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BARC – OCES - BIOSCIENCE

UNIT-1 BIOCHEMISTRY

PRACTICE QUESTIONS

A. Structure of Atoms, Chemical Bonds, and Molecules.

1. In living system, ionic bond is
   (1) Stronger than covalent bond
   (2) Equal to covalent bond in strength
   (3) Weaker than covalent bond
   (4) Weaker than hydrogen bond

2. Water is a good solvent for inorganic salts because of
   (1) Hydrogen bond
   (2) Dielectric constant
   (3) Polarity
   (4) Conductivity

3. The dynamic functions in the living systems are brought about by interplay of weak chemical interactions. Which of the following weak chemical interactions is the most important in determining the three-dimensional structure of macromolecules?
   (1) Van der waal's interaction
   (2) Electrostatic interactions
   (3) Hydrophobic interactions
   (4) Hydrogen bonds

4. What type of interactions are disrupted when nonpolar compounds come into contact with water?
   (1) Covalent bonds between water molecules.
   (2) Ionic bonds between water molecules.
   (3) The hydrogen-bonding network among water molecules.
   (4) The covalent bonds within the nonpolar compounds themselves.

5. Which of the following is a condensation reaction?
   (1) Addition of H_2O to a double bond
   (2) Linking an acid and an alcohol to make an ester and water
   (3) Addition of H to an alkene
   (4) Oxidation of ethanol to acetaldehyde

6. Inert gasses do not react with any other element because:
   (1) Their outermost electron level is filled with 8 electrons
   (2) The pressure is not high enough
   (3) The temperature is not high enough
   (4) Their nucleus is very small

7. Additional polymerization is often catalyzed by a chemical free radical. What is a 'free radical'?
   (1) It is a chemical species with one or more unpaired electrons
   (2) It is a chemical species with one or more double bonds
   (3) It is a chemical species with all paired electrons
   (4) It is a chemical species with all single bonds

8. Proton hopping in water is responsible for the high mobility of which ion?
   (1) Sodium (Na^+) (2) Potassium (K^+)
   (3) Chloride (Cl^-) (4) Hydronium (H_3O^+)

9. When a neutral metal sphere is charged by contact with a positively charged glass rod, the sphere:
   (1) Loses electrons (2) Gains electrons
   (3) Loses protons (4) Gains protons

10. In aqueous solutions, why are free protons (H^+) not observed?
    (1) They are too large to exist freely in water.
    (2) They immediately form covalent bonds with oxygen molecules.
    (3) They are immediately hydrated to form hydronium ions (H_3O^+).
    (4) They evaporate too quickly to be detected.

11. What is the typical clinical condition called when the pH of blood plasma is below the normal value of 7.4?
    (1) Neutrality (2) Acidemia
    (3) Alkalosis (4) Acidosis

12. The hydrogen bond is strongest in:
(1) $O-H\ldots S$ (2) $S-H\ldots O$
(3) $F-H\ldots S$ (4) $F-H\ldots O$

13. Temporary and weak attractions between molecules when oppositely charged molecules approach one another are called:
(1) Covalent bonds
(2) ionic bonds
(3) Hydrogen bonds
(4) Van der Waals attraction

14. What does it mean when we say that water acts as a "heat buffer"?
(1) It keeps the temperature of an organism relatively constant as the temperature of the surroundings fluctuates
(2) It increases the temperature of an organism as the temperature of the surroundings increases
(3) It decreases the temperature of an organism as the temperature of the surroundings increases
(4) It increases the temperature of an organism as the temperature of the surroundings decreases

15. Intramolecular hydrogen bonding is
(1) Hydrogen fluoride (2) m-Chlorophenol
(3) Water (4) o-Chlorophenol

B. Principles of biophysical chemistry (pH, buffer, thermodynamics, reaction kinetics, colligative properties).

1. A student conducted an experiment where CO_2 and N_2were bubbled through water in beakers A and B respectively. He recorded the pH in each of the solutions every 5 min. What is the most valid conclusion the student could draw from these results:

	pH reading	
Time (min)	A	B
5	7.5	7.5
10	7.2	7.3
15	7.0	7.5
20	6.8	7.4

(1) The change in pH was too small to be significant
(2) Bubbling CO_2 through water makes it more acidic
(3) Bubbling N_2 through water makes it more acidic
(4) Both CO_2 and N_2 make water more acidic

