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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 29 January, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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PART : CHEMISTRY

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

(A) 2,4-Dinitrophenol

(B) 4-Nitrophenol

(C) 2, 4, 5-Trimethylphenol

(D) Phenol

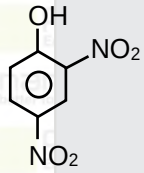
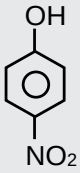
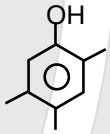
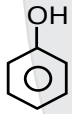
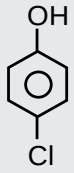
(E) 3-Chlorophenol

(1) (A), (E), (B), (D), (C) (2) (C), (E), (D), (B), (A)

(3) (C), (D), (E), (B), (A) (4) (A), (B), (E), (D), (C)

NTA. (4)

RESO. (4)

Sol. (A)  (B)  (C)  (D)  (E) 

Increasing order of pK_a means most acidic will be placed first.

–M groups at ortho and para position increases acidic strength in phenol hence (A) is most acidic.

+M, Hyperconjugation, +I decreases Ka value of hence (C) is least Acidic.

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

NTA. (2)

RESO. (2)

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

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

(Blue-green)

33. 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) $ZnO + C \xrightarrow{\Delta} Zn + CO$

NTA. (1)

RESO. (1)

Sol. Mond's process is : $Ni + 4CO \xrightarrow{\Delta} Ni(CO)_4$

34. 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

Choose the correct answer from the options given below:

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

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

NTA. (1)

RESO. (1)

35. The bond dissociation energy is highest for

(1) F_2 (2) Cl_2 (3) I_2 (4) Br_2

NTA. (2)

RESO. (2)

Sol. In F_2 due to small size LP – LP repulsion is high, bond dissociation energy is low.

Halogens	**Bond dissociation energy (KJ/Mol)**
F_2	158.8
Cl_2	242.6
Br_2	192.8
I_2	151.1

Order of bond dissociation energy is Cl – Cl > Br – Br > F – F > I – I.

36. Correct statement about smog is:

(1) Both NO_2 and SO_2 are present in classical smog.

(2) Classical smog also has high concentration of oxidizing agents.

(3) NO_2 is present in classical smog.

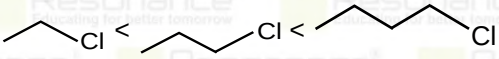
(4) Photochemical smog has high concentration of oxidizing agents.

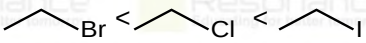
NTA. (4)

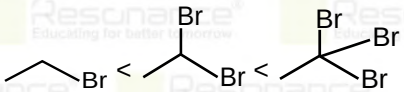
RESO. (4)

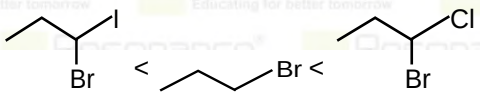
Sol. Photochemical smog has high concentration of oxidising agent like oxides of nitrogen, oxides of sulphur, acrolein & ozone.

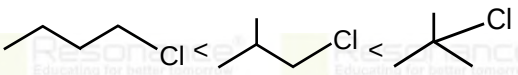
37. Identify the correct order for the given property for following compounds.

(A) Boiling Point : 

(B) Density : 

(C) Boiling Point : 

(D) Density : 

(E) Boiling Point :  < <

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

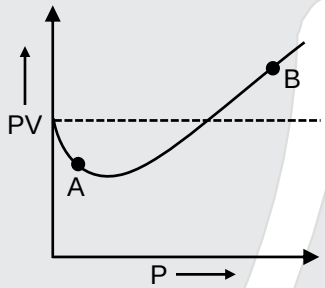
NTA. (2)

RESO. (2)

Sol. BP for almost same alkyle groups follows order RI > RB, RCl > RF and in general BP $\propto$ Homology series.

Density of halides increases with number of carbon atoms and at mass of halogen present.

38. For 1 mole of gas, the plot of pV vs p is the pressure and V



What is the value of compressibility factor at point A?

