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JEE (Main)

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

2021

COMPUTER BASED TEST (CBT)
Memory Based Questions & Solutions

Date: 20 July, 2021 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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PART : CHEMISTRY

1. Arrange the following complex in increasing order of intensity of colour.

$[Co(CN)_6]^{3-}$, $[Co(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$

(1) $[Co(CN)_6]^{3-}$, $Co(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$ (2) $[CoCl_4]^{2-}$, $Co(H_2O)_6]^{2+}$, $[Co(CN)_6]^{3-}$

(3) $[Co(CN)_6]^{3-}$, $[CoCl_4]^{2-}$, $Co(H_2O)_6]^{2+}$ (4) $Co(H_2O)_6]^{2+}$, $[Co(CN)_6]^{3-}$, $[CoCl_4]^{2-}$

Sol. **(1)**

	Complex	Colour
1.	$[Co(CN)_6]^{3-}$,	Yellow
2.	$Co(H_2O)_6]^{2+}$	Pink
3.	$[CoCl_4]^{2-}$	Blue

2. Which of the following does not disproportionate

(1) BrO^- (2) BrO_2^- (3) BrO_3^- (4) $BrO_4^{\ominus}$

Ans. (4)

Sol. In BrO_4^-, Br is in maximum oxidation state. So it can only reduce

3. A metal M on reaction with excess oxygen give MO_2 type oxide (as main product) then possible metal is.

(1) Li (2) Na (3) K (4) Mg

Ans. (3)

Sol. $K + O_2$ (excess) $\longrightarrow KO_2$

Potassium on reaction with excess oxygen give superoxide

4. Identify the correct increasing order of 1st ionisation energy of following

Al, Mg, Si, S, P

(1) Mg, Al, Si, P, S (2) Al, Mg, Si, S, P (3) Mg, Al, Si, S, P (4) Al, Mg, Si, P, S

Ans. **(2)**

Sol. Mg $3s^2$

Al $3s^23p^1$

Si $3s^23p^2$

P $3s^23p^3$

S $3s^23p^4$

So correct order : - Al < Mg < Si < S < P

5. Four moles of a diatomic gas is heated from 0ºC to 50ºC, find the heat supplied to the gas if work done by it is zero.

(1) 780 R (2) 500 R (3) 100 R (4) 650 R

Ans. **(2)**

Sol. w = 0

$\Delta E = q_v = nC_v\Delta T$

$$4 \times \frac{5R}{2} \times 50 = 500\ R$$

6. HNO_3 on reaction with P_4O_{10} gives an oxide 'A'

$P_4O_{10} + HNO_3 \longrightarrow A(\text{oxide})$

Nature of oxide A is

(1) acidic (2) Basic (3) Neutral (4) Amphoteric

Sol. $P_4O_{10} + 4HNO_3 \longrightarrow \underset{\text{'A'}}{2N_2O_5} + 4HPO_3$

Nature of oxide 'A' is "acidic".

7. An equimolar mixture of benzene ($P^o_{Benzene}$ = 70 torr and methyl benzene ($P^o_{Methyl\ Benzene}$ = 20 torr) is prepared, then find mole fraction of benzene in vapour phase.

Ans. 0.7

Sol. $P_{Total} = P^O_{Benzene}\ X_{Benzene} + P^O_{Toluene}\ X_{Toluene}$

$= (70)\ \frac{1}{2} + (20)\ \frac{1}{2}$

$= 35 + 10$

$= 45$

$$\frac{1}{P_{Total}} = \frac{Y_{Benzene}}{P^O_{Benzene}} + \frac{Y_{Toluene}}{P^O_{Toluene}}$$

$$\frac{1}{45} = \frac{Y_{Benzene}}{70} + \frac{1 - Y_{Benzene}}{20}$$

$$\frac{1}{45} = \frac{2Y_{Benzene} + 7(1 - Y_{Benzene})}{140}$$

$$\frac{1}{45} = \frac{2Y_{Benzene} + 7 - 7Y_{Benzene}}{140}$$

$$\frac{1}{45} = \frac{7 - 5Y_{Benzene}}{140}$$

$$\frac{1}{9} = \frac{7 - 5Y_{Benzene}}{28}$$

$28 = 63 - 45\ Y_{Benzene}$

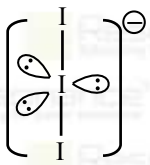
$$Y_{Benzene} = \frac{35}{45} = \frac{7}{9}$$

$Y_{Benzene} = 0.7$

8. Find total number of lone pair of electron on central atom in I_3^-

Ans. 3

Sol.



