plant, the phenotype of 25% progeny is dwarf and white. What will be the genotype of tall and red-flowered plant?

5. Give one example each from your daily life where the domestic waste can be effectively reused and recycled.

OR

In the environment, living organisms, whether plants or animals have some connection with each other. On the basis of the given statement define food chain and food web?

6. What is a homologous series? Explain with an example.

OR

What is methane? Draw its electron dot structure and name the type of bonds formed in this compound. Why are such compounds poor conductors of electricity and have low melting and boiling points?

7. (a) What is electromagnetic induction?
(b) Write any one method to induce current in a coil.

SECTION - B

8. What does HIV stands for? Is AIDS an infectious disease? List any four modes of spreading AIDS.

OR

Distinguish between a gamete and zygote. Explain their roles in sexual reproduction.

9. Name the two reproductive parts of a bisexual flower which contain the germ cells. State the location and function of its female reproductive part.

10. A bulb is rated 50 W; 220 V. Find the current drawn by it, when it is connected to a 220 V supply. Also find its resistance. If the given bulb is replaced by a bulb of rating 30 W; 220 V, will there be any change in the value of current and resistance? Justify your answer and determine the change.

OR

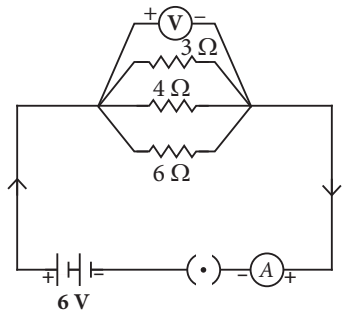
(a) State one difference between kilowatt and kilowatt hour. Express 1 kWh in joules.

(b) A bulb is rated 5V; 500 mA. Calculate the rated power and resistance of the bulb when it glows.

11. In the given circuit diagram calculate

(a) the total effective resistance of the circuit.

(b) the current through each resistor.



12. Mendel performed experiments on pea plant for several years and based on his observations he postulated laws of inheritance. Discuss the laws/principles of inheritance provided by him.

13. Out of the following food chain A, B and C, which one has the minimum number of trophic levels? If in each food chain, the same amount of energy is available to the producers, in which case will the organism at top of the food chain will get minimum energy for survival?

Food chain A : Plants → Deer → Tiger

Food chain B : Grass → Grasshopper → Frog → Snake → Eagle

Food chain C : Phytoplankton → Scorpion → Fish → Crane

SECTION - C

This section has 02 case-based questions (14 and 15). Each case is followed by 03 sub-questions (a, b and c). Parts a and b are compulsory. However, an internal choice has been provided in part c.

14. The strength of the magnetic field produced by a current-carrying circular coil (or circular wire) depends on (i) Current flowing through the coil. (ii) Radius of the circular coil. (iii) Number of turns of wire in the circular coil.

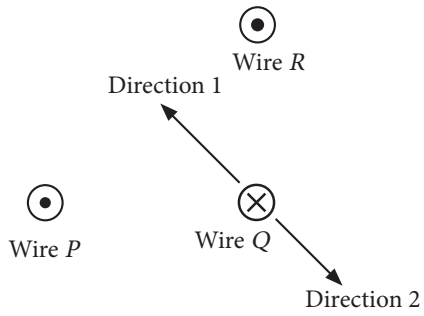
(a) A long horizontal power line is carrying a current of 100 A in the east-west direction. What is the direction of magnetic field at a point 1.0 m below it?

(b) What type of curve we get, between magnetic field and distance along the axis of a current carrying circular coil ?

(c) If a current carrying straight conductor is placed in east-west direction, then what is the direction of the force experienced by the conductor due to earth's magnetic field ?

OR

Three wires *P*, *Q* and *R* are oriented in the plane of the paper have the same amount of current flowing through them in the direction shown.



Given that the distance between the wire *P* and wire *Q* is the same as the distance between wire *Q* and wire *R*, what is the direction of the resultant magnetic force acting on wire *Q*?

15. Study the table related to three hydrocarbons *A*, *B*, *C* and answer the questions that follow.

Organic compound	Molecular formula
A	C_3H_8
B	C_5H_{10}
C	C_4H_6

(a) Why are *A*, *B* and *C* classified as hydrocarbons?