2. 700 ml of colorless solution is present in each of two bottles, A and B. The label on A reads, 1 M $NaCl$, while that on B reads 1 mole NaCl. Which of the following statements is correct?
(1) The amount of $NaCl$ in in each bottle is the same
(2) The concentration of $NaCl$ in each bottle is the same
(3) Bottle A has less amount of $NaCl$ than Bottle B
(4) The concentration of $NaCl$ is more in Bottle A than in Bottle B

3. The pKa of a monobasic organic acid is 4.2. The pH at which 95% of the acid will be in ionized form is:
(1) 5.02 (2) 5.38
(3) 2.92 (4) 3.71

4. Titration of c-lysine yielded $pK_1 = 3.0, pK_2 = 9.0$ and $pK_R = 6.0$. The pI value of this amino acid would be:
(1) 4.5 (2) 6.0
(3) 6.5 (4) 7.5

5. The relationship between the ratio of acid to base in a solution and its pH is described by the Henderson-Hasselbalch equation:
pH=pKa+$\log_{10}$([Base]/ [Acid])
The pK_a of acetic acid is 4.8. What is the approximate pH of an acetate solution containing 0.2M acetic acid and 2M acetate ion?
(1) 0.48 (2) 4.8
(3) 5.8 (4) 6.8

6. The pH of a 10^{-8} M hydrochloric acid solution would be:
(1) 8.25 (2) 6.98
(3) 7.05 (4) 6.58

7. A drop of water on glass slide takes a bead shape and why not alcohol?
(1) Water has high surface tension
(2) Alcohol has high surface tension
(3) Water has low surface tension
(4) Both (1) and (3)

8. At pH value greater than pKa of COOH group in the amino acid, the amino acid will be:
(1) Positive charged
(2) Negative charged
(3) No charge
(4) Both positive and negative charged

9. Buffering action of the hemoglobin is best achieved because it has:
   (1) High histidine content
   (2) Dissociable N-terminal
   (3) Dissociable C-terminal
   (4) High alanine content

10. Water is a very efficient thermal buffer, because of:
   (1) It's high heat capacity
   (2) Concentration of more salt
   (3) Low surface tension
   (4) Dissolve many organic matters

11. If an oxidation-reduction reaction with a two-electron transfer has a standard reduction potential of +0.3 volts, what is the free energy change under standard conditions?
   (1) +6.9 kcal/mol (2) -13.8 kcal/mol
   (3) +46.1 kcal/mol (4) +13.8 kcal/mol

12. What is the concentration of H+ in a solution of 0.1 M NaOH?
   (1) $0.1\ M$ (2) $0.01\ M$
   (3) $1.0 \times 10^{-14}\ M$ (4) $10^{-13}\ M$

13. What is the concentration of OH− in a solution with an H+ concentration of $1.3 \times 10^{-4}\ M$?
   (1) $0.7\ M$ (2) $0.07\ M$
   (3) $7.7 \times 10^{-11} M$ (4) $10^{-11}\ M$

14. What is the pH of a mixture of 0.042 M NaH2PO4 and 0.058 M Na2HPO4?
   (1) 7.0 (2) 7.2
   (3) 7.4 (4) 7.6

15. What is the pH optimum for the enzyme pepsin?
   (1) 7.0 (2) 1.5
   (3) 8.5 (4) 6.0

C. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

1. A sigmoidal plot of substrate concentration ([S]) versus reaction velocity (V) indicates which of the following?
   (1) Cooperative binding
   (2) Competitive inhibition
   (3) Michaelis-Menten kinetics
   (4) Non-competitive inhibition

2. The Michaelis-Menten equation can be represented as follows:

$$v = V_{max} \frac{[S]}{1 + [S]/Km}$$

For an intracellular enzyme to function optimally, which of the following statements regarding intracellular substrate concentration is true?
   (1) The intracellular substrate concentration should be greater than the Km of the enzyme.
   (2) The intracellular substrate concentration should be significantly lower than the Km of the enzyme.
   (3) The intracellular substrate concentration is independent of the Michaelis constant Km.
   (4) The intracellular substrate concentration should be approximately the same as that of the Km.

