ROY'S INSTITUTE OF COMPETITIVE EXAMINATION

The West Bengal Central School Service Commission

2nd SLST 2025

CHEMISTRY

[CLASSES : XI - XII]

1. Chemical formula of Marshall's acid is

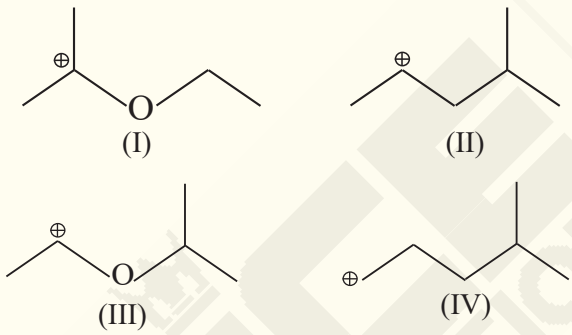
   (A) H_2SO_4

   (B) $H_2S_2O_8$

   (C) $H_2S_2O_7$

   (D) $H_2S_2O_5$

2. The correct stability order for the following carbocations is:



   (A) (II) > (IV) > (I) > (III)

   (B) (I) > (II) > (III) > (IV)

   (C) (II) > (I) > (IV) > (III)

   (D) (I) > (III) > (II) > (IV)

3. The relation between uncertainty in momentum (Δp_x) and uncertainty in position (Δx) of an electron is

   (A) $\Delta p_x . \Delta x \geq \frac{h}{4\pi}$

   (B) $\Delta p_x + \Delta x \geq \frac{h}{4\pi}$

   (C) $\Delta p_x - \Delta x \geq \frac{h}{4\pi}$

   (D) $\Delta p_x / \Delta x \geq \frac{h}{4\pi}$

4. In liquid ammonia solvent which of the following compounds acts as base?

(A) $NaNH_2$

(B) NH_4Cl

(C) NH_4NO_3

(D) $(NH_4)_2SO_4$

5. Identify the *wrong* statement about phosphorescence:

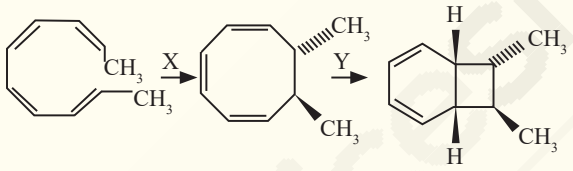
(A) Phosphorescence is not a result of rise in temperature.

(B) Phosphorescence is a specific type of luminiscence.

(C) Phosphorescence is a slow and delayed emission.

(D) Phosphorescence is a spin-allowed transition.

6. The conditions required for the following pericyclic reactions are:



(A) X → Thermal, Y → Thermal

(B) X → Photochemical, Y→ Thermal

(C) X → Photochemical, Y→ Photochemical

(D) X → Thermal, Y→ Photochemical

7. Oxidation state of 'Cr' in CrO_5 is

(A) +5

(B) +10

(C) +4

(D) +6

8. For an organic molecule,

the electronic transition/s observed is the UV-visible region is/are

(A) σ → σ*

(B) n → σ*

(C) n → π* and π → π*

(D) only π → π*

9. Addition of some amount of Ar gas to the reaction equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ maintaining

I. constant volume and

II. constant pressure

leads to following:

(A) For I, the equilibrium is shifted in forward direction and for II, the equilibrium is shifted in backward direction.

(B) For I, position of equilibrium remains unchanged and for II, the equilibrium is shifted in backward direction.

(C) For I, the equilibrium is shifted in backward direction and for II, the position of equilibrium remains unchanged.

(D) For I, the equilibrium is shifted in backward direction and for II, the equilibrium is shifted in forward direction.

