JEE-MAIN – JUNE, 2022

(Held On Tuesday 24th June, 2022) **TIME : 3 : 00 PM to 6 : 00 PM**

Chemistry

Test Pattern : JEE-MAIN Maximum Marks : 120

Topic Covered: FULL SYLLABUS

Important instruction:

1. Use Blue / Black Ball point pen only.
2. There are three sections of equal weightage in the question paper **Physics, Chemistry** and **Mathematics** having 30 questions in each subject. Each paper have 2 sections A and B.
3. You are awarded +4 marks for each correct answer and –1 marks for each incorrect answer.
4. Use of calculator and other electronic devices is not allowed during the exam.
5. No extra sheets will be provided for any kind of work.

Name of the Candidate (in Capitals) ____________________

Father's Name (in Capitals) ____________________

Form Number : in figures ____________________

: in words ____________________

Centre of Examination (in Capitals): ____________________

Candidate's Signature: ____________________ Invigilator's Signature : ____________________

Rough Space

YOUR TARGET IS TO SECURE GOOD RANK IN JEE-MAIN

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FINAL JEE–MAIN EXAMINATION – JUNE, 2022

(Held On Friday 24th June, 2022) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY **TEST PAPER WITH SOLUTION**

SECTION-A

1. 120 of an organic compound that contains only carbon and hydrogen gives 330g of CO_2 and 270g of water on complete combustion. The percentage of carbon and hydrogen, respectively are.

(A) 25 and 75 (B) 40 and 60

(C) 60 and 40 (D) 75 and 25

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Given mass of organic compound = 120

mass of $CO_2(g)$ = 330 g

mass of H_2O (ℓ) = 270 g

mass of carbon = $n_{CO_2} \times 12$

$= \frac{330}{44} \times 12 = 90g$

% of carbon = $\frac{90}{120} \times 100 = 75\%$

mass of hydrogen = $n_{H_2O} \times 2$

$= \frac{270}{18} \times 2 = 30g$

% of hydrogen = $\frac{30}{120} \times 100 = 25\%$

2. The energy of one mole of photons of radiation of wavelength 300 nm is

(Given : $h = 6.63 \times 10^{-34}$ Js, $N_A = 6.02 \times 10^{23} mol^{-1}$, $c = 3 \times 10^8 ms^{-1}$)

(A) 235 kJ mol^{-1} (B) 325 kJ mol^{-1}

(C) 399 kJ mol^{-1} (D) 435 kJ mol^{-1}

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Energy of one mole of photons = $\frac{hc}{\lambda} \times N_A$

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9}} \times 6.02 \times 10^{23}$

= 399.13×10^3 Joule/mole

= 399 kJ / mole

3. The correct order of bound orders of C_2^{2-}, N_2^{2-} and O_2^{2-} is, respectively.

(A) $C_2^{2-} < N_2^{2-} < O_2^{2-}$ (B) $O_2^{2-} < N_2^{2-} < C_2^{2-}$

(C) $C_2^{2-} < O_2^{2-} < N_2^{2-}$ (D) $N_2^{2-} < C_2^{2-} < O_2^{2-}$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol.

Species	Bond order
C_2^{2-}	3
N_2^{2-}	2
O_2^{2-}	1

4. At 25°C and 1 atm pressure, the enthalpies of combustion are as given below:

Substance	H_2	C(graphite)	$C_2H_6(g)$
$\frac{\Delta_C H^\ominus}{kJmol^{-1}}$	–286.0	–394.0	–1560.0

The enthalpy of formation of ethane is

(A) +54.0 kJ mol^{-1} (B) –68.0 kJ mol^{-1}

(C) –86.0 kJ mol^{-1} (D) +97.0 kJ mol^{-1}

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. $C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell)$

$\Delta_C H(C_2H_6) = 2\Delta_f H\ CO_2(g) + 3\Delta_f H(H_2O,\ell)$

$- \Delta_f H(C_2H_6,g)$

$-1560 = 2(-394) + 3(-286) - \Delta_f H(C_2H_6,g)$

$\Delta_f H(C_2H_6,g) = -86$ kJ/mole

5. For a first order reaction, the time required for completion of 90% reaction is 'x' times the half life of the reaction. The value of 'x' is