3. What does Kcat/Km signify?
   (1) Specificity of enzyme for different substrates
   (2) Rate of product formation
   (3) Rate of substrate consumption
   (4) Maximum rate of reaction

4. Enzymes catalyze chemical reactions by
   (1) Decreasing the activation energy
   (2) Increasing the activation energy
   (3) Providing a buffering effect
   (4) Regulating the concentration of substrates at optimal temperature and Ph

5. The data in the table in the table below is collected for an enzyme-catalyzed reaction.

[S] mM	$V_0(\mu mol.min^{-1})$
8×10^{-6}	80
2×10^{-5}	140
8×10^{-5}	224
4×10^{-3}	277
2×10^{-2}	280
1×10^{-1}	279

What is the approximate Km of this enzyme?
   (1) 8×10^{-6} Mm (2) 2.0×10^{-5} mM
   (3) 8.0×10^{-5} mM (4) 2×10^{-2} Mm

6. Two students independently isolated lactate dehydrogenase from chicken heart and measured its activity as a function of substrate concentration, each determining Vmax and Km of their own preparation. They both got the same Km but different Vmax. One student said they had isolated different forms of the same enzyme, the other said they had isolated the same form. To resolve their argument they must

(1) Measure the molecular weight of the enzyme
(2) Measure enzyme activity as a function of time after addition of substrate
(3) Determine the turnover number of each preparation
(4) All of the above

7. Which of the following statements are true?
(1) Vmax of an enzyme remains constant with increasing enzyme concentrations.
(2) K_M of an enzyme for a substrate remains constant with increasing enzyme concentrations.
(3) K_M of an enzyme for a substrate increases with increasing enzyme concentrations.
(4) Both K_M and Vmax of an enzyme remains constant with increasing enzyme concentrations.

8. A competitive inhibitor of an enzyme
(1) Decreases the K_m
(2) Decreases the V_{max}
(3) Decreases both the Km & V_{max}
(4) Increases the K_m

9. Kailash sir is carrying out an enzyme reaction in the laboratory and obtains a Km and Vmax value. He repeats the experiment but this time uses only 1/10th (one tenth) of the enzyme. What would he find?
(1) He would get the same result because the enzyme is the same and hence the properties are unchanged.
(2) The Vmax would change but Km would remain the same
(3) The Vmax is fixed but the Km would be 1/10th the original value.
(4) There would be a long lag in the start of the reaction because the enzyme concentration is less, but finally the enzyme would achieve the same Km and Vmax given sufficient time.

10. Cytochrome P450 is a member of which family of oxidoreductases?
(1) Catalase (2) Hydroperoxidase
(3) Oxidase (4) Oxygenase

11. By which of the following mechanisms does an enzyme increase the rate of a reaction?
(1) It provides energy to start the reaction
(2) It increases the rate of collision between molecules
(3) It lowers the activation energy of the reaction
(4) It changes the equilibrium point of the reaction

12. Match the following

LIST - 1	**LIST - 2**
(I) Allosteric enzyme	(1) PDC
(II) Isoenzyme	(2) Acetyl CoA
(III) Multienzyme complex	(3) LDH
(IV) Coenzyme	(4) ATcase

(A) I-1, II-4, III-4, IV-2. (B) I-4, II-3, III-1, IV-2
(C) I-3, II-1, III-4, IV-2. (D) I-2, II-4, III-3, IV-1.

