JEE Main March 2021

Question Paper With Text Solution

16 March. | Shift-2

CHEMISTRY

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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JEE MAIN MARCH 2021 | 16TH MARCH SHIFT-2

SECTION – A

1. The secondary structure of protein is stabilised by :

(1) Glycosidic bond

(2) Peptide bond

(3) Hydrogen bonding

(4) Van der Waals forces

Ans. Official Answer NTA (3)

Sol. Hydrogen bond stabilises backbone of polypeptide chain by attraction between

$$-\overset{\overset{O}{\|}}{C}-$$ and – NH –

2. The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M H_3PO_3 solution and 100 mL of 2 M H_3PO_2 solution, respectively, are :

(1) 100 mL and 100 mL

(2) 100 mL and 200 mL

(3) 50 mL and 50 mL

(4) 100 mL and 50 mL

Ans. Official Answer NTA (2)

Sol. $H_3PO_3 + NaOH \rightarrow$

equivalent of H_3PO_3 = equivalent of NaOH

$50 \times 1 \times 2 = 1 \times V \times 1$

$V = 100$ mL

$H_3PO_2 + NaOH \rightarrow$

equivalent of H_3PO_2 = equivalent of NaOH

$100 \times 2 \times 1 = 1 \times V \times 1$

$V = 200$ mL

3. Fex_2 and Fey_3 are known when x and y are :

(1) x = F, F*l*, Br, and y = F, C*l*, Br, I

(2) x = C*l*, Br, I and y = F, C*l*, Br, I

(3) x = F, C*l*, Br and y = F, C*l*, Br, I

(4) x = F, C*l*, Br, I and y = F, C*l*, Br

Ans. Official Answer NTA (4)

Sol. x = F, C*l*, Br, I

y = F, C*l*, Br

FeI_3 does not exist because Fe^{+3} is a strong oxidizing agent and I^- is a strong reducing agent.

$$FeI_3 \longrightarrow FeI_2 + \frac{1}{2}I_2$$

Not exist.

4. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53, and 83 are :

(1) X and Y are metalloids and Z is a metal.

(2) X, Y and Z are metals

(3) X and Z are non-metals and Y is a metalloid.

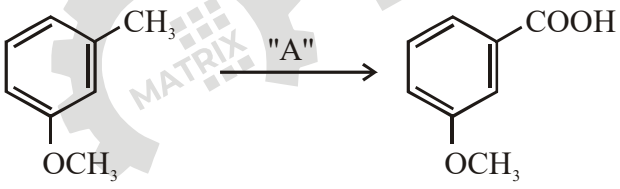
(4) X is a metalloid, Y is a non-metal and Z is a metal.

Ans. Official Answer NTA (4)

Sol. $X \Rightarrow {}_{33}As \Rightarrow$ Metalloid

$Y \Rightarrow {}_{53}I \Rightarrow$ Non metal

$Z \Rightarrow {}_{83}Bi \Rightarrow$ Metals

5. 

In the above reaction, the reagent "A" is :

(1) Alkaline $KMnO_4$, H^+

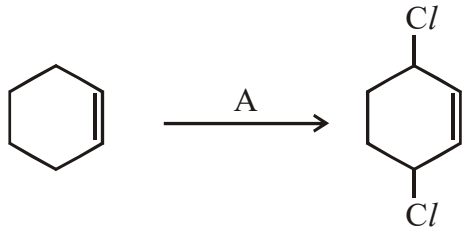
(2) HC*l*, Zn – Hg

(3) LiA*l*H_4

(4) $NaBH_4$, H_3O^+

Ans. Official Answer NTA (1)

Sol. Alkaline $KMnO_4$ is used as oxidising agent that convert alkyl group into carboxylic acid.

6. 

Identify the reagent(s) 'A' and condition (s) for the reaction.

(1) A = Cl_2 ; UV light

(2) A = Cl_2 ; dark, Anhydrous $AlCl_3$

(3) A = HCl, $ZnCl_2$

(4) A = HCl ; Anhydrous $AlCl_3$

Ans. Official Answer NTA (1)

Sol. Cl_2 in presence of UV light supports free radical formation and allylic position has stable free radical.

7. **Statement I** : Sodium hydride can be used as an oxidising agent.

Statement II : The lone pair of electrons on nitrogen in pyridine makes it basic.

Choose the **CORRECT** answer from the options given below :

(1) Both statement I and statement II are false

(2) Statement I is true but statement II is false

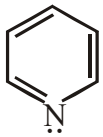
(3) Both statement I and statement II are true

(4) Statement I is false but statement II is true

Ans. Official Answer NTA (4)

Sol. Sodium hydride acts as reducing agent and pyridine is basic.

