IITJEE CHEMISTRY SAMPLE PAPER - I

Data required : Mass Number : H = 1, C = 12, Cl = 35.5

Gas constant : 0.0821 l atm K^{-1} mol^{-1}

8.314 $JK^{-1}mol^{-1}$

SECTION – I

Straight Objective Type

This section contains 8 multiple choice questions numbered 1 to 8. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

1. Which of the following is incorrect statement about OSF_4?
   (a) S atom has sp^3d hybridization.
   (b) OSF_4 has distorted trigonal pyramidal shape.
   (c) O atom is present at one of the equatorial position.
   (d) There is no lone pair on S.

2. Which one of the following statement about H_3BO_3 is not correct?
   (a) It is a weak tribasic acid.
   (b) It is prepared by acidifying an aqueous solution of borax.
   (c) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds.
   (d) It does not act as proton donor as it acts as a Lewis acid by accepting hydroxyl ions.

3. For a chemical reaction A $\longrightarrow$ product, the mechanism of the reaction postulated was as follows.

   $A(g) \underset{k_2}{\overset{k_1}{\rightleftharpoons}} 3B(g)$; $B(g) \xrightarrow[RDS]{k_3} C(g)$
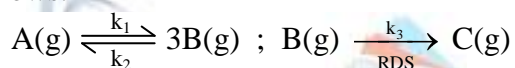
   If the reaction occurred with individual rate constants k_1, k_2 and k_3, determine activation energy for the overall reaction if the activation energies associated with these rate constants are $E_{a_1} = 180$ kJ $mole^{-1}$, $E_{a_2} = 90$ kJ $mole^{-1}$ and $E_{a_3} = 40$ kJ $mole^{-1}$.
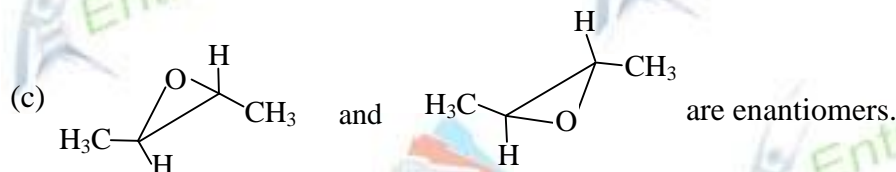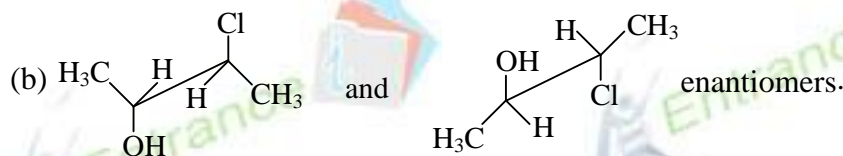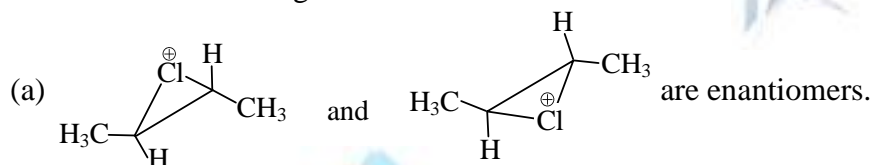   (a) 310 kJ   (b) –10 kJ
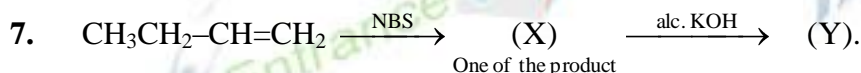   (c) 130 kJ   (d) 70 kJ

Space for rough work

4. 0.1M solution of three different sodium salts NaX, NaY and NaZ have pH values 7.0, 9.0 and 11.0 respectively. The correct order of dissociation constant values of these acids is

(a) $K_{HX} > K_{HY} > K_{HZ}$ (b) $K_{HX} < K_{HY} > K_{HZ}$

(c) $K_{HX} < K_{HY} < K_{HZ}$ (d) $K_{HX} > K_{HZ} > K_{HY}$

5. When one mole of an ideal gas is compressed to half of its initial volume and simultaneously heated to twice its initial temperature, the change in entropy (ΔS) is

(a) $C_v \ln 2$ (b) $C_p \ln 2$ (c) $R \ln 2$ (d) $(C_v - R) \ln 2$
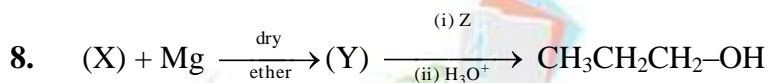
6. Which of the following statement is correct?

