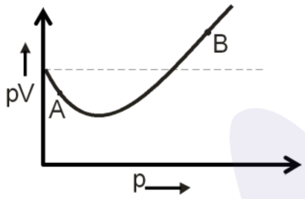
FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Sunday 29th January, 2023) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY | TEST PAPER WITH SOLUTION

SECTION-A

31. For 1 mol of gas, the plot of pV vs p is shown below. p is the pressure and V is the volume of the gas.



What is the value of compressibility factor at point A?

(1) $1-\frac{a}{RTV}$ (2) $1+\frac{b}{V}$

(3) $1-\frac{b}{V}$ (4) $1+\frac{a}{RTV}$

Official Ans. by NTA (1)

Ans. (1)

Sol. For 1 mole of real gas

PV = ZRT

from graph PV for real gas is less than PV for ideal gas at point A

$Z < 1$

$Z = 1 - \frac{a}{V_m RT}$

32. The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^+ is

(1) $\frac{5}{9\lambda}$ (2) $\frac{9\lambda}{5}$

(3) $\frac{36\lambda}{5}$ (4) $\frac{5\lambda}{9}$

Official Ans. by NTA (2)

Ans. (2)

Sol. For H: $\frac{1}{\lambda} = R_H \times 1^2\left(\frac{1}{1^2}-\frac{1}{\infty^2}\right)$ …(1)

$\frac{1}{\lambda_{He^+}} = R_H \times 2^2 \times \left(\frac{1}{4}-\frac{1}{9}\right)$ …. (2)

From (1) & (2) $\frac{\lambda_{He^+}}{\lambda} = \frac{9}{5}$

$\lambda_{He^+} = \lambda \times \frac{9}{5}$

$\lambda_{He^+} = \frac{9\lambda}{5}$

33. Which of the following salt solutions would coagulate the colloid soloution formed when $FeCl_3$ is added to NaOH solution, at the fastest rate?

(1) 10 mL of 0.2 mol dm^{-3} $AlCl_3$

(2) 10 mL of 0.1 mol dm^{-3} Na_2SO_4

(3) 10 mL of 0.1 mol dm^{-3} $Ca_3(PO_4)_2$

(4) 10 mL of 0.15 mol dm^{-3} $CaCl_2$

Official Ans. by NTA (1)

Ans. (1)

Sol. Sol. Formed is negatively charged solution, therefore Al^{3+} has highest coagulating power

34. The bond dissociation energy is highest for

(1) Cl_2

(2) I_2

(3) Br_2

(4) F_2

Official Ans. by NTA (1)

Ans. (1)

Sol. Bond energy of F_2 less than Cl_2 due to lone pair – lone pair repulsions.

Bond energy order $Cl_2 > Br_2 > F_2 > I_2$

35. The reaction representing the Mond process for metal refining is _______

(1) $Ni + 4CO \xrightarrow{\Delta} Ni(CO)_4$

(2) $2K[Au(CN)_2] + Zn \xrightarrow{\Delta} K_2[Zn(CN)_4] + 2Au$

(3) $Zr + 2I_2 \xrightarrow{\Delta} ZrI_4$

(4) $ZnO + C \xrightarrow{\Delta} Zn + CO$

Official Ans. by NTA (1)

Ans. (1)

Sol. Mond's process uses:

$Ni + 4CO \rightarrow [Ni(CO)_4]$

36. Which of the given compounds can enhance the efficiency of hydrogen storage tank?

(1) Li/P_4

(2) SiH_4

(3) $NaNi_5$

(4) Di-isobutylaluminium hydride

Official Ans. by NTA (3)

Ans. (3)

Sol. Refer NCERT

37. The correct order of hydration enthalpies is

(A) K^+

(B) Rb^+

(C) Mg^{2+}

(D) Cs^+

(E) Ca^{2+}

Choose the correct answer from the options given below:

(1) C > A > E > B > D

(2) E > C > A > B > D

(3) C > E > A > D > B

(4) C > E > A > B > D

Official Ans. by NTA (4)

Ans. (4)

Sol. Hydration enthalpies:

(i) $K^+ > Rb^+ > Cs^+$: (A) > (B) > (D)

(ii) $Mg^{+2} > Ca^{+2}$: (C) > (E)

Option (D)