I. NaH can not be used as an oxidising agent.

II. 

Lone pair on nitrogen is localised or present in sp^2 hybridized orbital.

8. Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.

(Atomic numbers Ce = 58, Gd = 64 and Eu = 63.)

(a) $(NH_4)_2[Ce(NO_3)_6]$ (b) $Gd(NO_3)_3$ and (c) $Eu(NO_3)_3$

Answer is :

(1) (c) < (a) < (b)

(2) (b) < (a) < (c)

(3) (a) < (b) < (c)

(4) (a) < (c) < (b)

Ans. Official Answer NTA (4)

Sol. (a) $[Ce^{+4}(NO_3)_6]^{2-}$

$_{58}Ce^{+4} \Rightarrow [Xe]^{54}\ 4f^{\circ}\ 5d^{\circ}\ 6s^2$

n = 0

(b) $[Gd^{+3}(NO_3)_3]$

$_{64}Gd = [Xe]\ 4f^7\ 5d^{\circ}\ 6s^{\circ}$

n = 7

(c) $[Eu^{+3}(NO_3)_3]$

$_{63}Eu^{+3} \Rightarrow 4f^6\ sd^{\circ}\ 6s^{\circ}$

n = 6

9. The **INCORRECT** statement regarding the structure of C_{60} is :

(1) The six-membered rings are fused to both six and five-membered rings.

(2) It contains 12 six-membered rings and 24 five-membered rings.

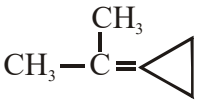
(3) Each carbon atom forms three sigma bonds.

(4) The five-membered rings are fused only to six-membered rings.

Ans. Official Answer NTA (2)

Sol. C_{60} has 20 six membered rings and 12 five-membered ring.

10. An unsaturated hydrocarbon X on ozonolysis gives A. Compound A When warmed with ammonical silver nitrarte forms a bright silver mirror along the sides of the test tube. The unsaturated hydrocarbon X is :

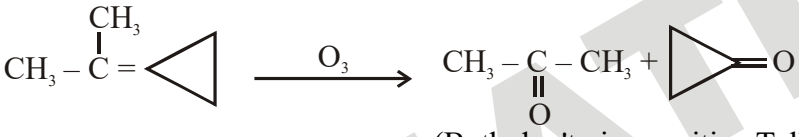
(1) 

(2) $CH_3 - C \equiv C - CH_3$

(3) $CH_3 - C(CH_3) = C(CH_3) - CH_3$

(4) $HC \equiv C - CH_2 - CH_3$

Ans. Official Answer NTA (4)

Sol. (1) 

(Both don't give positive Tollen's test)

(2) $CH_3 - C \equiv C - CH_3 \xrightarrow{O_3} CH_3 - \underset{\underset{O}{\|}}{C} - OH$

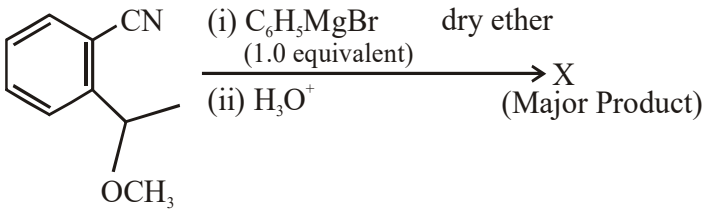
(Acetic acid doesn't give Tollen's test)

(3) $CH_3 - C(CH_3) = C(CH_3) - CH_3 \xrightarrow{O_3} CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$

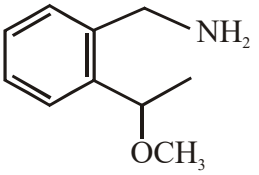
(Doesn't give Tollen's test)

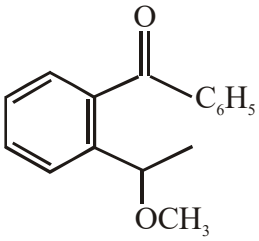
(4) $CH_3 - CH_2 - C \equiv CH \xrightarrow{O_3} CH_3 - CH_2 - \underset{\underset{O}{\|}}{C} - OH + H - \underset{\underset{O}{\|}}{C} - OH$

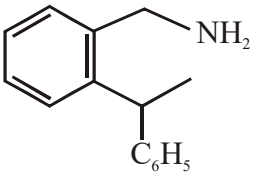
(Formic acid only gives positive Tollen's test.)

