FINAL JEE–MAIN EXAMINATION – FEBRUARY, 2021

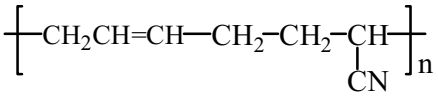
(Held On Friday 26th February, 2021) TIME : 9 : 00 AM to 12 : 00 NOON

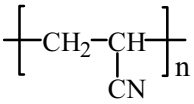
CHEMISTRY

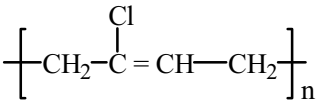
TEST PAPER WITH ANSWER & SOLUTION

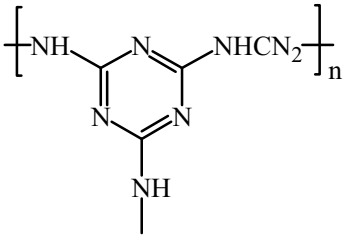
SECTION-A

1. The structure of Neoprene is -

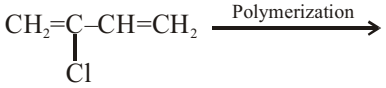
(1) 

(2) 

(3) 

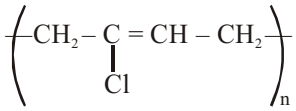
(4) 

Official Ans. by NTA (3)

Sol. 

Chloroprene

2–Chloro–1, 3–Butadiene



Neoprene

2. Find A, B and C in the following reactions :

$NH_3 + A + CO_2 \rightarrow (NH_4)_2CO_3$

$(NH_4)_2CO_3 + H_2O + B \rightarrow NH_4HCO_3$

$NH_4HCO_3 + NaCl \rightarrow NH_4Cl + C$

(1) A – O_2 ; B – CO_2 ; C – Na_2CO_3

(2) A – H_2O ; B – O_2 ; C – Na_2CO_3

(3) A – H_2O ; B – O_2 ; C – $NaHCO_3$

(4) A – H_2O ; B – CO_2 ; C – $NaHCO_3$

Official Ans. by NTA (4)

Sol. $\underset{(A)}{2NH_3 + H_2O + CO_2} \longrightarrow (NH_4)_2CO_3$

$(NH_4)_2CO_3 + H_2O + \underset{(B)}{CO_2} \longrightarrow 2NH_4HCO_3$

$NH_4HCO_3 + NaCl \longrightarrow \underset{(C)}{NaHCO_3} + NH_4Cl$

3. The presence of ozone in troposphere

(1) Protects us from the UV radiation

(2) Protects us from the X-ray radiation

(3) Protects us from greenhouse effect

(4) generates photochemical smog

Official Ans. by NTA (4)

Sol. The presence of ozone in troposphere generates photochemical smog.

4. Match List -I with List - II

List - I	**List - II**
Electronic configuration of elements	**Δ_i in kJ mol^{-1}**
(a) $1s^22s^2$	(i) 801
(b) $1s^22s^22p^4$	(ii) 899
(c) $1s^22s^22p^3$	(iii)1314
(d) $1s^22s^22p^1$	(iv)1402

Choose the most appropriate answer from the options given below -

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

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

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

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

Official Ans. by NTA (1)

Sol. (a) $1s^2\ 2s^2 \rightarrow$ Be

(b) $1s^2\ 2s^2\ 2p^4 \rightarrow$ O

(c) $1s^2\ 2s^2\ 2p^3 \rightarrow$ N

(d) $1s^2\ 2s^2\ 2p^1 \rightarrow$ B

The ionization enthalpy order is

B < Be < O < N

Be has more IE compared to B due to extra stability & N has more IE compared to oxygen due to extra stability

Hence, N → 1402 kJ/mol

O → 1314 kJ/mol

B → 801 kJ/mol

Be → 899 kJ/mol

5. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Dipole-dipole interactions are the only non-covalent interactions, resulting in hydrogen bond formation.

