



Case Based Questions

Q.No.1: The importance of molecular structure in the reactivity of organic compounds is understood by the reactions that produce aldehydes and ketones. We can prepare a carbonyl group by oxidation of an alcohol. For organic molecules, oxidation of a carbon atom is said to occur when a carbon-hydrogen bond is replaced by a carbon-oxygen bond. The reverse reaction—replacing a carbon-oxygen bond by a carbon-hydrogen bond—is a reduction of that carbon atom. Oxygen is generally assigned a -2 oxidation number unless it is elemental or attached to a fluorine. Hydrogen is generally assigned an oxidation number of $+1$ unless it is attached to a metal. Since carbon does not have a specific rule, its oxidation number is determined algebraically by factoring the atoms it is attached to and the overall charge of the molecule or ion. In general, a carbon atom attached to an oxygen atom will have a more positive oxidation number and a carbon atom attached to a hydrogen atom will have a more negative oxidation number. This explains the polarity in carbonyl compounds.

Aldehydes are oxidized easily by moist silver oxide or by potassium permanganate solution to the corresponding acids. The mechanism of the permanganate oxidation has some resemblance to the chromic acid oxidation of alcohols.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) What is the hybridization of the carbonyl carbon in aldehydes and ketones?

- a) sp
- b) sp^2
- c) sp^3
- d) sp^3d

(ii) Oxidation of $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ yields:

- a) $\text{CH}_3\text{CH}_2\text{CHO}$
- b) CH_3CHO
- c) CH_3COCH_3
- d) $\text{CH}_2=\text{CHCH}_3$

OR

(ii) Which of the following reagents cannot be used to oxidize primary alcohols to aldehydes.

- a) PCC
- b) KMnO_4 in acidic medium

c) CrO_3 in anhydrous medium

d) Heat in the presence of Cu at 573K

(iii) Which of the following carbonyl compounds is the most polar?

a) $\text{C}_2\text{H}_5\text{COCH}_3$

b) CH_3COCH_3

c) CH_3CHO

d) HCHO

(iv) A compound X with molecular formula $\text{C}_3\text{H}_8\text{O}$ can be completely oxidized to another compound Y whose molecular formula is $\text{C}_3\text{H}_6\text{O}_2$. The compound X is :

a) $\text{CH}_3\text{CH}_2\text{OCH}_3$

b) $\text{CH}_3\text{CH}_2\text{CHO}$

c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

d) $\text{CH}_3\text{CHOHCH}_3$

Q.No.2: Adsorption is mainly a consequence of surface energy. Generally, the surface particles which can be exposed partially tend to attract other particles to their site. Interestingly, adsorption is present in many physical, natural, biological and chemical systems and finds its use in many industrial applications. Adsorption is a process which involves the accumulation of a substance in molecular species in higher concentration on the surface. If we look at hydrogen, nitrogen and oxygen, these gases adsorb on activated charcoal. On the basis of forces between adsorbate and adsorbent, adsorption is of two types.

Physical adsorption: This type of adsorption is also known as physisorption. It is due to weak van der Waals' forces between adsorbate and adsorbent. For example, H_2 and N_2 gases adsorb on activated charcoal.

Chemical adsorption: This type of adsorption is also known as chemisorption. It is due to strong chemical forces of bonding type between adsorbate and adsorbent. We can take the example involving the formation of iron nitride on the surface when iron is heated in N_2 gas at 623 K. Adsorption of gas on a solid is a spontaneous exothermic reaction. Amount of heat liberated when a unit mass of a gas is adsorbed on the surface is called heat of adsorption.

In these questions(i-iv) a statement of assertion followed by statement of reason is given. Choose the correct answer out of the following choices:

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

(i) Assertion: When a finely divided active carbon is stirred into a dilute solution of dye, intensity of the colour of the solution is decreased.

Reason: The dye is adsorbed on the solid surface.

(ii) Assertion: The enthalpy of physisorption is greater than the enthalpy of

chemisorption.

Reason: The molecules of adsorbate and adsorbent are held together by van der Waals' forces of attraction in physisorption and by chemical bonds in chemisorption.

(iii) Assertion: As the temperature decreases, rate of physical adsorption increases.

Reason: Adsorption increases with the increase in temperature.

(iv) Assertion: Ammonia adsorbs more readily as compared to carbon dioxide on the surface of activated charcoal.

Reason: Ammonia is non-polar

OR

(iv) Assertion: Silica gel is used for drying air.

Reason: Silica gel adsorbs moisture from air.

Q.No.3: A colloid is a heterogeneous mixture whose particle size is intermediate between those of a solution and a suspension. The dispersed particles are spread evenly throughout the dispersion medium, which can be a solid, liquid, or gas. Because the dispersed particles of a colloid are not as large as those of a suspension, they do not settle out upon standing. Colloids are unlike solutions because their dispersed particles are much larger than those of a solution. The dispersed particles of a colloid cannot be separated by filtration, but they scatter light, a phenomenon called the Tyndall effect.

Tyndall Effect

When light is passed through a true solution, the dissolved particles are too small to deflect the light. However, the dispersed particles of a colloid, being larger, do deflect light. The Tyndall effect is the scattering of visible light by colloidal particles. You have undoubtedly "seen" a light beam as it passes through fog, smoke, or a scattering of dust particles suspended in air. All of these are colloids. Suspensions may scatter light, but if the number of suspended particles is sufficiently large, the suspension may simply be opaque and the light scattering will not occur.

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c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

(i) Assertion: Colloidal solution move towards anode and cathode when an electric current is passed through it.

Reason: They do not contain charge.

(ii) Assertion: True solution particles show Tyndall effect.

