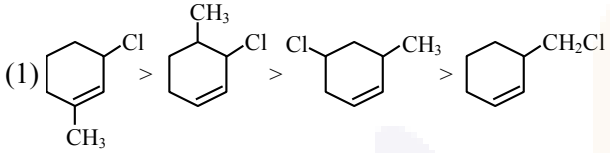
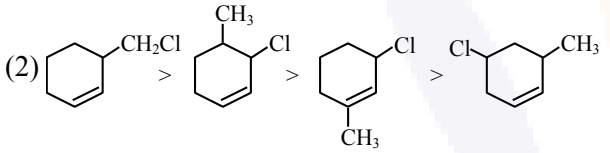
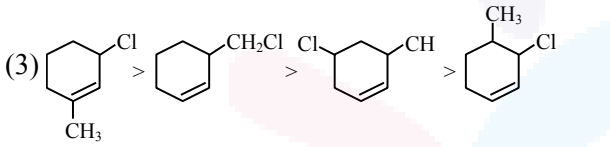
# FINAL JEE–MAIN EXAMINATION – AUGUST, 2021
## Held On Tuesday 31st August, 2021
## TIME: 9:00 AM to 12:00 NOON

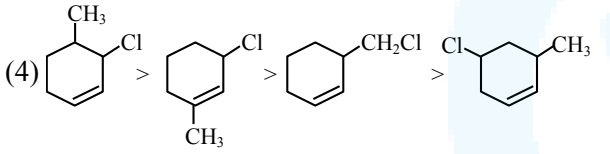
### SECTION-A

**1.** The **correct** order of reactivity of the given chlorides with acetate in acetic acid is :

(1) 

(2) 

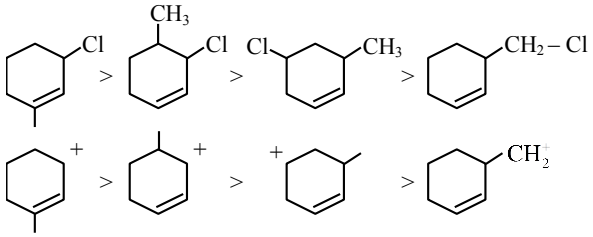
(3) 

(4) 

**Official Ans. by NTA (1)**

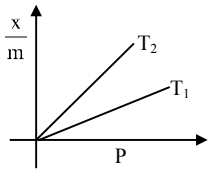
**Sol.** As it is example of $SN^1$.

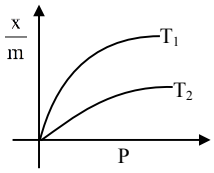
so carbocation stability ↑, reaction rate ↑

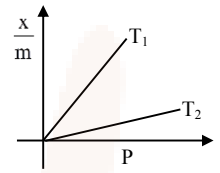


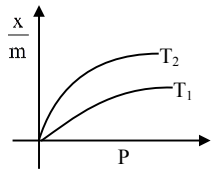
**2.** Select the graph that correctly describes the adsorption isotherms at two temperatures $T_1$ and $T_2$ ($T_1 > T_2$) for a gas :

(x – mass of the gas adsorbed ; m – mass of adsorbent ; P – pressure)

(1) 

(2) 

(3) 

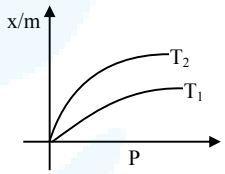
(4) 

**Official Ans. by NTA (4)**

**Sol.** $\frac{x}{m} \alpha P^{1/n} \left(0 < \frac{1}{n} < 1\right)$

On Increasing temperature $\frac{x}{m}$ decreases.

$\because$ adsorption is generally exothermic



$(T_1 > T_2)$

**3.** The major component/ingredient of Portland Cement is :

(1) tricalcium aluminate

(2) tricalcium silicate

(3) dicalcium aluminate

(4) dicalcium silicate

**Official Ans. by NTA (2)**

**Sol.** Major component of portland cement is "Tricalcium silicate (51% , $3CaO.SiO_2$)

**4.** In the structure of the dichromate ion, there is a :

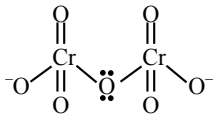
(1) linear symmetrical Cr–O–Cr bond.