13. The fraction of the total amount of a substance in a component which is released/or enters in given period of time is called
(1) Turnover time (2) Residence time
(3) Standing state (4) Turnover rate

14. _____ is a measure of randomness or disorder.
(1) Metabolism (2) Synthesis
(3) Entropy (4) Coupled reaction

15. The Lineweaver-Burk plot is used to graphically determine Km and Vmax from an enzyme that obeys classic Michaelis-Menten kinetics. When V is the reaction velocity at substrate concentration S, the Y-axis experimental data in the Lineweaver-Burk plot are expressed as:
(1) V (2) S
(3) 1/V (4) 1/S

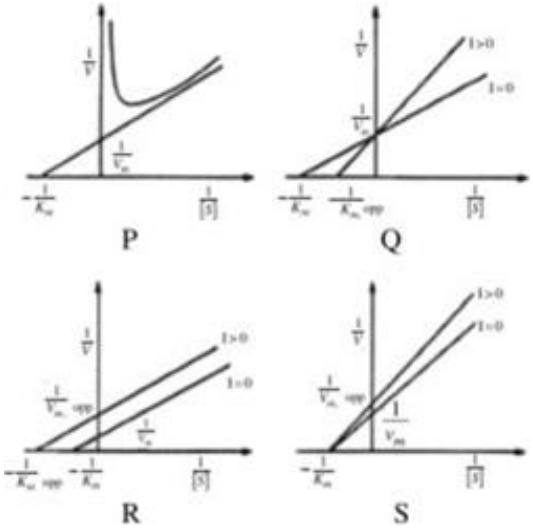
16. The enzymatic activity of the L-19 IVS ribozyme results from:
(1) Transesterification
(2) Phosphodiester bond hydrolysis
(3) Covalent bond formation
(4) Triphosphate bond cleavage

17. Choose the correct pairs from the following:

A	Isocitrate lyase	1	conversion of amino acid into glucose
B	PEP carboxykinase	2	Biotin
C	Pyruvate dehydrogenase complex	3	synthesis of glucose from acetate
D	Phosphofructokinase	4	lipoic acid
E	Pyruvate carboxylase	5	an allosteric enzyme

(1) A – 1, B – 2, C – 4, D – 5, E – 3
(2) A – 3, B –1, C – 4, D – 5, E – 2
(3) A – 3, B –1, C – 4, D – 2, E – 5
(4) A – 2, B –5, C –1, D – 4, E – 3

18. Kinetics of different forms of enzyme inhibition are graphically represented in Figs. P, Q, R and S. Select the correct combination from the following:



(1) P-Competitive, Q-Non-competitive, R-Substrate and S-Uncompetitive
(2) P-Non-competitive, Q-Uncompetitive, R-Substrate and S-Competitive
(3) P-Substrate, Q-Non-competitive, R-Uncompetitive and S-Competitive
(4) P-Substrate, Q-Competitive, R-Uncompetitive and S-Non-competitive

19. Statement (a): All enzymes are not necessarily proteins.
Statement (b): A class of DNA can perform catalytic activity.
(1) Both (a) and (b) are correct
(2) (a) is correct, but (b) is incorrect
(3) (a) is incorrect, but (b) is correct
(4) Both (a) and (b) are incorrect

20. 15 micrograms of amylase (mol. wt. 150 kDa acts on starch to produce maltose. If at maximal velocity, the enzyme released 6.84 mg of maltose (mol. wt. 342) per min, what is the turnover number?
(1) 2×10^5 per min (2) 2×10^4 per min
(3) 0.2×10^3 per min (4) 2×10^6 per min

21. Two statements are given below, one is Assertion (Ass) and the other is Reason (R). Select the correct answer from the codes given below:
Assertion (Ass): Allosteric enzymes show feedback inhibition Reason (R): The inhibition is competitive.
(1) Both (Ass) and (R) are correct and (R) is the correct explanation of (Ass)
(2) Both (Ass) and (R) are correct, but (R) is not the correct explanation of (Ass)
(3) (Ass) is true but (R) is false
(4) Both (Ass) and (R) are false

D. Confirmation of proteins (Ramachandran plot, secondary, tertiary, and quaternary structure; motif and folds; domains).

