JEE Main 2023 (1st Attempted)
(Shift - 02 Chemistry Paper) 24.01.2023

CHEMISTRY | **TEST PAPER WITH ANSWER**

SECTION-A

31. Which one amongst the following are good oxidizing agents?

A. Sm^{2+} B. Ce^{2+}

C. Ce^{4+} D. Tb^{4+}

Choose the most appropriate answer from the options given below :

(1) C only

(2) D only

(3) A and B only

(4) C and D only

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Ce^{+4} and Tb^{+4} act as oxidising agent.

32. What is the number of unpaired electron(s) in the highest occupied molecular orbital of the following species : $N_2 : N_2^+; O_2; O_2^+$?

(1) 0, 1, 2, 1 (2) 2, 1, 2, 1

(3) 0, 1, 0, 1 (4) 2, 1, 0, 1

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. N_2 -

$$\sigma ls^2\ \sigma^* ls^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2 = \pi 2p_y^2\ \underbrace{\sigma 2p_z^2}_{\text{HOMO}}$$

$$N_2^+ - \sigma ls^2\ \sigma^* ls^2\ \sigma^* 2s^2 \sigma^* 2s^2\ \pi 2p_x^2 = \pi 2p_y^2\ \underbrace{\sigma 2p_z^1}_{\text{HOMO}}$$

$$O_2 - \sigma ls^2\ \sigma^* ls^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2$$

$$\pi 2p_x^2 = \pi 2p_y^2$$

$$\pi^* 2p_x^1 = \pi^* 2p_y^1 (\text{HOMO})$$

$$O_2^+ - \sigma ls^2\ \sigma^* ls^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2 = \pi 2p_y^2$$

$$\pi^* 2p_x^1 = \pi^* 2p_y^0 (\text{HOMO})$$

$N_2 \Rightarrow$ 0 unpaired e^- in HOMO

$N_2^+ \Rightarrow$ 1 unpaired e^- in HOMO

$O_2 \Rightarrow$ 2 unpaired e^- in HOMO

$O_2^+ \Rightarrow$ 1 unpaired e^- in HOMO

33. Which of the following cannot be explained by crystal field theory?

(1) The order of spectrochemical series

(2)Magnetic properties of transition metal complexes

(3) Colour of metal complexes

(4) Stability of metal complexes

Official Ans. by NTA (4)

Allen Ans. (1)

Sol. Crystal field theory introduce spectrochemical series based upon the experimental values of Δ but can't explain it's order. While other three points are explained by CFT. Specially when the CFSE increases thermodynamic stability of the complex increases.

34. A student has studied the decomposition of a gas AB_3 at 25°C. He obtained the following data.

p (mm Hg)	50	100	200	400
Relative $t_{1/2}$ (s)	4	2	1	0.5

The order of the reaction is

(1) 0.5 (2) 2

(3) 1 (4) 0 (zero)

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $t_{\frac{1}{2}} \propto (P_O)^{1-n}$

$$\frac{(t_{\frac{1}{2}})_1}{(t_{\frac{1}{2}})_2} = \frac{(P_0)_1^{1-n}}{(P_{0_2})_2^{1-n}}$$

$$\Rightarrow \left(\frac{4}{2}\right) = \left(\frac{50}{100}\right)^{1-n}$$

$$\Rightarrow 2 = \left(\frac{1}{2}\right)^{1-n}$$

$$\Rightarrow 2 = (2)^{n-1}$$

$$\Rightarrow n - 1 = 1 \quad \Rightarrow n = 2$$

35. The number of s-electrons present in an ion with 55 protons in its unipositive state is

(1) 8 (2) 9

(3) 12 (4) 10

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $Z = 55$ [Cs] $\Rightarrow$ [Xe] $6s^1$

$[Cs^+] \Rightarrow$ [Xe] i.e. upto 5s count e^- of s-subshell

i.e. 1s, 2s, 3s, 4s, 5s $\Rightarrow$ 10 electrons

36. In which of the following reactions the hydrogen peroxide acts as a reducing agent?

(1) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(2) $2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2OH^-$

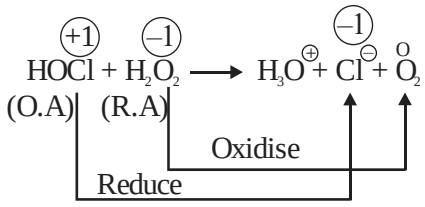
(3) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(4) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

Official Ans. by NTA (3)

Allen Ans. (3)

Sol.



