Chemistry

1. In a reaction, $2A + B \longrightarrow 3C$, the concentration of A decreases from 0.5 and L to 0.4 mol L⁻¹ in 10 minutes. The rate of production of C during this period is
   (a) 0.0 mol L⁻¹ min⁻¹ (b) 0.05 mol L⁻¹ min⁻¹
   (c) 0.01 mol L⁻¹ min⁻¹ (d) 0.04 mol L⁻¹ min⁻¹

2. Ammonium ion (NH₄⁺) reacts with nitrite ion (NO₂⁻) in aqueous solution according to the reaction
   $$NH_4^+(aq) + NO_2^-(aq) \longrightarrow N_2(g) + 2H_2O(l)$$
   The following initial rates of reaction have been measured for the given reactant concentrations.

Expt. No.	[NH₄⁺] (M)	[NO₂⁻] (M)	Rate (M/hr)
1	0.010	0.020	0.020
2	0.015	0.020	0.030
3	0.010	0.010	0.005

Which of the following is the rate law for this reaction?
(a) Rate = k [NH₄⁺] [NO₂⁻]²
(b) Rate = k [NH₄⁺]² [NO₂⁻]
(c) Rate = k [NH₄⁺] [NO₂⁻]
(d) Rate = k [NH₄⁺]² [NO₂⁻]²
(e) Rate = k [NH₄⁺]² [NO₂⁻]²

3. Gold sol can be prepared by
(a) hydrolysis of gold (III) chloride
(b) oxidation of gold by aqua-regia
(c) peptization
(d) treating gold (III) chloride with metallic zinc
(e) reduction of gold (III) chloride with formalin solution

4. The IUPAC name of the complex $[Co(NH_3)_4 (H_2O)_2]Cl_3$ is
(a) tetraamminediaquacobalt (III) chloride
(b) diamminetetraaquacobalt (II) chloride
(c) diamminetetraaquacobalt (III) chloride
(d) tetraaquadiamminecobalt (III) trichloride
(e) tetraamminediaquacobalt (III) trichloride

5. When but-2-yne is treated with Na in liquid ammonia
(a) propanone and ethanal
(b) ethanol and 2-butanone
(c) butanal and ethanal
(d) cis-2-butene and hydrogen
(e) trans-2-butene

6. The correct decreasing order of reactivity for a given alkyl (R) group in both S_N1 and S_N2 reaction mechanisms is
(a) 1-bromo-2-methylbutane
(b) 1-bromobutane
(c) 2-bromobutane
(d) 2-bromo-2-methylbutane
(e) there is no reaction

7. The compound of molecular formula $C_5H_{10}O$ and reacts with Tollen's reagent to give silver mirror but does not undergo aldol condensation. The compound A is
(a) pentanal
(b) 2-pentanone
(c) 2,2-dimethylpropanal
(d) 3-methyl-2-butanone

8. When n-hexane is heated with anhydrous $AlCl_3$ and HCl gas, the major product obtained is
(a) 1-chlorohexane
(b) 2-chlorohexane
(c) 3-chlorohexane
(d) hex-3-ene
(e) mixture of 2-methylpentane and 3-methylpentane

9. How many monochloro structural isomers are expected in free radical monochlorination of 2-methylbutane?
(a) 3
(b) 4
(c) 5
(d) 6

10. Chloroform reacts with oxygen in the presence of light to give
(a) carbon tetrachloride
(b) carbonyl chloride
(c) methyl chloride
(d) methylene chloride
(e) dichloromethane

11. Which one of the following is not expected to undergo iodoform reaction?
(a) Propan-2-ol
(b) Ethanal
(c) Butan-2-ol
(d) Ethanol
(e) Diphenyl methanol

12. Identify the combination of compounds that undergo aldol condensation followed by dehydration to produce but-2-enal
(a) two moles of ethanal
(b) two moles of ethanol
(c) methanal and propanone
(d) ethanal and propanone
(e) two moles of ethanol

13. The correct increasing order of the acid strength of benzoic acid (I), 4-nitrobenzoic acid (II), 3,4-dinitrobenzoic acid (III) and 4-methoxybenzoic acid (IV) is
(a) IV < I < II < III
(b) IV < III < II < I
(c) I < II < III < IV
(d) III < II < I < IV

15. An organic compound with the molecular formula C_3H_6O forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid. The organic compound is

(a) 2-ethylbenzaldehyde
(b) 3-methylbenzaldehyde
(c) 4-methylbenzaldehyde
(d) 2-methylbenzaldehyde
(e) 3-methylacetophenone

16. Phenol henzoxide is prepared from aniline by

(a) Rosenmund's reaction
(b) Reimann reaction
(c) Reimer-Tiemann reaction
(d) Wurtz reaction
(e) Cannizzaro reaction

17. Choose the correct order of decreasing basic strength of the following compounds in aqueous solution

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$, NH_3

(a) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$
(b) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$
(c) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$
(d) $NH_3 > CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$
(e) $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2 > NH_3$

18. Gabriel's phthalimide synthesis can be used to prepare

(a) ethanamine
(b) aniline
(c) N-methylmethanamine
(d) N-methylethanamine
(e) N,N-dimethylethanamine