(2) non-linear symmetrical Cr–O–Cr bond.

(3) linear unsymmetrical Cr–O–Cr bond.

(4) non-linear unsymmetrical Cr–O–Cr bond.

**Official Ans. by NTA (2)**

**Sol.** 

dichromate ion contain non-linear symmetrical Cr–O–Cr Bond

**5.** Which one of the following compounds contains β-$C_1$-$C_4$ glycosidic linkage ?

(1) Lactose (2) Sucrose

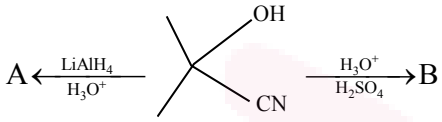
(3) Maltose (4) Amylose

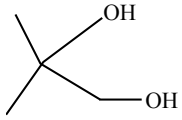
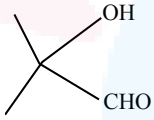
**Official Ans. by NTA (1)**

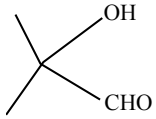
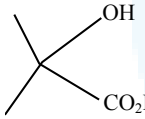
**Sol.** In Lactose it is β $C_1 - C_4$ glycosidic linkage.

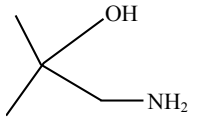
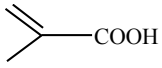
In Maltose, Amylose α $C_1 - C_4$ glycosidic linkage is present

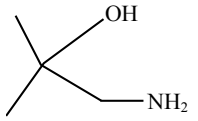
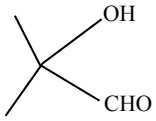
**6.** The major products A and B in the following set of reactions are :



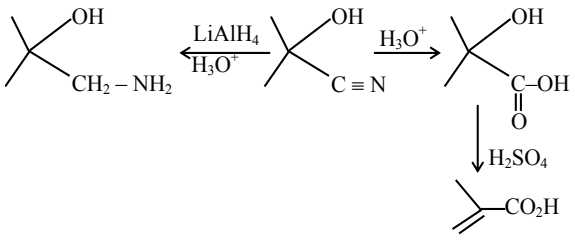
(1) A =  , B = 

(2) A =  , B = 

(3) A =  , B = 

(4) A =  , B = 

**Official Ans. by NTA (3)**

**Sol.** 

**7.** Which one of the following lanthanides exhibits +2 oxidation state with diamagnetic nature ? (Given Z for Nd = 60, Yb = 70, La = 57, Ce =58)

(1) Nd (2) Yb (3) La (4) Ce

**Official Ans. by NTA (2)**

**Sol.** Ytterbium shows +2 oxidation state with diamagnetic nature

So ans is 2

**8.** Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A) :** Aluminium is extracted from bauxite by the electrolysis of molten mixture of $Al_2O_3$ with cryolite.

**Reason (R) :** The oxidation state of Al in cryolite is +3.

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

(1) **(A)** is true but **(R)** is false

(2) **(A)** is false but **(R)** is true.

(3) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

(4) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**

**Official Ans. by NTA (4)**

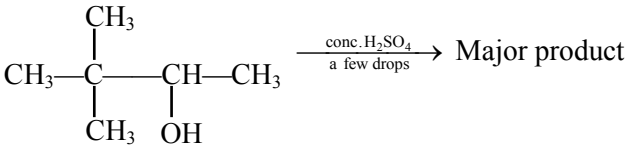
**Sol.** (A) Aluminium is reactive metal so Aluminium is extracted by electrolysis of Alumina with molten mixture of Cryolite

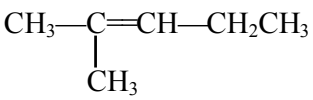
(B) Cryolite, $Na_3AlF_6$

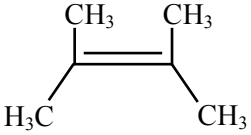
Here Al is in +3 O.S.