1. Which of the, and values of amino acid residues are sterically allowed according to Ramachandran plot?
(1) Both Φ and φ values are negative
(2) Both Φ and φ values are positive
(3) The value of Φ is negative and φ is positive
(4) The value of Φ is positive and φ is negative

2. Ramachandran plot
(1) Represents sterically allowed conformation of polypeptide
(2) Can give orientation of cofactors in proteins
(3) Can identify non-protein amino acids if present in proteins
(4) Presence of metal ions

3. The backbone atoms in a peptide linkage is as follows
(1) C-N-C-C (2) C-C-N-C
(3) C-O-N-C (4) C-C-O-N

4. The amino acid which occupies maximum area in Ramachandran plot is:
(1) Proline (2) Glycine
(3) Alanine (4) Leucine

5. Assertion (A): Tertiary structure is absolutely necessary for many biological activities of proteins.
Reason (R): Tertiary structure is more stable, due to the existence of other kinds of bonds.
(1) Both (A) and (R) are true, but (R) is not the correct explanation of (A)
(2) Both (A) and (R) are true, and (R) is the correct explanation of (A)
(3) (A) is true but (R) is false
(4) (A) is false and (R) is true

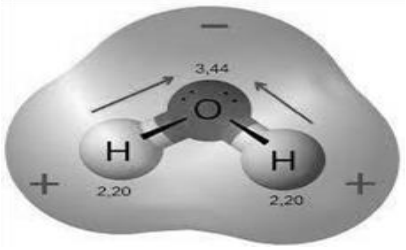
6. The peptide bond is:
M. partially double bonded
N. polar
O. mostly trans in proteins
P. planar

SOLUTION

A. Structure of Atoms, Chemical Bonds, and Molecules.

1. **Correct answer is (3):-** In the living system, ionic bonds are weaker than covalent bonds. As we know that covalent bond is the strongest bond and bond strength is 400 KJ/mole where ionic bond strength is 170 KJ/mole.

2. **Correct answer is (3):-**Water is a good solvent for inorganic salts because of polarity. The Polar nature of water is due to oxygen and hydrogen as they have different electronegativity values. As given in the figure that oxygen has two lone pairs of electrons that repel with each other and the electrons bonded to the hydrogen atoms so, the oxygen side has a partial negative charge and the hydrogen has a partial positive charge.



3. **Correct answer is (3):-** The dynamic functions in the living systems are brought about by interplay of weak chemical interactions and hydrophobic interactions is the most important in determining the three-dimensional structure of macromolecules, mostly protein and lipids.

4. **Correct answer is (3):-** The hydrogen-bonding network among water molecules. Nonpolar compounds disrupt the hydrogen-bonding network among water molecules because they cannot participate in hydrogen bonding. This disruption causes an energetically unfavorable ordering of water molecules around the nonpolar substances, contributing to the poor solubility of these compounds in water.

5. **Correct answer is (2):-** Condensation reaction is a type of chemical reaction, in which two molecules are combined to form single molecules, with loss of small molecules, usually water. Linking an acid and an alcohol to make an ester and water is a condensation reaction.

6. **Correct answer is (1):-** Inert gasses do not react with any other element because their outermost electron level is filled with 8 electrons. Group 8A of the periodic table are the inert gasses or noble gasses: helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn).

7. **Correct answer is (1):-** Free radical is a chemical species with one or more unpaired electrons. These unpaired electrons make radicals highly chemically reactive.

8. **Correct answer is (4):-** Proton hopping, also known as the Grotthuss mechanism, is a process where protons are rapidly transferred between hydrogen-bonded water molecules. This results in the high mobility of hydronium ions (H_3O^+) in water, as the process is much faster than the diffusion of other ions.

9. **Correct answer is (1):-** To make something positive we are essentially making it less negative. To make it less negative we would need to lose electrons. Protons cannot be removed from an atom, except in nuclear reactions that release large amounts of energy.

