IIT-JEE 2011   Chemistry Paper-I

PART I - CHEMISTRY

### SECTION - I (Total Marks : 21)
(Single Correct Choice Type)

This Section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. Dissolving 120 g of urea (mol. wt. 60) in 1000 g of water gave a solution of density 1.15 g / mL. The molarity of the solution is
    (A) 1.78 M   (B) 2.00 M   (C) 2.05 M   (D) 2.22 M

1. **(C)**

2. $AgNO_3$ (aq.) was added to an aqueous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is
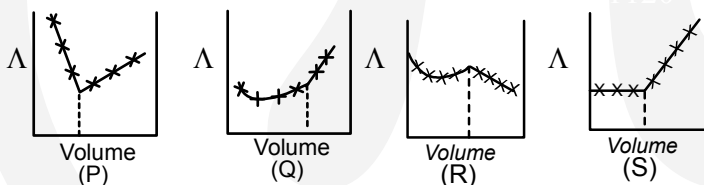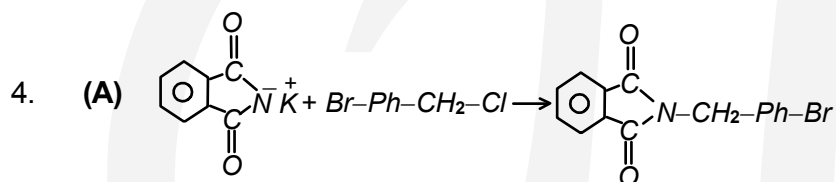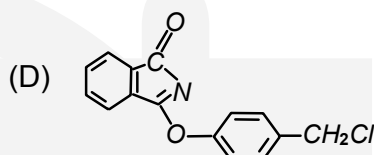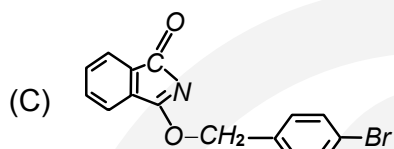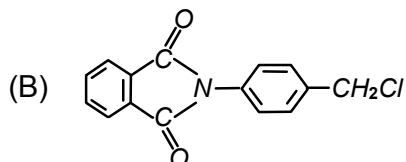

    (A) (P)   (B) (Q)   (C) (R)   (D) (S)

2. **(D)** $AgNO_3 + KCl \longrightarrow AgCl\downarrow + KNO_3$
    Conductivity will remain same for some time then gradually increase due to excess of KCl.

3. Among the following compounds, the most acidic is
    (A) *p*-nitrophenol   (B) *p*-hydroxybenzoic acid
    (C) *o*-hydroxybenzoic acid   (D) *p*-toluic acid

3. **(C)**   Due to ortho effect.

4. The major product of the following reaction is

$$\text{phthalimide} \xrightarrow[\text{(ii)} Br-C_6H_4-CH_2Cl]{\text{(i)} KOH}$$

(A) N–CH₂–(C₆H₄)–Br

(B) N–(C₆H₄)–CH₂Cl

(C) O–CH₂–(C₆H₄)–Br

(D) O–(C₆H₄)–CH₂Cl

4. **(A)**

$$\text{N}^{-}\text{K}^{+} + Br{-}Ph{-}CH_2{-}Cl \longrightarrow \text{N}{-}CH_2{-}Ph{-}Br$$
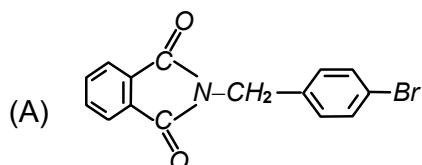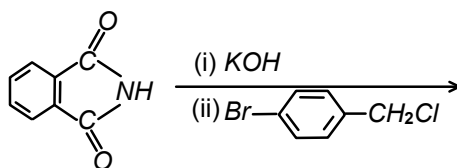
5. Extra pure N_2 can be obtained by heating
   (A) NH_3 with CuO (B) NH_4NO_3 (C) $(NH_4)_2Cr_2O_7$ (D) $Ba(N_3)_2$