[Note : The addition of an inert gas (Ar) at constant volume during the dissociation of PCl_5 does not affect the equilibrium position.
At constant pressure when inert gas is added during dissociation of PCl_5, since the product side has more moles of gas (2 moles) compared to the reactant side (1 mole), the equilibrium will shift to the right, favoring the dissociation of PCl_5]

10. IUPAC name of $[Cu(NH_3)_4(H_2O)]SO_4$ is

(A) Aquatetraamminecopper (II) sulphate

(B) Aquatetraamminecopper (I) sulphate

(C) Tetraammineaquacopper (I) sulphate

(D) Tetraammineaquacopper (II) sulphate

11. ΔH, ΔV and ΔS indicate changes respectively in enthalpy (H), volume (V) and entropy (S) for mixing two different ideal gases. Identify the correct statement:

(A) $\Delta H = 0, \Delta V = 0, \Delta S = 0$

(B) $\Delta H \neq 0, \Delta V = 0, \Delta S = 0$

(C) $\Delta H = 0, \Delta V > 0, \Delta S = 0$

(D) $\Delta H = 0, \Delta V = 0, \Delta S \neq 0$

12. Allowed rotational levels of a rigid diatomic molecule

(A) are equispaced.

(B) show spacing to decrease as one goes to higher energy levels.

(C) show spacing to increase as one goes to higher energy levels.

(D) may be equispaced or non-equispaced depending on the difference in mass of two atoms of the diatomic.

13. Identify the correct statement about equilibrium constant (K_{eq}) and ionic strength (i):

(A) K_{eq} is dimensionless and 'i' has dimension.

(B) Values of K_{eq} and 'i' depend on the unit of concentration taken.

(C) 'i' is dimensionless and unit of K_{eq} is according to the unit of concentration taken.

(D) Both of K_{eq} and 'i' are dimensionless.

14. Viscosity of a gas (η_g) and that of a liquid (η_l) vary with increase in temperature as follows:

(A) Both of η_g and η_l decrease.

(B) Both of η_g and η_l increase.

(C) η_g decreases, but η_l increases.

(D) η_g increases, but η_l decreases.

15. Lyophobic colloids are

(A) unstable, charged, less-hydrated and irreversible.

(B) stable, neutral, less-hydrated and reversible.

(C) unstable, charged, highly hydrated and reversible.

(D) stable, neutral, highly hydrated and irreversible.

16. When principal quantum number (n) of an atom is 4, total number of electrons present is

(A) 32

(B) 8

(C) 18

(D) 64

17. Identify [A] and [B] in the following radioactive reaction:

$$_{92}U^{238} \xrightarrow{-\alpha} [A] \xrightarrow{-\beta} [B]$$

(A) [A] = $_{90}Th^{234}$; [B] = $_{91}Pa^{234}$

(B) [A] = $_{91}Pa^{234}$; [B] = $_{90}Th^{234}$

(C) [A] = $_{92}U^{235}$; [B] = $_{90}Th^{231}$

(D) [A] = $_{88}Ra^{223}$; [B] = $_{90}Th^{234}$

18. Identify the true statement about extensive and intensive property:

(A) Concentration and volume are extensive property; pressure is intensive property.

(B) Mole-fraction is intensive property; chemical potential is extensive property.

(C) Energy and force are extensive property; temperature is intensive property.

(D) Refractive index is extensive property; EMF is intensive property.

19. At 25°C equivalent conductivities at infinite dilution (Λ°) of aqueous solution of HCl, NaCl and CH_3COONa are 426.2, 126.5 and 91 $ohm^{-1}\ cm^2\ equiv^{-1}$ respectively. At the same temperature, Λ° of CH_3COOH is

