PAPER-3 (B.E./B. TECH.)

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 09 January, 2020 (SHIFT-1) | TIME : (9.30 a.m. to 12.30 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

PART : CHEMISTRY

SECTION – 1 : (Maximum Marks : 80)

Straight Objective Type

This section contains **20 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

1. Determine wavelength of electron in 4^{th} Bohr's orbit ?

(1) $4\ \pi a_0$ (2) $2\ \pi a_0$ (3) $8\ \pi a_0$ (4) $6\ \pi a_0$

Ans. **(3)**

Sol. $2\ \pi r = n\lambda$

$$2\ \pi \times \frac{n^2}{Z} a_0 = n\lambda$$

$$2\ \pi \times \frac{4^2}{1} a_0 = n\lambda$$

$\lambda = 8\ \pi a_0$

2. Which of the following species have one unpaired electron each?

(1) O_2, O_2^- (2) O_2, O_2^+ (3) O_2^+, O_2^- (4) O_2, O_2^{2-}

Ans. **(3)**

Sol. $O_2 = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2 = \pi 2p_y^2\ \pi^* 2p_x^1 = \pi 2p_y^1$

3. For $Br_2(\ell)$

Enthalpy of atomisation = x kJ/mol

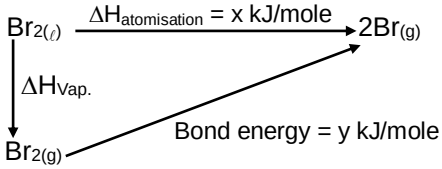
Bond dissociation enthalpy of bromine = y kJ/mole

then

(1) x > y (2) x < y (3) x = y (4) Relation does not exist

Ans. **(1)**

Sol.



$\Delta H_{atomisation} = \Delta H_{vap}$ + Bond energy

Hence x > y

4. Which of the following oxides are acidic, Basic Amphoteric Respectively.

(1) MgO, P_4O_{10}, Al_2O_3 (2) N_2O_3, Li_2O, Al_2O_3 (3) SO_3, Al_2O_3, Na_2O (4) P_4O_{10}, Al_2O_3, MgO

Ans. **(2)**

Sol. Non-metal oxides are acidic in nature

alkali metal oxides are basic in nature

Al_2O_3 is amphoteric.

5. Complex $Cr(H_2O)_6Cl_n$ shows geometrical isomerism and also reacts with $AgNO_3$ solution.
Given : Spin only magnetic moment = 3.8 B.M.
What is the IUPAC name of the complex.
(1) Hexaaquachromium(III) chloride
(2) Tetraaquadichloridochromium(III) chloride dihydrate
(3) Hexaaquachromium(IV) chloride
(4) Tetraaquadichloridochromium(IV) chloride dihydrate

Ans. **(2)**

Sol. $Cr(H_2O)_6Cl_n$ $(\mu_{complex})_{spin}$ = 3.8 B.M.
From data of magnetic moment oxidation number of Cr should be +3
Hence complex is $Cr(H_2O)_6Cl_3$.
Complex shows geometrical isomerism therefore formula of complex is $[Cr(H_2O)_4Cl_2]Cl\cdot 2H_2O$.
It's IUPAC Name: Tetraaquadichloridochromium(III) chloride dihydrate

6. The electronic configuration of bivalent Europium and trivalent cerium respectively is:
(Atomic Number : Xe = 54, Ce = 58, Eu = 63)
(1) $[Xe]4f^7$, $[Xe]4f^1$ (2) $[Xe]4f^7\ 6s^2$, $[Xe]4f^1$
(3) $[Xe]4f^76s^2$, $[Xe]4f^15d^16s^2$ (4) $[Xe]4f^7$, $[Xe]4f^15d^16s^2$

Ans. **(1)**

Sol. Eu^{2+} : $[Xe]4f^7$
Ce^{3+} : $[Xe]4f^1$

7. Ksp of $PbCl_2 = 1.6 \times 10^{-5}$
On mixing
300 mL, 0.134M $Pb(NO_3)_2$(aq.) + 100 mL, 0.4 M NaCl(aq.)
(1) Q > Ksp (2) Q < Ksp (3) Q = Ksp (4) Relation does not exit