37. The metal which is extracted by oxidation and subsequent reduction from its ore is :

(1) Al (2) Ag

(3) Cu (4) Fe

Official Ans. by NTA (2)

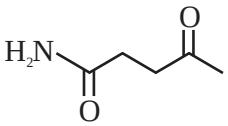
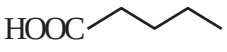
Allen Ans. (2)

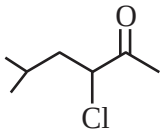
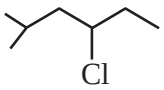
Sol. Ag.

$4Ag + 8CN^- + O_2 + 2H_2O \rightarrow 4[Ag(CN)_2]^- + 4OH^-$

$2[Ag(CN)_2]^{-1} + Zn \rightarrow 2Ag\downarrow + [Zn(CN)_4]^{-2}$

38. Given below are two statements :

Statement I :  under Clemmensen reduction conditions will give  .

Statement II :  under Wolff-Kishner reduction condition will give 

In the light of the above statements, choose the correct 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

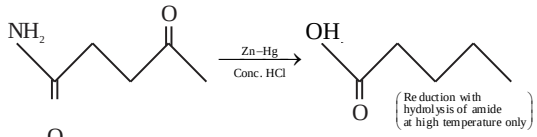
(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are true

Official Ans. by NTA (3)

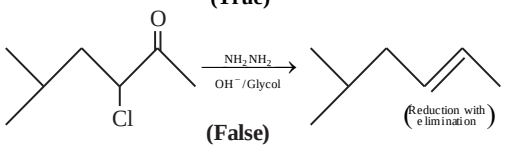
Allen Ans. (3)

Sol. S – I



(True)

S – II



(False)

39. Given below are two statements, one is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : Beryllium has less negative value of reduction potential compared to the other alkaline earth metals.

Reason R : Beryllium has large hydration energy due to small size of Be^{2+} but relatively large value of atomization enthalpy.

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

(1) A is correct but R is not correct

(2) Both A and R are correct and R is the correct explanation of A.

(3) A is not correct but R is correct

(4) Both A and R are correct and R is NOT the correct explanation of A.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Be has less negative value compared to other AEM. However it's reducing nature is due to large hydration energy associated with the small size of Be^{2+} ion and relatively large value of the atomization enthalpy of metal.

40. Match List I with List II

LIST I Type		**LIST II Name**	
A.	Antifertility drug	I.	Norethindrone
B.	Tranquilizer	II.	Meprobomate
C.	Antihistamine	III.	Seldane
D.	Antibiotic	IV.	Ampicillin

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Theoretical, NCERT based.

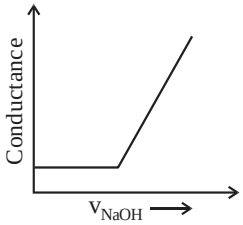
41. Given below are two statements, one is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A : Benzene is more stable than hypothetical cyclohexatriene.
Reason R : The delocalized π electron cloud is attracted more strongly by nuclei of carbon atoms.
In the light of the above statements, choose the correct 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 (3)
Allen Ans. (3)

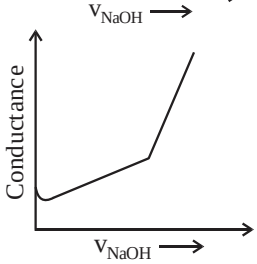
Sol. **Assertion – A :** Benzene is more stable than cyclohexatriene **(True)**

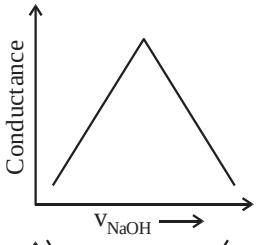
Reason – R : Delocalised $\pi-e$ cloud lies B.M.O so more attracted by nuclei of carbon atom.