(Given: ln 10 = 2.303 and log 2 = 0.3010)

(A) 1.12 (B) 2.43

(C) 3.32 (D) 33.31

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Given $t_{0.90} = t_{0.90} = xt_{1/2}$

First order rate constant

$$K = \frac{\ln 2}{t_{1/2}} = \frac{1}{xt_{1/2}} \ln \frac{A_0}{A_0 - A_0 \times \frac{90}{100}}$$

$$\frac{\ln 2}{t_{1/2}} = \frac{\ln 10}{xt_{1/2}}$$

$$x = \frac{\ln 10}{\ln 2} = \frac{2.303}{2.303 \times 0.3010} = 3.32$$

6. Metals generally melt at very high temperature. Amongst the following, the metal with the highest melting point will be

(A) Hg (B) Ag

(C) Ga (D) Cs

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Hg, Ga, Cs are liquid near room temperature But Ag(silver) is solid.

7. Which of the following chemical reactions represents Hall-Heroult Process?

(A) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$

(B) $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

(C) $FeO + CO \rightarrow Fe + CO_2$

(D) $2\left[Au(CN)_2\right]^-_{(aq)} + Zn(s) \rightarrow 2Au(s) + \left[Zn(CN_4)\right]^{2-}$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Hall Heroult process is the major industrial process for extraction of aluminium.

8. In the industrial production of which of the following, molecular hydrogen is obtained as a byproduct?

(A) NaOH (B) NaCl

(C)Na metal (D) Na_2CO_3

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Sodium hydroxide is generally prepared commercially by electrolysis of sodium chloride in castner Kellner cell.

at cathode : $Na + e^- \xrightarrow{Hg} Na -$ amalgum

Anode : $Cl^- \longrightarrow \frac{1}{2}Cl_2 + e^-$

The Na–amalgam is treated with water to give sodium hydroxide and hydrogen gas :

$2Na \text{ (amalgam)} + H_2O \rightarrow 2NaOH + H_2 + 2Hg$

9. Which one of the following compounds is used as a chemical in certain type of fire extinguishers?

(A) Baking Soda (B) Soda ash

(C) Washing Soda (D) Caustic Soda

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Sodium hydrogencarbonate (Baking soda), $NaHCO_3$ is used in the fire extinguishers.

10. PCl_5 is well known. but NCl_5 is not. Because.

(A) nitrogen is less reactive than phosphorous.

(B) nitrogen doesn't have d-orbitals in its valence shell.

(C) catenation tendency is weaker in nitrogen than phosphorous.

(D) size of phosphorous is larger than nitrogen.

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. PCl_5 forms five bonds by using the d–orbitals to "expand the octet". But NCl_5 does not exist because there are no d–orbitals in the valence shell (2^{nd} shell). Therefore there is no way to expand the octet.

11. Transition metal complex with highest value of crystal field splitting (Δ_0) will be

(A) $\left[Cr(H_2O)_6\right]^{3+}$ (B) $\left[Mo(H_2O)_6\right]^{3+}$

(C) $\left[Fe(H_2O)_6\right]^{3+}$ (D) $\left[Os(H_2O)_6\right]^{3+}$

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. CFSE of octahedral complexes with water is greater for 5d series metal centre ion as compared to 3d and 4d series metal centre.

12. Some gases are responsible for heating of atmosphere (green house effect). Identify from the following the gaseous species which does not cause it.

(A) CH_4 (B) O_3

(C) H_2O (D)N_2

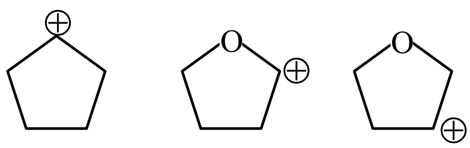
Official Ans. by NTA (D)

Allen Ans. (D)

Sol. CH_4, O_3 and H_2O causes global warming in Tropospheric level.

N_2 does not cause global warming.

