P R E F A C E

We take immense pleasure in presenting the book, **"ICMR JRF Lifescience"** a meticulously designed resource aimed at aiding aspiring students preparing for the prestigious ICMR JRF exams. Drawing from a rich bank of past question papers spanning 2018 to 2023, the book is structured to meet the exam's comprehensive demands, along with predictions of the most probable questions that might feature in upcoming examinations.

This book is divided into twenty specialized chapters, each focusing on essential topics in Life Sciences, including Biochemistry, Cell Biology, Molecular Biology, Immunology, Developmental Biology, Botany, Zoology, Genetics, Evolution, Ecology, Environmental Science, Applied Biology, Methods in Biology, Bioinformatics, Veterinary Science, General Knowledge, Scientific Phenomenon, General Aptitude, Statistics, and Microbiology. Each chapter is designed to instill a solid conceptual understanding, helping students traverse the breadth and depth of the subjects, making it an indispensable guide.

What sets this book apart is the detailed solutions provided for every question, enabling the students to gain a nuanced understanding and strategies to tackle similar problems. This approach is certain to nurture the aspirant's thought process and aid them in developing a unique problem-solving strategy, thereby strengthening their knowledge base and confidence.

Crafted with precision and expertise by the best academicians and educators, this book integrates their rich experience and deep understanding of life science subjects and examination patterns. Authors and reviewers have left no stone unturned to make this book the best resource available for ICMR JRF aspirants.

Our primary aim in presenting this book is to provide a robust platform for students to excel in their exams and ultimately in their academic pursuits. We believe that every reader will find this book exceptionally useful, and the concepts and solutions presented here will illuminate their path to success in the ICMR JRF exams.

In conclusion, we sincerely hope that this book will meet the demands of the students and prove to be a highly valuable resource in their journey towards cracking the ICMR JRF exams. Best of luck to all the aspirants.

Let the journey of exploration begin!

Team IFAS

A C K N O W L E D G M E N T S

This book, **"ICMR JRF Lifescience,"** is a product of countless hours of hard work, dedication, and collaborative effort. I am deeply thankful for the many hands that have helped shape it into its present form.

At the outset, I would like to express my deepest gratitude to our entire student body at the Institute for Advanced Studies (IFAS), who were the spark that ignited the idea of this book. You inspire me to strive for excellence every day.

I am especially indebted to Er. Radheshyam Choudhary, the founding CEO of IFAS Edutech Pvt. Ltd. and Director of IFAS Publications. His invaluable guidance and critical insights were instrumental in bringing this work to fruition.

My heartfelt thanks go to Mr. Digambar Jagtap, Mr. Vishal Bhujbal, Mr. Pranshu Dwivedi and Mr. Rakesh Kumar Kumawat. Their thoughtful reviews and assistance in preparing the systematic layout have enriched the content of this book.

I am grateful to Mr. Lalji Kanoujia and Ms. Mamta Marar, who diligently sorted and compiled questions by chapter and section. Yogesh Bishnoi, also deserve my sincere thanks for their meticulous proofreading and verification of answers.

To the entire IFAS team, I owe my gratitude for enabling me to continue my teaching and for making it possible to learn so much about the process of creating this book.

Special acknowledgment goes to the IFAS publication team, whose dedication and creativity breathed life into this project. Mr. Vikendra Metha deserves particular mention for his artistic skills, which transformed our ideas into an engaging cover page design and insightful text diagrams. My appreciation also extends to Mr. Govind Kumar Prajapat and his team, who handled the crucial tasks of formatting and typesetting with commendable efficiency.

Lastly, I want to express my humble greetings and gratitude to all those who have contributed their significant efforts, both acknowledged and unmentioned, to this venture. Your collective spirit and commitment have been the cornerstone of this project.

Thank you, everyone, for making this book a reality.

KAILASH CHOUDHARY

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BIOCHEMISTRY

CHAPTER 1

Section - 1: Atom, Molecule, Bonds & Interaction

Previous Year Questions

[2018]

1. Valency of carbon is
   (1) One (2) Two
   (3) Three (4) Four

[2018]

2. The energy-producing groups in the Adenosine Triphosphate
   (1) Purine groups (2) Sugar groups
   (3) Phosphate groups (4) Nitrogen groups

[2019]

3. Which of the following molecule yields the maximum number of ATPs upon oxidation?
   (1) Glutamate (2) Pyruvate
   (3) Palmitate (4) Glucose

[2022]

4. Which of the following fractions of petroleum has the lowest boiling point?
   (1) Diesel (2) Kerosene
   (3) Gasoline (4) Heavy oil

[2022]

5. Two ice cubes are pressed over each other until they unite to form one block. The force mainly responsible for holding them together is:
   (1) Van der Waals force
   (2) Dipole-dipole interaction
   (3) Hydrogen bonding
   (4) Covalent bonding