Ans. **(1)**

Sol. $Q = [Pb^{2+}][Cl^-]^2$

$$= \frac{300\times 0.134}{400}\times\left[\frac{100\times 0.4}{400}\right]^2$$

$$= \frac{3\times 0.134}{4}\times(0.1)^2$$

$= 0.105 \times 10^{-2}$
$=1.005 \times 10^{-3}$
Q > Ksp

8. Which of the following can not act as both oxidising and reducing agent ?
(1) H_2SO_3 (2) HNO_2 (3) H_3PO_4 (4) H_2O_2

Ans. **(3)**

Sol. As in H_3PO_4 Phosphorous is present it's maximum oxidation number state hence it cannot act as reducing agent.

9. First Ionisation energy of Be is higher than that of Boron.
Select the correct statements regarding this
(i) It is easier to extract electron from 2p orbital than 2s orbital
(ii) Penetration power of 2s orbital is greater than 2p orbital
(iii) Shielding of 2p electron by 2s electron
(iv) Radius of Boron atom is larger than that of Be
(1) (i), (ii), (iii), (iv) (2) (i), (iii), (iv) (3) (ii), (iii), (iv) (4) (i), (ii), (iii)

Ans. **(4)**

Sol. Theory Based.

10. $[PdFClBrI]^{2-}$ Number of Geometrical Isomers = n. For $[Fe(CN)_6]^{n-6}$, Determine the spin only magnetic moment and CFSE (Ignore the pairing energy)

(1) 1.73 B.M., $-2\Delta_0$ (2) 2.84 B.M., $-1.6\Delta_0$ (3) 0, $-1.6\Delta_0$ (4) 5.92 B.M., $-2.4\Delta_0$

Ans. **(1)**

Sol. Number of Geometrical Isomers in square planar $[PdFClBrI]^{2-}$ are = 3

Hence, n = 3

$[Fe(CN)_6]^{3-}$

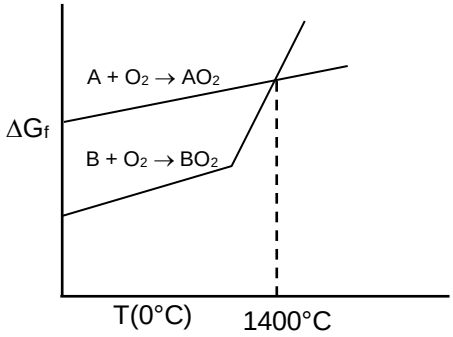
$Fe^{3+} = 3d^5$, According to CFT configuration is $t_{2g}^{221}e_g^{00}$

$\mu = \sqrt{n(n+2)}$ **=1.73 B.M.**

$CFSE = -0.4\Delta_0 \times nt_{2g} + 0.6\Delta_0 \times n_{eg}$

$= -0.4\Delta_0 \times 5 =$ **$-2.0\Delta_0$**

11. A can reduce BO_2 under which conditions.



(1) > 1400°C (2) < 1400°C

(3) > 1200°C and < 1400°C (4) < 1200°C

Ans. **(1)**

Sol. $A + BO_2 \longrightarrow B + AO_2$

ΔG = –ve

Only above **1400°C**

12. $A \longrightarrow B$ 700 K

$A \xrightarrow{C} B$ 500 K

Rate of reaction in absence of catalyst at 700 K is same as in presence of catalyst at 500 K. If catalyst decreases activation energy barrier by 30 kJ/mole, determine activation energy in presence of catalyst. (Assume 'A' factor to be same in both cases)