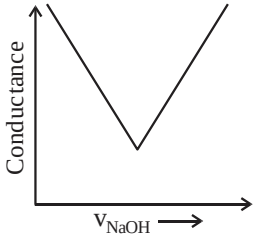
(True & Correct Explanation)

42. Choose the correct representation of conductometric titration of benzoic acid vs sodium hydroxide.

(1)


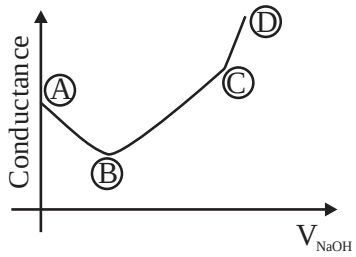
(2)


(3)


(4)


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

Sol. $\underset{(WA)}{C_6H_5COOH} + \underset{(SB)}{NaOH} \longrightarrow \underset{(Salt)}{C_6H_5COONa} + H_2O$

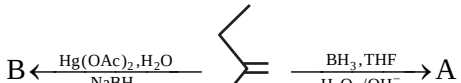


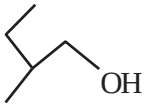
(A) $\rightarrow$ (B) Free H^+ ions are replaced by $Na^{\oplus}$ which decreases conductance.

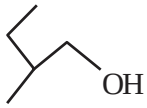
(B) $\rightarrow$ (C) Un-dissociated benzoic acid reacts with NaOH and forms salt which increases ions & conductance increases.

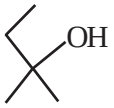
(C) $\rightarrow$ (D) After equivalence point at (3), NaOH added further increases $Na^{\oplus}$ & $OH^{\odot}$ ions which further increases the conductance.

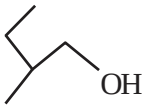
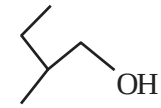
43. Find out the major products from the following reactions.



(1) A =  , B = 

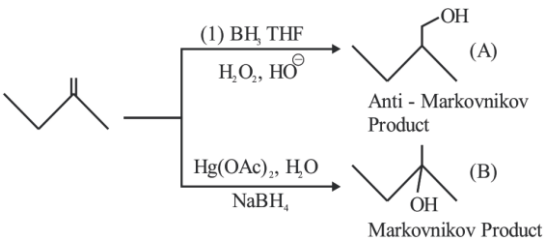
(2) A =  , B = 

(3) A =  , B = 

(4) A =  , B = 

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

Sol.



44. Correct statement is :
(1) An average human being consumes more food than air
(2) An average human being consumes nearly 15 times more air than food
(3) An average human being consumes equal amount of food and air
(4) An average human being consumes 100 times more air than food

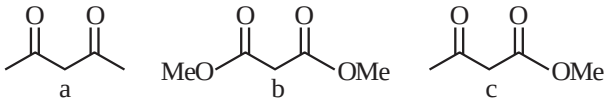
Official Ans. by NTA (2)
Allen Ans. (2)

Sol. Theoretical.

45. Given below are two statements :
Statement I : Pure Aniline and other arylamines are usually colourless.
Statement II : Arylamines get coloured on storage due to atmospheric reduction.
In the light of the above statements, choose the most appropriate answer from the options given below :
(1) Both Statement I and Statement II are incorrect
(2) Both Statement I and Statement II are correct
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Official Ans. by NTA (3)
Allen Ans. (3)

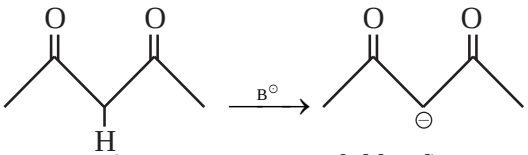
Sol. **Statement – 1 is (True)**
Pure aniline is colourless liquid
Statement – 2 is (False)
Aniline becomes dark brown due to action of air and light [oxidation]

46. Which will undergo deprotonation most readily in basic medium?



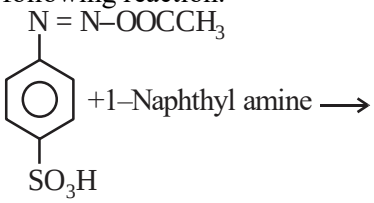
(1) a only
(2) c only
(3) Both a and c
(4) b only
Official Ans. by NTA (1)
Allen Ans. (1)