[2022]

6. All types of chemical forces are involved in an antigen-antibody interaction, EXCEPT:
   (1) Van der Waal forces (2) Hydrogen bonds
   (3) Hydrophobic bonds (4) Covalent bonds

[2023]

7. For converting mg/ml into molar units for a drug, you need to know:
   (1) Valency
   (2) Solubility
   (3) Molecular size
   (4) Gram molecular weight

Practice Questions

8. Which of the following is the smallest unit of an element that retains the properties of that element?
   (1) Ion (2) Atom
   (3) Molecule (4) Compound

9. Which of the following elements has the smallest atomic size?
   (1) Lithium (2) Sodium
   (3) Potassium (4) Rubidium

10. Which of the following statements about covalent bonds is true?
    (1) Covalent bonds involve the transfer of electrons between atoms.
    (2) Covalent bonds are stronger than ionic bonds.
    (3) Covalent bonds are formed between two nonmetals.
    (4) Covalent bonds are formed between a metal and a nonmetal.

11. Which of the following statements about ionic bonds is true?
    (1) Ionic bonds involve the sharing of electrons between atoms.
    (2) Ionic bonds are stronger than covalent bonds.
    (3) Ionic bonds are formed between two nonmetals.
    (4) Ionic bonds are formed between a metal and a nonmetal.

12. Which of the following elements has the highest electronegativity?
    (1) Carbon (2) Nitrogen
    (3) Oxygen (4) Fluorine

13. Which of the following is not a type of intermolecular force?
    (1) Ionic bonding
    (2) London dispersion forces
    (3) Dipole-dipole forces
    (4) Hydrogen bonding

14. Which of the following statements is true regarding hybridization?
    (1) Hybridization is the mixing of atomic orbitals to form new hybrid orbitals.
    (2) Hybridization only occurs in molecules that have double or triple bonds.
    (3) Hybrid orbitals have different shapes than the original atomic orbitals.
    (4) All of the above.

15. Which of the following types of bonds is the most polar?
    (1) C-C bond (2) C-N bond
    (3) C-O bond (4) C-F bond

16. Which of the following types of intermolecular forces is the strongest?
    (1) London dispersion forces (2) Dipole-dipole forces
    (3) Hydrogen bonding (4) Van der Waals forces

17. Which type of bond results from the transfer of electrons from one atom to another?
    (1) Ionic bond (2) Covalent bond
    (3) Metallic bond (4) Hydrogen bond

18. Which of the following molecules has the shortest bond length?
    (1) H2 (2) O2
    (3) N2 (4) F2

19. Which of the following molecules has the highest dipole moment?
    (1) CO2 (2) CH4
    (3) NH3 (4) H2O

20. Which of the following bonds is the weakest?
    (1) Covalent bond (2) Ionic bond
    (3) Hydrogen bond (4) Van der Waals force

21. What type of bond is responsible for the secondary structure of proteins?
    (1) Covalent bond (2) Ionic bond
    (3) Hydrogen bond (4) Van der Waals force

22. Which of the following bonds is most likely to have a significant ionic character?
    (1) H-Cl bond (2) H-F bond
    (3) C-Cl bond (4) C-F bond

23. Which of the following types of bonds is responsible for the absorption of infrared radiation by molecules?
    (1) Covalent bond
    (2) Ionic bond
    (3) Hydrogen bond
    (4) Dipole-dipole interaction

24. What is the relationship between the frequency and wavelength of electromagnetic radiation?
    (1) They are inversely proportional.
    (2) They are directly proportional.
    (3) They are unrelated.
    (4) The relationship depends on the type of radiation

25. Which of the following bond is most difficult to break?
    (1) C-O (2) C-P
    (3) C-N (4) C-S

Answer Key									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(4)	(3)	(3)	(3)	(3)	(4)	(4)	(2)	(4)	(3)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(4)	(4)	(1)	(4)	(4)	(3)	(1)	(4)	(4)	(4)
21	**22**	**23**	**24**	**25**					
(3)	(2)	(1)	(1)	(1)					

Answers with Explanation

Atom, Molecule, Bonds, and Interaction

1. Correct answer is (4): The valency of carbon is 4. This means that carbon can form four covalent bonds with other atoms. This is due to the fact that carbon has four valence electrons in its outermost energy level, and it can share these electrons with other atoms to form stable molecules.

2. Correct answer is (3): ATP is composed of an adenine base (a type of purine), a ribose sugar molecule, and three phosphate groups. The energy in ATP is stored in the high-energy phosphate bonds between the phosphate groups. When these bonds are broken through hydrolysis, energy is released, making the phosphate groups the primary energy-producing parts of ATP.

3. Correct answer is (3): Palmitate: Palmitate is a saturated fatty acid, and the complete oxidation of one molecule of palmitate yields approximately 129 ATP molecules.