(1) 75 kJ (2) 135 kJ (3) 105 kJ (4) 125 kJ

Ans. **(1)**

Sol. $K_{cat} = K$

$Ae^{-\frac{Ea_1}{RT_1}} = Ae^{-\frac{Ea_2}{RT_2}}$

$\frac{Ea_1}{T_1} = \frac{Ea_2}{T_2}$ $\quad Ea_1 = Ea_2 - 30$

$\frac{Ea_2 - 30}{500} = \frac{Ea_2}{700}$

$5Ea_2 = 7Ea_2 - 210$

$Ea_2 = \frac{210}{2} = 105$ kJ/mole

Activation energy of the catalysed reaction = 105 – 30 = 75 kJ/mole

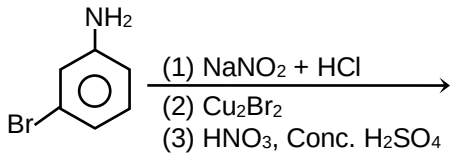
13. A substance 'X' having low melting point, does not conduct electricity in both solid and liquid state. 'X' can be :

(1) Hg (2) ZnS (3) SiC (4) CCl_4

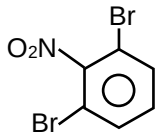
Ans. **(4)**

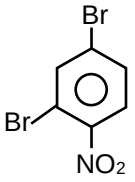
Sol. $CCl_4 \rightarrow$ Non-conductor in solid and liquid phase.

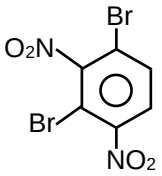
14.

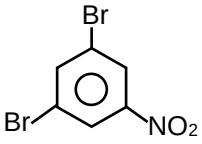


The major product for above sequence of reaction is:

(1) 

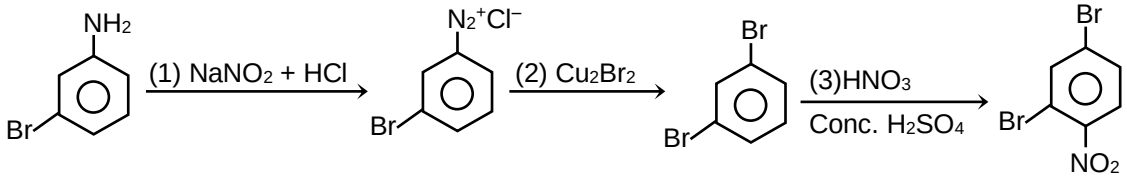
(2) 

(3) 

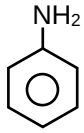
(4) 

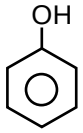
Ans. **(2)**

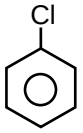
Sol.

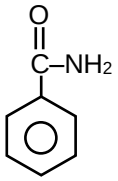


15. Which of the following can give highest yield in Friedel craft reaction?

(1) 

(2) 

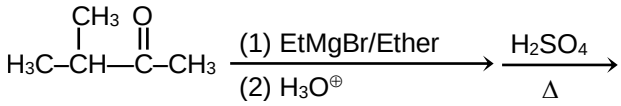
(3) 

(4) 

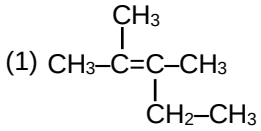
Ans. **(2)**

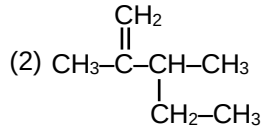
Sol. Aniline form anilinium complex with lewis acid so phenol is most reactive among the given compounds for electrophilic substitution reaction.

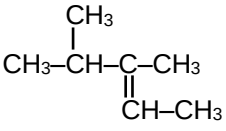
16.

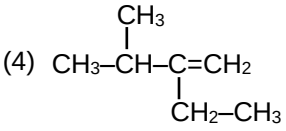


What will be the major product ?

(1) 

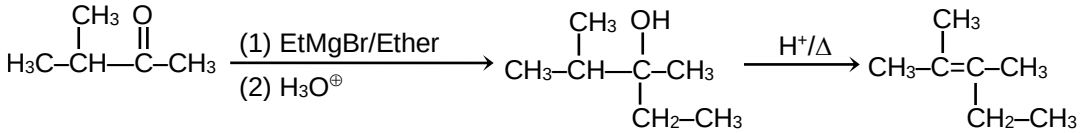
(2) 

(3) 

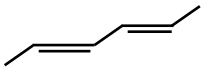
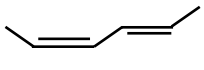
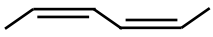
(4) 

Ans. **(1)**

Sol.



