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# JEE (Main)

**PAPER-1 (B.E./B. TECH.)**

# 2023

## COMPUTER BASED TEST (CBT)

## Memory Based Questions & Solutions

**Date: 29 January, 2023 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)**

**Duration: 3 Hours | Max. Marks: 300**

**SUBJECT: CHEMISTRY**

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Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222
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## PART : CHEMISTRY

**1.** Which of the following is a sulphide are ?
(1) Calamine (2) Siderite (3) Sphalerite (4) Malachite

**Ans.** **(3)**

**Sol.** Calamine – $ZnCO_3$
Siderite – $FeCO_3$
Sphalerite – $ZnS$

Malachite – $CuCO_3.Cu(OH)_2$

**2.** Give the increasing order of spin only magnetic moment of the following

(A) $[FeF_6]^{3-}$ (B) $[CoF_6]^{3-}$ (C) $[Co(C_2O_4)_3]^{3-}$

(1) A > B > C (2) A < B < C (3) A > C > B (4) B > A > C

**Ans.** **(1)**

**Sol.**

| Complex | Central Metal ion E. C. | NO. of unpaired electron | Magnetic moment $\mu = \sqrt{n(n+2)}$ BM |
|---|---|---|---|
| (1) $[FeF_6]^{3-}$ | $Fe^{3+}-3d^5-t_{2g}^{1,1,1}\ e_g^{1,1}$ | 5 | $\sqrt{35}$ BM |
| (2) $[CoF_6]^{3-}$ | $Co^{3+}-3d^6-t_{2g}^{2,1,1}\ e_g^{1,1}$ | 4 | $\sqrt{24}$ BM |
| (3) $[Co(C_2O_4)_3]^{3-}$ | $Co^{3+}-3d^6-t_{2g}^{2,2,2}\ e_g^{0,0}$ | 0 | 0 BM |

**3.** How many of the following oxides are acidic ?

$N_2O_3$, $N_2O$, $NO_2$, NO, $Na_2O$, $Cl_2O_7$, $SO_2$, CaO

**Ans.** **4**

**Sol.**

| Acidic oxides | Basic oxides | Neutral oxides |
|---|---|---|
| $N_2O_3$ | $Na_2O$ | $N_2O$ |
| $NO_2$ | CaO | NO |
| $Cl_2O_7$ | | |
| $SO_2$ | | |

**4.** **S-1** : The first ionization enthalpy difference of B to Al is more than that of Al and Ga.

**S-2** : Ga has completely filled d-orbitals, which have low screening effect.

(1) Both S-1 & S-2 are correct. (2) S-1 in correct & S-2 in incorrect.

(3) S-1 in incorrect & S-2 in correct. (4) Both S-1 & S-2 are incorrect.

**Ans.** **(1)**

**Sol.**

| Element | B | Al | Ga | In | Tl |
|---|---|---|---|---|---|
| $IE_1$ (KJ/mol) | 801 | 577 | 579 | 558 | 589 |

$\Delta IE_1$ of B & Al in greater than $\Delta IE_1$ of Al & Ga.

This is due to completely filled d-orbitals in Ga and d-electron have low screening effect to compensate the increase in nuclear charge.





**5.** Compare the bond order of the following species.

$O_2^{-2}$ , NO, CO

(1) $O_2^{-2}$ > NO > CO (2) $O_2^{-2}$ > CO > NO (3) CO > NO > $O_2^{-2}$ (4) NO > CO > $O_2^{-2}$

**Ans.** **(3)**

**Sol.**

| Species | Molecular Orbital configuration | Band order = $\frac{1}{2}(N_b - B_a)$ |
|---|---|---|
| CO | $KK^*\sigma_{2s}^2\sigma_{2s}^{*2}\left(\pi_{2p_x}^2 = \pi_{2p_y}^2\right)\sigma_{2p_z^2}$ | $\frac{1}{2}(10-4) = 3$ |
| NO | $KK^*\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2p_z^2}\left(\pi_{2p_x}^2 = \pi_{2p_y}^2\right)\left(\pi_{2p_x}^{*1} = \pi_{2p_y}^{*0}\right)$ | $\frac{1}{2}(10-5) = 2.5$ |
| $O_2^{-2}$ | $KK^*\sigma_{2s}^2\sigma_{2s}^{*2}\ \sigma_{2p_z^2}\left(\pi_{2p_x}^2 = \pi_{2p_y}^2\right)\left(\pi_{2p_x}^{*2} = \pi_{2p_y}^{*2}\right)$ | $\frac{1}{2}(10-8) = 1$ |