5. **(D)** $Ba(N_3)_2 \xrightarrow{\Delta H} Ba \downarrow + 3N_2$
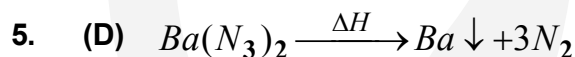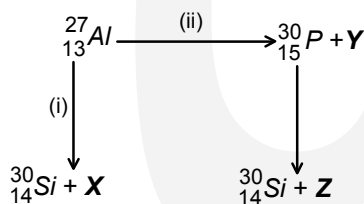
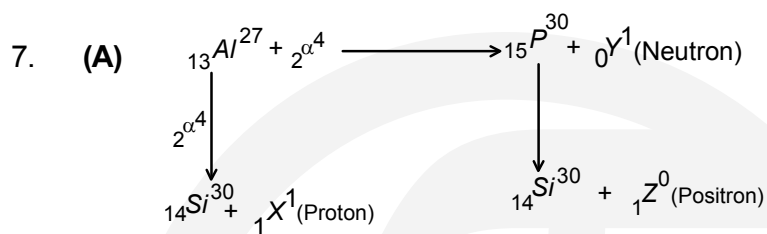6. Geometrical shapes of the complexes formed by the reaction of Ni^{2+} with Cl^-, CN^- and H_2O, respectively are
   (A) Octahedral, tetrahedral and square planar
   (B) Tetrahedral, square planar and octahedral
   (C) Square planar, tetrahedral and octahedral
   (D) Octahedral, square planar and octahedral

6. **(B)** $[NiCl_4]^{-2}$ sp^3
   $[Ni(CN)_4]^{-2}$ dsp^2
   $[Ni(H_2O)_6]^{+2}$ sp^3d^2

7. Bombardment of aluminum by α-particle leads to its artificial disintegration in two ways, (i) and (ii) as shown. Products X, Y and Z respectively are,

(A) Proton, neutron, positron   (B) Neutron, positron, proton

(C) Proton, positron, neutron   (D) Positron, proton, neutron

7. **(A)**

$$_{13}Al^{27} + \, _2\alpha^4 \longrightarrow \, _{15}P^{30} + \, _0Y^1 \text{(Neutron)}$$

$$\downarrow \, _2\alpha^4$$

$$_{14}Si^{30} + \, _1X^1 \text{(Proton)}$$

$$\downarrow$$

$$_{14}Si^{30} + \, _1Z^0 \text{(Positron)}$$

$$^{27}_{13}Al \xrightarrow{\text{(ii)}} \, ^{30}_{15}P + Y$$

$$\downarrow \text{(i)}$$

$$^{30}_{14}Si + X \qquad\qquad ^{30}_{14}Si + Z$$

SECTION - II (Total Marks : 16)
(Multiple Correct Answers Type)

This section contains 4 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

8. Amongst the given options, the compound(s) in which all the atoms are in one plane in all the possible conformations (if any), is (are)

(A) $H_2C-C(H)=C(H)-CH_2$

(B) $H-C{\equiv}C-C(H)=CH_2$

(C) $H_2C=C=O$

(D) $H_2C=C=CH_2$
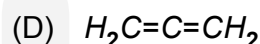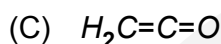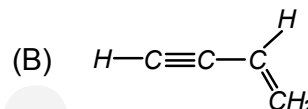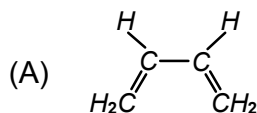
8. **(BC)**

9. According to kinetic theory of gases.
    (A) Collisions are always elastic.
    (B) Heavier molecules transfer more momentum to the wall of the container.
    (C) Only a small number of molecules have very high velocity.
    (D) Between collisions, the molecules move in straight lines with constant velocities.

9. **(AD)**   Option C is correct but not mentioned in the kinetic theory of gases.

10. The correct statement(s) pertaining to the adsorption of a gas on a solid surface is (are)
    (A) Adsorption is always exothermic
    (B) Physisorption may transform into chemisorption at high temperature.
    (C) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature.
    (D) Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation.