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

38. The magnetic behaviour of Li_2O, Na_2O_2 and KO_2, respectively, are

(1) diamagnetic, paramagnetic and diamagnetic

(2) paramagnetic, paramagnetic and diamagnetic

(3) paramagnetic, diamagnetic and paramagnetic

(4) diamagnetic, diamagnetic and paramagnetic

Official Ans. by NTA (4)

Ans. (4)

Sol. $Li_2O \rightarrow O^{2-} \rightarrow$ diamagnetic

$Na_2O_2 \rightarrow O_2^{2-} \rightarrow$ diamagnetic

$KO_2 \rightarrow O_2^{-} \rightarrow$ paramagnetic

39. "A" obtained by Ostwald's method involving air oxidation of NH_3, upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test

(1) NO_2, N_2O_5

(2) NO_2, N_2O_4

(3) NO, NO_2

(4) N_2O_3, NO_2

Official Ans. by NTA (3)

Ans. (3)

Sol. $4NH_3 + 5O_2 \xrightarrow{\Delta} \underset{(A)}{4NO} + 6H_2O$

$2NO + O_2 \longrightarrow \underset{(B)}{2NO_2}$

40. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn & Co are -0.26 V, - 0.41 V, + 1.57 V and +1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

(1) V^{2+} and Mn^{2+}

(2) Cr^{2+} and CO^{2+}

(3) V^{2+} and Cr^{2+}

(4) Mn^{2+} and Co^{2+}

Official Ans. by NTA (3)

Ans. (3)

Sol. Metal cation with (–) value of reduction potential (M^{+3}/M^{+2})or with (+) value of oxidation potential (M^{+2}/M^{+3}) will liberate H_2

Therefore they will reduce H^+

i.eV^{+2} and Cr^{+2}

41. Correct statement about smog is

(1) NO_2 is present in classical smog

(2) Both NO_2 and SO_2 are present in classical smog

(3) Photochemical smog has high concentration of oxidizing agents

(4) Classical smog also has high concentration of oxidizing agents

Official Ans. by NTA (3)

Ans. (3)

Sol. Photochemical smog has high concentration of oxidising agents

NO_2 is produced from NO and O_3 in the presence of sunlight

Classical smog contain smoke, fog and SO_2 and it is known as reducing smog, as chemically it is reducing mixture

42. Chiral complex from the following is :

Here en = ethylene diamine

(1) cis – $[PtCl_2(en)_2]^{2+}$

(2) trans – $[PtCl_2(en)_2]^{2+}$

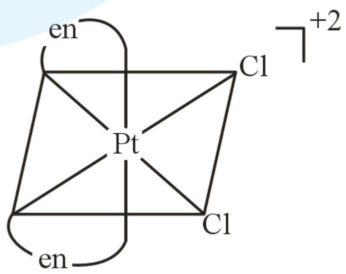
(3) cis – $[PtCl_2(NH_3)_2]$

(4) trans – $[Co(NH_3)_4Cl_2]^+$

Official Ans. by NTA (1)

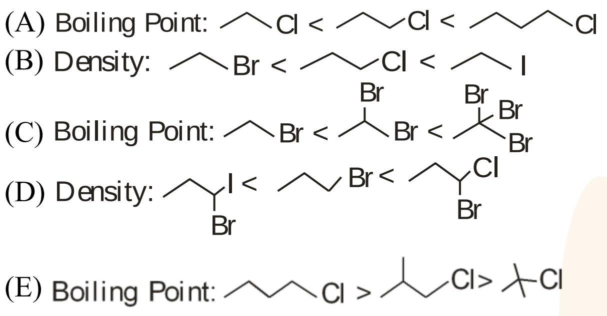
Ans. (1)

Sol.



this is chiral complex form

43. Identify the correct order for the given property for following compounds



Choose the correct answer from the option given below :-

(1) (B), (C) and (D) only

(2) (A), (C) and (E) only

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

(4) (A), (B) and (E) only

Official Ans. by NTA (2)

Ans. (2)

Sol. Boiling point of alkyl halide increases with increase in size, mass of halogen atom and size of alkyl group

Boiling point of isomeric alkyl halide decreases with increase in branching

Density increases with increase in atomic mass of halogen atom

44. The increasing order of pK_a for the following phenols is

(1) 2, 4-Dinitrophenol

(2) 4 - Nitrophenol

(3) 2, 4, 5- Trimethylphenol

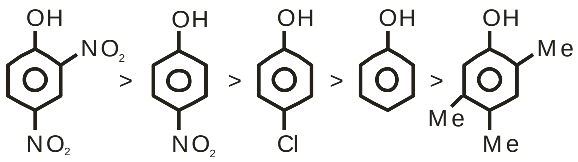
(4) Phenol

(5) 3-Chlorophenol

Official Ans. by NTA (2)

