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FINAL JEE–MAIN EXAMINATION – JANUARY, 2020

(Held On Tuesday 07th JANUARY, 2020) TIME : 9 : 30 AM to 12 : 30 PM

CHEMISTRY

TEST PAPER WITH SOLUTION

1. A solution of m-chloroaniline, m-chlorophenol and m-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of $NaHCO_3$ to give fraction A. The left over organic phase was extracted with dilute NaOH solution to give fraction B. The final organic layer was labelled as fraction C. Fractions A, B and C, contain respectively :

(1) m-chlorobenzoic acid, m-chloroaniline and m-chlorophenol

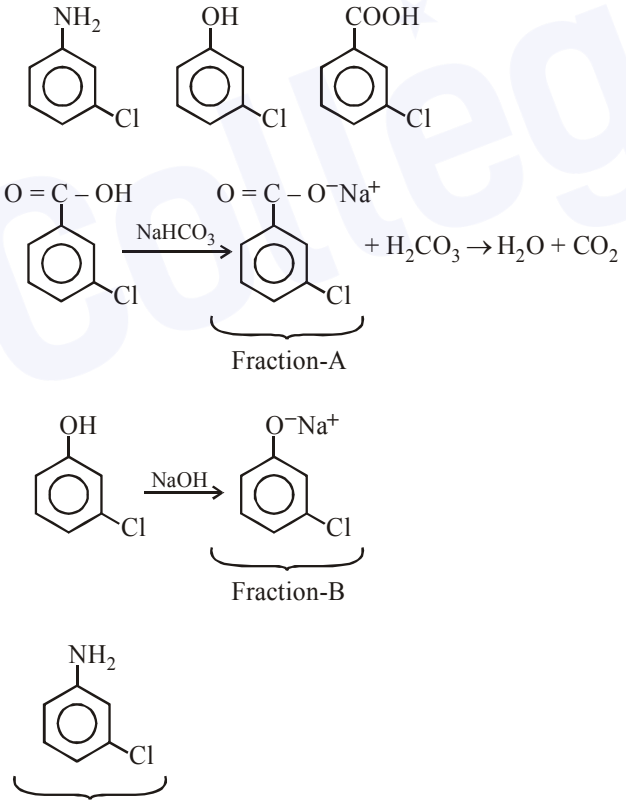
(2) m-chloroaniline, m-chlorobenzoic acid and m-chlorophenol

(3) m-chlorobenzoic acid, m-chlorophenol and m-chloroaniline

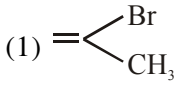
(4) m-chlorophenol, m-chlorobenzoic acid and m-chloroaniline

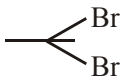
NTA Ans. (3)

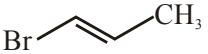
Sol.

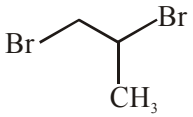


2. 1-methyl ethylene oxide when treated with an excess of HBr produces :

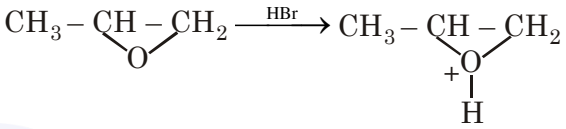
(1) 

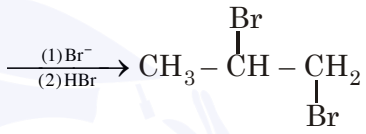
(2) 

(3) 

(4) 

NTA Ans. (4)

Sol. 



3. Amongst the following statements, that which was not proposed by Dalton was :

(1) all the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.

(2) chemical reactions involve reorganisation of atoms. These are neither created nor destroyed in a chemical reaction.

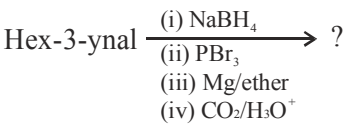
(3) when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T & P.

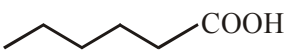
(4) matter consists of indivisible atoms.