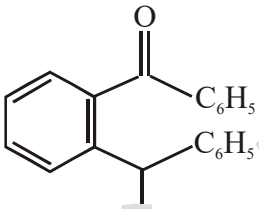
11. 

The structure of X is :

(1) 

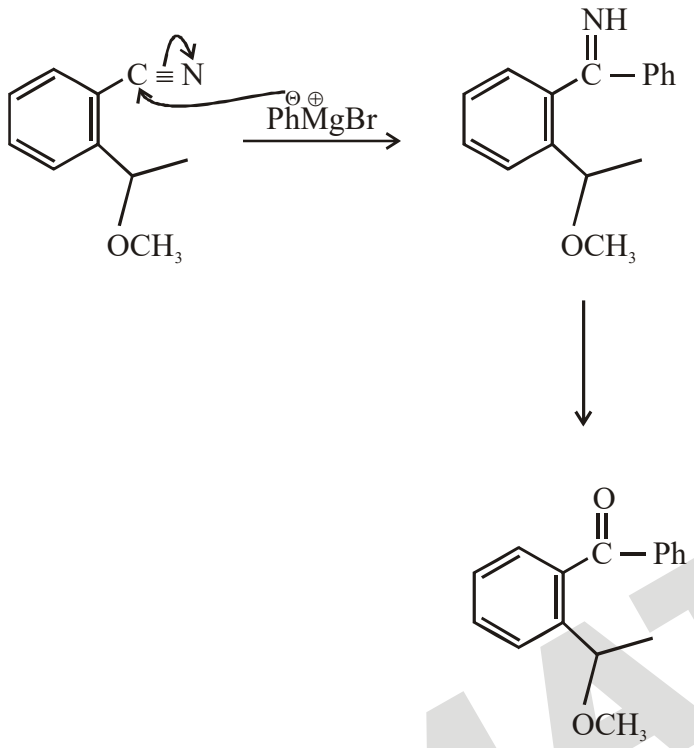
(2) 

(3) 

(4) 

Ans. Official Answer NTA (2)

Sol.



12. The **INCORRECT** statements below regarding colloidal solutions is :

(1) An ordinary filter paper can stop the flow of colloidal particles.

(2) The flocculating power of Al^{3+} is more than that of Na^{+}.

(3) A colloidal solution shows colligative properties.

(4) A colloidal solution shows Brownian motion of colloidal particles.

Ans. Official Answer NTA (1)

Sol. An ordinary filter paper can not stop the flow of colloidal particles.

13. Which of the following polymer is used in the manufacture of wood laminates ?

(1) Melamine formaldehyde resin

(2) Phenol and formaldehyde resin

(3) *cis*-poly isoprene

(4) Urea formaldehyde resin

Ans. Official Answer NTA (4)

Sol. Urea formaldehyde is used for laminated sheets.

14. Which of the following is least basic ?

(1) $(CH_3CO)\ddot{N}HC_2H_5$

(2) $(CH_3CO)_2\ddot{N}H$

(3) $(C_2H_5)_3\ddot{N}$

(4) $(C_2H_5)_2\ddot{N}H$

Ans. Official Answer NTA (2)

Sol. $CH_3 - \overset{O}{\overset{\|}{C}} - NH - \overset{O}{\overset{\|}{C}} - CH_3$

lone pair of N is involved in resonance with two carbonyl groups. So, It is least basic.

15. Identify the elements X and Y using the ionisation energy values given below :

	Ionization energy (kJ/mol)	
	1^{st}	2^{nd}
X	495	4563
Y	731	1450

(1) X = Mg ; Y = F

(2) X = F ; Y = Mg

(3) X = Na ; Y = Mg

(4) X = Mg ; Y = Na

Ans. Official Answer NTA (3)

Sol. The diffrence between I^{st} and II^{nd} ionization energy is very high. So X is alkali metal.

16. The green house gas/es is (are) :

(A) Carbon dioxide

(B) Oxygen

(C) Water vapour

(D) Methane

Choose the most appropriate answer from the options given below :

(1) (A) and (C) only

(2) (A) and (B) only

(3) (A) only

(4) (A), (C) and (D) only

Ans. Official Answer NTA (4)

Sol. Green house gases are water vapour (H_2O), CO_2, CH_4

17. Ammonolysis of Alkyl halides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is :

(1) To activate NH_3 used in the reaction

(2) to increase the reactivity of alkyl halide

(3) To remove acidic impurities

(4) To remove basic impurities

Ans. Official Answer NTA (3)

Sol. NaOH absorbs acidic impurities so that they don't react with ammonia

18. Which of the following reduction reaction CANNOT be carried out with coke ?

(1) $Al_2O_2 \rightarrow Al$

(2) $ZnO \rightarrow Zn$

(3) $Fe_2O_3 \rightarrow Fe$

(4) $Cu_2O \rightarrow Cu$

Ans. Official Answer NTA (1)

Sol. Al is extracted by elctrolytic reduction of Al_2O_3

19. The correct statements about H_2O_2 are :

(A) Used in the treatment of effluents.