(b) Which of these organic compounds is an alkyne?

(c) To which homologous series does C_5H_{10} belong to? State its general formula and give the formula of next member of this series.

OR

Do the compounds *A* and *B* belong to the same homologous series? If not, state the general formula of the homologous series of compound *A*.

Solution

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1. (a) Order of ionic radius: $O^{2-} > F^{-} > Na^{+}$
Number of electrons : 10 10 10
Number of protons : 8 9 11
All the given ions contain same number of electrons. Due to the presence of highest number of protons in Na^{+}, its effective nuclear charge (Z_{eff}) is highest and, therefore, its radius is smallest. O^{2-} contains lowest number of protons. Its effective nuclear charge is lowest and therefore, its ionic radius is largest.
Greater is the ratio of Z/e, smaller is the radius of the ion where Z = number of protons, e = number of electrons
(b) Order of ionic radius: $I^{-} > I > I^{+}$
Number of electrons : 54 53 52
Number of protons : 53 53 53
Effective nuclear charge is lowest in I^{-} which results in larger atomic size. Effective nuclear charge is highest in I^{+} and hence it is smallest in size.

2. Amongst group-17 elements, fluorine is the most reactive and iodine is the least reactive.

Element	Symbol	Reactivity
Fluorine	F (9)	Most reactive
Chlorine	Cl (17)	Chemical reactivity ↓ Decreases
Bromine	Br (35)	
Iodine	I (53)	Least reactive

As one moves down the group, the number of electron shells goes on increasing. Thus, with the increased number of electron shells, the nucleus loses its power to attract more electrons, so as to complete its outermost orbit. This, in turn, lowers the reactivity of elements.

OR

Valency of an element is determined by the number of electrons present in its outermost shell. For elements having outermost electrons 1 to 4, valencies are equivalent to their respective valence electrons.
For elements having outermost electrons 5 to 8, valency is calculated as;
Valency = 8 – (Number of valence electrons)
For element having atomic number = 9
Electronic configuration = 2, 7
Valency = 8 – 7 = 1

3. Two advantages of spore producing organisms are:
(i) Some spores help organism to survive during harsh environmental conditions as spores are covered by thick walls which protect them until they come in contact with moist surface and germinate.
(ii) Spores are generally very small and light. Therefore, it ensures easy dispersal by wind, water and animal.

4. (a) Pea plants used by Mendel for his experiments had 7 pairs of contrasting characters.
(b) Test cross is a cross between an individual of unknown genotype and recessive parent to test whether an individual is homozygous (pure) or heterozygous (hybrid).
(c) Parents : TtRr × ttrr
Gametes : TR Tr tR tr tr
F_1 : TtRr Ttrr ttRr ttrr
1 : 1 : 1 : 1
Genotype of tall red-flowered plant is TtRr.

5. We can reuse plastic and glass jars of jams and pickles, etc., for the purpose of storage of things like salt, sugar, tea, etc., whereas we can recycle newspapers, plastic of some types, broken glass and metalwares for making fresh paper, plastic, glass and metal objects.

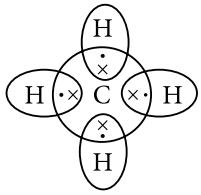
OR

A straight line sequence of 'who eats whom' or eating and being eaten in an ecosystem is called a food chain. A network of cross connecting food chains involving producers, consumers and decomposers are termed as a food web.

6. A homologous series can be defined as a family of organic compounds having the same functional group, similar chemical properties and the successive members of which differ by a $-CH_2$ group or 14 mass units. For example, CH_3OH (methanol), CH_3CH_2OH (ethanol), $CH_3CH_2CH_2OH$ (propanol), $CH_3CH_2CH_2CH_2OH$ (butanol), etc. constitute a homologous series of alcohols. They have the same functional group, *i.e.*, —OH (hydroxyl). The difference between any two successive members is a $—CH_2$ group and 14 mass units.

OR

Methane is the first member of alkane series having molecular formula CH_4.
Covalent bonds are those bonds which are formed by sharing the valence electrons between two atoms. Electron dot structure of methane is shown in the figure.



