FINAL JEE–MAIN EXAMINATION – JUNE, 2022

(Held On Tuesday 28th June, 2022) **TIME : 9 : 00 AM to 12 : 00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

1. The incorrect statement about the imperfections in solids is :

(A) Schottky defect decreases the density of the substance.

(B) Interstitial defect increases the density of the substance.

(C) Frenkel defect does not alter the density of the substance.

(D) Vacancy defect increases the density of the substance.

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Due to vacancy defect density of the substance will decrease.

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2. The Zeta potential is related to which property of colloids"

(A) Colour

(B) Tyndall effect

(C) Charge on the surface of colloidal particles

(D) Brownian movement

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. The potential difference between the fixed and diffused layer of charges in a colloidal particle is called zeta potential

3. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above 'E' in the group is

(A) $3s^2.\ 3p^4$ (B) $3d^{10}.\ 4s^2,\ 4p^4$

(C) $4d^{10}.\ 5s^2,\ 5p^4$ (D) $2s^2,$ p4

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. $E \Rightarrow [Ar]\ 3d^{10}\ 4s^2\ 4p^4$

Element above $E \Rightarrow [Ne]\ 3s^2\ 3p^4$

4. Given are two statements one is labelled as Assertion A and other is labelled as Reason R.
Assertion A :Magnesium can reduce Al_2O_3 at a temperature below 1350°C, while above 1350°C aluminium can reduce MgO.
Reason R : The melting and boiling points of magnesium are lower than those of aluminium.
In light of the above statements. choose most appropriate answer from the options given below:
(A) Both A and R are correct. and R is correct explanation of A.
(B) Both A and R are correct. but R is NOT the correct explanation of A.
(C) A is correct R is not correct.
(D) A is not correct. R is correct.
Official Ans. by NTA (B)

Allen Ans. (B)

Sol. From Ellingham diagram given in NCERT, it can be seen that Mg, MgO line crosses Al, Al_2O_3 line after 1350ºC hence assertion is true.

Yes, Mg have lower MP and BP than aluminium but it does not explain the above fact.

5. Dihydrogen reacts with CuO to give
(A) CuH_2
(B) Cu
(C) Cu_2O
(D) $Cu(OH)_2$
Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $CuO + H_2 \rightarrow Cu + H_2O$ (under hot conditions)

6. Nitrogen gas is obtained by thermal decomposition of
(A) $Ba(NO_3)_2$ (B) $Ba(N_3)_2$
(C) $NaNO_2$ (D) $NaNO_3$
Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $Ba(N_3)_2 \rightarrow Ba + 3N_2$

7. Given below are two statements :
Statement -I :The pentavalent oxide of group- 15 element. E_2O_5. is less acidic than trivalent oxide. E_2O_3. of the same element.
Statement -II :The acidic character of trivalent oxide of group 15 elements. E_2O_3. decreases down the group.
In light of the above statements. choose most appropriate answer from the options given below:
(A) Both Statement I and Statement II are true.
(B) Both Statement I and Statement II are false.
(C) Statement I true. but statement II is false.
(D) Statement I is false but statement II is true.
Official Ans. by NTA (D)

Allen Ans. (D)

Sol. As +ve oxidation state increases, EN of element increases hence acidic character increases. Down the group, non-metallic character decreases, acidic character decreases.

Acidic character : $E_2O_5 > E_2O_3$

Down the group, acidic character of E_2O_3 decreases

8. Which one of the lanthanoids given below is the most stable in divalent form?
(A) Ce (Atomic Number 58)
(B) Sm (Atomic Number 62)
(C) Eu (Atomic Number 63)
(D) Yb (Atomic Number 70)
Official Ans. by NTA (C)

Allen Ans. (C)

Sol. $E^{o}_{M^{3+}/M^{2+}} \Rightarrow$ Eu: -0.35, Yb: -1.05

Hence, due to more reduction potential in Eu as compared to Yb, it can concluded that Eu^{2+} is more stable than Yb^{2+}.

9. Given below are two statements :
Statement I : $[Ni(CN)4]^{2-}$ is square planar and diamagnetic complex. with dsp^2 hybridization for Ni but $[Ni(CO)_4]$ is tetrahedral. paramagnetic and with sp^3-hybridication for Ni.
Statement II: $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both have same d-electron configuration have same geometry and are paramagnetic.
In light the above statements. choose the correct answer form the options given below:
(A) Both Statement I and Statement II are true.
(B) Both Statement I and Statement II are false.
(C) Statement I is correct but statement II is false.
(D) Statement I is incorrect but statement II is true.
Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $[Ni(CN)_4]^{2-}$: d^8 configuration, SFL, sq. planar splitting (dsp^2), diamagnetic.

