Class 12 Chemistry: Original Pre-Board Practice

CBSE

Question Paper | Grade 12 | Chemistry

Teachers Lab classroom material

CBSE context | 70 marks | 3 hours | 33 questions. Original Teachers Lab practice material. Use the supplied data; do not use a calculator. Attempt one option wherever an OR is provided.

Multiple-choice questions: 16 x 1 = 16 marks

1. A colligative property (1 mark)

For an ideal dilute solution of non-volatile, non-electrolyte solute, which determines the lowering of vapour pressure?
A. The colour of the solute
B. The number of solute particles relative to solvent particles
C. The shape of the container
D. The stirring speed alone

2. Henry’s law (1 mark)

At constant temperature, the partial pressure of a gas above its dilute solution doubles. According to Henry’s law, its mole fraction in solution becomes:
A. half
B. unchanged
C. double
D. four times

3. Dilution (1 mark)

On dilution, the molar conductivity of a weak electrolyte increases substantially mainly because:
A. its degree of ionisation increases
B. the total number of solute molecules always doubles
C. ions become neutral atoms
D. the solution becomes a metal

4. Rate constant units (1 mark)

The rate constant of a first-order reaction has units:
A. mol L^-1 s^-1
B. L mol^-1 s^-1
C. s^-1
D. mol^2 L^-2 s^-1

5. A half-life (1 mark)

For a first-order reaction at fixed temperature, its half-life is:
A. directly proportional to initial concentration
B. independent of initial concentration
C. zero at low concentration
D. always equal to the reaction time

6. A colourless ion (1 mark)

Which aqueous ion is generally colourless because it has a d0 configuration? Atomic numbers: Sc 21, Ti 22, V 23, Cu 29.
A. Ti3+
B. V3+
C. Cu2+
D. Sc3+

7. Lanthanide contraction (1 mark)

The gradual decrease in lanthanoid ionic radii mainly results from:
A. excellent shielding by 4f electrons
B. poor shielding by 4f electrons as nuclear charge increases
C. loss of all protons
D. identical nuclear charge in every lanthanoid

8. An oxidation state (1 mark)

What is the oxidation state of cobalt in [Co(NH3)5Cl]Cl2?
A. +1
B. +2
C. +3
D. +5

9. Geometrical isomerism (1 mark)

Which square-planar complex can show cis and trans isomerism?
A. [Pt(NH3)2Cl2]
B. [PtCl4]2-
C. [Pt(NH3)4]2+
D. [Ni(CO)4], tetrahedral

10. SN1 reactivity (1 mark)

Under comparable conditions in a suitable polar protic solvent, which is most likely to react fastest by SN1?
A. Chloromethane
B. Chloroethane
C. 1-Chloropropane
D. 2-Chloro-2-methylpropane

11. A phenol test (1 mark)

Which sample typically gives a violet colour with neutral ferric chloride solution?
A. Ethanol
B. Phenol
C. Ethoxyethane
D. Propan-2-ol

12. Tollens' reagent (1 mark)

Which compound normally gives a positive Tollens' test?
A. Propanone
B. Ethanal
C. Ethanoic acid
D. Ethoxyethane

13. Basicity (1 mark)

Which is least basic among the following in aqueous solution?
A. Ethylamine
B. Methylamine
C. Ammonia
D. Aniline

14. A reducing sugar (1 mark)

Which is a reducing sugar?
A. Sucrose
B. Glucose
C. Starch, as a bulk polysaccharide
D. Cellulose, as a bulk polysaccharide

15. A linkage (1 mark)

Monosaccharide units in a disaccharide connect through a:
A. peptide linkage
B. glycosidic linkage
C. metallic bond
D. phosphodiester linkage

16. Protein structure (1 mark)

The alpha-helix of a protein is stabilised mainly by:
A. hydrogen bonds along the peptide chain
B. new peptide bonds between every turn
C. ionic bonds with sodium metal
D. glycosidic linkages

Very short answers: 5 x 2 = 10 marks

17. An ideal binary solution (2 marks)

At a fixed temperature, an ideal solution contains liquids A and B with x(A) = 0.40. The vapour pressures of pure A and B are 100 kPa and 60 kPa. Calculate the total vapour pressure.

OR

An ideal dilute solution contains a non-volatile non-electrolyte. Explain why its vapour pressure is lower than that of pure solvent at the same temperature, and state Raoult's law for the solvent.

18. Two half-lives (2 marks)

A first-order reaction has a half-life of 20 minutes. How long does it take for 75% of the initial reactant to be consumed? Explain.

19. A reduction half-equation (2 marks)

Write the reduction half-equation for permanganate ion to Mn2+ in acidic solution. State the change in manganese oxidation state.

20. Name the complex (2 marks)

Give the IUPAC name of [Co(NH3)5Cl]Cl2 and show how you find the oxidation state of cobalt.

21. Aryl and alkyl halides (2 marks)

Explain two reasons why chlorobenzene is less reactive than chloroethane towards ordinary nucleophilic substitution.

OR

For bromoethane, state the product with aqueous KOH and the product with alcoholic KOH on heating.