(A) 461.7 $ohm^{-1}\ cm^2\ equiv^{-1}$

(B) 390.7 $ohm^{-1}\ cm^2\ equiv^{-1}$

(C) 643.7 $ohm^{-1}\ cm^2\ equiv^{-1}$

(D) 208.7 $ohm^{-1}\ cm^2\ equiv^{-1}$

20. The ground state electronic configuration of Ni^{2+} is

(A) [Ar] $4s^2 3d^6$

(B) [Ar] $4s^2 3d^4$

(C) [Ar] $4s^0 3d^8$

(D) [Ar] $4s^0 3d^6$

21. Applying VSEPR theory predict the geometry and hybridisation of PCl_5:

(A) Trigonal bipyramidal and sp^3d

(B) Tetrahedral and sp^3

(C) Octahedral and sp^3d^2

(D) Linear and sp

22. Identify the set with molecules having all vibrational modes IR as well as Raman active:

(A) CO_2, H_2O, NH_3

(B) H_2O, HCl, CO

(C) CS_2, CH_4, HC1

(D) NH_3, CO_2, CH_4

23. If silicon is separately doped with Arsenic and Aluminium, the generated semiconductors will be

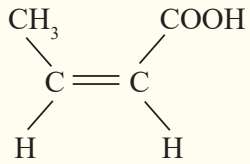
(A) 'n' type and 'p' type respectively

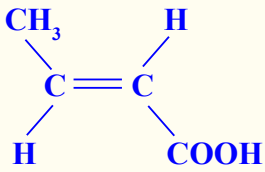
(B) 'p' type and 'n' type respectively

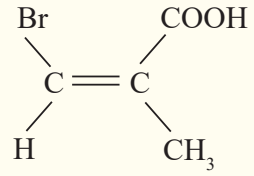
(C) 'n' type and 'n' type respectively

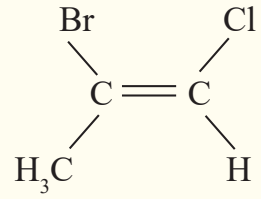
(D) 'p' type and 'p' type respectively

24. Which one of the following molecules best represents the *E*-isomer?

(A) 

(B) 

(C) 

(D) 

25. Conductivity (specific conductance) (κ) and equivalent conductivity (^) of aqueous solution of CH_3COOH (RI) and HCl (RII) would vary with increase in dilution as follows:

(A) κ as well as ^ increase for both of RI and RII.

(B) For RI, κ as well as ^ decrease; for RII, κ as well as ^ increase.

(C) κ for RI decreases while that of RII increases; ^ for both of RI and RII decrease.

(D) κ for RI decreases while that of RII increases; ^ for both of RI and RII increase.

[**Note : On dilution, the specific conductance of both weak and strong electrolytes decreases. On dilution, the equivalent conductance increases for both weak and strong electrolytes.]**

26. Graphs of variation of log(*k*) [logarithm of reaction rate constant] with respect to $\sqrt{i}$ (*i* = ionic strength of reaction solution) for the following reactions have slopes as follows:

I. Inversion of sucrose solution

II. $2I^- + S_2O_3^{2-} \rightarrow I_2 + 2SO_4^{2-}$

III. $H_2O_2 + 2Br^- + 2H^+ \rightarrow 2H_2O + Br_2$

(A) Positive for all reactions.

(B) Zero for all reactions.

(C) Zero for reaction I, positive for reaction II and negative for reaction III.

(D) Zero for reaction I, negative for reactions II and III.

27. A cubic crystal lattice has co-ordination number and radius ratio range

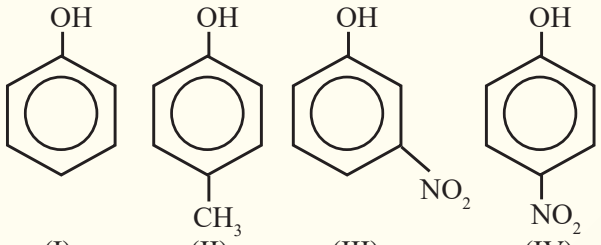
(A) 4 and 0·225–0·414 respectively

(B) 6 and 0·414–0·732 respectively

(C) 8 and 0·732–1·000 respectively

(D) 2 and 0·225–0·414 respectively

28. Among the following compounds, the correct order of acidity is:



(I) (II) (III) (IV)

(A) (III) > (IV) > (I) > (II)

(B) (I) > (IV) > (III) > (II)

(C) (II) > (I) > (III) > (IV)

(D) (IV) > (III) > (I) > (II)

29. The correct order of polarizability for the given molecules is

(A) HF < HCl < HBr < HI

(B) HI<HBr < HCl < HF

(C) HCl > HBr > HI > HF

(D) HF > HCl > HBr > HI

30. The temperature at which the properties of a real gas do coincide with those of a perfect gas as $P \rightarrow 0$ is known as

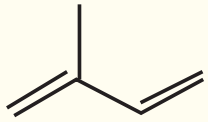
(A) Critical temperature

(B) Boyle temperature

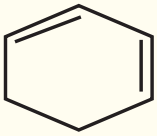
(C) Inversion temperature

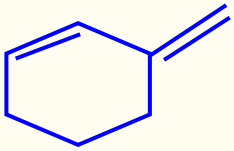
(D) Debye temperature

31. Among the following dienes, which one will not take part in Diels-Alder reaction?

(A) 

(B) 

(C) 

(D) 

32. For a reaction, rate constant is found experimentally to decrease with increase in temperature. Identify the correct statement below:

(A) The reaction does not obey Arrhenius equation.