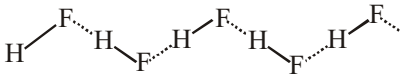
Reason R : Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) A is false but R is true
(2) Both A and R are true and R is the correct explanation of A
(3) A is true R is false
(4) Both A and R are true but R is NOT the correct explanation of A

Official Ans. by NTA (1)

Sol. Assertion is incorrect since in hydrogen bonding, Dipole–dipole interactions are non-covalent but ion-dipole interaction can also result in H-bond formation. Reason is correct since F is most electronegative element & structure is



Symmetrical H-bonds are present

6. Statements about heavy water are given below.

A. Heavy water is used in exchange reactions for the study of reaction mechanisms.

B. Heavy water is prepared by exhaustive electrolysis of water

C. Heavy water has higher boiling point than ordinary water.

D. Viscosity of H_2O is greater than D_2O

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

Official Ans. by NTA (1)

Sol. Heavy water is used in exchange reactions for study of reaction mechanisms
Heavy water is prepared by exhaustive electrolysis of water.
B.P. of D_2O = 374.4 K
B.P. of H_2O = 373 K
Viscosity of H_2O = 0.89 centipoise
Viscosity of D_2O = 1.107 centipoise

7. The orbital having two radial as well as two angular nodes is -

(1) 3p (2) 4f (3) 4d (4) 5d

7. **Offcial Ans. by NTA (4)**

Sol. $n - l - 1 = 2$
$l = 2$
$n - 2 - 1 = 2$
$n = 5$

8. Match List -I with List - II

List - I (Ore)	**List - II (Element Present)**
(a) Kernite	(i) Tin
(b) Cassiterite	(ii) Boron
(c) Calamine	(iii) Fluorine
(d) Cryolite	(iv) Zinc

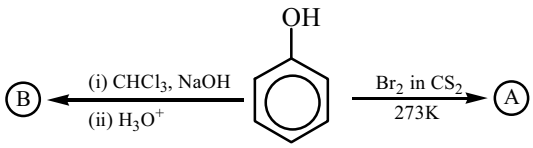
Choose the most appropriate answer from the options given below.

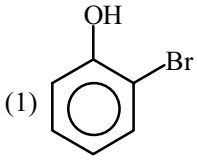
(1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)
(2) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)
(3) (a) → (ii), (b) → (iv), (c) → (i), (d) → (iii)
(4) (a) → (iii), (b) → (i), (c) → (ii), (d) → (iv)

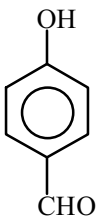
Official Ans. by NTA (2)

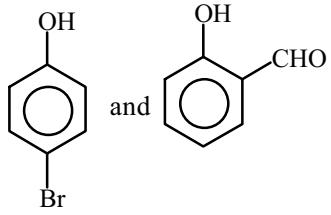
Sol. Kernite = $Na_2B_4O_7.4H_2O$
Cassiterite = SnO_2
Calamine = $ZnCO_3$
Cryolite = $Na_3A\ell F_6$

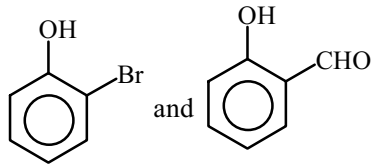
9. Identify the major products A and B respectively in the following reactions of phenol.

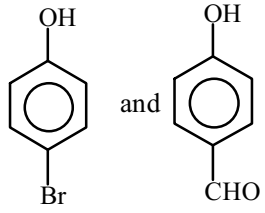


(1) 

and 

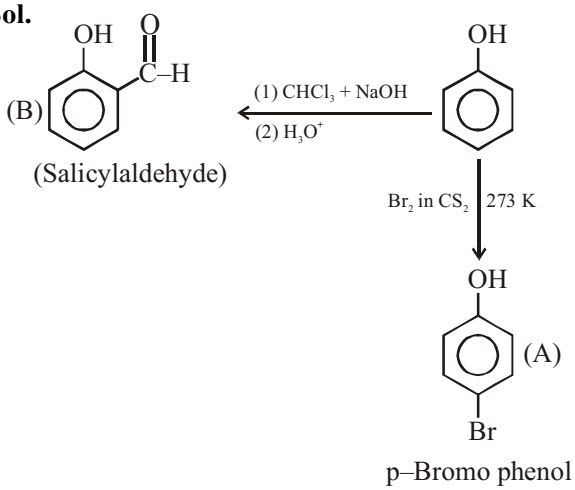
(2)  and

(3)  and

(4)  and

Official Ans. by NTA (2)

Sol.