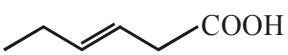
NTA Ans. (3)

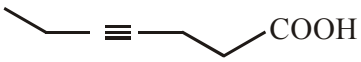
Sol. Option(3) is according to Gaylussac's law of volume combination.

4. What is the product of following reaction ?



(1) 

(2) 

(3) 

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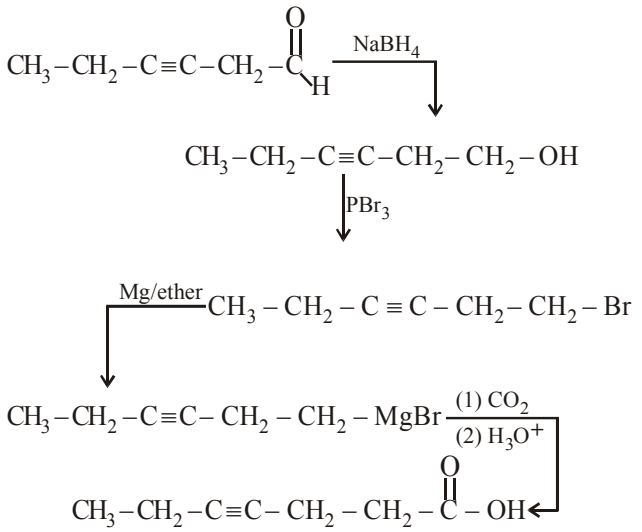
NTA Ans. (3)

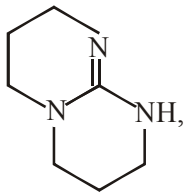
Sol.



5. The increasing order of pK_b for the following compounds will be :

$NH_2 - CH = NH$,

(A)



(B)

CH_3NHCH_3

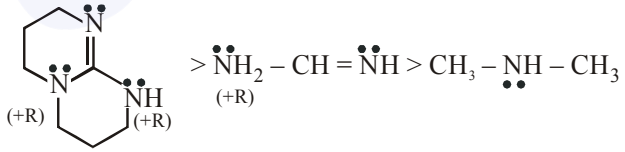
(C)

(1) (A) < (B) < (C) (2) (C) < (A) < (B)

(3) (B) < (A) < (C) (4) (B) < (C) < (A)

NTA Ans. (3)

Sol. Base strength order



(B) (A) (C)

pk_b order (C > A > B)

6. The atomic radius of Ag is closest to :

(1) Cu (2) Hg (3) Au (4) Ni

NTA Ans. (3)

Sol. Atomic radius of Ag and Au is nearly same due

7. The dipole moments of CCl_4, $CHCl_3$ and CH_4 are in the order :

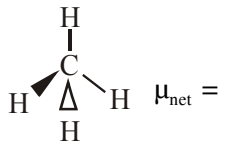
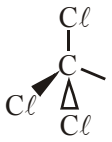
(1) $CH_4 = CCl_4 < CHCl_3$

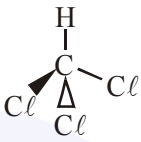
(2) $CH_4 < CCl_4 < CHCl_3$

(3) $CCl_4 < CH_4 < CHCl_3$

(4) $CHCl_3 < CH_4 = CCl_4$

NTA Ans. (1)

Sol.  $\mu_{net} = 0$  $\mu_{net} = 0$

 $\mu_{net} \neq 0$

8. Given that the standard potentials (E°) of Cu^{2+}/Cu and Cu^{+}/Cu are 0.34 V and 0.522 V respectively, the E° of Cu^{2+}/Cu^{+} is :

(1) +0.158 V (2) 0.182 V

(3) –0.182 V (4) –0.158 V

NTA Ans. (1)

Sol.