13. Arrange the following carbocations in decreasing order of stability.



A B C

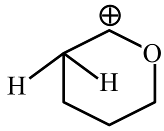
(A) A > C > B (B) A > B > C

(C) C > B > A (D) C > A > B

Official Ans. by NTA (A)

Allen Ans. (Bonus)

Sol. Carbocation is stabilised by resonance with lone pairs on oxygen atom and +H effect of 2a hydrogens



B > A > C

14. Given below are two statements.

Statement I : The presence of weaker π- bonds make alkenes less stable than alkanes.

Statement II : The strength of the double bond is greater than that of carbon-carbon single bond.

In the light of the above statements, choose the *correct* answer from the options given below.

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect.

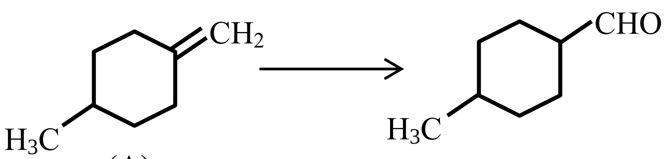
(C) Statement I is correct but Statement II is incorrect.

(D) Statement I is incorrect but Statement II is correct.

Official Ans. by NTA (A)

Allen Ans. (A)

15. Which of the following reagents/ reactions will convert 'A' to 'B'?



(A) (B)

(A) PCC oxidation

(B) Ozonolysis

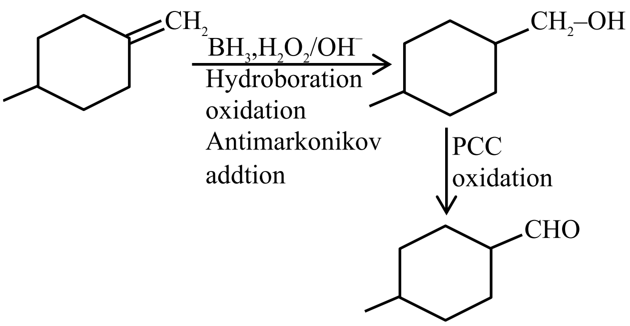
(C) BH_3,H_2O_2 / ^{-}OH followed by PCC oxidation

(D)HBr, hydrolysis followed by oxidation by $K_2Cr_2O_7$.

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. BH_3, $H_2O_2/^{-}OH$ followed by PCC oxidation.



16. Hex-4-ene-2-ol on treatment with PCC gives 'A'. 'A' on reaction with sodium hypoiodite gives 'B', which on further heating with soda lime gives 'C'. The compound 'C' is

(A) 2- pentene (B) proponaldehyde

(C) 2-butene (D) 4-methylpent-2-ene

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.

$CH_3–CH=CH–CH_2–\underset{\displaystyle |\atop OH}{CH}–CH_3$

$\downarrow$ PCC

$CH_3–CH=CH–CH_2–\underset{\displaystyle \|\atop O}{C}H–CH_3$ (A)

$\downarrow$ NaOI

$CH_3–CH=CH–CH_2–COOH + CHI_3$ (B)

$\downarrow$ NaOH+CaO, $–CO_2$

$CH_3–CH=CH–CH_3$ (C) But-2-ene

17. The conversion of propan-1-ol to n-butylamine involves the sequential addition of reagents. The correct sequential order of reagents is.

(A)(i) $SOCl_2$ (ii) KCN (iii) H_2/Ni,Na(Hg)/C_2H_5OH

(B) (i) HCl (ii) H_2/Ni, Na(Hg)/C_2H_5OH

(C) (i) $SOCl_2$ (ii) KCN (iii) CH_3NH_2

(D) (i) HCl (ii) CH_3NH_2

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

$\underset{\text{Propanol}}{CH_3–CH_2–CH_2–OH} \longrightarrow \underset{\text{n-Butanamine}}{CH_3–CH_2–CH_2–CH_2NH_2}$

$\downarrow SOCl_2$ $\qquad$ $\uparrow H_2/Ni, Hg/C_2H_5OH$

$CH_3–CH_2–CH_2–Cl \xrightarrow{KCN} CH_3–CH_2–CH_2–CN$

18. Which of the following is **not** an example of a condensation polymer?

(A) Nylon 6,6 (B) Decron

(C) Buna-N (D) Silicone

Official Ans. by NTA (C)

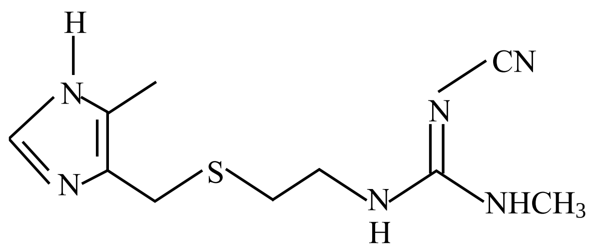
Allen Ans. (C)

Sol. Buna-N is an addition copolymer of 1,3-butadiene and acrylonitrile.