Sol. Most easily deprotonation



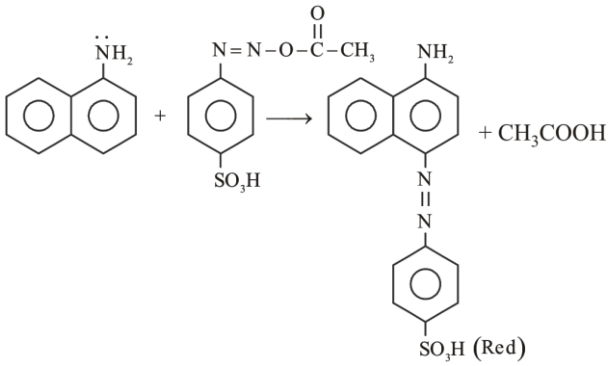
(More resonance stabilibsed)

47. Choose the correct colour of the product for the following reaction.



(1) Yellow (2) White
(3) Red (4) Blue
Official Ans. by NTA (3)
Allen Ans. (3)

Sol.



48. Identify the correct statements about alkali metals.
A. The order of standard reduction potential $(M^+ | M)$ for alkali metal ions is Na > Rb > Li.
B. CsI is highly soluble in water.
C. Lithium carbonate is highly stable to heat.
D. Potassium dissolved in concentrated liquid ammonia is blue in colour and paramagnetic.
E. All the alkali metal hydrides are ionic solids.
Choose the correct answer from the options given below
(1) A, B, D only (2) C and E only
(3) A and E only (4) A, B and E only
Official Ans. by NTA (3)
Allen Ans. (3)

Sol. (1) Na > Cs > Li – true {If considered with sign}
The low solubility of CsI is due to smaller hydration enthalpy of it's two ions .
Li_2CO_3 is highly stable to heat - false
In Conc. NH_3, K formed blue solution – true
All the alkali metal hydrides are ionic solid (True).

49. The hybridization and magnetic behaviour of cobalt ion in $[Co(NH_3)_6]^{3+}$ complex, respectively is
(1) sp^3d^2 and diamagnetic
(2) d^2sp^3 and paramagnetic
(3) d^2sp^3 and diamagnetic
(4) sp^3d^2 and paramagnetic
Official Ans. by NTA (3)
Allen Ans. (3)

Sol. $[Co(NH_3)_6]^{+3}$ – d^2sp^3, diamagnetic

50. $K_2Cr_2O_7$ paper acidified with dilute H_2SO_4 turns green when exposed to
(1) Carbon dioxide
(2) Sulphur trioxide
(3) Hydrogen sulphide
(4) Sulphur dioxide
Official Ans. by NTA (4)
Allen Ans. (4)

Sol. $3SO_2 + Cr_2O_7^{2-} + 2H^+ \rightarrow 3SO_4^{2-} + 2Cr^{+3} + H_2O$
green

SECTION-B

51. The number of statement/s which are the characteristics of physisorption is _____.

A. It is highly specific in nature

B. Enthalpy of adsorption is high

C. It decreases with increase in temperature

D. It results into unimolecular layer

E. No activation energy is needed

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. **For physisorptions**

(a)Decreases with increase in temperature

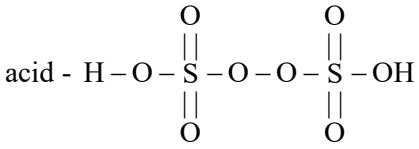
(b)No appreciable activation energy is required

52. Sum of π-bonds present in peroxodisulphuric acid and pyrosulphuric acid is

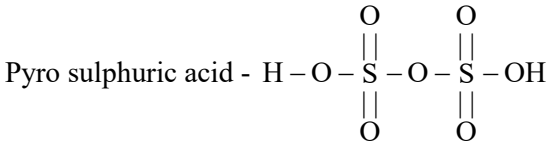
Official Ans. by NTA (8)

Allen Ans. (8)

Sol. Peroxodisulphuric



No. of π – bonds = 4



No. of π – bonds = 4

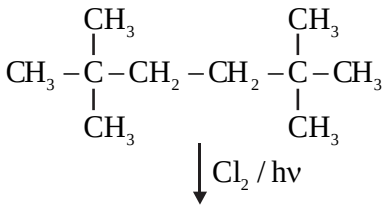
Total π – bonds = 8

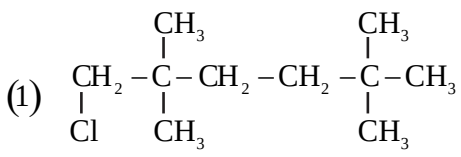
53. Maximum number of isomeric monochloro derivatives which can be obtained from 2,2,5,5-tetramethylhexane by chlorination is _____