	E^0	ΔG^0
$Cu^{2\oplus} + 2e^{\oplus} \longrightarrow Cu$	0.34	$= -2F\ (0.34)$
$Cu^{\oplus} + e^{\oplus} \longrightarrow Cu$	0.522	$= -F\ (0.522)$
$Cu^{2\oplus} + e^{\oplus} \longrightarrow Cu^{+}$		

$\Delta G^0 = -2F\ (0.34) - (-F(0.522) = -F\ (0.68 - 0.522) = -F\ (0.158)$

$$E^0 = \frac{-F(0.158)}{-F} = 0.158V$$

9. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is :

(1) less efficient as it exchanges only anions

(2) more efficient as it can exchange only cations

(3) less efficient as the resins cannot be regenerated

(4) more efficient as it can exchange both cations as well as anions

Sol. (a) Zeolite method removes only cations (Ca^{2+} and Mg^{2+} ion) present in hard water

$2NaZ + M^{2+}(aq) \rightarrow MZ_2(s) + 2Na^+(aq)$ (M→Mg, Ca)

(b) Synthetic resin method removes cations (Ca^{2+} and Mg^{2+} ion) and anions (like Cl^-, HCO_3^-, SO_4^{2-} etc.)

(i) $2RNa(s) + M^{2+}(aq) \rightarrow R_2M(s) + 2Na^+(aq)$ (Cation exchange resin) (M→Mg, Ca)

(ii) $RNH^+_3\,OH^-(s) + X^-(aq) \rightarrow RNH_3^+X^-(s) + OH^-(aq)$ (Anion exchange resin) (X^-=Cl^-,HCO_3^-,SO_4^{2-} etc)

10. The relative strength of interionic/ intermolecular forces in decreasing order is :

(1) ion-dipole > ion-ion > dipole-dipole

(2) dipole-dipole > ion-dipole > ion-ion

(3) ion-dipole > dipole-dipole > ion-ion

(4) ion-ion > ion-dipole > dipole-dipole

NTA Ans. (4)

Sol. Order is

ion – ion > ion – dipole > dipole – dipole

11. Consider the following reactions :

(a) $(CH_3)_3CCH(OH)CH_3 \xrightarrow{conc.H_2SO_4}$

(b) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{alc.KOH}$

(c) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow[\text{It should be } (CH_3)_3CO^{\ominus}K^{\oplus}]{\text{given by NTA } (CH_3)_3O^{\ominus}K^{\oplus}}$

(d) $(CH_3)_2\underset{\underset{OH}{|}}{C}–CH_2–CHO \xrightarrow{\Delta}$

Which of these reaction(s) will not produce Saytzeff product ?

(1) (c) only (2) (a), (c) and (d)

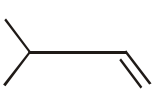
(3) (d) only (4) (b) and (d)

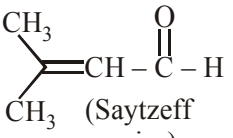
NTA Ans. (1)

Sol.

(a) $CH_3-\underset{\underset{CH_3}{|}}{\overset{CH_3}{\overset{|}{C}}}-\underset{OH}{\underset{|}{CH}}-CH_3 \xrightarrow[-H_2O]{H^+} CH_3-\underset{CH_3}{\overset{CH_3}{\overset{|}{C}}}-\overset{+}{CH}-CH_3 \xrightarrow{} CH_3-\underset{+}{\overset{CH_3}{\overset{|}{C}}}-\underset{CH}{\underset{|}{CH}}-CH_3 \xrightarrow[-H^+]{}$ 

(b) $CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}-CH_3 \xrightarrow[\Delta]{alc.KOH} CH_3-\underset{CH_3}{\overset{|}{C}}=CH-CH_3$ (Saytzeff major)

(c) $CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\overset{\alpha}{\underset{|}{CH}}}-\overset{\beta}{CH_3} \xrightarrow{O^-K^+/\Delta}$  (Hoffmann major)

(d) $CH_3-\underset{CH_3}{\overset{OH}{\overset{|}{CH}}}-CH_2-\overset{O}{\overset{\|}{C}}-H \xrightarrow{\Delta}$  (Saytzeff major)

$(CH_3)_3O^-K^+$ is incorrect representation of potassium tert-butoxide [$(CH_3)_3CO^-K^+$].