10. Given below are two statements :

Statement I : A mixture of chloroform and aniline can be separated by simple distillation.

Statement II : When separating aniline from a mixture of aniline and water by steam distillation aniline boils below its boiling point.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) **Statement-I** is false but **Statement II** is true

(2) **Both Statement-I** and **Statement II** are false

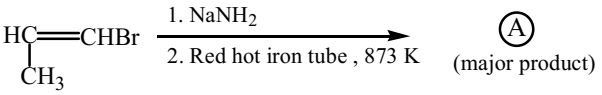
(3) **Statement-I** is true but **Statement II** is false

(4) **Both Statement-I** and **Statement II** are true

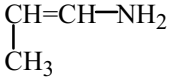
Official Ans. by NTA (4)

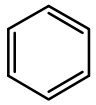
Sol. **Statement 1 :** B.P. of chloroform = 334 K
B.P. of aniline = 457 K
thus can be seprated of simple distillation.
Statement 2 : Mixture of aniline and water seprated by simple distillation.

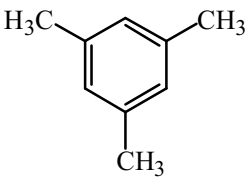
11. For the given reaction :



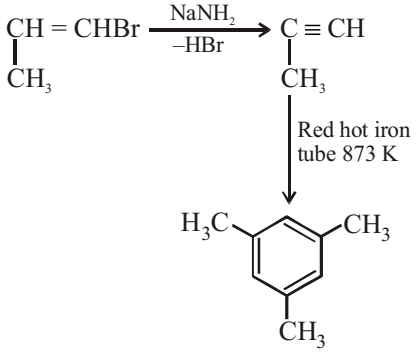
(1) $CH_3CH_2CH_2NH_2$

(2) 

(3) 

(4) 

Official Ans. by NTA (4)

Sol. 

12. On treating a compound with warm dil. H_2SO_4, gas X is evolved which turns $K_2Cr_2O_7$ paper acidified with dil. H_2SO_4 to a green compound Y. X and Y respectively are -

(1) X = SO_2, Y = Cr_2O_3

(2) X = SO_3, Y = Cr_2O_3

(3) X = SO_2, Y = $Cr_2(SO_4)_3$

(4) X = SO_3, Y = $Cr_2(SO_4)_3$

Official Ans. by NTA (3)

Sol. $SO_2 + \text{dil } H_2SO_4 \longrightarrow SO_3(g)$

$SO_3 + K_2Cr_2O_7 \xrightarrow[H_2SO_4]{\text{dil.}} Cr_2(SO_4)_3$

13. Which of the following is 'a' FALSE statement?

(1) Carius tube is used in the estimation of sulphur in an organic compound

(2) Carius method is used for the estimation of nitrogen in an organic compound

(3) Phosphoric acid produced on oxidation of phosphorus present in an organic compound is precipitated as $Mg_2P_2O_7$ by adding magnesia mixture.

(4) Kjeldahl's method is used for the estimation of nitrogen in an organic compound

Official Ans. by NTA (2)

Sol. Carius method is used in the estimation of halogen in organic compounds.

14. Which of the following vitamin is helpful in delaying the blood clotting -

(1) Vitamin C (2) Vitamin B

(3) Vitamin E (4) Vitamin K

Official Ans. by NTA (4)

Sol. Vitamin helpful in delaying the blood clotting is Vitamin K

15. $\underset{(C_4H_8Cl_2)}{A} \xrightarrow[373K]{\text{Hydrolysis}} \underset{(C_4H_8O)}{B}$

B reacts with Hydroxyl amine but does not give Tollen's test. Identify A and B

(1) 1,1-Dichlorobutane and 2-Butanone

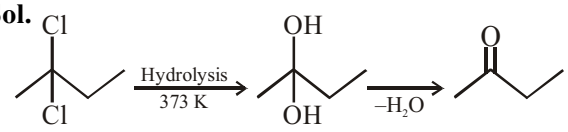
(2) 2,2-Dichlorobutane and Butanal

(3) 1,1-Dichlorobutane and Butanal

(4) 2,2-Dichlorobutane and 2-butan-one

Official Ans. by NTA (4)

Sol.