$CH_2=CH–CH=CH_2 + CH_2=\underset{\displaystyle |\atop CN}{C}H$

$\underset{\text{Buna-N}}{[–CH_2–CH=CH–CH_2–CH_2–\underset{\displaystyle |\atop CN}{C}H–]_n}$

19. The structure shown below is of which well-known drug molecule?



(A) Ranitidine (B) Seldane

(C) Cimetidine (D) Codeine

Official Ans. by NTA (C)

Allen Ans. (C)

20. In the flame test of a mixture of salts, a green flame with blue centre was observed. Which one of the following cations may be present?

(A) Cu^{2+} (B) Sr^{2+}

(C) Ba^{2+} (D) Ca^{2+}

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

Ion	Colour of the flame
(A) Cu^{+2}	green flame with blue centre
(B) Sr^{2+}	Crimson Red
(C) Ba^{2+}	Apple green

SECTION-B

1. At 300 K, a sample of 3.0 g of gas A occupies the same volume as 0.2 g of hydrogen at 200 K at the same pressure. The molar mass of gas A is____ g mol^{-1} (nearest integer) Assume that the behaviour of gases as ideal. (Given: The molar mass of hydrogen (H_2) gas is 2.0 g mol^{-1})

Official Ans. by NTA (45)

Allen Ans. (45)

Sol. Given : Ideal gas A and H_2 gas at same pressure and volume.

From ideal gas equation pv = nRT

$n_1T_1 = n_2T_2$

$$\frac{3}{\text{GMM of A}} \times 300 = \frac{0.2}{2} \times 200$$

GMM of A = 45 g/mole

2. A company dissolves 'X' amount of CO_2 at 298 K in 1 litre of water to prepare soda water

X =____ × 10^{-3}g. (nearest integer)

(Given: partial pressure of CO_2 at 298 K= 0.835 bar.

Henry's law constant for CO_2 at 298 K = 1.67 kbar.

Atomic mass of H,C and O is 1, 12 and 6 g mol^{-1}, respectively)

Official Ans. by NTA (1221)

Allen Ans. (1222 & 1223)

Sol. From Henry law

$$P = K_H X_{CO_2}$$

$$0.835 = 1.67 \times 10^3 \times 1.67 \times 10^3 \times \frac{w_{CO_2}/44}{\frac{w_{CO_2}}{44} + \frac{1000}{18}}$$

$$w_{CO_2} = 1.2228\text{g} = 1222.8 \times 10^{-3}\text{ g}$$

Or

$$P = K_H X_{CO_2}$$

$$0.835 = 1.67 \times 10^3 \times \frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}}$$

$$0.835 = 1.67 \times 10^3 \times \frac{w_{CO_2}/44}{\frac{1000}{18}}$$

$$w_{CO_2} = 1.2222\text{g} = 1222.2 \times 10^{-3}\text{g}$$

3. PCl_5 dissociates as

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

5 moles of PCl_5 are placed in a 200 litre vessel which contains 2 moles of N_2 and is maintained at 600 K. The equilibrium pressure is 2.46 atm. The equilibrium constant K_p for the dissociation of PCl_5 is_____ × 10^{-3}. (nearest integer)

(Given: R = 0.082 L atm K^{-1} mol^{-1} : Assume ideal gas behaviour)

Official Ans. by NTA (1107)

Allen Ans. (1107)

Sol. Given : 2 mole of N_2 gas was present as inert gas.