So it is possible that it can be given as **Bonus**

12. The purest form of commercial iron is

(1) scrap iron and pig iron

(2) wrought iron

(3) cast iron

(4) pig iron

NTA Ans. (2)

Sol. Wrought iron is purest from of commercial iron.

13. At 35°C, the vapour pressure of CS_2 is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS_2 in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is :

(1) heat must be absorbed in order to produce the solution at 35°C

(2) Raoult's law is not obeyed by this system

(3) a mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL

(4) CS_2 and acetone are less attracted to each other than to themselves

NTA Ans. (3)

Sol. The vapour pressure of mixture (= 600 mm Hg) is greater than the individual vapour pressure of its constituents (Vapour pressure of CS_2 = 512 mm Hg, acetone = 344 mm Hg). Hence, the solution formed shows positive deviation from Raoult's law.

$\Rightarrow (1)\,\Delta_{Sol}H > 0$, (2) Raoult's law is not obeyed

(3) $\Delta_{sol.}$ Volume > 0

(4) CS_2 and Acetone are less attracted to each

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14. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively are :

(1) – 333, – 349, – 325 and – 296

(2) –296, – 325, – 333 and – 349

(3) – 333, – 325, – 349 and – 296

(4) –349, – 333, – 325 and – 296

NTA Ans. (1)

Sol. Order of electron gain enthalpy (magnitude) is Cl > F > Br > I

15. The number of orbitals associated with quantum numbers n = 5, $m_s = +\frac{1}{2}$ is :

(1) 11 (2) 25 (3) 15 (4) 50

NTA Ans. (2)

Sol. No. of orbitals = $n^2 = 5^2 = 25$

For n = 5, no. of orbitals = $n^2 = 25$

Total number of orbitals is equal to no. of electrons having $m_s = \frac{1}{2}$

16. Match the following :

(i) Riboflavin	(a) Beriberi
(ii) Thiamine	(b) Scurvy
(iii)Pyridoxine	(c) Cheilosis
(iv)Ascorbic acid	(d) Convulsions

(1) (i)-(c), (ii)-(a), (iii)-(d), (iv)-(b)

(2) (i)-(c), (ii)-(d), (iii)-(a), (iv)-(b)

(3) (i)-(d), (ii)-(b), (iii)-(a), (iv)-(c)

(4) (i)-(a), (ii)-(d), (iii)-(c), (iv)-(b)

NTA Ans. (1)

Sol. (i) Riboflavin ⟶ (c) Cheilosis

(ii) Thiamine ⟶ (a) Beriberi

(iii) Pyridoxin ⟶ (d) Convulsions

(iv) Ascorbic acid ⟶ (b) Scurvy

17. The theory that can completely/properly explain the nature of bonding in $[Ni(CO)_4]$ is:

(1) Werner's theory

(2) Crystal field theory

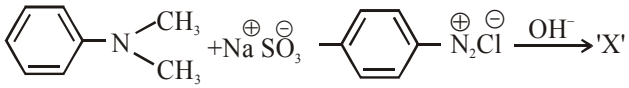
(3) Valence bond theory

(4) Molecular orbital theory

NTA Ans. (4)

Sol. In complex $[Ni(CO)_4]$ decrease in Ni–C bond length and increase in C–O bond length as well as it's magnetic property is explained by MOT.

18. Consider the following reaction :



The product 'X' is used :

(1) in acid base titration as an indicator

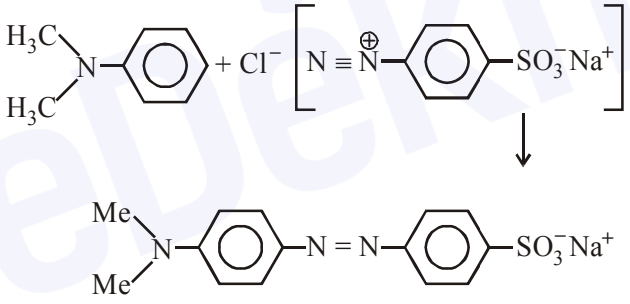
(2) in protein estimation as an alternative to ninhydrin

(3) in laboratory test for phenols

(4) as food grade colourant

NTA Ans. (1)

Sol.