(B) Such a reaction is not possible.

(C) The reaction is a multistep one.

(D) The reaction obeys Arrhenius equation.

33. Wilkinson's catalyst is used for

(A) Polymerisation reaction

(B) Hydroformylation reaction

(C) Hydrogenation of alkene

(D) Hydrolysis reaction

34. For a particular van der Waal gas the magnitudes of Boyle temperature (T_b), inversion temperature (T_i) and critical temperature (T_c) follow the order-

(A) $T_c < T_b < T_i$

(B) $T_b = T_c > T_i$

(C) $T_i > T_c > T_b$

(D) $T_b = T_i < T_c$

35. The conversion of acetophenone to acetanilide is best accomplished by using

(A) Beckmann rearrangement

(B) Lossen rearrangement

(C) Curtius rearrangement

(D) Hofmann rearrangement

36. Which of the following compounds exhibits Jahn–Teller distartion?

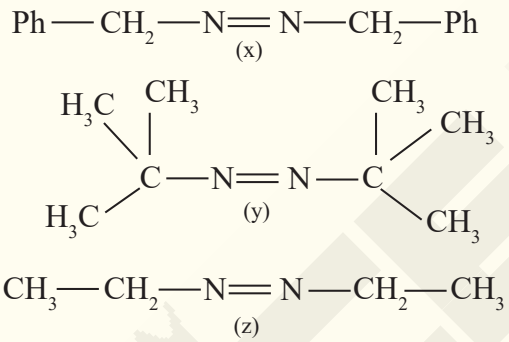
(A) $[Mn(H_2O)_6]^{2+}$

(B) $[Mn(H_2O)_6]^{3+}$

(C) $[Cr(H_2O)_6]^{3+}$

(D) $[Fe(CN)_6]^{4-}$

37. Among the following molecules, the correct order of the rate of evolution of nitrogen is:



(A) y > z > x

(B) z > y > x

(C) x > z > y

(D) x > y > z

38. According to Molecular Orbital theory bond order of O_2^+ and O_2^- is

(A) 2·0 and 2·5 respectively

(B) 1·5 and 2·5 respectively

(C) 1·0 and 3·0 respectively

(D) 2·5 and 1·5 respectively

39. Which one of the following molecules is not an aromatic compound?

(A) Cyclopentadienyl anion

(B) Cyclooctatetraenyl dianion

(C) Tropylium cation

(D) Cyclopentadienyl cation

40. The dark purple colour of $KMnO_4$ solution is due to

(A) d–d transition

(B) ligand field transition

(C) charge transfer transition

(D) σ–π* transition

41. Which one of the following amino acids will show a net negative charge at physiological pH (~7.4)?

(A) Glycine

(B) Lysine

(C) Histidine

(D) Glutamic acid

42. For an ideal gas the magnitude of most probable velocity (c_m), average velocity (c_a) and root mean square velocity (c_r) at a particular temperature follows the following order:

(A) $C_m > C_a > C_r$

(B) $C_r > C_a > C_m$

(C) $C_a > C_r > C_m$

(D) $C_r > C_m > C_a$

43. Which one among the following is a pseudohalogen?

(A) $(SCN)_2$

(B) Cl_2

(C) $BrCl_3$

(D) I_3^-

44. Which of the following reagents can be used to distinguish between 1-butyne and 2-butyne?

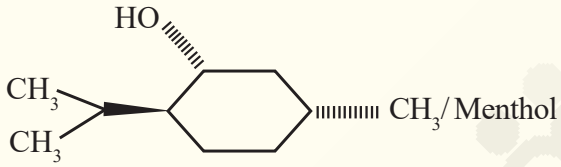
(A) Br_2 / CCl_4

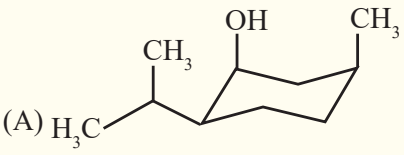
(B) H_2 / Lindlar's catalyst

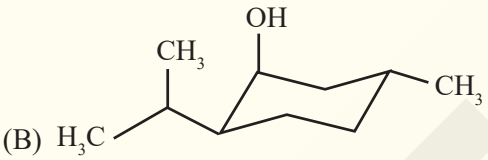
(C) Dilute H_2SO_4 / $HgSO_4$

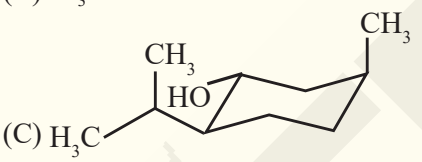
(D) Ammonical $CuCl_2$ solution

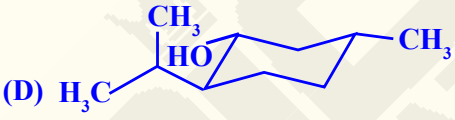
45. Which one of the following conformations best represents the organic compound, Menthol?



(A) 

(B) 

(C) 

(D) 

46. When aniline is heated with glycerol in the presence of sulphuric acid and nitrobenzene, it gives quinoline. This reaction is called

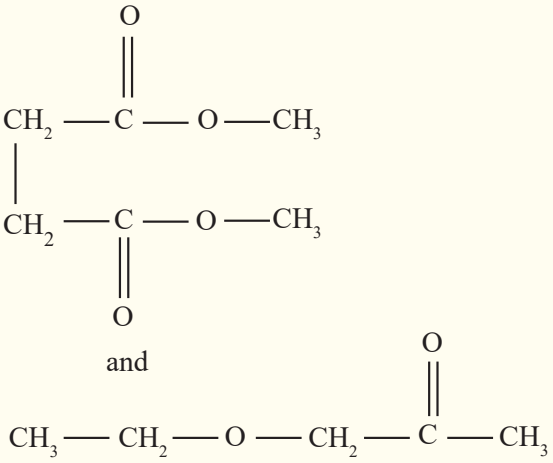
(A) Fisher synthesis

(B) Skraup synthesis

(C) Paal-Knorr synthesis

(D) Hantzsch synthesis

47. How many signals in the ^1H NMR spectra will be obtained for the following two molecules?



and

(A) 2, 2 respectively

(B) 2, 4 respectively

(C) 3, 4 respectively

(D) 4, 3 respectively

48. A particular reaction may take place with or without catalysis. In comparison to the uncatalysed reaction, for the catalysed reaction at the same temperature

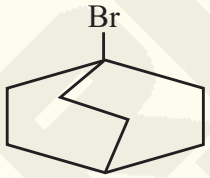
(A) the value of K_{eq} decreases.

(B) the value of K_{eq} increases.

(C) the values of both the forward rate constant k_f and the backward rate constant k_b increase, but K_{eq} remains unchanged.

(D) the values of both k_f and k_b change and also the value of K_{eq} changes.

49. The correct order of reactivity of the given organic halides towards unimolecular substitution is:

I. 

II. 

III. 

IV. 