Covalent compounds are generally poor conductors of electricity because they do not have free electrons or ions. They have low melting and boiling points because the forces of attraction between molecules of covalent compounds are very weak. On applying a small amount of heat, these molecular forces break.

7. (a) It is the phenomenon of producing induced current in a closed circuit by changing magnetic flux linked with it.
(b) By keeping the magnet in a fixed position and moving the coil towards and away from the magnet, we can induce current in the coil.

8. HIV stands for Human Immunodeficiency Virus. Yes, AIDS is an infectious disease. It is transmitted sexually or through exposure to contaminated blood.

Four modes of spreading AIDS are :
(i) Unprotected sex with an infected partner
(ii) Use of contaminated needle and syringes
(iii) Use of contaminated razors for shaving
(iv) Transfusion of infected blood or blood products.

OR

Differences between gamete and zygote are:

S. No.	Gamete	Zygote
(i)	Gamete is the germ cell that takes part in fertilisation during sexual reproduction.	Zygote is the product of fertilisation, formed by fusion of male and female gametes.
(ii)	Gamete is haploid. There are two types of gametes - sperm in male and ovum in female.	Zygote is diploid.
(iii)	Gamete carries characteristic of one parent only.	Zygote contains characteristics of both the parents.

Gamete is a reproductive cell. It is of two types – sperm and ovum, each having one set of chromosomes obtained from respective parent. During sexual reproduction, haploid sperm and ovum fuse together to form diploid zygote. The latter grows by mitosis to develop into embryo and subsequently forms the new individual.

9. The two reproductive parts of a bisexual flower which contain the germ cells are carpel (female reproductive part) and stamen (male reproductive part). Carpel is situated in the centre of the flower as a flask-shaped structure. A carpel is made up of three parts–stigma, style and ovary. The distal part of a carpel is called stigma. Stigma is responsible for receiving pollen during pollination.
Style is an elongated tubular structure which connects stigma with ovary. The basal swollen part of carpel is ovary. Ovary bears several ovules. After fertilisation ovules form seeds and ovary forms the fruit.

10. In first case, $P = 50$ W, $V = 220$ V

Current drawn, $I = \frac{P}{V} = \frac{50}{220} = 0.22$ A

Also, resistance of bulb,

$$R = \frac{V^2}{P} = \frac{(220)^2}{50} = 968\ \Omega$$

In second case, $P = 30$ W, $V = 220$ V

Current drawn, $I = \frac{P}{V} = \frac{30}{220} = 0.13$ A

Also, resistance of the bulb,

$$R = \frac{V^2}{P} = \frac{(220)^2}{30} = 1613\ \Omega$$

Hence, by replacing 50 W bulb to 30 W bulb, having same source of voltage the amount of current flows decreases while resistance increases.

OR

(a) Kilowatt is unit of power and kilowatt hour is a unit of energy.
1 kWh = 1000 W × 1 h
= 1000 W × 3600 s = 3600000 J = 3.6×10^6 J
(b) Here, $V = 5$ V, $I = 500$ mA = 0.5 A
Power rating of bulb is
$P = VI = (5 \times 0.5)$W = 2.5 W
Resistance of the bulb is $R = V/I = (5/0.5)\ \Omega = 10\ \Omega$

11. For the given circuit
$R_1 = 3\ \Omega$, $R_2 = 4\ \Omega$, $R_3 = 6\ \Omega$ and $V = 6$ V.
(a) Total effective resistance of the circuit, R_{eq} is given by

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{3} + \frac{1}{4} + \frac{1}{6} = \frac{9}{12}$$

or, $R_{eq} = \frac{12}{9}\ \Omega = \frac{4}{3}\ \Omega = 1.33\ \Omega$

(b) Since, potential difference across each resistor connected in parallel is same.
So, $V_1 = V_2 = V_3 = 6$ V
Applying Ohm's law,

$$V_1 = I_1 R_1 \text{ or } I_1 = \frac{V_1}{R_1} \text{ or } I_1 = \frac{6}{3}\text{ A} = 2\text{ A}$$

Similarly, $I_2 = \frac{6\text{ A}}{4} = 1.5$ A and $I_3 = \frac{6}{6}\text{ A} = 1$ A

(Note that net current in the circuit is $I = I_1 + I_2 + I_3$)

12. Mendel formulated three principles/laws of heredity, which are as follows:

(i) Principle of dominance: In a hybrid or heterozygous individual, two dissimilar unit factors are present for one character. Out of two factors (genes) only one is able to express itself and it prevents expression of the other. The one which expressed itself is called dominant gene or factor and the one which remains unexpressed is called recessive factor or gene.