19. The sugar moiety present in RNA molecule is

(a) β-D-2-deoxyribose
(b) β-D-2-deoxyfructose
(c) β-D-glucopyranose
(d) β-D-ribose
(e) β-D-fructofuranose

20. Novlac, the linear polymer used in paints is

(a) copolymer of 1,3-butadiene and styrene
(b) obtained by the polymerisation of methyl methacrylate
(c) initial product obtained in the condensation of phenol and formaldehyde in the presence of acid
(d) obtained by the condensation of the caprolactam
(e) copolymer of melamine and formaldehyde

21. The carbohydrate used as storge molecule in animal is

(a) sucrose
(b) maltose
(c) glycogen

(d) glucagon
(e) glucose

22. Green chemistry deals with

(a) study of plant physiology
(b) study of extraction of natural products from plants
(c) detailed study of reactions involved in the synthesis of chlorophyll
(d) utilization of existing knowledge base for reducing the chemical hazards along with developmental activities
(e) synthesis of chemical compounds using green light

23. A 200 W electric bulb of 80% efficiency emits a light of 6626 Å wavelength. The number of photons emitted per second by the lamp is (h = 6.626 × 10⁻³⁴ J s)

(a) 5.33×10^{20}
(b) 6.68×10^{20}
(c) 4.45×10^{20}

(d) 4.00×10^{20}
(e) 3.35×10^{20}

24. The shortest wavelength of the line in hydrogen atomic spectrum of Laman series when $R_H = 109678$ cm⁻¹ is

(a) 1215.67 Å
(b) 912 Å
(c) 1002.7 Å

(d) 1127.30 Å
(e) 1234.7 Å

25. The work function of a metal is 5 eV. What is the kinetic energy of the photoelectron ejected from the metal surface if the energy of the incident radiation is 6.2 eV? (1 eV = 1.6 × 10⁻¹⁹)

(a) 6.626×10^{-20} J
(b) 3.82×10^{-19} J
(c) 1.92×10^{-19} J

(d) 4.42×10^{-19} J
(e) 1.92×10^{-17} J

26. The lattice energy of NaCl is 788 kJ mol⁻¹. This means that 788 kJ of energy is required

(a) to separate one mole of solid NaCl into one mole of Na⁺ and one mole of Cl⁻ ions at infinite distance
(b) to separate one mole of solid NaCl into one mole of Na⁺ and one mole of Cl⁻ ions in close distance
(c) to separate one mole of NaCl into one mole of Na⁺(g) and one mole of Cl⁻(g) ions

(a) to convert one mole of solid NaCl into one mole of gaseous NaCl

(c) to convert one mole of gaseous NaCl into one mole of solid NaCl

(b) to separate one mole of gaseous NaCl into one mole of $Na^+(g)$ and one mole of $Cl^-(g)$ to infinite distance

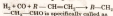**27.** Arrange the following species in the correct order of their stability
$$O_2, I_2, O_2^-, O_2^{2-}$$
(a) $LI_2 = He_2^+ < C_2^- < H_2^-$ (b) $C_2^- < O_2 < C_2 < C_2^-$
(c) $O_2 < C_2 < C_2^- < H_2^-$ (d) $C_2 < C_2^- < H_2^- < C_2$

28. Molecular formulae and shapes of some molecules are given below. Choose the incorrect match.

	Formula	Shape
(a)	NH_3	Trigonal pyramidal
(b)	CH_4	Tetrahedral
(c)	XeF_4	Square planar
(d)	PCl_5	Trigonal bipyramidal
(e)	BF_3	Trigonal planar

29. Potassium dichromate belongs to which crystal system?
(a) Triclinic   (b) Orthorhombic
(c) Triclinic   (d) Hexagonal

30. If two moles of an ideal gas at 500 K occupies a volume of 41 L, the pressure of the gas is
($R = 0.082$ L atm K⁻¹ mol⁻¹)
(a) 2 atm   (b) 3 atm
(c) 4 atm   (d) 1 atm

31. At STP, K, the density of a certain gaseous oxide at 2 atm is same as that of dioxygen at 5 atm. The molecular mass of the oxide (in g mol⁻¹) is
(a) 80   (b) 64
(c) 70   (d) 65

32. The reaction of H_2 is given below
$$H_2 + O_2 \rightarrow R - CH=CH_2 \rightarrow R-CH_2-CH_3$$
(a) hydrogenation   (b) hydration
(c) dehydration

33. Which of the following are isoelectronic species?
(i) NH_3 (ii) CH_4^+
(iii) NH_2^- (iv) NH_4^+
Choose the correct answer from the codes given below.
(a) (i), (ii), (iii)   (b) (i), (iii), (iv)
(c) (ii), (iii), (iv)   (d) (i), (ii), (iv)

34. The salt of an alkali metal gives violet colour in the flame test. Its aqueous solution gives a white precipitate with barium chloride in hydrochloric acid medium. The salt is
(a) KCl   (b) K_2SO_4
(c) $KClO_4$ (d) K_2CrO_4