$[Ni(CO)_4]$: d^{10} config (after excitation), SFL, tetrahedral splitting (sp^3), diamagnetic.

$[NiCl_4]^{2-}$: d^8 config, WFL, tetrahedral splitting (sp^3), paramagnetic(2 unpaired e^-).

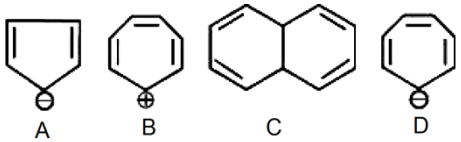
10. Which amongst the following is not a pesticide ?
(A) DDT
(B) Organophosphates
(C) Dieldrin
(D) Sodium arsenite
Official Ans. by NTA (D)

Allen Ans. (D)

11. Which one of the following techniques is not used to spot components of a mixture separated on thin layer chromatographic plate?
(A) I_2 (Solid)
(B) U.V. Light
(C) Visualisation agent as a component of mobile phase
(D) Spraying of an appropriate reagent
Official Ans. by NTA (C)

Allen Ans. (C)

12. Which of the following structures are aromatic in nature?



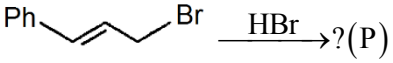
(A) A,B,C and D
(B) Only A and B
(C) Only A and C
(D) Only B, C and D
Official Ans. by NTA (B)

Allen Ans. (B)

Sol. A, B aromatic

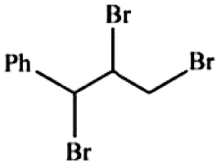
C,D is nonaromatic

13. The major product (P) in the reaction

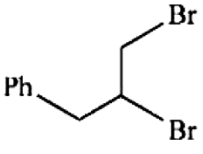


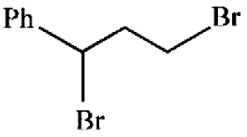
[Ph is – C_6H_5] is

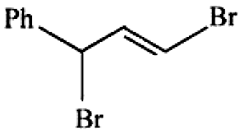
(A)



(B)



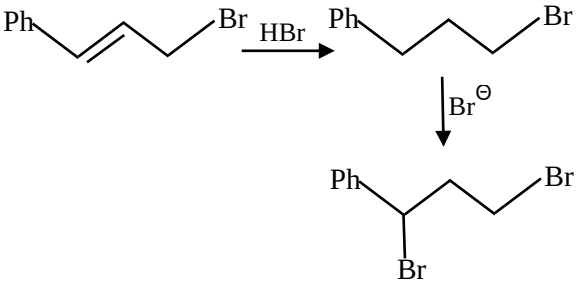
(C) 

(D) 

Official Ans. by NTA (C)

Allen Ans. (C)

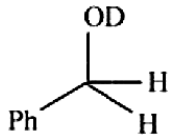
Sol.

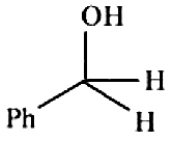


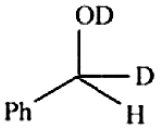
14. The correct structure of product 'A' formed in the following reaction.

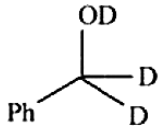
$$PhCHO + Ph\cdot CHO \xrightarrow[\text{in } D_2O]{NaOD} A + Ph-\overset{O}{\overset{\|}{C}}-O^-$$

$(Ph \text{ is} -C_6H_5)$

(A) 

(B) 

(C) 

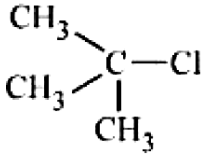
(D) 

Official Ans. by NTA (A)

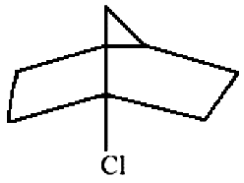
Allen Ans. (A)

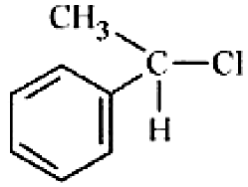
Sol. $PhCH = O + PhCH = O \xrightarrow{OD/D_2O} PhCH_2OD + PhCO_2^-$

15. Which one of the following compounds is inactive towards S_N1 reaction?

(A) 

(B) 

(C) 

(D) 

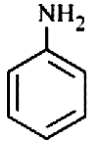
Official Ans. by NTA (C)

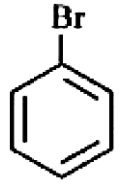
Allen Ans. (C)

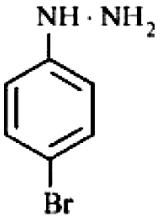
Sol. **Sol.** The carbocation fromed is very unstable.