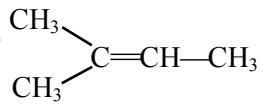
So Answer is 4

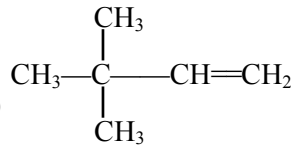
**9.** The major product formed in the following reaction is :



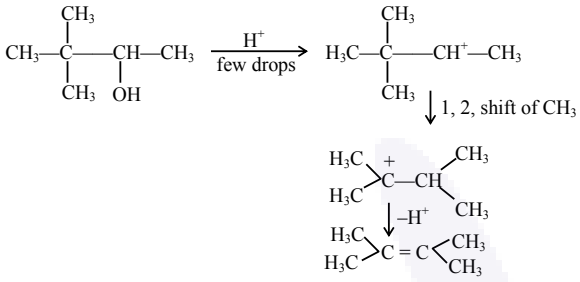
(1) 

(2) 

(3) 

(4) 

**Official Ans. by NTA (2)**

**Sol.** 

**10.** Monomer of Novolac is :

(1) 3-Hydroxybutanoic acid

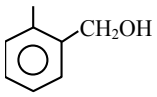
(2) phenol and melamine

(3) o-Hydroxymethylphenol

(4) 1,3-Butadiene and styrene

**Official Ans. by NTA (3)**

**Sol.** Monomer of Novolac is

 O-hydroxy methyl phenol

**11.** Given below are two statements :

**Statement-I :** The process of producing syn-gas is called gasification of coal.

**Statement-II :** The composition of syn-gas is $CO + CO_2 + H_2$ (1 : 1 : 1)

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

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

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

**Official Ans. by NTA (2)**

**Sol.** The process of producing syn-gas from coal is called gasification of coal.

Syn-gas having composition of CO & $H_2$ in 1 : 1

**12.** Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A) :** Treatment of bromine water with propene yields 1-bromopropan-2-ol.

**Reason (R) :** Attack of water on bromonium ion follows Markovnikov rule and results in 1-bromopropan-2-ol.

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

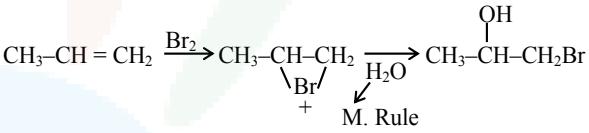
(1) Both **(A)** and **(R)** are true but **(R)** is NOT the correct explanation of **(A)**

(2) **(A)** is false but **(R)** is true.

(3) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(4) **(A)** is true but **(R)** is false

**Official Ans. by NTA (3)**

**Sol.** 

Its IUPAC name 1-bromopropan–2-ol

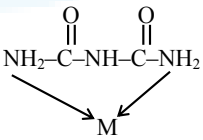
A and R are true and (R) is the correct explanation of (A)

**13.** The denticity of an organic ligand, biuret is :

(1) 2 (2) 4

(3) 3 (4) 6

**Official Ans. by NTA (1)**

**Sol.** 

Biuret :- Bidentate ligand

The denticity of organic ligand is 2.

**14.** Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A) :** Metallic character decreases and non-metallic character increases on moving from left to right in a period.

**Reason (R) :** It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.

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) **(A)** is true but **(R)** is false

(3) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

(4) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**

**Official Ans. by NTA (2)**

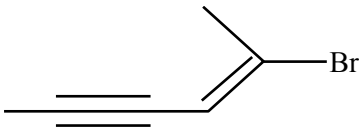
**Sol.** From left to right in periodic table :-

Metallic character decreases

Non-metallic character increases

$\Rightarrow$ It is due to increase in ionization enthalpy and increase in electron gain enthalpy.