35. In which one of the following the central atom is sp³ hybridised?
(a) BF_3 (b) PCl_5
(c) NH_4^+ (d) XeF_4

36. Which one of the following statements is not true in respect of properties of interhalogen compounds?
(a) They are all covalent compounds
(b) They are volatile solids & liquids except ClF
(c) IF_7 has square pyramidal structure
(d) They are all paramagnetic in nature
(e) BrF_5 is used in the preparation of UF_6 in the enrichment of ^{235}U

37. Which of the following is an incorrect statement?
(a) Both $KMnO_4$ and $K_2Cr_2O_7$ ...
(b) O_2 oxidises Mn^{2+} to oxide species
(c) O_2 oxidises aqueous Al at $pH > 2$
(d) The two oxygen-oxygen bond lengths in O_3 are identical
(e) CO_2 is used as an oxidising agent in the manufacture of $KMnO_4$

38. The correct disordering order of oxidising power of the following is
(a) $MnO_2 > MnO_4^- > Cr_2O_7^{2-}$
(b) $VO_2^+ > MnO_4^- > Cr_2O_7^{2-}$
(c) $MnO_4^- > Cr_2O_7^{2-} > VO_2^+$
(d) $MnO_4^- > VO_2^+ > Cr_2O_7^{2-}$

39. The number of electrons that are involved in the reduction of permanganate to manganese (II) salt, manganate and manganese dioxide respectively are
(a) 5, 3, 1
(b) 5, 2, 1
(c) 3, 2, 1
(d) 5, 1, 3

40. The calculated magnetic moment of a divalent ion of an atom with atomic number 24 in aqueous solution is
(a) 4.90 BM
(b) 5.92 BM
(c) 2.84 BM
(d) 3.87 BM

41. The entropy of vaporisation of a liquid is 58 JK^{-1} mol^{-1}. If 100 g of its vapour condenses at its boiling point of 125°C, the value of entropy change for the process is
(a) $-100 \, JK^{-1}$
(b) $-58 \, JK^{-1}$
(c) $-123 \, JK^{-1}$
(d) $123 \, JK^{-1}$

42. The values of limiting molar conductance of H^+ and $HCOO^-$ ions are respectively 347 and 53.0 $S \, cm^2 \, mol^{-1}$. The dissociation constant of methanoic acid at 298 K is
(a) 1.1×10^{-4}
(b) 5.4×10^{-5}
(c) 2.1×10^{-4}
(d) 2.1×10^{-5}

43. In a closed cylinder of capacity 24.6 L, the following reaction occurs at 27°C.
$$A_2(g) \rightleftharpoons B_2(g) + 2C(g)$$
At equilibrium, 1 g of $B_2(g)$ (molar mass 16 g) is present. The equilibrium constant K_c for the equilibrium in atm^{-1} unit
$(R = 0.082 \, L \, atm \, K^{-1} \, mol^{-1})$
(a) ...
(b) ...
(c) ...
(d) ...

44. The pH of a saturated solution of a metal hydroxide of formula $X(OH)_2$ is 12.0 at 298 K. What is the solubility product of a metal hydroxide at 298 K (in $mol^3 \, L^{-3}$)?
(a) 2×10^{-3}
(b) 1×10^{-12}
(c) 2×10^{-14}
(d) 1×10^{-15}

45. An aqueous solution containing 3 g of a solute of molar mass 111.6 g mol^{-1} in a certain mass of water freezes at $-0.125°C$. The mass of water in grams present in the solution is $(K_f = 1.86 \, K \, kg \, mol^{-1})$
(a) 300
(b) 400
(c) 500
(d) 250

46. A sample of sea water contains $5 \times 10^{-3} \, g$ of dissolved oxygen in 1 kg of the sample. The concentration of O_2 in that sea water sample in ppm is
(a) 10
(b) 5
(c) 20
(d) 2.5

47. The change in potential of the half-cell Cu^{2+}/Cu, when aqueous Cu^{2+} solution is diluted 100 times (from $\frac{2.303RT}{F} = 0.06 \, V$)
(a) increases by 120 mV
(b) decreases by 120 mV
(c) increases by 60 mV
(d) decreases by 60 mV
(e) no change

48. Consider the following electrolytic cells
(a) $M(s)/M^{2+}(aq. \, 0.1 \, M) \, || \, X^{2+}(aq. \, 0.01 \, M), \, X(s)$
(b) $M(s)/M^{2+}(aq. \, 0.1 \, M) \, || \, X^{2+}(aq. \, 1 \, M), \, X(s)$
(c) $M(s)/M^{2+}(aq. \, 1 \, M) \, || \, X^{2+}(aq. \, 0.1 \, M), \, X(s)$
(d) $M(s)/M^{2+}(aq. \, 0.01 \, M) \, || \, X^{2+}(aq. \, 0.1 \, M), \, X(s)$
The cell EMF of the above cells are E_1, E_2, E_3 and E_4 respectively. Which one of the following is true?
(a) $E_1 > E_2 > E_3 > E_4$
(b) $E_3 > E_2 > E_4 > E_1$
(c) $E_2 > E_4 > E_3 > E_1$
(d) $E_2 > E_3 > E_1 > E_4$