Ans. (2)

Sol. Order of acidity for following phenol is



- M and – I increases acidity

+ M and + I decreases acidity

45. Match **List I** with **List II**.

List-I	List-II
Reaction	Reagents
(A) Hoffmann Degradation	(I) Conc.KOH, Δ
(B) Clemenson reduction	(II) $CHCl_3$, $NaOH/H_3O^+$
(C) Cannizaro reaction	(III) Br_2, NaOH
(D) Reimer-Tiemann reaction	(IV) Zn-Hg/HCl

(1) (A) – III, (B) – IV, (C) – II, (D) - I

(2) (A) – II, (B) – IV, (C) – I, (D) - III

(3) (A) – III, (B) – IV, (C) – I, (D) - II

(4) (A) – II, (B) – I, (C) – III, (D) - IV

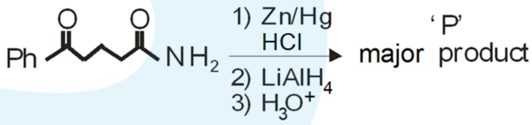
Official Ans. by NTA (3)

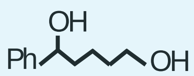
Ans. (3)

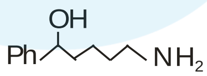
Sol.

Reactions	Reagent used
(A) Hoffmann degradation	$Br_2/NaOH$
(B) Clemenson reduction	Zn– Hg/HCl
(C) Cannizaro reaction	conc.KOH/Δ
(D) Reimer-Tiemann reaction	$CHCl_3$, $NaOH/H_3O^+$

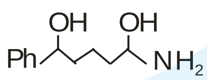
46. The major product 'P' for the following sequence of reactions is:



(1) 

(2) 

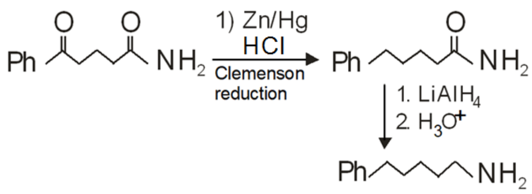
(3) 

(4) 

Official Ans. by NTA (3)

Ans. (3)

Sol.



47. During the borax bead test with $CuSO_4$, a blue green colour of the bead was observed in oxidising flame due to the formation of

(1) Cu_3B_2 (2) Cu

(3) $Cu(BO_2)_2$ (4) CuO

Official Ans. by NTA (3)

Ans. (3)

Sol. Blue green colour is due to formation of $Cu(BO_2)_2$

$CuSO_4 \xrightarrow{\Delta} CuO + SO_3$

$CuO + B_2O_3 \rightarrow Cu(BO_2)_2$

48. Match List I with List II

List I	List II
Antimicrobials	**Names**
(A) Narrow Spectrum Antibiotic	(I) Furacin
(B) Antiseptic	(II) Sulphur dioxide
(C) Disinfectants	(III) Penicillin-G
(D) Broad spectrum antibiotic	(IV) Chloramphenicol

(1) (A) – III, (B) – I, (C) – II, (D) - IV

(2) (A) – I, (B) – II, (C) – IV, (D) - III

(3) (A) – II, (B) – I, (C) – IV, (D) - III

(4) (A) – III, (B) – I, (C) – IV, (D) - II

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. (A) Narrow spectrum antibiotic – penicillin-G

(B) Antiseptic – Furacine

(C) Disinfectants – sulphur dioxide

(D) Broad spectrum antisiotics – chloramphenicol

49. Number of cyclic tripeptides formed with 2 amino acids A and B is:

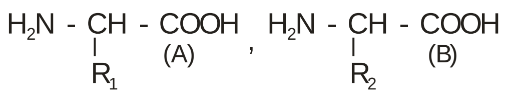
(1) 2 (2) 3

(3) 5 (4) 4

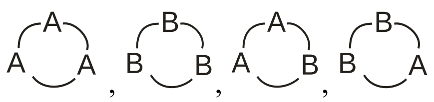
Official Ans. by NTA (4)

Ans. (4)

Sol. Two amino acid are



Tripeptide are formed from three amino acids



50. Compound that will give positive Lassaigne's test for both nitrogen and halogen is

(1) $N_2H_4.HCl$

(2) CH_3NH_2. HCl

(3) NH_4Cl

(4) $NH_2OH.HCl$

Official Ans. by NTA (2)

Ans. (2)

Sol. $CH_3NH_2 . HCl \xrightarrow[\text{fusion}]{\text{Na}} NaCN$ and NaCl

NaCN gives +ve test for nitrogen and

NaCl gives +ve test for halogen

SECTION-B

51. Millimoles of calcium hydroxide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is _______ (Nearest integer). Assume complete dissociation.