$(C_4H_8Cl_2)$ (A) (C_4H_8O) (B)

16. Compound A used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries. Compound A is :

(1) PbO_2 (2) PbO

(3) $PbSO_4$ (4) Pb_3O_4

Official Ans. by NTA (1)

Sol. PbO_2 is amphoteric and strong oxidizing agent and also a component of lead storage batteries.

17. Which one of the following lanthanoids does not form MO_2? [M is lanthanoid metal]

(1) Pr (2) Dy

(3) Nd (4) Yb

Official Ans. by NTA (4)

Sol. Yb is the only element that do not form MO_2 type oxide

18. Given below are two statements :

Statement I : o-Nitrophenol is steam volatile due to intramolecular hydrogen bonding.

Statement II : o-Nitrophenol has high melting due to hydrogen bonding.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Statement I is false but Statement II is true

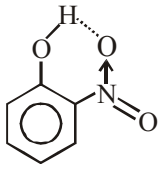
(2) Both statement I and statement II are true

(3) Both statement I and statement II are false

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

Official Ans. by NTA (4)

Sol.

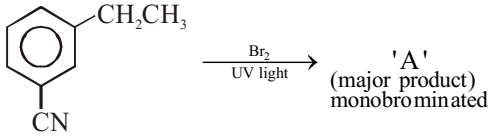


Intramolecular H–bonding

thus it is more volatile due to intramolecular H-bonding.

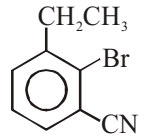
Melting point depends on packing efficiency not on H-bonding thus statement II is false

19. For the given reaction :

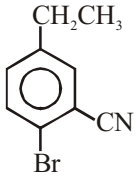


What is 'A'?

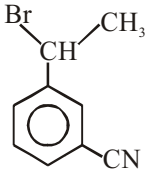
(1)



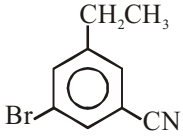
(2)



(3)

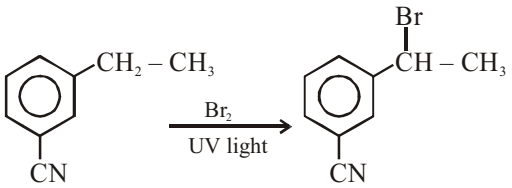


(4)



Official Ans. by NTA (3)

Sol.



20. An amine on reaction with benzenesulphonyl chloride produces a compound insoluble in alkaline solution. This amine can be prepared by ammonolysis of ethyl chloride. The correct structure of amine is :

(1) 

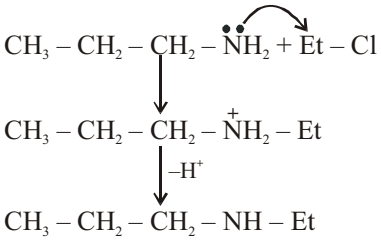
(2) $CH_3CH_2NH_2$

(3) $CH_3CH_2CH_2NHCH_3$

(4) $CH_3CH_2CH_2\overset{H}{N}-CH_2CH_3$

Official Ans. by NTA (4)

Sol. It has to be 2° amine because on reaction with benzene sulphonylchloride it gives water in soluble product. As it is formed by ammonolysis of ethylchloride, so it has to be R–NH–Et type.



SECTION-B

1. For a chemical reaction A + B ⇌ C + D (Δ_rH^0 = 80kJ mol^{-1}) the entropy change Δ_rS^0 depends on the temperature T (in K) as (Δ_rS^0 = 2T (J K^{-1} mol^{-1}).

Minimum temperature at which it will become spontaneous is _____K.(Integer)

1. Official Ans. by NTA (200)

$\Delta G^0 = \Delta H^0 - T \times \Delta S^0$

$\Delta G^0 = \Delta H^0 - T \times (2T)$

T = 200K

2. The number of significant figures in 50000.020 × 10^{-3} is _____.

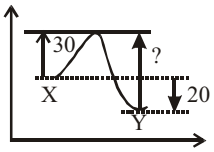
2. Official Ans. by NTA (7)

Sol. 50000.020 × 10^{-3}

3. An exothermic reaction X → Y has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is –20 kJ, then the activation energy for the reverse reaction in kJ is _____.(Integer answer)

3. Official Ans. by NTA (50)

Sol. X ⟶ Y



4. Consider the following reaction

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$, $E^o = 1.51$ V.