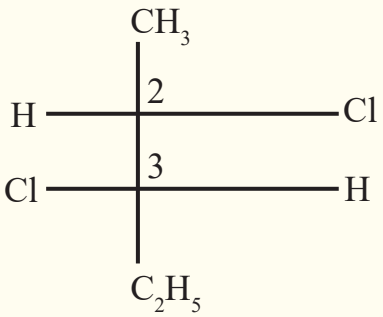
(A) I > II > III > IV

(B) I > II > IV > III

(C) II > III > IV > I

(D) II > III > I > IV

50. The configuration at C-2 and C-3 of the compound given below is:



(A) 2R, 3S

(B) 2S, 3R

(C) 2S, 3S

(D) 2R, 3R

51. $CH_3NH_2 + CHCl_3 + KOH \rightarrow (A) + KCl + H_2O$

The compound (A) in the above-mentioned reaction is

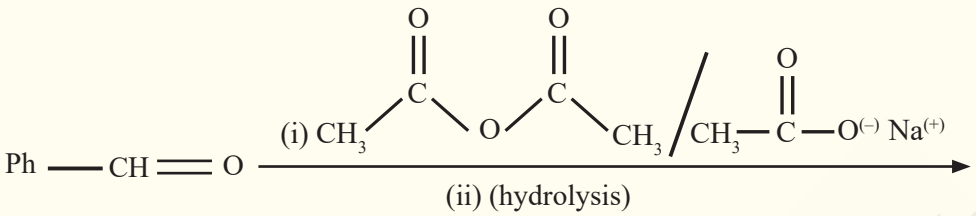
(A) CH_3CN

(B) CH_3NHCH_3

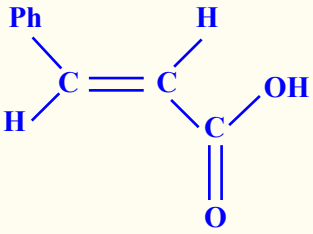
(C) $CH_3-\overset{(-)}{N}\equiv\overset{(+)}{C}$

(D) $CH_3-\overset{(+)}{N}\equiv\overset{(-)}{C}$

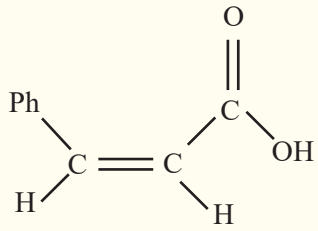
52. The major product (X) formed in the following reaction is:



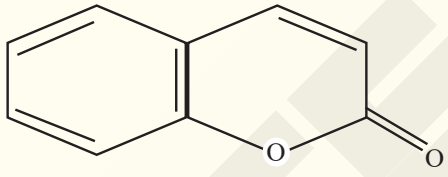
(A)



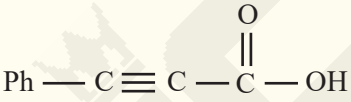
(B)



(C)



(D)



53. Which of the following pairs are epimeric with respect to each other?

(A) (D)-glucose and (D)-ribose

(B) (D)-fructose and (D)-glucose

(C) (D)-glucose and (D)-galactose

(D) (D)-mannose and (D)-galactose

54. Hydrolysis of diborane produces

(A) Metaboric acid

(B) Polymetaborate

(C) Orthoboric acid

(D) Boric anhydride

55. Cu metal, Li metal and Po metal show respectively face-centred (FCC), body-centred (BCC) and simple cubic (SC) crystal structure. Identify the correct order of percentage of space occupied by the atoms in these crystals:

(A) SC > BCC > FCC

(B) FCC > BCC > SC

(C) FCC > SC > BCC

(D) BCC > SC > FCC

56. Identify the correct statement for an ideal dilute solution:

(A) Both of solute and solvent obey Raoult's law.

(B) Only solvent obeys Raoult's law.

(C) Only solute obeys Raoult's law.

(D) At high temperature dilute solution behaves exactly as ideal solution.

57. Calculate pH of a buffer solution composed of 0˙7(M) formic acid and 0˙7(M) sodium formate. [Given – pk_a of formic acid = 3˙75]

(A) 1·50

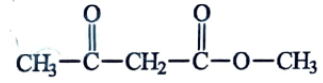
(B) 3·75

(C) 8·10

(D) 2·30

58. Among the following molecules, the correct order of en-ol content is:

I. 

II. 

III. 

(A) III > I > II

(B) I > III > II

(C) II > III > I

(D) I > II > III

59. The ground state term symbol of oxygen atom is

(A) $^{2}S_{\frac{1}{2}}$

(B) $^{3}P_{2}$

(C) $^{2}P_{\frac{3}{2}}$

(D) $^{1}S_{0}$

60. Which of the following isomerism is observed in $[Co(NH_3)_5(NO_2)]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$?

(A) Linkage isomerism

(B) Ionisation isomerism

(C) Co-ordination isomerism

(D) Hydrate isomerism

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