(1) $1 - \frac{b}{V}$ (2) $1 - \frac{a}{RTV}$ (3) $1 + \frac{b}{V}$ (4) $1 + \frac{a}{RTV}$

NTA. (2)

RESO. (2)

Sol. For 1 mole of real gas

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

In low pressure range

$$\left(p + \frac{a}{V^2}\right)V = RT$$

$$\Rightarrow PV + \frac{a}{V} = RT$$

$$\frac{PV}{RT} + \frac{a}{VRT} = 1$$

$$Z = 1 - \frac{a}{VRT}$$

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

(1) Li/P_4 (2) Di-isobutylaluminium hydride

(3) SiH_4 (4) $NaNi_5$

NTA. (4)

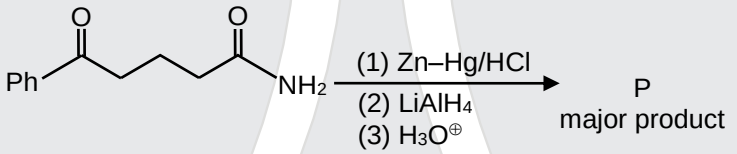
RESO. (4)

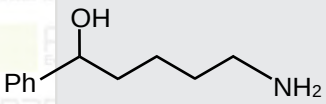
Sol. Tanks of metal alloy like $NaNi_5$, Ti-TiH_2, Mg-MgH_2 etc., are in use for storage of dihydrogen.

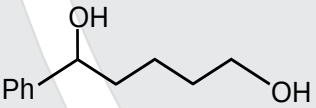
40. Number of cyclic tripeptides formed with 2 amino acids A and B is:
(1) 2 (2) 4 (3) 3 (4) 5
NTA. (2)
RESO. (2)
Sol. AAA, BBB, ABA, BAB are 4 possible cyclic structures.

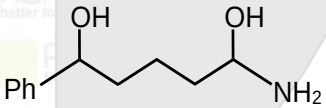
41. The magnetic behaviour of Li_2O, Na_2O_2 and KO_2, respectively, are
(1) diamagnetic, paramagnetic and diamagnetic
(2) diamagnetic, diamagnetic and paramagnetic
(3) paramagnetic, paramagnetic and diamagnetic
(4) paramagnetic, diamagnetic and paramagnetic
NTA. (2)
RESO. (2)
Sol. O^{-2} & O_2^{-2} are diamagnetic, O_2^- is paramagnetic.

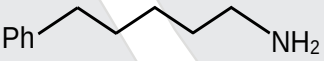
42. The major product 'P' for the following sequence of reactions is:



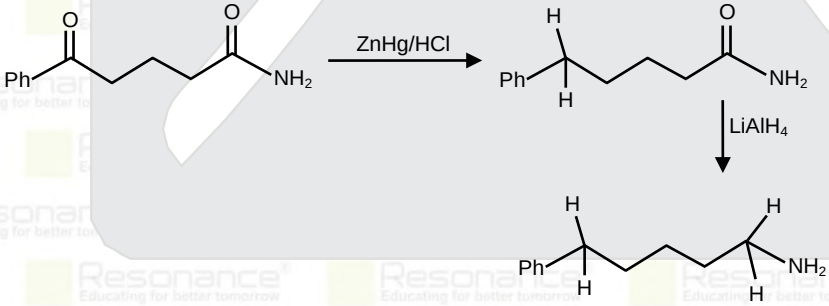
(1) 

(2) 

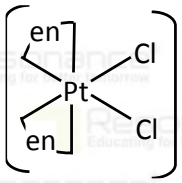
(3) 

(4) 

NTA. (4)
RESO. (4)
Sol.



43. Chiral complex from the following is:
Here en = ethylene diamine
(1) cis-$[PtCl_2(NH_3)_2]$ (2) trans-$[PtCl_2(en)_2]^{2+}$
(3) trans-$[Co(NH_3)_4Cl_2]^+$ (4) cis-$[PtCl_2(en)_2]^{2+}$
NTA. (4)
RESO. (4)

Sol. 

cis-$[PtCl_2(en)_2]^{2+}$ is chiral.

44. 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 > E > A > B > D (2) C > E > A > D > B (3) C > A > E > B > D (4) E > C > A > B > D

NTA. (1)

RESO. (1)

Sol. $Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

Decreasing the size, hydration energy increases.

45. Match List-I with List-II.

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

Choose the correct answer from the options given below:

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

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

NTA. (2)

RESO. (2)

Sol. Based on Facts.

46. "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 oxyacid also produces "A" gives positive brown ring test.

Identify and A and B, respectively.