B.O. : CO > NO > $O_2^{-2}$

**6.** If Bohr's radius of H-atom in ground state is 0.6 Å. Find out the Bohr's radius of $He^+$ ion in 3rd orbit.

(1) 5.4 Å (2) 2.7 Å (3) 1.8 Å (4) 0.98 Å

**Ans.** **(2)**

**Sol.** $r_n = r_0\frac{n^2}{z}$

$(r_3) = \frac{(1)^2}{2}$ 0.6 Å

$(r_1)_H = r_0 \frac{(1)^2}{1} = 0.6\text{Å}$

$(r_3)_{He^+} = r_0 \frac{(n)^2}{z}$

$= 0.6\left(\frac{3^2}{2}\right) = 0.6 \times \frac{9}{2} = 2.7\text{Å}$

**7.** Match the column :

| | Column-I | | Column-II |
|---|---|---|---|
| (i) | Dispersion medium moves in and electric filed. | (a) | Osmosis |
| (ii) | Solvent molecules pass through steric permeable membrane towards solvent side. | (b) | Electrophoresis |
| (iii) | Movement of charged colloidal particle under the influence of applied electric potential towards oppositely charged electrodes. | (c) | Electro osmosis |
| (iv) | Solvent molecules pass through steric permeable membrane towards solution side. | (d) | Reverse osmosis |

(1) (i) – c, (ii) – d, (iii) – b, (iv) – a (2) (i) – b, (ii) – a, (iii) – c, (iv) – d
(3) (i) – a, (ii) – b, (iii) – c, (iv) – d (4) (i) – d, (ii) – c, (iii) – a, (iv) – b

**Ans.** **(1)**





**Sol.** (i) **Electro osmosis:** When movement of colloidal particles is prevented by some suitable means (porous diaphragm or semi permeable membranes), it is observed that the D.M. begins to move in an electric field. This phenomenon is termed electrosmosis.
(ii) Solvent molecules pass through semi-permeable membrane towards solvent side is termed as reverse osmosis.
(iii) When an electric potential is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis.
(iv) Solvent molecules pass through semipermeable membrane towards the solution side is termed as osmosis.

**8.** For a reaction, $A \rightarrow B$, the value of rate constant is $1.4 \times 10^{-4}$ L $mol^{-1}$ $sec^{-1}$. Then the order of the reaction is:

**Ans.** **2**

**Sol.** For nth order reaction

$$\text{Units of } k = \frac{\text{Rate}}{(\text{conc})^n} = mol^{1-n} L^{n-1} S^{-1}$$

For a given reaction unit of k $mol^{-1}$ L $sec^{-1}$
$\therefore$ Order of the reaction (n) = 2

**9.** An organic compound of mass 0.1 g on complete combustion with excess of oxygen gives 0.183 g of $CO_2$ and 0.181 g of $H_2O$. The percentage of carbon present in the organic compound is : (Nearest integer)

**Ans.** **50**

**Sol.** Mass of carbon present in 44 g $CO_2$ = 12 g.

$$\text{Mass of carbon present in 0.183g } CO_2 = \frac{0.183 \times 12}{44} = 0.05\text{g}.$$

$$\% \text{ of carbon} = \frac{\text{Mass of carbon}}{\text{Mass of organic Compound}} \times 100 = \frac{0.05}{0.1} \times 100 = 50\,\%$$

**10.** **S-1** : Nickel is used as catalyst in syngas production and edible fats.
**S-2** : The process of producing 'syngas' from coal is called coal gasification.
(1) Both S-1 and S-2 are correct. (2) S-1 is incorrect & S-2 is correct.
(3) S-1 is correct & S-2 is incorrect. (4) Both S-1 & S-2 are incorrect.

**Ans.** **(1)**

**Sol.** $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270\,K} CO(g) + 3H_2(g)$

Hydrogenation of vegetable oils using Ni catalyst gives edible fats.

$C(s) + H_2O(g) \xrightarrow{1270\,K}$ $CO(g) + H_2(g)$ (coal gasification)

$C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$ (coal gasification)

**11.** **S-1** : Silicon forms both electron deficient and electron rich hydrides.
**S-2** : All elements of group 14 hydrides are electron precise compounds and are in tetrahedral geometry.
(1) Both S-1 & S-2 are correct. (2) S-1 is incorrect & S-2 is correct.
(3) S-1 is correct & S-2 is incorrect. (4) Both S-1 & S-2 are incorrect.