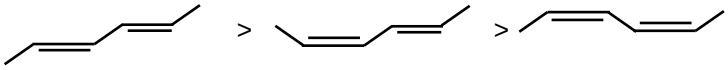
17. Which of the following is correct order for heat of combustion?

(A)  (B)  (C) 

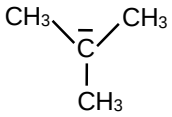
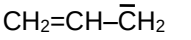
(1) C > B > A (2) A > B > C (3) B > A > C (4) C > A > B

Ans. **(1)**

Sol. In isomers of hydrocarbon heat of combustion depends upon their stabilities.
As the stability increases heat of combustion decreases.

Stability order 

18. Write the correct order of basicity.

(a) (b) (c) (d) (e)

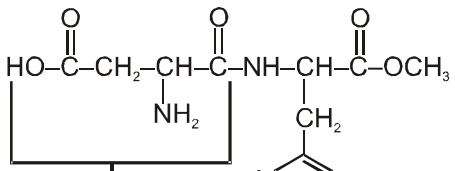
(1) a > b > d > e > c (2) a > b > e > d > c
(3) b > a > d > c > e (4) c > e > d > b > a

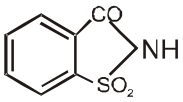
Ans. **(1)**

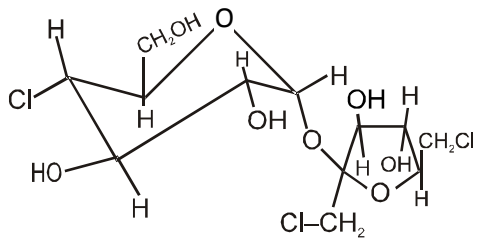
Sol. Basicity is inversely proportional to electronegativity.

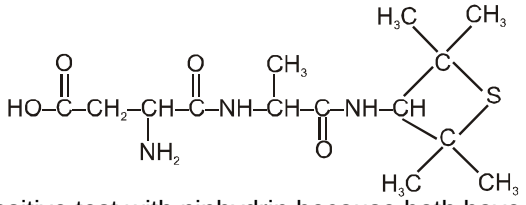
19. A, B, C and D are four artificial sweetners.
(i) A & D give positive test with ninhydrin.
(ii) C form precipitate with $AgNO_3$ in the lassaigne extract of the sugar.
(iii) B & D give positive test with sodium nitroprusside.
Correct option is:`
(1) A – Saccharine, B – Aspartame, C – Sucralose, D – Alitame
(2) A – Aspartame, B – Saccharine, C – Sucralose, D – Alitame
(3) A – Saccharine, B – Aspartame, C – Alitame , D – Sucralose
(4) A – Aspartame, B – Sucralose, C – Saccharine, D – Alitame

Ans. **(2)**

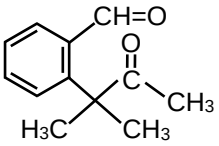
Sol. A – Aspartame 

B – Saccharine 

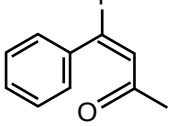
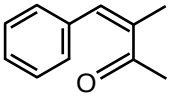
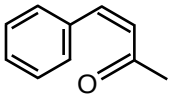
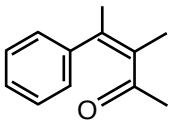
C – Sucralose 

D – Alitame 

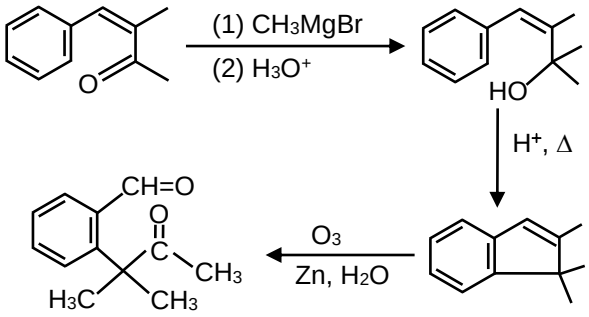
(i) A & D give positive test with ninhydrin because both have free carboxylic and amine groups.
(ii) C form precipitate with $AgNO_3$ in the lassaigne extract of the sugar because it has chlorine atoms.
(iii) B & D give positive test with sodium nitroprusside because both have sulphur atoms.