(1) NO, NO_2 (2) NO_2, N_2O_4 (3) N_2O_3, NO_2 (4) NO_2, N_2O_5

NTA. (1)

RESO. (1)

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

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

$NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$

$HNO_2 \longrightarrow NO + H_2O + HNO_3$

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

(1) $\frac{9\lambda}{5}$ (2) $\frac{36\lambda}{5}$ (3) $\frac{5\lambda}{9}$ (4) $\frac{5}{9\lambda}$

NTA. (1)

RESO. (1)

Sol. (1) For Hydrogen atom (Z = 1) : $\left(\frac{1}{\lambda}\right)_H = R_H (1)^2 \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] \rightarrow$ Last line

(2) For He^+ atom (Z = 2) : $\left(\frac{1}{\lambda}\right)_{He^+} = R_H (2)^2 \left[\frac{1}{2^2} - \frac{1}{3^2}\right] = R_H\left[1 - \frac{4}{9}\right] = R_H\left(\frac{5}{9}\right) \rightarrow$ first line

From (1) & (2)

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

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

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

(1) $NH_2OH.HCl$ (2) CH_3NH_2HCl (3) NH_4Cl (4) N_2H_4HCl

NTA. (2)

RESO. (2)

Sol. Lassaigne test for both Nitrogen & Halogen is given by the compound which have C, N as well as X atom in the compound.

49. 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+} abd Mn^{2+} (2) Mn^{2+} and Co^{2+} (3) Cr^{2+} and Co^{2+} (4) V^{2+} and Cr^{2+}

NTA. (4)

RESO. (4)

Sol. The metal ion for which have less value of reduction potential than ($E^0_{H^+|H_2} = 0$) can release H_2 on reaction with dilute acid. So, V^{+2} and Cr^{+2} reduce H^+ to H_2.

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

(1) 10 mL of 0.1 mol dm^{-3} $AlCl_3$ (2) 10 mL of 0.2 mol dm^{-3} $AlCl_3$

(3) 10 mL of 0.15 mol dm^{-3} $CaCl_2$ (4) 10 mL of 0.1 mol dm^{-3} Na_2SO_4

NTA. (2)

RESO. (2)

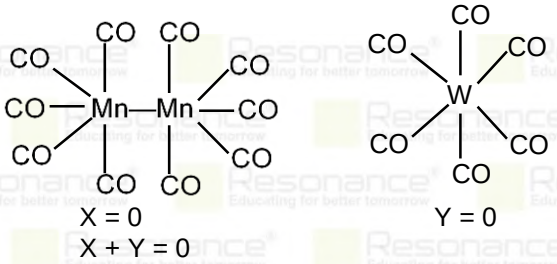
Sol. When $FeCl_3$ is added to NaOH solution then negatively charged sol is formed. So Al^{+3} with more conc. has high coagulation power.

51. The sum of bridging carbonyl is $W(CO)_6$ and $Mn_2(CO)_{10}$ is _____.

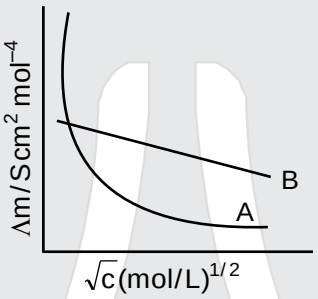
NTA. (0)

RESO. (0)

Sol.



52. Following figure shows dependence of molar conductance of two electrolytes on concentration, Λ_m^o is the limiting molar conductivity.



The number of incorrect statement(s) from the following is _____.

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

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

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

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

NTA. (2)
RESO. (2)
Sol. Both (A) & (C) are incorrect.

53. The number of molecules or ions from the following which do not have odd number of electrons are ____.

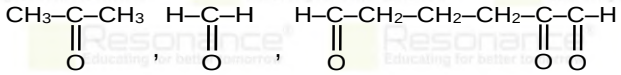
(A) NO_2
(B) ICl_4^-
(C) BrF_3
(D) ClO_2
(E) NO_2^+
(F) NO

NTA. (3)
RESO. (2)
Sol.

Species	Total electron
NO_2	23
ICl_4^-	122
BrF_3	62
ClO_2	33
NO_2^+	22
NO	15

ICl_4^-, BrF_3 and NO_2^+ are not having odd number of electrons. NO_2, ClO_2 and NO have odd number of electrons.

54. 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



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

NTA. (3)

RESO. (3)

Sol. $C_{10}H_{16}$ has DU = 3

Now milli moles of hydrocarbon and H_2 gas are as follows respectively:

$\frac{17}{136}$ = milli moles of hydrocarbon = .125

$\frac{8.40}{22400}\times 10^3$ = .375 mm of H_2 gas

Hence, they are in ratio 1 : 3 to confirm 3π Bonds in molecules

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 reactions is 2×10^{-3} at 2300 K.