**Ans.** **(2)**





**12.** Which of the relation is correct ?
(A) $\Delta G = \Delta H - T\Delta S$ at constant T & P. (B) $\Delta S = \frac{q_{rev}}{T}$.
(C) $\Delta U = q + W$ (D) $\Delta H = \Delta U + \Delta ngRT$
(1) A & B only (2) A, B and C only (3) B, C & D only (4) A, B, C and D

**Ans.** **(4)**

**13.** Which of the following product is formed by the heat decomposition of $LiNO_3$.
(1) $Li_2O$, $NO_2$ and $O_2$ (2) Li, NO and $O_2$ (3) $Li_3N$ and $O_2$ (4) $LiNO_2$, $NO_2$ and $O_2$

**Ans.** **(1)**

**Sol.** $4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$
$2NaNO_3 \longrightarrow 2NaNO_2 + O_2$

**14.** The indicator used in the titration of X against sodium thiosulphate is Y.
X and Y respectively are.
(1) X – Iodine Y – Starch. (2) X – Iodine Y – Phenolphthalein.
(3) X – Iodine Y – Methyl orange. (4) X – Iodine Y – Phenol red.

**Ans.** **(1)**

**Sol.** $2Na_2S_2O_3 + I_2 \xrightarrow{\text{Starch}} 2NaI + Na_2S_4O_6$.

**15.** The all voids present in 0.02 mol of a compound forming hexagonal close packing crystal structure are x $\times 10^{21}$. The value of X is : (Given $N_A = 6 \times 10^{23}$) ..... (Nearest integer).

**Ans.** (36)

**Sol.** Given mole of compound = 0.02 mol
Number of atoms in 0.02 mol = $0.02 \times 6 \times 10^{23} = 12 \times 10^{21}$
Number of octahedral voids = No. of atoms = $12 \times 10^{21}$
Number of tetrahedral voids = 2 × No. of atoms = $2 \times 12 \times 10^{21} = 24 \times 10^{21}$
Total number of voids = no. of octahedral voids + no. of tetrahedral voids
Total no. voids in 0.02 mole compound = $12 \times 10^{21} + 24 \times 10^{21} = 36 \times 10^{21}$

**16.** Match the following :

| | Column-I | | Column-II |
|---|---|---|---|
| (i) | Van't Hoff factor (i) | (p) | Solutions having same osmotic pressure |
| (ii) | Isotonic solutions | (q) | Binary mixtures having same composition in liquid and vapour phase and boil at constant temperature |
| (iii) | Azeotropic solutions | (r) | Cryoscopic constant |
| (iv) | $K_f$ | (s) | $\frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$ |

(1) (i) – s, (ii) – p, (iii) – q, (iv) – r (2) (i) – p, (ii) – s, (iii) – q, (iv) – r
(3) (i) – s, (ii) – p, (iii) – r, (iv) – q (4) (i) – q, (ii) – p, (iii) – s, (iv) – r

**Ans.** **(1)**

**17.** A and B are radioactive atoms with molar mass 16 and 32 respectively. The half-lives of A and B are one day and ½ day respectively. If initially 320 g of each A and B is taken. The total number of atoms left after two days are $x \times 10^{23}$. The value of 'x' is : (Nearest integer)

**Ans.** **(34)**

**Sol.** No. of moles of A = $\frac{320}{16}$ = 20 moles

No. of moles of B = $\frac{320}{32}$ = 10 moles

A (20 mole) $\xrightarrow{1\text{ day}}$ 10 moles $\xrightarrow{1\text{ day}}$ 5 moles

B (10 mole) $\xrightarrow{0.5\text{ day}}$ 5 moles $\xrightarrow{0.5\text{ day}}$ 2.5 moles $\xrightarrow{0.5\text{ day}}$ 1.25 moles $\xrightarrow{0.5\text{ day}}$ 0.625 moles

No. of 'A' atoms left after 2 days = $5 \times N_A$

$= 5 \times 6 \times 10^{23}$

$= 30 \times 10^{23}$ atoms

No. of 'B' atoms left after 2 days = $0.625 \times N_A$

$= 0.625 \times 6 \times 10^{23}$

$= 3.75 \times 10^{23}$ atoms

Total number of atoms left after 2 days = $30 \times 10^{23} + 3.75 \times 10^{23}$

$= 34 \times 10^{23}$

**18.** 0.69 gm of Na reacts with water and produces NaOH which is neutralised by 73 g/ml of HCl. The volume of HCl required for complete neutralization of NaOH is $x \times 10^{-3}$ mL. The value of 'x' is :

**Ans.** (15)

**Sol.** $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Number of moles of Na = No. of moles of NaOH

$n_{NaOH} = \frac{0.69}{23} = 0.03$

$NaOH + HCl \longrightarrow NaCl + H_2O$

Moles of HCl = moles of NaOH

$(\text{Molarity} \times V)_{HCl}$ = Number of moles of NaOH

$\left(\frac{73 \times 1000}{36.5 \times 1}\right) \times V = 0.03 = 1.5 \times 10^{-5}$ L = 0.015 mL = $15 \times 10^{-3}$ mL