Total lone pair on central atom = 3.

9. Which of the following have positive electrode potential for reaction $M^{2+}_{(aq)} + 2e^- \rightarrow M$.

(1) Co (2) Ni (3) Cu (4) Zn

Ans. (3)

Sol. Cu^{2+} (aq) + $2e^- \longrightarrow$ Cu $E^o_{Cu^{2+}/Cu} = 0.34V$

10. Which of the following is most easily economically refined by Fractional distillation.

(1) Zn (2) Ni (3) Cu (4) Fe

Ans. (1)

Sol. "Theory Based"

Fractional distillation process utilizes the boiling point difference between metal and that of impurity. Using this process, crude zinc containing Cd, Fe and Pb as impurities can be refined.

11. Among the following pairs which is incorrect regarding similarity in properties.

(1) $Be(OH)_2$, $Al(OH)_3$ (2) NaOH, $Ca(OH)_2$ (3) $B(OH)_3$, H_3PO_4 (4) $B(OH)_3$, $Mg(OH)_2$

Ans. (4)

Sol. $B(OH)_3$ is H_3BO_3 is acidic in nature.

$Mg(OH)_2$ is basic in nature.

12. **Statement-1 :** Dihedral angle of H_2O_2 in gas is around 90º.

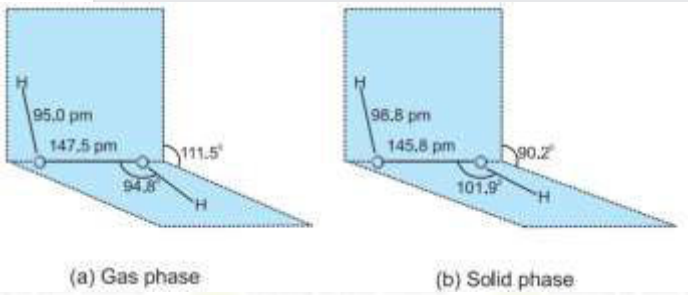
Statement-2 : Dihedral angle of H_2O_2 in solid is around 111.5º.

are the statements ture of false.

(1) True, True (2) True, False (3) False, True (4) False, False

Ans. (4)

Sol.



(a) H_2O_2 structure in gas phase, dihedral angle is 111.5°. (b) H_2O_2 structure in solid phase at 110 K, dihedral angle is 90.2°.

The dihedral angle of H_2O_2 in gaseous phase is approximate 111.5º. While dihydral angle in solid H_2O_2 is affected by hydrogen bonding and it is 90.2º in solid state.

13. 4.5 gram mass of a substance [molar mass = 90 g/mol] is dissolved in 250 ml solution, then molarity of solution is -

Ans. 0.2

Sol. Molarity (M) = $\frac{W_{solute} \times 1000}{GMM_{solute} \times V_{sol^n}}$

$M = \frac{4.5 \times 1000}{90 \times 250} = \frac{4.5 \times 4}{90} = 0.2$ M.

14. What is the magnetic moment (Spin only) of complex $[Co(CN)_6]^{4-}$:
[Report your answer to nearest integer]

Ans. (2)

Sol. $[Co(CN)_6]^{4-} \Rightarrow Co^{2+} \Rightarrow 3d^7\ 4s^0$

So number of unpaired electrons = 1.

$\mu = \sqrt{n(n+2)} = \sqrt{3}$

$\mu = 1.73$ BM ≈ 2 BM.

15. 10000 KJ energy is needed per day, if heat of combustion of glucose is 2700 KJ/Mole. Then how many gram of glucose is needed per day for this : [Report your answer to nearest integer].

Ans. 667

Sol. $C_6H_{12}O_6 + 6H_2O \longrightarrow 6CO_{2(g)} + 6H_2O$, $\Delta H = 2700$ KJ /mole
Glucose

No. of mole of glucose require for production of 10,000 KJ heat is = $\frac{10,000}{2700}$ mole.

Total mass of glucose = $\frac{10,000}{2700} \times 180 = 666.67$ gram.

16. The value of ℓ (azimuthal quantum number) for valence shell electron of Ga^+ ion is ____.

Ans. 0

Sol. Ga = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^1$

$Ga^+ = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$

Azimuthal Quantum number (ℓ) for valence shell electron is 0.