(ii) Principle of segregation : The two unit factors of a character which remain together in an individual do not get mixed up, or get contaminated and keep their distinct identity. They separate or segregate during gamete formation so that each gamete receives only one factor (gene) for each character and is always pure.

(iii) Principle of independent assortment: This principle states that the unit factor of each character is assorted or distributed into the gametes independently of the unit factors (genes) of any other character and gets randomly rearranged in the offspring. For example, in Mendel's dihybrid cross, the offspring of F_1 generation on self breeding produced four types of offspring. Two types were similar to parents while the remaining two types had combination of traits. This became possible because the unit factors of the two characters assorted independent to each other.

13. In the given food chains A, B and C, food chain A has minimum trophic levels. It has only three trophic levels.

Suppose in each food chain same amount of energy (5000 kJ energy) is available to the producers then according to 10% law we can calculate:

Food chain A : Plants (5000 kJ) → Deer (500 kJ) → Tiger (50 kJ)

Food chain B : Grass (5000 kJ) → Grasshopper (500 kJ) → Frog (50 kJ) → Snake (5 kJ) → Eagle (0.5 kJ)

Food chain C : Phytoplankton (5000 kJ) → Scorpion (500 kJ) → Fish (50 kJ) → Crane (5 kJ)

According to the above calculation we can deduce that food chain B has 5 trophic level, hence top consumer of food chain B, eagle will get minimum energy for survival.

14. (a) The current flows in the east-west direction. From right hand thumb rule, we get the direction of magnetic field as from north to south. The direction of magnetic field will be same at every point below the power line.

(b) At smaller distances, the magnetic field will be described by concentric circles around the wire. As the distance increases, the circles become larger and larger. At the centre of the loop/coil, the magnetic field will appear as straight line.

(c) The force will act in upward direction perpendicular to both, the direction of current as well as to the field. The direction of force experienced by the conductor gets reversed, *i.e.*, in the downward direction.

OR

Force between wire *P* and wire *Q* :

The dot symbol indicates that current is flowing out of wire *P*.

The cross symbol indicates that current is flowing into wire *Q*.

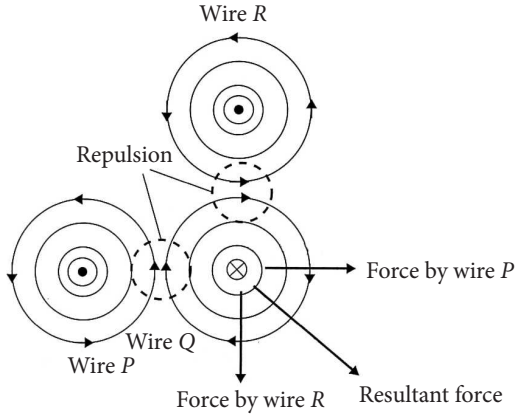
Using right-hand thumb rule, the two magnetic fields produce a repulsive force. The magnetic force acting on wire *Q* by wire *P* acts to the right.

Force between wire *R* and wire *Q* :

The dot symbol indicates that current is flowing out of wire *R*.

The cross symbol indicates that current is flowing into wire *Q*.

Using right-hand thumb rule, the two magnetic fields produce a repulsive force. The magnetic force acting on wire *Q* by wire *R* acts downward.



The resultant of the forces is indicated in the diagram shown.

15. (a) *A*, *B* and *C* are classified as hydrocarbons because these compounds are made up of carbon and hydrogen only.

(b) The compound *C*(C_4H_6) is an alkyne. Its general formula is C_nH_{2n-2}.

(c) C_5H_{10} is an alkene having a general formula C_nH_{2n}. The next member of this series is C_6H_{12}.

OR

No, *A* and *B* do not belong to same homologous series. *A* is an alkane while *B* is an alkene. The general formula of the homologous series of compound *A* is C_nH_{2n+2}.