**19.** A hydrocarbon for combustion requires 9.5 equivalents of oxygen and produces 3 equivalents of water. The formula of hydrocarbon is :

(1) $C_8H_8$ (2) $C_6H_6$ (3) $C_2H_6$ (4) $C_2H_4$

**Ans.** (1)

**Sol.** $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

No. of equivalents of $O_2$ = No. of equivalents of $H_2O$

No. of equivalents of $H_2O = \frac{y}{2} = 3$

$y = 6$

No. of equivalents of $O_2 = x + \frac{y}{4} = 9.5$

$x + \frac{6}{4} = 9.5$

$x = 9.5 - 1.5 = 8$

$C_xH_y = C_8H_6$



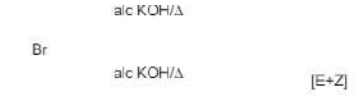


**20.** In which of the given molecules, dehydrohalogenation forms maximum number of isomers (excluding rearrangement) :

(1)  (2) (3)  (4) 

**Ans.** (1)

**Sol.**




overall-3-isomers

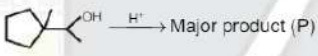
**21.** Which of the following disease can be cured by equanil drugs.

(1) Pain (2) Stomach ulcer

(3) Hypertension (4) Depression

**Ans.** (4)

**Sol.** Equanil is a tranquilizer and it is used to treat depression.

**22.**  Major product (P) is :

(1) (2) (3) (4)

**Ans.** (3)

**Sol.**

**23.** How many tetrapeptide can be formed from amino acids (F, L, Y, Q, T), where F = Phenyl alanine, L = Leucine, Y = Tyrosine, Q = Glutamine and T = Threonine

**Ans.** (120)

**23.** Propanamide $\xrightarrow{Br_2/KOH}$ Product (P) is :

(1) Ethanamine (2) Propanenitrile

(3) Acetylpropylamine (4) Ethanenitrile

**Ans.** (1)

**Sol.** $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2/KOH} CH_3-CH_2-NH_2$

Propanamide Ethanenitrile





**24.** The correct match for the list-I and list-II

| List-I | List-II |
|---|---|
| (i) Thermosetting | (p) Polyester |
| (ii) Thermo plastic | (q) Urea formaldehyde resin |
| (iii) Elastomer | (r) Poly styrene |
| (iv) Fiber | (s) Neoprene |

(1) i → q, ii → r, iii → s, iv → p

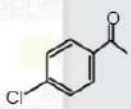
(2) i → p, ii → r, iii → s, iv → q

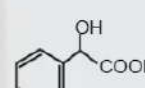
(3) i → q, ii → s, iii → r, iv → p

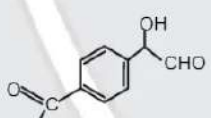
(4) i → q, ii → s, iii → p, iv → r

**Ans.** (1)

**Sol.** Based on fact.

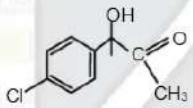
**25.**  $\xrightarrow[2.\ H_3O^+]{1.\ KCN}$ (A) $\xrightarrow[H_3O^+]{MeMgBr\ excess}$ Product P is :

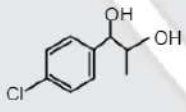


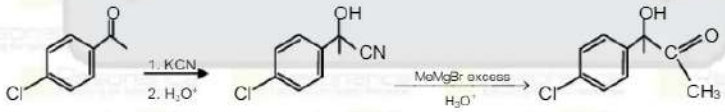
(1)

(2)

(3) 

(4) 

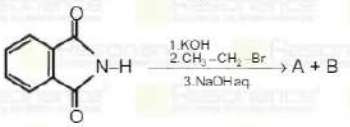
**Ans.** **(3)**

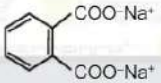
**Sol.** 

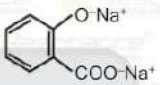


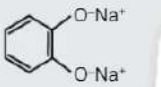



**26.** Product A and B in the given reaction is :



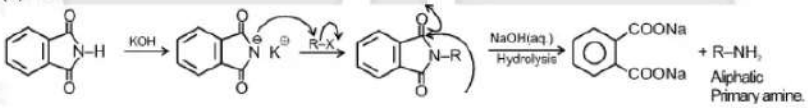

(1) $CH_3–CH_2–NH_2$ and 

(2) $CH_3–CH_2–NH_2$ and 

(3) $CH_3–CH_2–NH_2$ and 

(4) $CH_2CH_3$ and $H_2O$

**Ans.** **(1)**

**Sol.** 

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