(a) and are enantiomers.

(b) and enantiomers.

(c) and are enantiomers.

(d) All are correct.

7. $CH_3CH_2-CH=CH_2 \xrightarrow{NBS} \underset{\text{One of the product}}{(X)} \xrightarrow{\text{alc. KOH}} (Y).$

The compound (Y) is

(a) But-3-en-2-ol   (b) But-3-en-1-ol   (c) 1, 3-Butadiene   (d) 1,2-Butadiene

8. $(X) + Mg \xrightarrow[\text{ether}]{\text{dry}} (Y) \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } Z} CH_3CH_2CH_2-OH$

Identify (X) and (Z) in the above sequence of reaction,

(a) CH_3CH_2Br and HCHO   (b) CH_3Br and

(c) CH_3Br and CH_3CH_2CHO (d) CH_3Br and CH_3CHO

Space for rough work

This section contains 4 reasoning type questions numbered 9 to 12. Each question contains Statement-1 and Statement-2. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

Directions: Read the following questions and choose

    (A) Statement-1 is True, **Statement-2** is True ; **Statement-2** is a correct explanation for **Statement-1**.

    (B) Statement-1 is True, **Statement-2** is True ; **Statement-2** is not a correct explanation for **Statement-1**.

    (C) Statement-1 is True, **Statement-2** is False.

    (D) Statement-1 is False, **Statement-2** is True.

9. **Statement-1:** Adding an inert gas to dissociation equilibrium of gaseous N_2O_4 at constant pressure and temperature increases the dissociation.

    Statement-2: Molar concentration of the reactants and products decreases on the addition of inert gas.

    (a) A   (b) B   (c) C   (d) D

10. **Statement-1:** Cs can be used as cathode in photoelectric cells.

    Statement-2: Alkali metals have very low ionization energies.

    (a) A   (b) B   (c) C   (d) D

11. **Statement-1:** Nitration of aniline can be done by protecting $-NH_2$ group by acetylation.

    Statement-2: Aniline ring being electron rich is oxidized by concentrated HNO_3.

    (a) A   (b) B   (c) C   (d) D

12. **Statement-1:** $\begin{array}{c} CHO \\ | \\ CHO \end{array} \xrightarrow{NaOH(50\%)} \begin{array}{c} COO^- \\ | \\ CH_2OH \end{array}$ is an example of intramolecular Cannizzaro reaction.

    Statement-2: In Cannizzaro's reaction aldehyde must have an α–H atom.

    (a) A   (b) B   (c) C   (d) D

Space for rough work

SECTION–III
Linked Comprehension Type

This section contains 2 paragraphs C_{13}–C_{18}. Based upon the paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

Passage-I

Mild oxidizing agents, e.g. bromine water, Tollen's reagent, Fehling's solution etc., oxidize aldoses into aldonic acid. Both glucose and fructose can be oxidized by Tollen's reagent and Fehling's solution despite the presence of a keto group in fructose. Strong oxidizing agents like conc. HNO_3 oxidizes glucose to a dibasic acid. Fructose under similar conditions is also oxidized. All carbohydrates are quantitatively oxidized by lead tetraacetate or periodic acid. This reaction is used to elucidate the structure of carbohydrates. Both glucose and fructose can be reduced by red P/HI, $LiAlH_4$, Clemmensen and Wolff-Kishner reduction.