(B) Used as both oxidising and reducting agents.

(C) The two hydroxyl groups lie in the same plane

(D) Miscible with water.

Choose the correct answer from the options given below "

(1) (C) and (D) only

(2) (A), (B) and (D) only

(3) (A), (C) and (D) only

(4) (A), (B), (C) and (D)

Ans. Official Answer NTA (2)

Sol. Properties of H_2O_2

(A) H_2O_2 used in the treatment of effluents.
(B) H_2O_2 can act as both oxidizing and reducing agent.
(C) H_2O_2 has open book like structure i.e. non planar molecule.
(D) Miscible with water due to hydrogen bonding.

20. Match **List-I** with **List-II** :

List-I	**List-II**
Test/Reagents/Observation(s)	**Species detected**
(a) Lassaigne's Test	(i) Carbon
(b) Cu(II) oxide	(ii) Sulphur
(c) Silver nitrate	(iii) N, S, P, and halogen
(d) The sodium fusion extract gives black precipitate with acetic acid and lead acetate	(iv) Halogen Specifically

The correct match is :

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

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

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

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

Ans. Official Answer NTA (3)

Sol. (a) Lassaigne's test is used to detect N,S,P and halogens.

(b) Cu (II) oxide reagent used for the detection of carbon.

(c) $AgNO_3$ is specifically used for the detection of halogens.

$$NaX + AgNO_3 \xrightarrow{HNO_3} \underset{\text{(ppt)}}{AgX\downarrow}$$

(d) $$Na_2S + (CH_3COO)_2Pb \xrightarrow{HNO_3} \underset{\text{(black ppt)}}{PbS\downarrow} + 2\,CH_3COONa$$

SECTION – B

1. When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution,..... $\times 10^{-5}$ moles of lead sulphate precipitate out. (Round off to the Nearest Interger).

Ans. Official Answer NTA (525)

Sol. $3Pb(NO_3)_2 + Cr_2(SO_4)_3 \rightarrow 3PbSO_4 + 2\,Cr(NO_3)_3$

35×0.15 20×0.12

5.25 milimole 2.4 milimole

$Pb(NO_3)_2$ is limiting reagent and moles of $PbSO_4$ formed is 5.25×10^{-3}

2. The number of orbitals with n = 5, $m_l = +2$ is .....(Round off to the Nearest Integer).

Ans. Official Answer NTA (3)

Sol. Fro n = 5, Possible subshells are

5s, 5p, 5d, 5f, 5g

5s $\Rightarrow m_l =$ | 0 |

5p $\Rightarrow m_l =$ | +1 | 0 | –1 |

5d $\Rightarrow m_l =$ | +2 | +1 | 0 | –1 | – 2 |

5f $\Rightarrow m_l =$ | +3 | +2 | +1 | 0 | –1 | – 2 | –3 |

5g $\Rightarrow m_l =$ | +4 | +3 | +2 | +1 | 0 | –1 | –2 | –3 | –4 |

5d, 5f and 5g, each has one orbital with $m_l = +2$

3. At 25°C, 50 g of iron reacts with HCl to form FeCl_2. The evolved hydrogen gas expands against a constant pressure of 1 bar. The work done by the gas during this expansion is .....J.

(Round off to the Nearest Integer).

[Given : R = 8.314 $mol^{-1}K^{-1}$. Assume, hydrogen is an ideal gas]

[Atomic mass of Fe is 55.85 u]

Ans. Official Answer NTA (2218)

Sol. $Fe + 2HCl \rightarrow FeCl_2 + H_2$

$\frac{50}{55.85}$mole $\frac{50}{55.85}$mole

$W = -\Delta n_g RT$

$= -\frac{50}{55.85} \times 8.314 \times 298$

$= -2218.05$ J

4. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d – d transition. The octahedral splitting energy for the above complex ..... $\times 10^{-19}$ J. (Round off to the Nearest Integer)

$h = 6.626 \times 10^{-34}$ Js ; $c = 3 \times 10^8$ ms^{-1}.

Ans. Official Answer NTA (4)

Sol. $\Delta_0 = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{498 \times 10^{-9}}$

$= 3.99 \times 10^{-19}$ J

$= 4 \times 10^{-19}$ J

5. At 363 K, the vapour pressure of A is 21 kPa and that of B is 18 kPa. One mole of A and 2 moles of B are mixed. Assuming that this solution is ideal, the vapour pressure of the mixture is ..... kPa. (Round off to the Nearest Integer).