**15.** Choose the **correct** name for compound given below :




(1) (4E)-5-Bromo-hex-4-en-2-yne

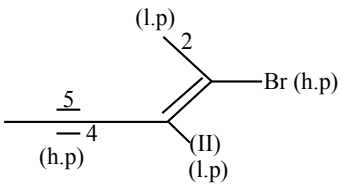
(2) (2E)-2-Bromo-hex-4-yn-2-ene

(3) (2E)-2-Bromo-hex-2-en-4-yne

(4) (4E)-5-Bromo-hex-2-en-4-yne

**Official Ans. by NTA (3)**

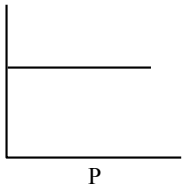
**Sol.**

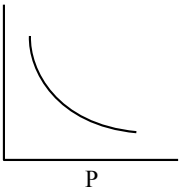


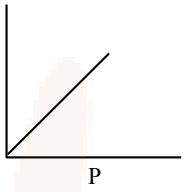

h.p. $\Rightarrow$ higher priority
l.p. $\Rightarrow$ lower priority

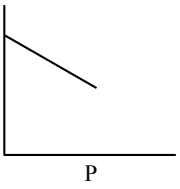
2E –2- bromo hex –2- en–4-yne

**16.** Which one of the following is the correct PV vs P plot at constant temperature for an ideal gas ? (P and V stand for pressure and volume of the gas respectively)

(1) 


(2) 

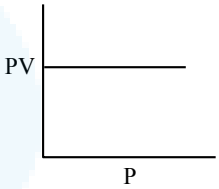

(3) 


(4) 


**Official Ans. by NTA (1)**

**Sol.** PV = nRT (n,T constant)

PV = constant




**17.** Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)** :

**Assertion (A) :** A simple distillation can be used to separate a mixture of propanol and propanone.

**Reason (R) :** Two liquids with a difference of more than 20°C in their boiling points can be separated by simple distillations.

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 correct but **(R)** is not the correct explanation of **(A)**

(3) **(A)** is true but **(R)** is false

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

**Official Ans. by NTA (4)**

**Sol.** Both assertion & reason are correct & (R) is the correct explanation of (A)

**18.** Which one of the following 0.10 M aqueous solutions will exhibit the largest freezing point depression ?

(1) hydrazine (2) glucose

(3) glycine (4) $KHSO_4$

**Official Ans. by NTA (4)**

**18.** $\because$ Van't Hoff factor is highest for $KHSO_4$

$\therefore$ colligative property ($\Delta T_f$) will be highest for $KHSO_4$

**19.** BOD values (in ppm) for clean water (A) and polluted water (B) are expected respectively :

(1) A > 50, B < 27 (2) A > 25, B < 17

(3) A < 5, B > 17 (4) A > 15, B > 47

**Official Ans. by NTA (3)**

**Sol.** BOD values of clean water (A) is less than 5 ppm

So A < 5

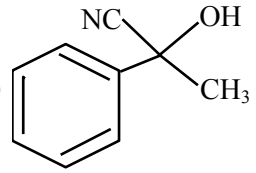
BOD values of polluted water (B is greater than 17 ppm

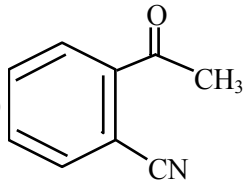
So B > 17

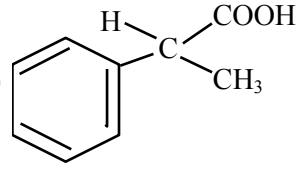
So Ans. is 3

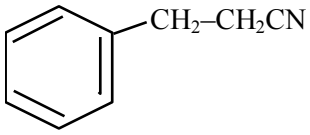
**20.** The structure of product C, formed by the following sequence of reactions is :

$CH_3COOH + SOCl_2 \longrightarrow A \xrightarrow[AlCl_3]{Benzene} B \xrightarrow[-OH]{KCN} C$