10. **(ABD)**   Physisorption is favourable at low temperature.

11. Extraction of metal from the ore **cassiterite** involves
    (A) Carbon reduction of an oxide ore   (B) self-reduction of a sulphide ore
    (C) Removal of copper impurity   (D) Removal of iron impurity

11. **(ACD)** $SnO_2 + 2C \longrightarrow Sn + 2CO$
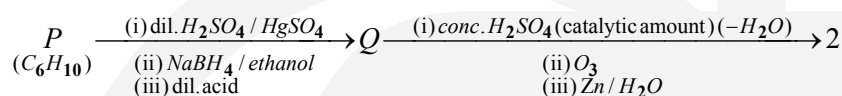   Tin is purified by liquation and polling.

This Section contains **2 paragraphs.** Based upon one of the paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.
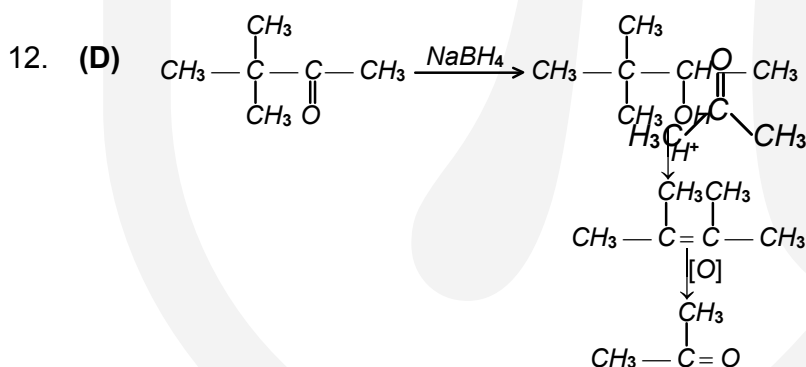
Paragraph for Question Nos. 12 and 13

An acyclic hydrocarbon P, having molecular formula C_6H_{10}, gave acetone as the only organic product through the following sequence of reactions, in which Q is an intermediate organic compound.

$$P \atop (C_6H_{10}) \xrightarrow[\substack{(ii)\,NaBH_4\,/\,ethanol \\ (iii)\,dil.\,acid}]{(i)\,dil.\,H_2SO_4\,/\,HgSO_4} Q \xrightarrow[\substack{(ii)\,O_3 \\ (iii)\,Zn\,/\,H_2O}]{(i)\,conc.\,H_2SO_4\,(catalytic\,amount)\,(-H_2O)} 2$$

12. The structure of compound P is

(A) $CH_3CH_2CH_2CH_2 — C \equiv C — H$

(B) $H_3CH_2C — C \equiv C — CH_3CH_3$

(C) $\begin{matrix} H_3C \\ H \\ H_3C \end{matrix}\!\!\!> C — C \equiv C — CH_3$

(D) $\begin{matrix} H_3C \\ H_3C \\ H_3C \end{matrix}\!\!\!> C — C \equiv C — H$

12. **(D)**

13. The structure of the compound Q is

(A) $\begin{matrix} H_3C \\ H \\ H_3C \end{matrix}\!\!\!> C — \underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}} — CH_2CH_3$

(B) $\begin{matrix} H_3C \\ H_3C \\ H_3C \end{matrix}\!\!\!> C — \underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}} — CH_3$

(C) $\begin{matrix} H_3C \\ H \\ H_3C \end{matrix}\!\!\!> C — CH_2\overset{\overset{OH}{|}}{C}HCH_3$

(D) $CH_3CH_2CH_2\overset{\overset{OH}{|}}{C}HCH_2CH_3$

13. **(B)**

Paragraph for Question Nos. 14 to 16.

When a metal rod M is dipped into an aqueous colourless concentrated solution of compound N, the solution turns light blue. Addition of aqueous $NaCl$ to the blue solution gives a white precipitate O. Addition of aqueous NH_3 dissolves O and gives an intense blue solution.