10. **Correct answer is (3):-** They are immediately hydrated to form hydronium ions (H_3O^+).Free protons (H^+) are highly reactive and cannot exist alone in aqueous solutions. They quickly react with water molecules to form hydronium ions (H_3O^+), which is a more stable form due to the proton's strong affinity for the lone pair electrons of the oxygen atom in water.

11. **Correct answer is (4):-** Acidosis is the condition wherein the pH of blood plasma falls below the normal range, typically below 7.35. In severe, uncontrolled diabetes, for example, the accumulation of acidic ketone bodies can lead to this decrease in pH. Acidemia is a term sometimes used to indicate the same condition but specifically refers to the acidity of the blood itself, not just the plasma.

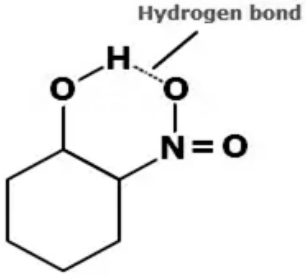
12. **Correct answer is (4):-** The hydrogen bond is strongest when there's a large electronegativity

difference between the hydrogen (H) and the other atom. In your options: (4) F-H ... O. This involves a hydrogen bond between an H and an O, with fluorine (F) being highly electronegative. Fluorine is the most electronegative element, so this bond is the strongest.

13. **Correct answer is (4):-** Van der Waals bond: A weak attractive force between atoms or nonpolar molecules caused by a temporary change in dipole moment arising from a brief shift of orbital electrons to one side of one atom or molecule, creating a similar shift in adjacent atoms or molecules.

14. **Correct answer is (1):-** Water acts as a "heat buffer" because it has a high specific heat capacity, meaning it can absorb or release a lot of heat with minimal change in its own temperature. This property helps maintain a stable temperature in organisms and environments, protecting them from rapid temperature fluctuations.

15. **Correct Answer is (4):-** Intramolecular H–bonding is present in ortho-nitrophenol.



Ortho-Nitro phenol

B. Principles of biophysical chemistry (pH, buffer, thermodynamics, reaction kinetics, colligative properties).

1. **Correct answer is (2):-** When CO2 (carbon dioxide) is bubbled through water, it dissolves and forms carbonic acid, as shown in the following reaction: **CO2 + H2O -> H2CO3.** The student conducted the experiment by bubbling CO2 through water in beaker A and N2 through water in beaker B. He recorded the pH in each of the solutions every 5 minutes. After a period of time, he found that the pH of the solution in beaker A decreased, while the pH of the solution in beaker B did not change. This indicates that bubbling CO2 through water makes it more acidic, while bubbling N2 through water does not change the pH of the water.

2. **Correct Answer is (3):-** A 1 M NaCl solution means that there is 1 mole of NaCl dissolved in 1 liter of solution. So, in a 700 ml solution, there will be 0.7 moles of NaCl.
A 1 mole NaCl solution means that there is 1 mole of NaCl in the solution, regardless of the volume of the solution. So, in a 700 ml solution, there will be 1 mole of NaCl.
Therefore, Bottle A has less amount of NaCl than Bottle B.

3. **Correct Answer is (3):-** To determine the pH at which 95% of the acid will be in ionized form, we can use the Henderson-Hasselbalch equation:
pH = pKa + log([A-]/[HA])
Where: pH = the pH of the solution pKa = the negative logarithm of the acid dissociation constant (4.2 in this case) [A-] = concentration of the ionized form of the acid [HA] = concentration of the non-ionized form of the acid
Since we want to find the pH at which 95% of the acid is in the ionized form, we can set [A-] to 0.95 and [HA] to 0.05 (since 95% in the ionized form means 5% in the non-ionized form).
Let's plug these values into the Henderson-Hasselbalch equation:
pH = 4.2 + log(0.95/0.05)
pH = 4.2 + log(19)
Now, let's calculate the logarithm:
log(19) ≈ 1.278
Now, add this value back to the pKa:
pH ≈ 4.2 + 1.278 ≈ 5.478
Now, we need to round the pH value to one decimal place since the pKa was given to one decimal place. The answer will be approximately:
pH ≈ 5.5
Among the given options, the closest pH value is (2) 5.38.