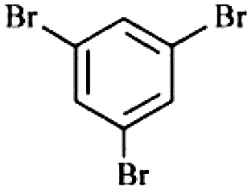
So it is inactive towards S_N1

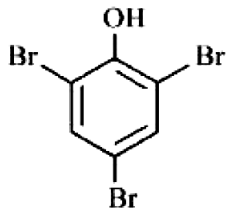
16. Identify the major product formed in the following sequence of reactions :



(A) 

(B) 

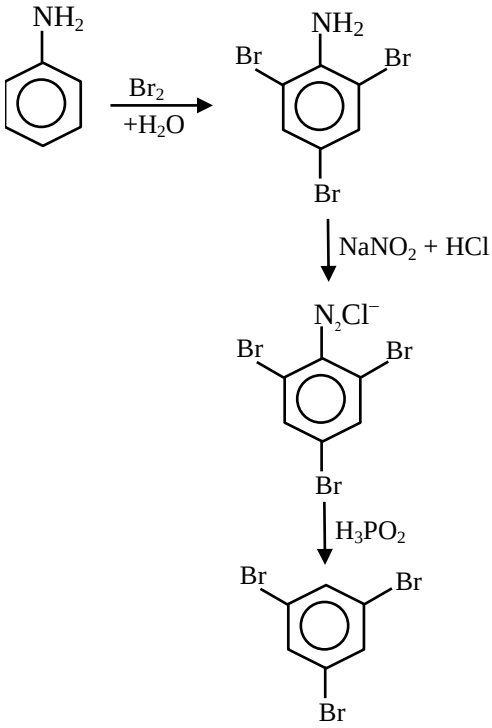
(C) 

(D) 

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.



17. A primary aliphatic amine on reaction with nitrous acid in cold (273 K) and there after raising temperature of reaction mixture to room temperature (298 K). Gives a/an

(A) nitrile (B) alcohol

(C) diazonium salt (D) secondary amine

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $R-NH_2 \xrightarrow[+HCl]{NaNO_2} R-N_2^+ \rightarrow R^+ \xrightarrow[H_2O]{} R-OH$

18. Which one of the following is **NOT** a copolymer ?

(A) Buna-S (B) Neoprene

(C) PHBV (D) Butadiene-styrene

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Buna-S, PHBr and Butadiene-styrene are copolymer. Only neoprene is namopolymer.

19. Stability of α - Helix structure of proteins depends upon

(A) dipolar interaction

(B) H-bonding interaction

(C) van der Waals forces

(D) π -stacking interaction

Official Ans. by NTA (B)

Allen Ans. (B)

20. The formula of the purple colour formed in Laissaigne's test for sulphur using sodium nitroprusside is

(A) $NaFe[Fe(CN)_6]$ (B) $Na[Cr(NH_3)_2(NCS)_4]$

(C) $Na_2[Fe(CN)_5(NO)]$ (D) $Na_4[Fe(CN)_5(NOS)]$

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. $Na_2S + Na_2[Fe(CN)_5NO] \rightarrow Na_4[Fe(CN)_5NO_5]$

SECTION-B

1. A 2.0 g sample containing MnO_2 is treated with HCl liberating Cl_2. The Cl_2 gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of MnO_2 in the sample is _____. (Nearest integer)

[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16, I = 127, Na = 23, K = 39, S = 32]

Official Ans. by NTA (13)

Allen Ans. (13)

Sol.

$MnO_2 + HCl \longrightarrow Cl_2 + Mn^{+2}$

6 meq 6 meq

$= 3\,m\,mol$

$Cl_2 + KI \longrightarrow Cl^- + I_2$

6 meq 6 meq

$I_2 + Na_2S_2O_3 \longrightarrow I^- + Na_2S_4O_6$

6 meq $6\,m\,mol = 6\,meq$

$\%MnO_2 = \frac{3\times10^{-3}\times87}{2}\times100$

= 13.05%

Ans. 13

2. If the work function of a metal is 6.63×10^{-19} J, the maximum wavelength of the photon required to remove a photoelectron from the metal is _____ nm. (Nearest integer)

[Given : $h = 6.63 \times 10^{-34}$ J s, and $c = 3 \times 10^8$ m s^{-1}]

Official Ans. by NTA (300)

Allen Ans. (300)

Sol. $\phi = 6.63 \times 10^{-19} J = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$

$\Rightarrow \lambda = 3 \times 10^{-7} m = 300 \text{ nm}$

3. The hybridization of P exhibited in PF_5 is sp^xd^y. The value of y is _____.

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $PF_5 \Rightarrow sp^3d$ hybridisation

(5 sigma bonds, zero lone pair on central atom)

Value of y = 1

4. 4.0 L of an ideal gas is allowed to expand isothermally into vacuum until the total volume is 20 L. The amount of heat absorbed in this expansion is _____ L atm.