Official Ans. by NTA (5)

Allen Ans. (5)

Sol. $\because$ pH = 12

$\therefore [H^+] = 10^{-12}$ M

$\therefore [OH^-] = 10^{-2}$ M

$\therefore [Ca(OH)_2] = 5 \times 10^{-3}$ M

$$5 \times 10^{-3} = \frac{\text{milli moles of } Ca(OH)_2}{100\,mL}$$

milli moles of $Ca(OH)_2 = 5 \times 10^{-1}$

Ans. = 5

52. The number of molecules or ions from the following, which do not have odd number of electrons are _________ .

(A) NO_2

(B) ICl_4^-

(C) BrF_3

(D) ClO_2

(E) NO_2^+

(F) NO

Official Ans. by NTA (3)

Ans. (3)

Sol. BrF_3 and NO_2^+ do not have odd number of e^-

53. Consider the following reaction approaching equilibrium at 27ºC and 1 atm pressure

$$A + B \underset{K_r = 10^2}{\overset{K_f = 10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change $(\Delta_r G^\circ)$ at 27ºC is (–) _______ kJ mol^{-1}

(Nearest integer).

(Given : R = 8.3 J K^{-1} mol^{-1} and ln 10=2.3)

Official Ans. by NTA (6)

Ans. (6)

Sol. $\because \Delta G^\circ = -RT \ln K_{eq}$

and $K_{eq} = \frac{K_f}{K_b}$

$\therefore K_{eq} = \frac{10^3}{10^2} = 10$

$\therefore \Delta G = -RT \ln 10$

$\Rightarrow -(8.3 \times 300 \times 2.3) = -5.7$ kJ $mole^{-1} \approx 6$ kJ $mole^{-1}$(nearest integer)

Ans = 6

54. Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15ºC. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at –0.8º C. The solutbility product of $PbCl_2$ formed is ______ $\times 10^{-6}$ at 298 K. (Nearest integer)

Given : K_b = 0.5 K kg mol^{-1} and K_f = 1.8 kg mol^{-1}. Assume molality to be equal to molarity in all cases.

Official Ans. by NTA (13)

Ans. (13)

Sol. Let a mole $Pb(NO_3)_2$ be added

$Pb(NO_3)_2 \rightarrow Pb^{2+} + 2NO_3^-$

a a 2a

$\Delta T_b = 0.15 = 0.5\,[3a] \Rightarrow a = 0.1$

$$Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_2(s)$$

t = 0 0.1 0.2

t = ∞ (0.1 – x) (0.2 – 2x)

In final solution

$$\Delta T_f = 0.8 = 1.8\left[\frac{0.3 - 3x + 0.2 + 0.2}{1}\right]$$

$$\Rightarrow x = \frac{2.3}{27}$$

$$\Rightarrow K_{sp} = \left(0.1 - \frac{2.3}{27}\right)\left(0.2 - \frac{4.6}{27}\right)^2 = 13 \times 10^{-6}$$

55. Water decomposes at 2300 K

$$H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$$

The percent of water decomposing at 2300 K and 1 bar is ________ (Nearest integer).

Equilibrium constant for the reaction is 2×10^{-3} at 2300 K

Official Ans. by NTA (2)

Ans. (2)

Sol. $H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$

$P_0[1-\alpha]$ $P_0\alpha$ $\frac{P_0\alpha}{2}$ partial pr. at eq.