4. **Correct answer is (2):-** The pI is calculated as the average of the pK values of the amino and carboxyl groups:
pI = (pK1 + pK2) / 2
pI = (3.0 + 9.0) / 2 pI = 12.0 / 2 pI = 6.0

5. **Correct answer is (3):-** To find the approximate pH of the acetate solution, you can use the Henderson-Hasselbalch equation:
pH = pKa + log10([Base] / [Acid])
In this case, acetic acid (CH3COOH) is the weak acid, and acetate ion (CH3COO-) is its conjugate base.
pKa of acetic acid (CH3COOH) is 4.8.
[Acid] = 0.2 M (the concentration of acetic acid).
[Base] = 2 M (the concentration of acetate ion).
Now, plug these values into the Henderson-Hasselbalch equation:
pH = 4.8 + log10(2 / 0.2)
pH = 4.8 + log10(10)
pH = 4.8 + 1
pH = 5.8

6. **Correct answer is (2):-** Since HCl is a strong acid, it completely ionizes. As the concentration of H+ from ionization is equal to the concentration of OH from water, let us consider it X. Hence, the pH value of 1 × 10-8 (M) HCl is 6.98.As HCL is a strong acid hence its pH never 8.in this condition the pH is always considered the value slightly less than 7.Therefore the pH IS 6.98.

7. **Correct answer is (1):-** Water has a higher surface tension than alcohol. This means that the water molecules are more attracted to each other than they are to the glass slide. As a result, the water molecules tend to form a bead shape on the glass slide. Alcohol, on the other hand, has a lower surface tension than water. This means that the alcohol molecules are less attracted to each other than they are to the glass slide. As a result, the alcohol molecules tend to spread out on the glass slide and not form a bead shape.

8. **Correct answer is (2):-** The pKa of the COOH group in an amino acid is the pH at which the COOH group is half-protonated and half-deprotonated. At a pH greater than the pKa, the COOH group will be deprotonated, meaning that it will lose its hydrogen atom. This will result in a negative charge on the amino acid.

9. **Correct answer is (1):-** The buffering action of hemoglobin is primarily due to the presence of histidine residues. Histidine contains an imidazole group, which can act as a weak acid, donating or accepting protons (H+ ions) in response to changes in pH. Hemoglobin is a protein that contains multiple histidine residues in its structure.

10. **Correct answer is (1):-** Water has a high heat capacity, which means it can absorb and store a large amount of heat energy without a significant increase in temperature. This property makes water an efficient thermal buffer, as it can help regulate temperature changes in the environment.

11. **Correct answer is (2):-** The free energy change of an electrochemical reaction can be calculated using the following equation:
ΔG = -nFΔE° where:
- ΔG is the free energy change in joules per mole
- n is the number of electrons transferred in the reaction
- F is the Faraday constant (96485.33 coulombs per mole of electrons)
- ΔE° is the standard cell potential in volts

In this case, the number of electrons transferred is 2 and the standard cell potential is +0.3 volts. Therefore, the free energy change is:
ΔG = -2 * 96485.33 coulombs per mole of electrons * +0.3 volts = -58131.2 joules per mole
To convert the free energy change from joules per mole to kilocalories per mole, we need to divide by 4184 joules per kilocalorie:
ΔG = -58131.2 joules per mole / 4184 joules per kilocalorie = -13.8 kilocalories per mole
Therefore, the answer is (2) -13.8 kcal/mol.