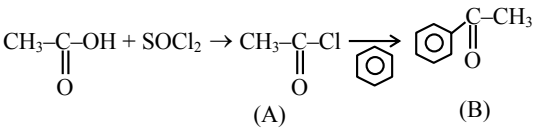
(1) 

(2) 

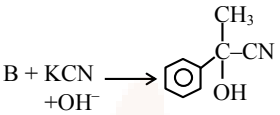
(3) 

(4) 

**Official Ans. by NTA (1)**

**Sol.** 

(A) (B)



## SECTION-B

**1.** Consider the following cell reaction :

$$Cd_{(s)} + Hg_2SO_{4(s)} + \frac{9}{5}H_2O_{(l)} \rightleftharpoons CdSO_4 \cdot \frac{9}{5}H_2O_{(s)} + 2Hg_{(l)}$$

The value of $E^0_{cell}$ is 4.315 V at 25°C. If $\Delta H° = -825.2$ kJ mol$^{-1}$, the standard entropy change $\Delta S°$ in J K$^{-1}$ is _____. (Nearest integer)

[Given : Faraday constant = 96487 C mol$^{-1}$]

**Official Ans. by NTA (25)**

**Sol.** $\Delta G° = -nFE° = \Delta H° - T\Delta S°$

$$= \frac{\Delta H° + nFE°}{T}$$

$$= \frac{\left(-825.2\times10^3\right) + \left(2\times96487\times4.315\right)}{298}$$

$$= \frac{-825.2\times10^3 + 832.682\times10^3}{298}$$

$$= \frac{7.483\times10^3}{298} = 25.11 \text{ JK}^{-1}\text{mol}^{-1}$$

$\therefore$ Nearest integer answer is 25

**2.** The molarity of the solution prepared by dissolving 6.3 g of oxalic acid ($H_2C_2O_4.2H_2O$) in 250 mL of water in mol L$^{-1}$ is x × 10$^{-2}$. The value of x is _____. (Nearest integer)

[Atomic mass : H : 1.0, C : 12.0, O : 16.0]

**Official Ans. by NTA (20)**

**Sol.** $[H_2C_2O_4.2H_2O] = \frac{\text{weight}/M_W}{V(L)}$

$$\Rightarrow x \times 10^{-2} = \frac{6.3/126}{250/1000}$$

$x = 20$

**3.** Consider the sulphides HgS, PbS, CuS, $Sb_2S_3$, $As_2S_3$ and CdS. Number of these sulphides soluble in 50% $HNO_3$ is _____.

**Official Ans. by NTA (4)**

**Sol.** Pbs, CuS, $As_2S_3$, CdS are soluble in 50% $HNO_3$

HgS, $Sb_2S_3$ are insoluble in 50% $HNO_3$

So Answer is 4.

**4.** The total number of reagents from those given below, that can convert nitrobenzene into aniline is _____. (Integer answer)

I. Sn – HCl

II. Sn – $NH_4OH$

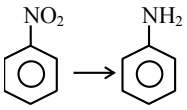
III. Fe – HCl

IV. Zn – HCl

V. $H_2$ – Pd

VI. $H_2$ – Raney Nickel

**Official Ans. by NTA (5)**

**Sol.** 

Reagents used can be

(i) Sn + HCl

(ii) Fe + HCl

(iii) Zn + HCl

(iv) $H_2$ – Pd

(v) $H_2$ (Raney Ni)

**5.** The number of halogen/(s) forming halic (V) acid is _____.

**Official Ans. by NTA (3)**

**Sol.** The number of halogen forming halic (V) acid

$HClO_3$

$HBrO_3$

$HIO_3$

So Answer is 3

**6.** For a first order reaction, the ratio of the time for 75% completion of a reaction to the time for 50% completion is _____. (Integer answer)