17. What is the difference in energy between 2nd and 3rd orbit of He^+ ion (in eV) is -
[Report your answer to nearest integer]

Ans. 8

Sol. $(E_{He^+})_{n=2} = -13.6 \times \frac{(2)^2}{(2)^2} = -13.6$ ev

$(E_{He^+})_{n=3} = -13.6 \times \frac{(2)^2}{(3)^2} = -13.6 \times \frac{4}{9}$

$(E_{He^+})_{n=3} - (E_{He^+})_{n=2} = 13.6\left[1-\frac{4}{9}\right]$

$= 13.6\left[\frac{5}{9}\right] = 7.55$ eV

18. Anion of a compound 'x' gives brown ring test and cation gives deep blue coloration with NH_4OH and also gives precipitate with HCl & H_2S, then compound 'x' is

(1) $Cu(NO_3)_2$ (2) $Pb(NO_3)_2$ (3) $Pb(NO_2)_2$ (4) $Zn(NO_3)_2$

Sol. Nitrates give brown ring test.

$Cu^{2+} + 4NH_3(aq) \longrightarrow [Cu(NH_3)_4]^{2+}(aq)$

Deep Blue

$Cu^{2+} + H_2S \xrightarrow{H^+} Cu_2S \downarrow$

Black

19. What is the value of second excitation energy of Li^{2+}

(1) 108.8 eV (2) 81.6 eV (3) 13.6 eV (4) 95.2 eV

Ans. (1)

Sol.

$\left[\Delta E_{u^{-2+}}\right]_{1\to3} = 13.6 \times 2^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$= 13.6 \times (3)^2\left[\frac{1}{1} - \frac{1}{9}\right]$

$= 13.6 \times 9\left[\frac{8}{9}\right]$

$= 13.6 \times 8 = 108.8$ eV

20. $P + CHCl_3 \xrightarrow{KOH} \underset{\text{Poisonous Product}}{Q}$

Identify compound P and Q respectively

(1) Primary amine, secondary amine
(2) Primary amine, Primary amine
(3) Primary amine, Isonitrile
(4) Secondary amine, Isonitrile

Ans. (3)

Sol. Only 1° amines give carbylamines reaction

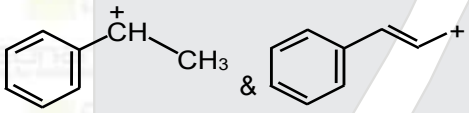
$$\underset{\substack{1^\circ \text{ Amine} \\ (P)}}{R-NH_2} + CHCl_3 + 3KOH \longrightarrow \underset{\substack{\text{Isonitrile} \\ \text{(Poisonous product)} \\ (Q)}}{R-NC} + 3KCl + 3H_2O$$

21. In which of the following carbocation are resonance stabilised

(A) (B) (C) (D)

(1) A, B
(2) A, C
(3) A, D
(4) A, B, C

Ans. (3)

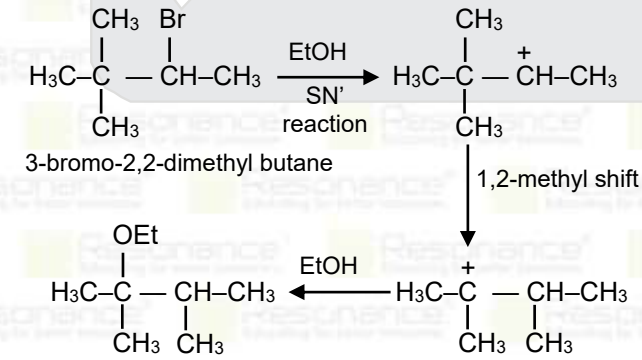
Sol.  (A) & (D) are resonance stabilised carbocations.

22. When ethanol is reacts with 3-Bromo-2,2-dimethyl butane then product formed is :

(1) 2, 2-Dimethyl-3-ethoxybutane
(2) 2-Ethoxy-2,3-dimethyl butane
(3) 2-Ethoxy-2-methyl pentane
(4) 3-Ethoxy-2,2-Dimethyl butane

Ans. (2)

Sol.

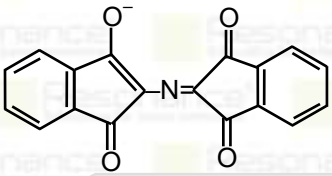


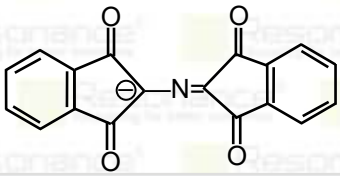
3-bromo-2,2-dimethyl butane

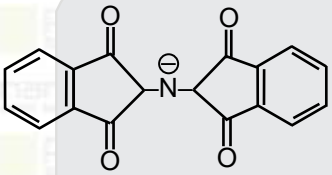
2-Ethoxy-2,3-dimethyl butane

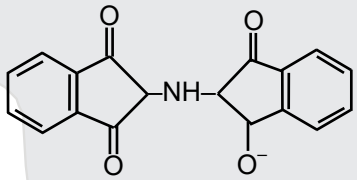
23. Ninhydrin + $NH_2-\underset{}{\overset{R}{\overset{|}{C}}}H-COOH$ ⟶ Product is ?