Reason: The scattering is directly proportional to the size of particles of the solution.

(iii) Assertion: Brownian movement is shown by colloidal particles.

Reason: Brownian movement arises due to the impact of molecules of dispersion medium with colloidal particles.

(iv) Assertion: Sky appears blue in color.

Reason: Colloidal particles of dust scatter blue light.

OR

(iv) Assertion: When a beam of light is passed through a colloidal solution placed in a dark place, the path of beam becomes visible.

Reason: Light gets scattered by the colloidal particles.

Q.No.4: In general, there are two types of protein molecules: fibrous proteins and globular proteins. Fibrous proteins are insoluble and elongated. Globular proteins are soluble and compact. Fibrous and Globular proteins may comprise one or more types of protein structures and they include primary, secondary, tertiary and quaternary structure. These structures are based on the level of complexity of the folding of a polypeptide chain.

Primary Structure: It is a specific sequence of amino acids. The order of amino acids bonded together is detected by information stored in genes.

Secondary Structure: It is the shape in which a long polypeptide chain can exist. It is formed by hydrogen bonds between the atoms along the backbone of the polypeptide chain.

Tertiary Structure: It is determined by R-groups. It is a three-dimensional shape of a protein. Many numbers of tertiary structure fold to form quaternary Structure.

Quaternary Structure: It is the arrangement of multiple folded protein subunits in a multi-subunit complex.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) Beta-pleated sheets are an example of:

- a) Primary Structure
- b) Secondary Structure
- c) Tertiary Structure
- d) Quaternary Structure

(ii) Which of the following structures have hydrogen bonds between polypeptide chains arranged parallelly?

- a) Primary structure
- b) Alpha-helix structure
- c) Beta-Pleated sheets
- d) Tertiary structure

OR

(ii) A tripeptide has :

- a) 3 amino acids and 1 peptide bond
- b) 3 amino acids and 2 peptide bonds
- c) 3 amino acids and 3 peptide bonds
- d) 3 amino acids and 4 peptide bonds

(iii) Which of the following statements are true about proteins?

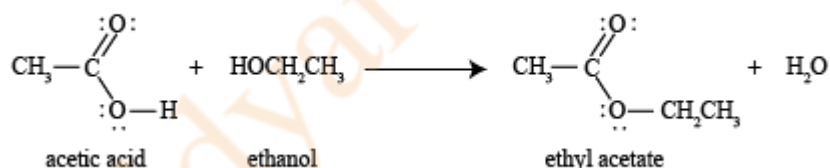
- a) Proteins are made up of amino acids.
- b) Proteins are essential for the development of skin, teeth and bones.
- c) Protein is the only nutrient that can build, repair and maintain body tissues.
- d) All of the above

(iv) What is a bond between amino acids called?

- a) Ionic Bond
- b) Peptide Bond
- c) Hydrogen bond
- d) Acidic bond

Q.No.5: Read the passage given below and answer the following questions:

The odor of vinegar is caused by the presence of acetic acid, a carboxylic acid, in the vinegar. The odor of ripe bananas and many other fruits is due to the presence of esters, compounds that can be prepared by the reaction of a carboxylic acid with alcohol. Because esters do not have hydrogen bonds between molecules, they have lower vapor pressures than the alcohols and carboxylic acids from which they are derived. Both carboxylic acids and esters contain a carbonyl group with a second oxygen atom bonded to the carbon atom in the carbonyl group by a single bond. In a carboxylic acid, the second oxygen atom also bonds to a hydrogen atom. In an ester, the second oxygen atom bonds to another carbon atom. The names for carboxylic acids and esters include prefixes that denote the lengths of the carbon chains in the molecules and are derived following nomenclature rules similar to those for inorganic acids and salts. Esters are produced by the reaction of acids with alcohols.



The distinctive and attractive odors and flavors of many flowers, perfumes, and ripe fruits are due to the presence of one or more esters. Among the most important of the natural esters are fats (such as lard, tallow, and butter) and oils (such as linseed, cottonseed, and olive oils), which are esters of the trihydroxyl alcohol glycerine, $\text{C}_3\text{H}_5(\text{OH})_3$, with large carboxylic acids, such as palmitic acid, $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, stearic acid, $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, and oleic acid, $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$. Oleic acid is an unsaturated acid; it contains a $\text{C}=\text{C}$ double bond. Palmitic and stearic acids are saturated acids that contain no double or triple bonds.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) Reaction of ethyl formate with an excess of CH_3MgI followed by hydrolysis gives:

- a) Ethanol

b) Propanal

c) Iso-propyl alcohol

d) N-propyl alcohol

(ii) Benzoic acid reacts with conc. HNO_3 and conc. H_2SO_4 to give:

a) o,p- dinitrobenzoic acid

b) o- nitrobenzoic acid

c) p-nitrobenzoic acid

d) m-nitrobenzoic acid

OR

(ii)) Which of the following statements is wrong?

a) For the synthesis of esters from carboxylic acids and alcohols, we can often use a base as a catalyst.

b) For the synthesis of esters from carboxylic acids and alcohols, we can often use an additional acid as a catalyst.

c) For the alkaline hydrolysis of carboxylic esters, we need to use an excess of base.

d) For the hydrolysis of carboxylic esters under acidic conditions, we need only a catalytic amount of an additional acid.

(iii) Dry heating of calcium acetate $(\text{CH}_3\text{COO})_2\text{Ca}$ gives:

a) Acetaldehyde

b) Acetic acid

c) Acetone

d) Ethane

(iv) Hydrolysis of ethyl acetate in the presence of NaOH produces:

a) Ethanoic acid

b) Sodium acetate and ethanol

c) Sodium acetate

d) Ethanoic acid and ethanol