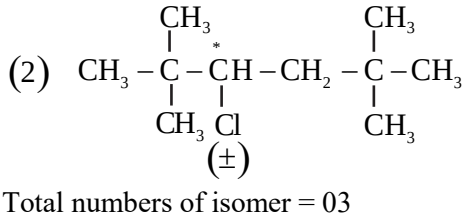
Official Ans. by NTA (3)

Allen Ans. (3)

Sol.







Total numbers of isomer = 03

54. Total number of tripeptides possible by mixing of valine and proline is _____

Official Ans. by NTA (8)

Allen Ans. (8)

Sol. No. of possible tripeptide :

Val & Pro is 2^3

(1) val – val – val (2)pro – pro – pro

(3)val – pro – pro (4)pro – val – pro

(5)val – val – pro (6)val – pro – val

(7)pro – pro – val (8)pro – val – val

55. The number of units, which are used to express concentration of solutions from the following is _____.

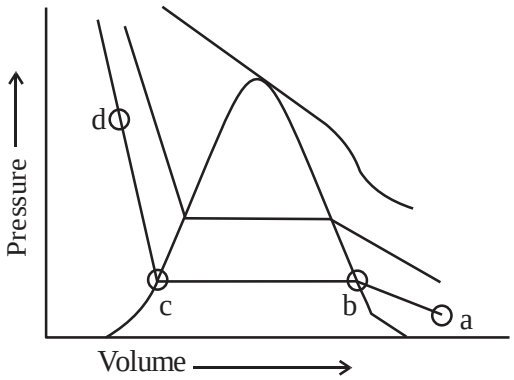
Mass percent, Mole, Mole fraction, Molarity, ppm, Molality.

Official Ans. by NTA (5)

Allen Ans. (5)

Sol. Mass percent, mole fraction, molarity, ppm, molality are used for measuring concentration terms.

56. The number of statement's, which are correct with respect to the compression of carbon dioxide from point (a) in the Andrews isotherm from the following is _____.



A. Carbon dioxide remains as a gas upto point (b)

B. Liquid carbon dioxide appears at point (c)

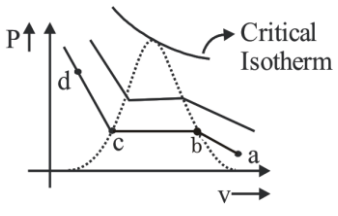
C. Liquid and gaseous carbon dioxide coexist between points (b) and (c)

D. As the volume decreases from (b) to (c), the amount of liquid decreases

Official Ans. by NTA (2)

Allen Ans. (2)

Sol.



At

(a) $\rightarrow$ CO_2 exist as gas

(b) $\rightarrow$ liquefaction of CO_2 starts

(c) $\rightarrow$ liquefaction ends

(d) $\rightarrow$ CO_2 exist as liquid.

Between (b) & (c) $\rightarrow$ liquid and gaseous CO_2 co-exist.

As volume changes from (b) to (c) gas decreases and liquid increases.

(A), (C) $\rightarrow$ correct

7. The Total pressure observed by mixing two liquid A and B is 350 mm Hg when their mole fractions are 0.7 and 0.3 respectively.

The Total pressure becomes 410 mm Hg if the mole fractions are changed to 0.2 and 0.8 respectively for A and B. The vapour pressure of pure A is _____ mm Hg. (Nearest integer)

Consider the liquids and solutions behave ideally.