Ans. Official Answer NTA (19)

Sol. $P_T = P_A^0 X_A + P_B^0 X_B$

$= 21 \times \frac{1}{3} + 18 \times \frac{2}{3}$

$= 19$

6. Sulphurous acid (H_2SO_3) has $Ka_1 = 1.7 \times 10^{-2}$ and $Ka_2 = 6.4 \times 10^{-8}$. The pH of 0.588 M H_2SO_3 is ..... (Round off to the Nearest Integer).

Ans. Official Answer NTA (1)

Sol. p^H of H_2SO_3 can be calculated by considering only first dissociation of H_2SO_3

$$p^H = \frac{1}{2}\left(p^{Ka_1} - \log c\right)$$

$$= \frac{1}{2}[2 - \log 1.7 - \log 0.588]$$

$$= \frac{1}{2}[2 - \log (1.7 \times 0.588)]$$

$$= \frac{1}{2}[2 - \log(0.996)]$$

$$\approx 1$$

7. In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is ..... (Round off to the Nearest Integer).

[Given : Aqueous tension at 287 K = 14 mm of Hg]

Ans. Official Answer NTA (19)

Sol. Pressure of gas = 758 – 14 = 744 mm Hg

$$\frac{744}{760} \times \frac{30}{1000} = n_{N_2} \times 0.0821 \times 287$$

$$n_{N_2} = 12.464 \times 10^{-4}$$

$$w_{N_2} = 12.464 \times 10^{-4} \times 28 = 0.03489$$

$$\%N_2 = \frac{0.03489}{0.184} \times 100$$

$$= 18.96$$

8. Ga (Atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is ..... $\times 10^{21}$. (Round off to the Nearest Integer).

[Given : $N_A = 6.023 \times 10^{23}$]

Ans. Official Answer NTA (15)

Sol. In HCP structure → 12 T.V. + 6 O.V.

in HCP structure → 6 atoms

total number of Ga atoms = $\frac{.581}{70}\times 6.23\times 10^{23}$

$= 4.99 \times 10^{21}$ atoms

in 6 atoms of HCP = total 18 voids

4.99×10^{21} atom of Ga = $\frac{18}{6}\times 4.99\times 10^{21}$

$= 15\times 10^{21}$ voids

9. A and B decompose via first order kinetic with half-lives 54.0 min and 18.0 min respectively. Starting from an equimolar non reactive mixture of A and B, the time taken for the concentration of A to become 16 times that of B is ..... min. (Round off to the Nearst Integer).

Ans. Official Answer NTA (108)

Sol. For A

$$\frac{l\text{n}2}{54}\times t = l\text{n}\left(\frac{A_0}{A_t}\right) \quad .....(1)$$

For B

$$\frac{l\text{n}2}{18}\times t = l\text{n}\left(\frac{B_0}{B_t}\right) \quad .....(2)$$

$\because A_t = 16B_t, A_0 = B_0$

From (1) $\Rightarrow$ $\frac{l\text{n}2}{54}\times t = l\text{n}\left(\frac{B_0}{16B_t}\right)$

Using equation (2) $\Rightarrow$ $\frac{l\text{n}2}{54}\times t = \frac{l\text{n}2}{18}\times t - l\text{n}(16)$

$\frac{2l\text{n}2}{54}\times t = l\text{n}(16)$

$t = 108$

10. A 5.0 m mol dm^{-3} aqueous solution of KC*l* has a conductance of 0.55 mS when measured in a cell of cell constant 1.3 cm^{-1}. The molar conductivity of this solution is .....

mSm^2mol^{-1}. (Round off to the Nearest Integer).

Ans. Official Answer NTA (143)

Ans. Official Answer By Matrix (14)

Sol. $\lambda = \frac{K \times 1000}{M}$

$K = G \times G^*$

$= 0.55 \times 10^{-3} \times 1.3$

$K = 0.715 \times 10^{-3}$ Scm^{-1}

$M = 5 \times 10^{-3}$ mol/*l*itre

$\lambda = \frac{0.715 \times 10^{-3} \times 1000}{5 \times 10^{-3}}$

$\lambda = 143$ $Scm^2\ mol^{-1}$

$= 143 \times 10^{-4}\ Sm^2\ mol^{-1}$

$= 14.3 \times 10^{-3}\ Sm^2\ mol^{-1}$

$= 14.3\ msm^2\ mol^{-1}$