$$P_0\left[1 + \frac{\alpha}{2}\right] = 1 \qquad ...(i)$$

$$K_p = \frac{(P_{H_2})(P_{O_2})^{1/2}}{P_{H_2O}}$$

$$\frac{(P_0\alpha)\left(\frac{P_0\alpha}{2}\right)^{1/2}}{P_0[1-\alpha]} = 2\times10^{-3}$$

since α is negligible w.r.t 1 so $P_0 = 1$ and $1 - \alpha \approx 1$

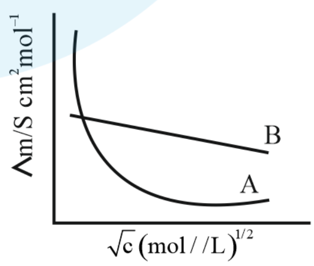
$$\frac{\alpha\sqrt{\alpha}}{\sqrt{2}} = 2\times10^{-3}$$

$\alpha^{3/2} = 2^{3/2} \times 10^{-3}$

$\alpha = 2^{3/2 \times 2/3} \times 10^{-3 \times 2/3}$

$\alpha = 2 \times 10^{-2}$ $\%\,\alpha = 2\%$

56. Following figure shows dependence of molar conductance of two electrolytes on concentration. $\overset{0}{\Lambda m}$ is the limiting molar conductivity.



The number of **Incorrect** statement(s) from the following is ________

(A) Λ_m^0 for electrolyte A is obtained by extrapolation

(B) For electrolyte B, vx Λm vs $\sqrt{c}$ graph is a straight line with intercept equal to Λ_m^0

(C) At infinite dilution, the value of degree of dissociation approach zero for electrolyte B.

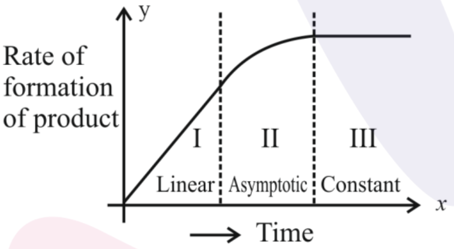
(D) Λ_m^0 for any electrolyte A or B can be calculated using λ^o for individual ions.

Official Ans. by NTA (2)

Ans. (2)

Sol. Statement (A) and Statement (C) are incorrect

57. For certain chemical reaction $X \rightarrow Y$, the rate of formation of product is plotted against the time as shown in the figure. The number of **Correct** statement/s from the following is _______



(A) Over all order of this reaction is one

(B) Order of this reaction can't be determined

(C) In region-I and III, the reaction is of first and zero order respectively

(D) In region-II, the reaction is of first order

(E) In region-II, the order of reaction is in the range of 0.1 to 0.9.

Official Ans. by NTA (2)

Ans. (1)

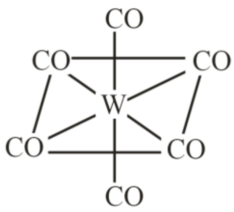
Sol. Only option (B) is correct as order cannot be determined

58. The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is ________ .

Official Ans. by NTA (0)

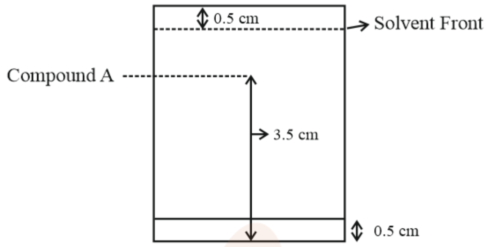
Ans. (0)

Sol.



$[(CO)_5Mn - Mn(CO)_5]$

59. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound 'A' is ______ $\times 10^{-1}$.



Official Ans. by NTA (6)

Ans. (6)

Sol. $R_f = \dfrac{\text{Distance moved by the substance from base line}}{\text{Distance moved by the solvent from base line}}$

$= \dfrac{3.0 \text{ cm}}{5.0 \text{ cm}} = 0.6$ or 6×10^{-1}

60. 17 mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at 0ºC and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields

$CH_3-\underset{\underset{O}{\|}}{C}-CH_3$, $H-\underset{\underset{O}{\|}}{C}-H$, $H-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-H$

The number of double bond/s present in the hydrocarbon is ________ .

Official Ans. by NTA (3)

Ans. (3)

Sol. Moles of hydrocarbon $= \dfrac{17 \times 10^{-3}}{136} = 1.25 \times 10^{-4}$

Mole of H_2 gas

$\Rightarrow 1 \times \dfrac{8.40}{1000} = n \times 0.0821 \times 273$

$\Rightarrow n = 3.75 \times 10^{-4}$

Hydrogen molecule used for 1 molecule of hydrocarbon is 3

$= \dfrac{3.75 \times 10^{-4}}{1.25 \times 10^{-4}} = 3$