13. Which of the following cannot be oxidized by bromine water?
    (a) D-arabinose   (b) D-glyceraldehyde
    (c) L-glucose   (d) L-fructose

14. Number of moles of lead tetraacetate required to oxidize 100 ml of 0.1M fructose solution are
    (a) 0.01   (b) 0.03
    (c) 0.05   (d) 0.06

15. Fructose on oxidation with conc. HNO_3 gives
    (a) saccharic acid   (b) tartaric acid
    (c) glycollic acid   (d) both (b) and (c)

Space for rough work

Passage-II

The emission of electrons from a metal surface when exposed to light radiations of appropriate wavelength is called photoelectric effect. The emitted electrons are called photoelectrons. Work function or threshold energy may be defined as the minimum amount of energy required to eject electrons from a metal surface.

According to Einstein–

Maximum kinetic energy of ejected electron = absorbed energy – work function

$$\frac{1}{2}mv_{max}^2 = h(\nu) - h(\nu_0) = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$$

where ν_0 and λ_0 are threshold frequency and threshold wavelength.

Stopping potential: It is the minimum potential at which the photoelectric current becomes zero.

16. In the photoelectric effect, the slope of straight line graph between stopping potential (V_0) and frequency of incident light (ν) gives

   (a) charge on electron.
   (b) work function of emitter.
   (c) Planck's constant.
   (d) ratio of Planck's constant to charge on electron.
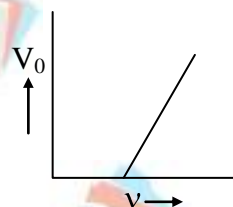
17. The stopping potential as a function of frequency is plotted for two different photoelectric surfaces A and B. The graph shows that the work function A is

   (a) greater than that of B.
   (b) smaller that that of B.
   (c) same as that of B.
   (d) such that no comparison can be done from given graph.
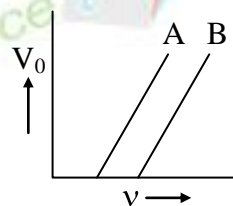
18. The following figure indicates the energy levels of a certain atom. When the system moves from 2E level to E, a photon of wavelength λ is emitted. The wavelength of photon produced during the transition from energy level 4E/3 to E is

   (a) $\dfrac{\lambda}{3}$ (b) $\dfrac{3\lambda}{4}$ (c) $\dfrac{4\lambda}{3}$ (d) 3λ
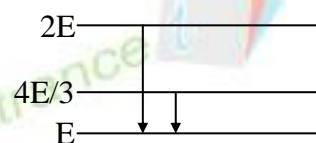
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SECTION–IV

Matrix–Match Type

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. Statements (A), (B), (C), (D) in **Column I** have to be matched with statements (1, 2, 3, 4) in **Column II**. One statement in first column has one or more than one match with the statements in second column. The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A–1,3, B–3, C–2,3 and D–2,4, then the correctly bubbled 4×4 matrix should be as follows:

```
      1   2   3   4
A   ( 1 ) ( 2 ) ( 3 ) ( 4 )
B   ( 1 ) ( 2 ) ( 3 ) ( 4 )
C   ( 1 ) ( 2 ) ( 3 ) ( 4 )
D   ( 1 ) ( 2 ) ( 3 ) ( 4 )
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1.

Column I	Column II
(A) Starch	**1.** Polymers of α-amino acid
(B) Nylon –66	**2.** Polymer of α-D-Glucose
(C) Proteins	**3.** Polyamide
(D) Natural rubber	**4.** Isoprene

2.

Column I	Column II
(A) Multimolecular colloid	**1.** Sulphur
(B) Physical adsorption	**2.** Protein
(C) Chemical adsorption	**3.** Reversible process
(D) Macromolecular colloid	**4.** Irreversible process

Space for rough work

SECTION–V
Subjective or Numerical Type

1. The equivalent weight of an element is 9. Its chloride has a vapour density 66.75. What is valency of the element?

2. A cylinder contains 15 kg of butane gas at 27°C and 10 atmospheric pressure. It was leaking and its pressure fell down 8 atmospheric pressure after one day. What amount of the gas (in kg) is leaked out?

Space for rough work