Equilibrium pressure = 2.46 atm

$$PCl_5(g) \rightleftharpoons PCl_3(g) + C\ell_2(g)$$

	$PCl_5(g)$	$PCl_3(g)$	$C\ell_2(g)$
t = 0	5	0	0
t = Eq^m	5 – x	x	x

from ideal gas equation

PV = nRT

2.46 × 200 = (5 – x + x + x + 2) × 0.082 × 600

x = 3

$$K_P = \frac{n_{PCl_3} \times n_{Cl_2}}{n_{PCl_5}} \times \left[\frac{P_{total}}{n_{total}}\right]$$

$$\frac{3 \times 3}{2} \times \frac{2.46}{10} = 1.107 = 1107 \times 10^{-3}$$

4. The resistance of conductivity cell containing 0.01 M KCl solution at 298 K is 1750 Ω. If the conductively of 0.01 M KCl solution at 298 K is 0.152 × 10^{-3} S cm^{-1}, then the cell constant of the conductivity cell is_______× 10^{-3} cm^{-1}.

Official Ans. by NTA (266)

Allen Ans. (266)

Sol. $K = \frac{1}{R} \times \text{cell constant}$

$0.152 \times 10^{-3} = \frac{1}{1750}$ cell constant

cell constant = 266×10^{-3}

5. When 200 mL of 0.2 M acetic acid is shaken with 0.6 g of wood charcoal, the final concentration of acetic after adsorption is 0.1 M. The mass of acetic acid adsorbed per garm of carbon is_____ g.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. weight of wood charcoal = 0.6 g

Mass of acetic acid adsorbed = $\frac{M_1V_1 - M_2V_2}{1000} \times 60$

$= \frac{0.2 \times 200 - 0.1 \times 200}{1000} \times 60$

= 1.2 g

Mass of acetic acid adsorbed per gram of carbon = $\frac{1.2}{0.6} = 2$

6. (a) Baryte, (b) Galena, (c) Zinc blende and (d) Copper pyrites. How many of these minerals are sulphide based?

Official Ans. by NTA (3)

Allen Ans. (3)

Sol.

(1) Baryte : $BaSO_4$

(2) Galena : PbS

(3) Zinc blende : ZnS

(4) Copper pyrite : $CuFeS_2$

(2)–(4): sulphide (S^{2-}) ores

7. Manganese (VI) has ability to disproportionate in acidic solution. The difference in oxidation states of two ions it forms in acidic solution is______

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. MnO_4^{2-} disproportionates in a neutral or acidic solution to give MnO_4^- and Mn^{+4}

$$3MnO_4^{2-} + 3H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

O.S. of Mn in MnO_4^- = +7

O.S. of Mn in MnO_2 = +4

difference = 3

8. 0.2 g of an organic compound was subjected to estimation of nitrogen by Dumas method in which volume of N_2 evolved (at STP) was found to be 22.400 mL. The percentage of nitrogen in the compound is____.[nearest integer]

(Given: Molar mass of N_2 is 28 mol^{-1}. Molar volume of N_2 at STP : 22.4 L)

Official Ans. by NTA (14)

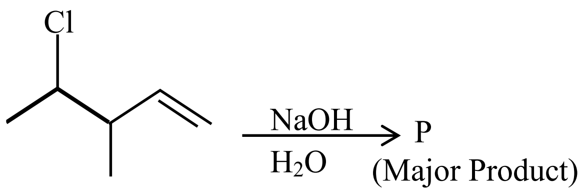
Allen Ans. (14)

Sol. weight of organic compound = 0.2g

mass of N_2(g) evolved = $\frac{22.4 \times 10^{-3}}{22.4} \times 28$

$= 28 \times 10^{-3}$g

$\% \text{ of } N = \frac{28 \times 10^{-3}}{0.2} \times 100 = 14$

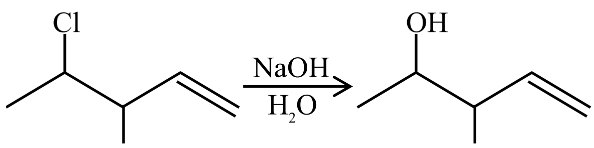
9. 

Consider the above reaction. The number of π electrons present in the product 'P' is____.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Number of π electron = 2



10. In alanylglycylleucylalanylvaline, the number of peptide linkages is______.

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. There are Five amino acids and four peptide linkages.