20. Compound (P) (P gives Iodoform test) $\xrightarrow[(2)\ H_3O^+]{(1)\ CH_3MgBr}$ $\xrightarrow[(3)\ \text{Conc. } H_2SO_4 + \Delta]{O_3/Zn,\ H_2O}$ 

Predict the compound (P) on the basis of above sequence of the reactions?
Where compound (P) gives positive Iodoform test.

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

Ans. **(2)**

Sol. 

SECTION – 2 : (Maximum Marks : 20)

- This section contains **FIVE (05)** questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.
- If the numerical value has more than two decimal places **truncate/round-off** the value upto **TWO** decimal places.
- Full Marks : **+4** If ONLY the correct option is chosen.
- Zero Marks : **0** In all other cases

21. Given a solution of HNO_3 of density 1.4 g/mL and 63% w/w. Determine molarity of HNO_3 solution.

Ans. **14.00**

Sol. 63% w/w $\longrightarrow$ HNO_3 solution

$$M = \frac{63 \times 1.4}{63 \times 100} \times 1000 \text{ mole/L}$$

$M = 14$ mole/L

22. Determine degree of hardness in term of ppm of $CaCO_3$ of 10^{-3} molar $MgSO_4$ (aq).

Ans. **100.00**

Sol. 10^{-3} molar $MgSO_4 \equiv 10^{-3}$ moles of $MgSO_4$ present in 1 L solutions.

$n_{CaCO_3} \equiv n_{MgSO_4}$

$$ppm_{(\text{in term of } CaCO_3)} = \frac{10^{-3} \times 100}{1000} \times 10^6$$

$ppm_{(\text{in term of } CaCO_3)} = 100$ ppm

23. Determine the amount of NaCl to be dissolved in 600g H_2O to decrease the freezing point by 0.2°C
Given : k_f of H_2O = 2 k-m^{-1}
density of $H_2O(\ell)$ = 1 g/ml

Ans. **01.76**

Sol. $\Delta T_f = 0.2°C$

$\Delta T_f = ik_f m$

$$0.2 = 2 \times 2 \times \frac{\omega}{58.5} \times i\frac{1000}{600}$$

$$\omega = \frac{0.2 \times 58.5 \times 600}{1000 \times 4}$$

$$= \frac{1.2 \times 58.5}{40} = 01.76g$$

24. On passing a particular amount of electricity in $AgNO_3$ solution, 108 g of Ag is deposited. What will be the volume of O_2(g) in litre liberated at 1 bar, 273k by same quantity of electricity?

Ans. **05.68**

Sol. $\left(n_{Ag}\right)_{deposit} = \frac{108}{108} - 1\, mole$

$Ag^+ + e^- \longrightarrow Ag$

1F charge is required to deposit 1 mole of Ag

$H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$

2F charge deposit $\longrightarrow \frac{1}{2} mole$

1F charge will deposit $\longrightarrow \frac{1}{4} mole$

$$V_{O_2} = \frac{nRT}{P}$$

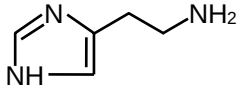
$$= \frac{1}{4} \times \frac{0.08314 \times 273}{1}$$

$$= \frac{1}{4} \times 22.7$$

$v_{o_2} = 5.675L$

25. Find percentage nitrogen by mass in Histamine?

Ans. **37.84**

Sol. Structure of Histamine is 

Molecular formula of Histamine is $C_5H_9N_3$
Molecular mass of Histamine is 111

Percentage nitrogen by mass in Histamine = $\frac{42}{111} \times 100 = 37.84$