12. **Correct answer is (4):-** We begin with the equation for the ion product of water:
$$K_w = [H^+][OH^-]$$
With $[OH^-] = 0.1M$, solving for $[H^+]$ gives
$$[H^+] = \frac{K_w}{[OH^-]} = \frac{1 \times 10^{-14}M^2}{01M} = \frac{10^{-14}M^2}{10^{-1}M}$$
$$= 10^{-13}M$$

13. **Correct answer is (3):-** We begin with the equation for the ion product of water:
$$K_w = [H^+][OH^-]$$
With $[H^+] = 1.3 \times 10^{-4}M$, solving for $[OH^-]$ gives
$$[OH^-] = \frac{K_w}{[H^+]} = \frac{1 \times 10^{-14}M^2}{0.00013M} = \frac{10^{-14}M^2}{1.3 \times 10^{-4}M}$$
$$= 7.7 \times 10^{-11}M$$

14. **Correct answer is (1):-** We use the Henderson-Hasselbalch equation, which we'll express here as

$$pH = pK_a + \log\frac{[conjugate\ base]}{[acid]}$$

In this case, the acid (the species that gives up a proton) is $H_2PO_4^-$, and the conjugate base (the species that gains a proton) is $H_2PO_4^{2-}$. Substituting the given concentration of acid and conjugate base and the $pK_a(6.86)$.

$$pH = 6.86 + \log\frac{0.058}{0.042} = 6.86 + 0.14 = 7.0$$

15. **Correct answer is (2):-** Pepsin is a digestive enzyme that works optimally in the highly acidic environment of the stomach. The gastric juice in the stomach has a pH of approximately 1.5, which is ideal for the activity of pepsin.

C. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

1. **Correct answer (3):-** Michaelis-Menten kinetics. A sigmoidal plot of substrate concentration ([S]) versus reaction velocity (V) is characteristic of enzymes following the Michaelis-Menten kinetics. In this plot, at low substrate concentrations, the velocity increases steeply, and as substrate concentration increases, the velocity reaches a plateau, indicating that the enzyme is saturated with substrate.

2. **Correct answer is (4):-** The intracellular substrate concentration should be approximately the same as the Km value. This is because when the substrate concentration is approximately the same as the Km value, the enzyme is half-saturated with substrate. This means that the enzyme is able to bind to the substrate and catalyze the reaction at a maximum rate.

3. **Correct answer is (2):-** Catalytic efficiency is the ratio of turnover number and Michaelis-Menten constant. It denotes the rate of product formation.

4. **Correct answer is (1):-** Enzymes are biological catalysts that speed up chemical reactions in living organisms. They work by lowering the activation energy of a reaction. Activation energy is the minimum amount of energy required to start a chemical reaction. By decreasing this energy barrier, enzymes make it easier for the reaction to occur, even at lower temperatures, thus increasing the rate of the reaction.

5. **Correct answer is (2):-** In enzyme catalyzed reaction Km is the substrate concentration when V_0 = 1/2 Vmax.
Km = [S], V_0 = 1/2 Vmax
Km = [S], $2V_0$ = Vmax.
Here Vmax is 280 µmol. min^{-1}
so [S] = Km = 2 x 10^{-2}mM.

6. **Correct answer is (3):-** Turnover number depends on Vmax and enzyme concentration. Turnover number does not depend on Michaelis-Menten constant (Km). Hence to resolve the argument determination of the turnover number of each preparation will be required.

7. **Correct answer is (2):-** We know that Vmax= Kcat* Enzyme concentration. Here we can see that Vmax is directly proportional to enzyme concentration hence changes in enzyme concentration does not depend on Michaelis-Menten constant (Km).

8. **Correct answer is (4):-** In competitive inhibition competitive inhibitor and substrate compete for the same active site of the enzyme. In this type of reversible inhibition **Km** (Michaelis-Menten constant) increases but Vmax remains constant.

9. **Correct answer is (2):-** Vmax is directly proportional to the enzyme concentration and enzyme concentration does not depend on Km (Michaelis-Menten constant). Hence Km remains constant in variable enzyme concentration. When Mustan sir uses only 1/10th of the enzyme, the Vmax would change because the rate of the reaction would be limited by the lower enzyme concentration. However, the Km would remain the same because it is a property of the enzyme-substrate complex and is independent of enzyme concentration.

10. **Correct answer (4):-** Oxygenase. Cytochrome P450 is a member of the oxygenase family of oxidoreductases. It catalyzes the insertion of one atom of oxygen into organic substrates.