(Methyl orange)

It is an acid base indicator

19. The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is :

(1) Diammine (methanamine) chlorido platinum (II) chloride

(2) Bisammine (methanamine) chlorido platinum (II) chloride

(3) Diamminechlorido (aminomethane) platinum(II) chloride

(4) Diamminechlorido (methanamine) platinum (II) chloride

NTA Ans. (4)

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20. Oxidation number of potassium in K_2O, K_2O_2 and KO_2 , respectively, is :

(1) +1, +4 and +2

(2) +1, +2 and +4

(3) +1, +1 and +1

(4) +2 , +1 and $+\frac{1}{2}$

NTA Ans. (3)

Sol. Potasium has an oxidation of +1 (only) in combined state.

21. For the reaction ;

$A(l) \rightarrow 2B(g)$

ΔU = 2.1 kcal , ΔS = 20 cal K^{-1} at 300 K

Hence ΔG in kcal is_____ .

NTA Ans. (–2.70 to –2.71)

Sol. $A(\ell) \longrightarrow 2B(g)$

ΔU = 2.1 Kcal , ΔS= 20 cal K^{-1} at 300 K

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta G = \Delta H - T\Delta S$

$\Delta G = \Delta U + \Delta n_g RT - T\Delta S$

$$= 2.1 + \frac{2\times 2\times 300}{1000} - \frac{300\times 20}{1000}$$

(R = 2 cal K^{-1} mol^{-1})

= 2.1 + 1.2 – 6 = – 2.70 Kcal/mol

22. During the nuclear explosion, one of the products is ^{90}Sr with half life of 6.93 years. if 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years , is required to reduce it by 90% if it is not lost metabolically_____ .

NTA Ans. (23 to 23.03)

Sol. All nuclear decays follow first order kinetics

$$t = \frac{1}{k}\ell n\frac{[A_0]}{[A]}$$

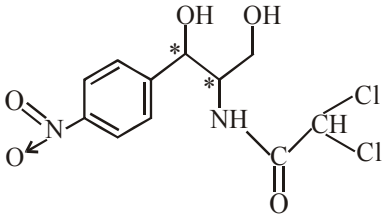
$$= \frac{(t_{1/2})}{0.693}\times 2.303 \ \log_{10} 10 \ = 10 \times 2.303 \times 1$$

= 23.03 years

23. The number of chiral carbons in chloramphenicol is _____ .

NTA Ans. (2)

Sol.



Chloramphenicol

24. Two solutions A and B, each of 100 L was made by dissolving 4g of NaOH and 9.8 g of H_2SO_4 in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is_____.

NTA Ans. (10.60)

Sol. 4 gm of NaOH in 100 L sol. $\Rightarrow$ 10^{-3} M sol.

9.8 gm of H_2SO_4 in 100 L sol. $\Rightarrow$ 10^{-3} M sol.

Mixture : 40L of 10^{-3} M NaOH and 10 L of 10^{-3} M H_2SO_4 sol.

Final Conc. of OH^-

$$= \frac{10^{-3}(40\times 1 - 10\times 1\times 2)}{40+10} = 6\times 10^{-4} M$$

pOH = – log (6×10^{-4})

= 4 – log 6 = 4 – 0.60 = 3.40

pH = 14 – 3.40 = 10.60

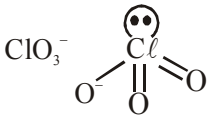
25. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is _____.

NTA Ans. (1.66 to 1.67)

Sol. $3Cl_2 + 6NaOH \rightarrow \underset{(X)}{5NaCl} + \underset{(X)}{NaClO_3} + 3H_2O$

$NaCl + AgNO_3 \rightarrow AgCl \downarrow + NaNO_3$

(X)



Bond order of Cl–O Bond = $1 + \frac{2}{3} = \frac{5}{3}$

= 1.66 or 1.67