Official Ans. by NTA (0)

Allen Ans. (0)

Sol. For free expansion: $P_{ext} = 0$, $w = 0$

$q = 0$, $\Delta U = 0$

Ans. 0

5. The vapour pressures of two volatile liquids A and B at 25°C are 50 Torr and 100 Torr, respectively. If the liquid mixture contains 0.3 mole fraction of A, then the mole fraction of liquid B in the vapour phase is $\frac{x}{17}$. The value of x is _____.

Official Ans. by NTA (14)

Allen Ans. (14)

Sol. $\frac{y_B}{1-y_B} = \frac{P_B^o}{P_A^o}\left[\frac{X_B}{1-X_B}\right]$

$\Rightarrow \frac{y_B}{1-y_B} = \frac{100}{50}\left[\frac{0.7}{0.3}\right] = \frac{14}{3}$

$\Rightarrow y_B = \frac{14}{17}$

Ans. 14

6. The solubility product of a sparingly soluble salt A_2X_3 is 1.1×10^{-23}. If specific conductance of the solution is 3×10^{-5} S m^{-1}, the limiting molar conductivity of the solution is $x \times 10^{-3}$ S m^2 mol^{-1}. The value of x is _____.

Official Ans. by NTA (3)

Allen Ans. (3)

$A_2X_{3(s)} \rightleftharpoons 2A^{+3}_{(aq)} + 3X^{-2}_{(aq)}$

solubility = sM 2s 3s

$(2s)^2(3s)^3 = 1.1 \times 10^{-23}$

$108\ s^5 = 1.1 \times 10^{-23}$

$s \simeq 10^{-5} M = 10^{-5} \frac{mol}{L} = 0.01 \frac{mol}{m^3}$

Now $\wedge_m \simeq \wedge_m^\infty = \frac{k}{m} = \frac{k}{s}$

$\Rightarrow \wedge_m^\infty = \frac{3 \times 10^{-5}}{0.01} = 3 \times 10^{-3}$ S-m^2/mol

Ans. 3

7. The quantity of electricity in Faraday needed to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} is _____.

Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $Cr_2O_7^{-2} + 6e^- \longrightarrow 2Cr^{+3}$

1mol 6mol

$\Rightarrow$ number of faradays = moles of electrons

= 6

8. For a first order reaction $A \rightarrow B$, the rate constant, $k = 5.5 \times 10^{-14} s^{-1}$. The time required for 67% completion of reaction is $x \times 10^{-1}$ times the half life of reaction. The value of x is _____ (Nearest integer)

(Given : log 3 = 0.4771)

Official Ans. by NTA (16)

Allen Ans. (16)

Sol. $t_{67\%} = \frac{1}{k}\ln\left(\frac{1}{1-0.67}\right) = \frac{t_{1/2}}{\ln 2} \times \ln\left(\frac{1}{1-\frac{2}{3}}\right)$

$t_{67\%} = \frac{t_{1/2}}{\log 2} \times \log 3 = \frac{t_{1/2} \times 0.4771}{0.301}$

$\Rightarrow t_{67\%} = 1.585 \times t_{1/2}$

$X \times 10^{-1} = 1.585$

$\Rightarrow X = 15.85$

Ans.16

9. Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ is _____.

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Carbonyl complex compounds have tendency to show synergic bonding.

10. In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is _____% (nearest integer)

(Relative atomic masses of Ag and Br are 108u and 80u, respectively).

Official Ans. by NTA (34)

Allen Ans. (34)

Sol

$$\underset{0.5\,g}{O.C} \longrightarrow \underset{0.4\,g}{AgBr}$$

$$\text{mol of Br} = \text{mol of AgBr} = \frac{0.4}{188}$$

$$\%\ \text{Br} = \%\text{Br} = \frac{\frac{0.4}{188}\times 80}{0.5}\times 100$$

$$= 34.04\%$$