α-amino acid

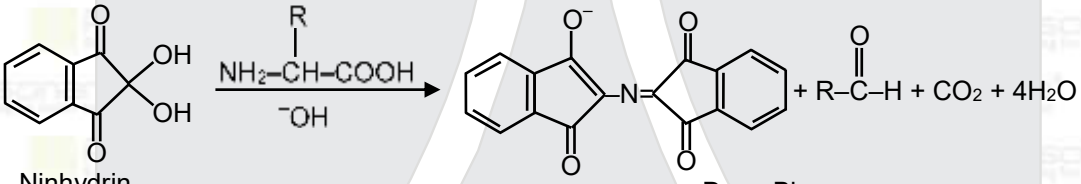
(1) 

(2) 

(3) 

(4) 

Ans. (1)

Sol. 

Ninhydrin

Deep Blue
Ruhe mann's purple

Ninhydrin is useful for identification of α-amino acid which react with ninhydrin and give deep blue colour.

24.  $\xrightarrow[H_2SO_4/\Delta]{KMnO_4}$ A

 $\xrightarrow[H_2O/273\,K]{KMnO_4}$ B

A, B are respectively.

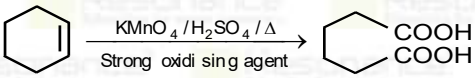
(1) both diol

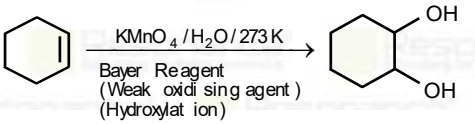
(2) both dicarboxylic acid

(3) A is dicarboxylic acid and B is diol

(4) A is diol and B is dicarboxylic acid

Ans. (3)

Sol. 



25. Orlon is a :

(1) Polyamide (2) Polyester (3) Polyacrylonitrile (4) Polycarbonate

Ans. (3)

Sol. Orlon is a polymer of acrylonitrile also known as PAN

$$CH_2 = CH - C \equiv N \longrightarrow \left(- CH_2 - \underset{}{\overset{CN}{\overset{|}{C}H}} - \right)_n$$

Acrylonitrile PAN or orlon

26. Which of the following is better for green chemistry in day to day life (Domestic Purpose)

(1) $Cl_2C = CCl_2$ as dry cleaning agent liquid (2) Liquid CO_2 for cloth cleaning

(2) Cl_2 gas a bleaching agent of paper (4) CCl_4 as dry cleaning agent

Ans. (2)

Sol. $CCl_2 = CCl_2$ was earlier used as solvent for dry cleaning agent but it is carcinogen. So liquid CO_2 is used. Replacement of halogenated solvent by liquid CO_2 will result in less harm to ground water.

27. Which of the following incorrect :

(1) Amylose is branched (2) Starch in made up of α-glucose

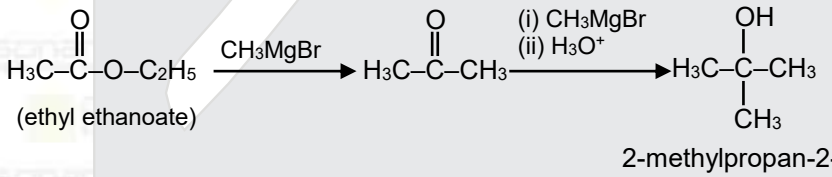
(3) Glycogen is also called animal starch (4) β-glycosidic linkage for cellulose

Ans. (1)

28. How many mole of CH_3MgBr are required to convert ethylethanoate to 2-methylpropan-2-ol :

Ans. (2)

Sol.



(ethyl ethanoate) 2-methylpropan-2-ol

29. Which condition is required to show tyndall effect by colloidal solution.

(1) The refractive indice's of the dispersed phase and dispersion medium differ greatly in magnitude.

(2) The refractive indices of dispersed phase and the dispersion medium are exactly same in magnitude.

(3) The refractive indices of the dispersed phase and the dispersion medium do no differ much in magnitude.

(4) None of these

Ans. (1)

Sol. Theory Based.