14. The metal rod M is
    (A) Fe (B) Cu (C) Ni (D) Co

14. **(B)** $Cu + 2AgNO_3 \longrightarrow 2Ag + Cu(NO_3)_2$
    $Ag^+ + Cl^- \longrightarrow AgCl$
    $AgCl + 2NH_3 \longrightarrow Ag(NH_3)_2{}^+$
    $Cu^{+2} + 4NH_3 \longrightarrow Cu(NH_3)_4{}^+$

15. The compound N is
    (A) $AgNO_3$ (B) $Zn(NO_3)_2$ (C) $Al(NO_3)_3$ (D) $Pb(NO_3)_2$

15. **(A)**

16. The final solution contains
    (A) $[Pb(NH_3)_4]^{2+}$ and $[CoCl_4]^{2-}$ (B) $[Al(NH_3)_4]^{3+}$ and $[Cu(NH_3)_4]^{2+}$
    (C) $[Ag(NH_3)_2]^+$ and $[Cu(NH_3)_4]^{2+}$ (D) $[Ag(NH_3)_2]^+$ and $[Ni(NH_3)_6]^{2+}$

16. **(C)**

Section - IV (Total Marks : 28)
(Integer Answer Type)

This section contains **7 questions**. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

17. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metal is

| Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
(ϕ) (eV)	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

17. **(4)** 3000 A° $\approx$ 4.1 eV.

$\therefore$ All below this value will eject photo electron.

18. To an evacuated vessel with movable piston under external pressure of 1 atm., 0.1 mol of He and 1.0 mol of an unknown compound (vapour pressure 0.68 atm. at 0° C) are introduced. Considering the ideal gas behaviour, the total volume (in litre) of the gases at 0° C is close to.

18. **(7)** $0.1 \times \dfrac{1}{12} \times \dfrac{273}{0.32} = 7$

19. Reaction of Br_2 with Na_2CO_3 in aqueous solution gives sodium bromide and sodium bromate with evolution of CO_2 gas. The number of sodium bromide molecules involved in the balanced chemical equation is.

19. **(5)** $3Br_2 + 3Na_2CO_3 \longrightarrow 5NaBr + NaBrO_3 + 3CO_2$
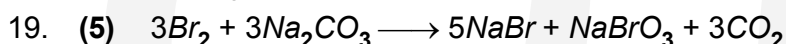
20. The difference in the oxidation numbers of the two types of sulphur atoms in $Na_2S_4O_6$ is.

20. **(5)**

$5 - 0 = 5$
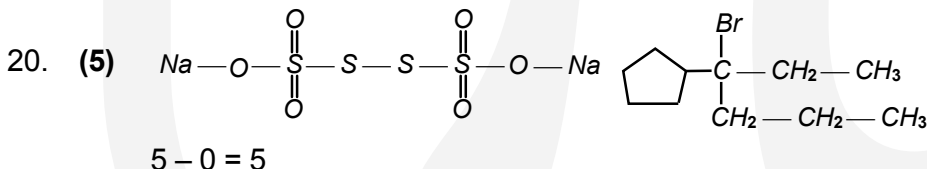
21. A decapeptide (Mol. Wt. 796) on complete hydrolysis gives glycine (Mol. Wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is.

21. **(6)** $\dfrac{\{796 + (9 \times 18)\} \times 47}{100 \times 75} = 6$

22. The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is.

22. **(5)**

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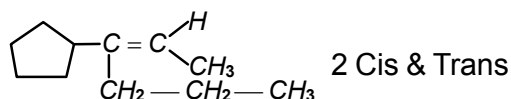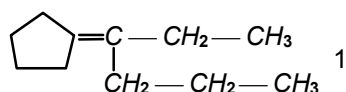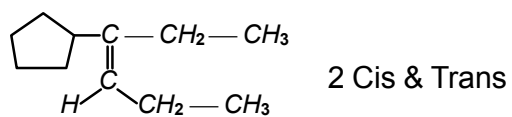
23. The maximum number of electrons that can have principal quantum number, $n = 3$, and spin quantum number, $m_s = -1/2$, is.

23. **(9)** $3s = 1$ $3p = 3,$ $3d = 5$