**Official Ans. by NTA (2)**

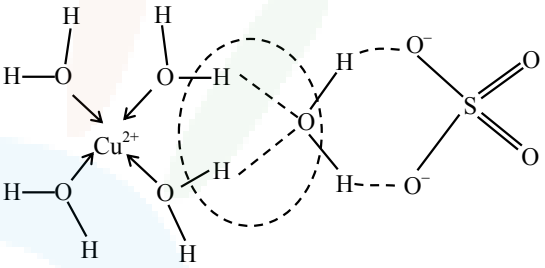
**Sol.** $k = \frac{2.303}{t}\log\frac{a}{a-x}$

$$\frac{2.303}{t_{50\%}}\log\frac{100}{100-50} = \frac{2.303}{t_{75\%}}\log\frac{100}{100-75}$$

$t_{75\%} = 2\ t_{50\%}$

**7.** The number of hydrogen bonded water molecule(s) associated with stoichiometry $CuSO_4.5H_2O$ is _____.

**Official Ans. by NTA (1)**

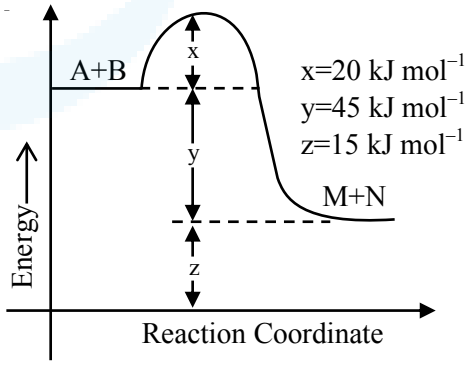
**Sol.** 

One hydrogen bonded $H_2O$ molecule

**8.** According to the following figure, the magnitude of the enthalpy change of the reaction

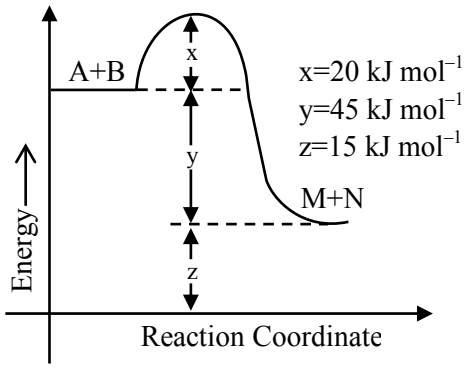
$A + B \rightarrow M + N$ in kJ $mol^{-1}$

is equal to _____. (Integer answer)




**Official Ans. by NTA (45)**

**Sol.**




$\Delta H = E_{a_f} - E_{a_b}$

$= 20 - 65$

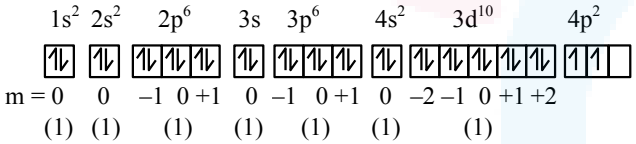
$= -45$ KJ/ mol

$|\Delta H| = 45$ KJ/mol

**9.** Ge(Z = 32) in its ground state electronic configuration has x completely filled orbitals with $m_l = 0$. The value of x is _____.

**Official Ans. by NTA (7)**

**Sol.**




Completely filled orbital with $m_\ell = 0$ are

$= 1+1+1+1+1+1+1$

$= 7$

So Answer is 7

**10.** $A_3B_2$ is a sparingly soluble salt of molar mass M (g mol$^{-1}$) and solubility x g L$^{-1}$ . The solubility product satisfies $K_{sp} = a\left(\frac{x}{M}\right)^5$ . The value of $a$ is _____. (Integer answer)

**Official Ans. by NTA (108)**

**Sol.** $A_3B_2\,(s) \rightleftharpoons 3A^{+2}_{(aq)} + 2B^{-3}_{(aq)}$

3s 2s

$K_{SP} = (3s)^3\,(2s)^2$

$K_{SP} = 108\ S^5$ & $s = (X/M)$

$K_{SP} = 108\left(\frac{x}{m}\right)^5$

given $K_{SP} = a\left(\frac{x}{m}\right)^5$

comparing a = 108