NTA. (2)

RESO. (2)

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

$1-\alpha \qquad \alpha \qquad \alpha/2$

$$K_p = \frac{\alpha.\left(\frac{\alpha}{2}\right)^{\frac{1}{2}}}{1-\alpha} = 2 \times 10^{-3}$$

$$= \frac{(\alpha)^{\frac{3}{2}}}{\sqrt{2}\,(1-\alpha)} = 2 \times 10^{-3}$$

$= (\alpha)^{\frac{3}{2}} = 2\sqrt{2} \times 10^{-3}$ ($\alpha << 1$)

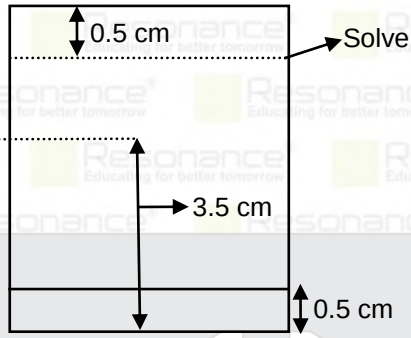
$(\alpha)^{\frac{3}{2}} = \sqrt{8} \times 10^{-3}$

$(\alpha)^3 = (2)^3 \times 10^{-6}$

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

$\%\alpha = 2 \times 10^{-2} \times 100 = 2$

56. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound 'A' is _____ × 10^{-1}.



NTA. (6)
RESO. (6)

57. 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 –0.8ºC. The solubility product of $PbCl_2$ formed is _____ × 10^6 at 298 K. (Nearest integer)
Given: K_b = 0.5 K kg mol^{-1} and K_f = 1.8 K kg mol^{-1}. Assume molality to be equal to molarity in all cases.

NTA. (13)
RESO. (13)

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

$\Delta T_b = ik_bm$

$(100.15 - 100) = 3 \times 0.5 \times m$

$0.15 = 1.5 \times m$

$m = \frac{0.15}{1.5} = 0.1$

No. of moles of Pb^{+2} = 0.1

$NaCl \longrightarrow Na^+ + Cl^-$

(0.2) (0.2) (0.2)

$Pb^{2+} + 2Cl^- \longrightarrow PbCl_2\downarrow$

(0.1) (0.2)

$(0.1-\alpha)$ $(0.2-2\alpha)$ 2α

$\Delta T_f = i \times k_f \times m$

$0.8 = 1.8\left[\frac{0.1-\alpha+0.2-2\alpha+0.2+0.2}{1}\right]$

$0.8 = 1.8[0.7 - 3\lambda]$

$\alpha = \frac{1.8\times0.7-0.8}{1.8\times3} = 0.085$

$[Pb^{+2}] = 0.1 - 0.085 = 0.015$

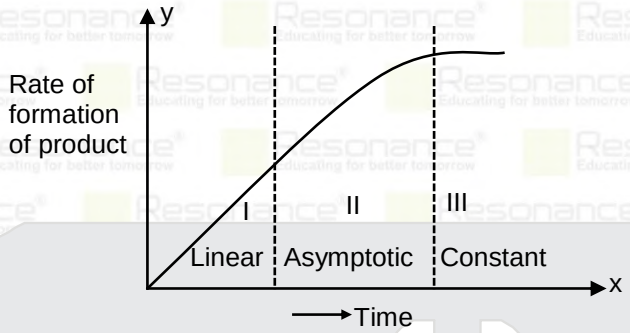
$[Cl^-] = 0.2 - 0.085 \times 2 = 0.03$

$PbCl_2 \rightleftharpoons Pb^{+2} + 2Cl^-$

$K_{sp} = [Pb^{+2}][Cl^-]^2$

$K_{sp} = 13.5 \times 10^{-6}$

58. For certain chemical reaction X→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 on first order

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

NTA. (2)

RESO. (2)

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

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

59. Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure

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

The standard Gibb's energy change (Δ, G°) at 27°C is (–) _____ kJ mol^{-1} (Nearest integer).

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

NTA. (6)

RESO. (6)

Sol. $K_{eq} = \frac{K_f}{K_b} = \frac{10^3}{10^2} = 10$

$\Delta G^o = -RT\ \ell n\ k_{eq}$

$= -8.3 \times 300\ \ell n\ (10)$

$= -8.3 \times 300 \times 2.3$

$= -5.72 \times 10^3$ J mol^{-1}

$= -5.72$ KJ mol^{-1}

≈ 6 KJ mol^{-1}

60. Millimoles of calcium hydroxide required to produce mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. the value of x is _____ (Nearest integer).

Assume complete dissociation.

NTA. **(5)**

RESO. **(5)**

Sol. pH = 12 $\Rightarrow$ pOH = 2 so $[OH^-] = 10^{-2}$ M.

Milimole of $[OH^-] = 10^{-2} \times 100 = 1$

$Ca(OH)_2(s) \longrightarrow Ca^{2+}(aq.) + 2\,OH^-(aq.)$

$\frac{1}{2}$ milimole 1 milimole

milimole of $Ca(OH)_2 = \frac{1}{2} = 5 \times 10^{-1}$ milimole.

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