Short answers: 7 x 3 = 21 marks

22. Osmotic pressure (3 marks)

A solution contains 0.010 mol of glucose in 1.00 L of solution at 298 K. Treat it as ideal and glucose as a non-electrolyte. Calculate its osmotic pressure. Use R = 0.0821 L atm mol^-1 K^-1.

23. A non-standard cell (3 marks)

For Zn(s) | Zn2+(0.10 M) || Cu2+(1.0 M) | Cu(s) at 298 K, E0(cell) = 1.10 V. Find E(cell). Use E = E0 - (0.0591/n) log10 Q. State n and Q.

24. Concentration and time (3 marks)

A reaction has [A] = 0.80 mol L^-1 at 0 min, 0.40 at 10 min and 0.20 at 20 min. The data follow first-order kinetics. Calculate k and the time for 90% consumption from the initial concentration. Use ln 2 = 0.693 and ln 10 = 2.303.

25. Configurations and radii (3 marks)

Explain: (a) Mn2+ resists oxidation to Mn3+ more than its simple charge might suggest; (b) Fe3+ has a half-filled d configuration; (c) Zr and Hf have similar radii. Atomic numbers: Mn 25, Fe 26.

26. Ligands and magnetism (3 marks)

Compare [NiCl4]2- and [Ni(CN)4]2- in terms of nickel oxidation state, geometry and unpaired electrons using the usual valence-bond description. Atomic number Ni = 28.

27. Substitution and stereochemistry (3 marks)

(a) Write the product when bromoethane reacts with aqueous KOH. (b) Write the product with alcoholic KOH on heating. (c) Explain inversion of configuration in an SN2 reaction at a chiral carbon.

28. Three unlabelled samples (3 marks)

Three samples contain ethanal, propanone and ethanoic acid, separately. Describe a sequence of tests to identify them. State what you observe and avoid treating the iodoform test as unique to propanone.

Case-based questions: 2 x 4 = 8 marks

29. Case study: changing a functional group (4 marks)

A teacher compares related compounds in a reaction sequence. Controlled oxidation of ethanol gives compound P; further oxidation gives Q. P reacts with methylmagnesium bromide followed by hydrolysis to give R. P can also be reduced with NaBH4.
(a) Name P. (b) Name Q. (c) Name R and classify its alcohol group. (d) Name the NaBH4 reduction product of P.

30. Case study: sugars and proteins (4 marks)

A school laboratory uses sucrose solutions before and after acid hydrolysis, a peptide model and a diagram of heated egg protein. Answer each independent question.
(a) Name the two monosaccharides formed on sucrose hydrolysis. (b) Explain why sucrose is non-reducing but its hydrolysis products can give reducing-sugar tests. (c) Name the linkage joining amino acids in a peptide. (d) Describe the structural change in protein denaturation without claiming that ordinary denaturation necessarily breaks peptide bonds.

Long answers: 3 x 5 = 15 marks

31. A zinc-copper cell and electrolysis (5 marks)

(a) Write the anode half-equation and cathode half-equation for a standard Zn-Cu galvanic cell. (b) Calculate E0(cell) from E0(Cu2+/Cu) = +0.34 V and E0(Zn2+/Zn) = -0.76 V. (c) Calculate Delta G0 per mole of cell reaction. (d) In a separate Cu2+ electrolysis, what mass of copper deposits when 1930 C passes at 100% current efficiency? Use F = 96500 C mol^-1 and M(Cu) = 63.5 g mol^-1.

OR

For a standard Zn-Cu cell use E0 = 1.10 V, n = 2 and F = 96500 C mol^-1. (a) State the direction of electron flow through the wire. (b) Explain the role of the salt bridge. (c) Calculate Delta G0. (d) State how E changes when [Zn2+] increases while [Cu2+] stays fixed. (e) State E at equilibrium.

32. Phenols and ethers (5 marks)

(a) Explain why phenol reacts with aqueous NaOH more readily than ethanol. Give the relevant stabilisation and the product. (b) Write a Williamson synthesis of ethoxyethane. (c) Give the organic products when anisole reacts with HI under the usual cleavage conditions. (d) Name the oxidation product of propan-2-ol.

OR

(a) State the observation and product when phenol reacts with bromine water. (b) Name the product of acid-catalysed dehydration of ethanol at a suitable high temperature. (c) Name the product of complete oxidation of ethanol using acidified dichromate. (d) Give the initial organic products when methoxyethane reacts with one equivalent of HI under normal cleavage conditions.

33. Aromatic amine transformations (5 marks)

Starting from nitrobenzene: (a) give reagents to obtain aniline; (b) give reagents and temperature to make benzenediazonium chloride from aniline; (c) state the product of warming that salt with water; (d) name the product of aniline with ethanoyl chloride under suitable conditions; (e) order ethylamine, ammonia and aniline by decreasing aqueous basicity and explain aniline's position.

OR

(a) State a positive carbylamine test for a primary amine, including reagents and observation. (b) Explain how the Hinsberg test distinguishes a primary from a secondary amine using solubility in alkali. (c) State the purpose of keeping diazotisation of aniline cold.