Official Ans. by NTA (314)

Allen Ans. (314)

Sol. Let V.P. of pure A be P_A^0

Let V.P of pure B be P_B^0

When $X_A = 0.7$ & $X_B = 0.3$

$P_s = 350$

$\Rightarrow P_A^0 \times 0.7 + P_B^0 \times 0.3 = 350$ ...(i)

When $X_A = 0.2$ & $X_B = 0.8$

$P_s = 410$

$\Rightarrow P_A^0 \times 0.2 + P_B^0 \times 0.8 = 410$ ...(ii)

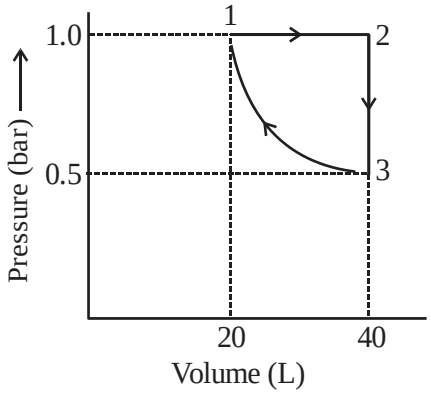
Solving (i) and (ii)

$P_A^0 = 314$ mm Hg

$P_B^0 = 434$ mm Hg

= (314)

58. One mole of an ideal monoatomic gas is subjected to changes as shown in the graph. The magnitude of the work done (by the system or on the system) is _____ J (nearest integer).



Given : log 2 = 0.3, ln 10 = 2.3

Official Ans. by NTA (620)

Allen Ans. (620)

Sol. $1 \rightarrow 2 \Rightarrow$ Isobaric process

$2 \rightarrow 3 \Rightarrow$ Isochoric process

$3 \rightarrow 1 \Rightarrow$ Isothermal process

$$W = W_{1\rightarrow 2} + W_{2\rightarrow 3} + W_{3\rightarrow 1}$$

$$= \left(-P(V_2 - V_1) + 0 \left[-P_1 V_1 \ln \left(\frac{V_2}{V_1} \right) \right] \right)$$

$$= \left[-1 \times (40 - 20) + 0 + \left[-1 \times 20 \ln \left(\frac{20}{40} \right) \right] \right]$$

$$= -20 + 20 \ln 2$$

$$= -20 + 20 \times 2.3 \times 0.3$$

$$= -6.2 \text{ bar L}$$

$$|W| = 6.2 \text{ bar l} = 620 \text{ J}$$

59. If the pKa of lactic acid is 5, then the pH of 0.005 M calcium lactate solution at 25° C is _____ $\times 10^{-1}$ (Nearest integer)

Lactic acid $CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}} - COOH$

Official Ans. by NTA (85)

Allen Ans. (85)

Sol. Concentration of calcium lactate = 0.005 M,:

concentration of lactate ion = (2 × 0.005) M.

Calcium lactate is a salt of weak acid + strong base

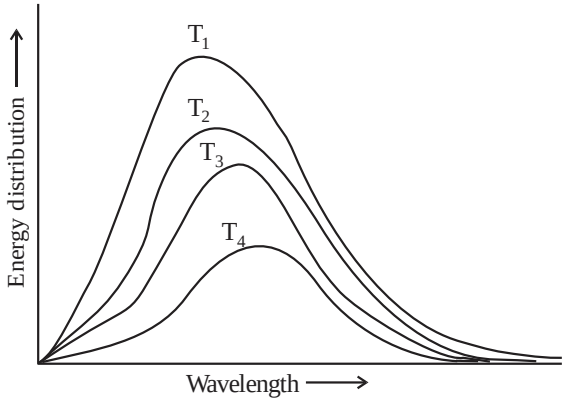
$\therefore$ Salt hydrolysis will take place.

$$pH = 7 + \frac{1}{2}(pKa + \log C)$$

$$= 7 + \frac{1}{2}(5 + \log(2 \times 0.005))$$

$$= 7 + \frac{1}{2}[5 - 2\log 10] = 7 + \frac{1}{2} \times 3 = 8.5 = 85 \times 10^{-1}$$

60. Following figure shows spectrum of an ideal black body at four different temperatures. The number of **correct** statement/s from the following is _____.



A. $T_4 > T_3 > T_2 > T_1$

B. The black body consists of particles performing simple harmonic motion.

C. The peak of the spectrum shifts to shorter wavelength as temperature increases.

D. $\frac{T_1}{v_1} = \frac{T_2}{v_2} = \frac{T_3}{v_3} \neq$ constant

E. The given spectrum could be explained using quantisation of energy.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. The spectrum of Black body radiation is explained using quantization of energy. With increase in temperature, peak of spectrum shifts to shorter wavelength or higher frequency. For above graph $\rightarrow T_1 > T_2 > T_3 > T_4$.