The quantity of electricity required in Faraday to reduce five moles of MnO_4^- is____.

4. Official Ans. by NTA (25)

5. A certain gas obeys P(V_m–b)= RT. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$. The value of *x* is_____.

(Integer answer) (Z : compressibility factor)

5. Official Ans. by NTA (1)

Sol. $Z = 1 + \frac{Pb}{RT}$

$\left(\frac{\partial Z}{dP}\right)_T = 0 + \frac{b}{RT} \times 1$

6. A homogeneous ideal gaseous reaction $AB_{2(g)} \rightleftharpoons A_{(g)} + 2B_{(g)}$ is carried out in a 25 litre flask at 27°C. The initial amount of AB_2 was 1 mole and the equilibrium pressure was 1.9 atm. The value of K_P is *x* × 10^{-2}. The value of *x* is_____.(Integer answer)

Official Ans. by NTA (74)

Allen Ans.(72 to 75)

Sol. $AB_2 = A + 2B$

$1 \quad - \quad -$

$1-\alpha \quad \alpha \quad 2\alpha$

$= 0.535 \quad 0.465 \quad 0.93$

$1.9 \times 25 = n_T \times 0.08206 \times 300$

$n_T = 1.93 = 1 + 2\alpha$

$\alpha = 0.465$

$$Kp = \frac{\left(\frac{0.465}{1.93}\times 19\right)\left(\frac{0.93}{1.93}\times 1.9\right)^2}{\left(\frac{0.535}{1.93}\times 1.9\right)}$$

$\simeq 73 \times 10^{-2}$ atm^2

7. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is _____.

Official Ans. by NTA (6)

Sol. $Cr_2O_7^{2-} + OH^- \longrightarrow CrO_4^{2-}$

Oxidation state of Cr in CrO_4^{2-} is +6

8. 224 mL of $SO_{2(g)}$ at 298 K and 1 atm is passed through 100 mL of 0.1 M NaOH solution. The non-volatile solute produced is dissolved in 36 g of water. The lowering of vapour pressure of solution (assuming the solution is dilute) $\left(P_{(H_2O)} = 24 \text{ mm of Hg}\right)$ is $x \times 10^{-2}$ mm of Hg, the value of x is _____. (Integer answer)

8. Official Ans. by NTA (12)

Sol.(1) $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

$\frac{224}{0.0821\times 298}$ 10mmol 5mmol

$= 9.2$ m mol (L.R.) (i = 3)

$P^s = P^0 . X_{solvent}$

$= 24 \times \frac{2}{(2+15\times 10^{-3})}$

$= 23.82$

$\Delta P = 0.18$ torr $= 18 \times 10^{-2}$ torr.

Sol.(2) $SO_2 + NaOH \rightarrow NaHSO_3$

$9.2 \quad 10 \quad -$

$- \quad 0.8 \quad 9.2$

$\Delta P = P^0 . X_{solute}$

$= 24 \times \frac{(1.6+18.4)}{2020}$

$= 0.2376 = 23.76 \times 10^{-2}$

9. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume of oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is_____.

[R = 0.0821 L atm K^{-1} mol^{-1}]

9. Official Ans. by NTA (2)

Sol. $$V = \frac{\frac{3.12}{32}\times 0.0821\times 300}{1} = 2.40 l$$

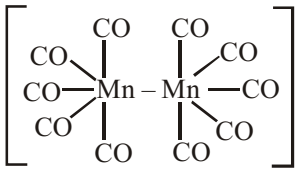
$\because$ 1.2 gm adsorbs 2.40 l

$\therefore$ 1 gm adsorbs 2 l

10. Number of bridging CO ligands in $[Mn_2(CO)_{10}]$ is _____.

Official Ans. by NTA (0)

Sol. $Mn_2(CO)_{10}$ structure is



Zero bridging CO ligands are present