4. Correct Answer is (3): Gasoline has a boiling point of around 30°C to 70°C.

5. **Correct answer is (3):** Two ice cubes, when pressed with each other, form one block due to the hydrogen bond formation. The electrostatic force of attraction between the positively charged hydrogen atom of one molecule with the negatively charged oxygen atom of another molecule forms an H-bond which holds the two cubes together.

6. **Correct answer is (4):** Covalent bonds involve the sharing of electrons between atoms and are much stronger than non-covalent bonds, so they are not typically involved in antigen-antibody interactions, which require a degree of flexibility and reversibility.

7. **Correct answer is (4):-** The gram molecular weight (also known as molar mass or molecular weight) of the drug is necessary to perform the conversion from milligrams per milliliter (mg/ml) to molar units (usually expressed in moles per liter or Molarity). This calculation allows you to determine the concentration of the drug in molar terms

8. **Correct answer is (2):** An atom is the smallest unit of an element that retains the properties of that element. It is made up of protons, neutrons, and electrons

9. **Correct answer is (4):** So, among lithium (Li), sodium (Na), potassium (K), and rubidium (Rb), lithium being at the top of Group 1 has the smallest atomic size. As you go down the group, sodium, potassium, and rubidium successively have larger atomic sizes due to the increase in the number of electron shells. Therefore, in the context of these elements within the same group, lithium typically possesses the smallest atomic size.

10. **Correct answer is (3):** Covalent bonds are formed between two nonmetals. Correct answer is: Covalent bonds are formed by the sharing of electrons between two nonmetal atoms. They are usually weaker than ionic bonds, which involve the transfer of electrons between a metal and a nonmetal.

11. **Correct answer is (4):** Ionic bonds are formed between a metal and a nonmetal. Correct answer is: Ionic bonds are formed by the transfer of electrons from a metal atom to a nonmetal atom. They are usually stronger than covalent bonds.

12. **Correct answer is (4):** Fluorine Electronegativity is a measure of an atom's ability to attract electrons toward itself. Fluorine has the highest electronegativity among the given options, as it is the most reactive nonmetal.

13. **Correct answer is (1):** Ionic bonding is a type of bond that occurs between ions, not between molecules. The other options are all types of intermolecular forces.

14. **Correct answer is (4):** Hybridization is a crucial concept in chemistry that explains the geometry and bonding patterns of molecules. It involves the mixing of atomic orbitals to form new hybrid orbitals, which have different shapes and energies than the original atomic orbitals. This process is particularly important for understanding the geometry of molecules with double or triple bonds.

15. **Correct answer is (4):** The C-F bond is the most polar of the given options because fluorine is the most electronegative element, and carbon is less electronegative than oxygen or nitrogen.

16. **Correct answer is (3):** Hydrogen bonding is a special type of dipole-dipole force that occurs when a hydrogen atom is covalently bonded to a highly electronegative atom such as nitrogen, oxygen, or fluorine. It is stronger than the other types of intermolecular forces listed.

17. **Correct answer is (1):** An ionic bond is formed when electrons are transferred from one atom to another, typically between a metal and a nonmetal.

18. **Correct answer is (4):** F2 has the shortest bond length due to the strong electronegativity of fluorine, which results in a strong attraction between the two atoms.

19. **Correct answer is (4):** H2O has the highest dipole moment due to its polar covalent bond and bent shape, which results in a separation of charge and a net dipole moment.

20. **Correct answer is (4):** Van der Waals force. Van der Waals forces are the weakest of all intermolecular forces and are caused by the temporary dipoles that occur when electrons move randomly around a molecule.

21. **Correct answer is (3):** The hydrogen bonds between amino acid residues in a protein are responsible for the secondary structure, such as alpha helices and beta sheets.

22. **Correct answer is (2):** H-F bond. Fluorine is the most electronegative element, and the electronegativity difference between hydrogen and fluorine is the greatest among the options, indicating a high ionic character

23. **Correct answer is (1):** Infrared radiation is largely thermal energy. It induces stronger molecular vibrations in covalent bonds, which can be viewed as springs holding together two masses, or atoms. Covalent bonds can vibrate in several modes, including stretching, rocking, and scissoring.

24. **Correct answer is (1):** They are inversely proportional. The frequency and wavelength of electromagnetic radiation are related by the equation $c = \lambda\nu$, where c is the speed of light, λ is the wavelength, and ν is the frequency. As the frequency increases, the wavelength decreases, and vice versa.

25. **Correct answer is (1):** Carbon is common in all the options. The strength of covalent bonds is depending on the size of atoms and the polarity of bonds. Polar covalent bonds are stronger than non-polar covalent bonds. The difference between the electronegativity of nitrogen and oxygen is quite large. Therefore, the polar covalent bond C-O is more stable than another.