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.

Teacher answer key

This sample's unit allocation

Unit	Marks
Solutions	7
Electrochemistry	9
Chemical Kinetics	7
d- and f-Block Elements	7
Coordination Compounds	7
Haloalkanes and Haloarenes	6
Alcohols, Phenols and Ethers	6
Aldehydes, Ketones and Carboxylic Acids	8
Amines	6
Biomolecules	7

Internal alternatives carry equal marks. Award one option only.

1. A colligative property (1 mark)

1. B. A colligative property depends on the relative number of solute particles under the stated conditions.

2. Henry’s law (1 mark)

1. C. p = KH x, so doubling p doubles x when KH stays constant.

3. Dilution (1 mark)

1. A. Dilution favours ionisation of a weak electrolyte, increasing the fraction present as ions.

4. Rate constant units (1 mark)

1. C. For rate = k[A], k has units of inverse time.

5. A half-life (1 mark)

1. B. t1/2 = 0.693/k, independent of the initial concentration.

6. A colourless ion (1 mark)

1. D. Sc3+ is d0, so it has no d-d transition responsible for these characteristic colours.

7. Lanthanide contraction (1 mark)

1. B. Poor 4f shielding permits increasing effective nuclear charge to contract the electron cloud.

8. An oxidation state (1 mark)

1. C. Two outer chloride ions imply a +2 complex ion; the inner chlorido ligand is -1, giving cobalt +3.

9. Geometrical isomerism (1 mark)

1. A. The two pairs of ligands can occupy adjacent or opposite positions in square-planar [Pt(NH3)2Cl2].

10. SN1 reactivity (1 mark)

1. D. The tertiary carbocation intermediate is more stable than the corresponding primary or methyl carbocation.

11. A phenol test (1 mark)

1. B. Phenol gives the characteristic ferric chloride colour under suitable test conditions.

12. Tollens’ reagent (1 mark)

1. B. Ethanal is an aldehyde and reduces Tollens’ reagent to silver.

13. Basicity (1 mark)

1. D. Delocalisation of the nitrogen lone pair into the aromatic ring reduces its availability for protonation in aniline.

14. A reducing sugar (1 mark)

1. B. Glucose has a reducing form in equilibrium and gives standard reducing-sugar tests.

15. A linkage (1 mark)

1. B. A glycosidic linkage joins the monosaccharide units.

16. Protein structure (1 mark)

1. A. Hydrogen bonding stabilises this secondary structure.

17. An ideal binary solution (2 marks)

1. p(A) = 0.40 x 100 = 40 kPa and p(B) = 0.60 x 60 = 36 kPa.
2. Total vapour pressure = 40 + 36 = 76 kPa.

OR: alternative marking points

1. The solvent mole fraction is below 1, so its partial pressure is lower.
2. p(solvent) = x(solvent) p0(solvent).

18. Two half-lives (2 marks)

1. After one half-life 50% remains; after two, 25% remains, corresponding to 75% consumption.
2. Time = 2 x 20 = 40 minutes.

19. A reduction half-equation (2 marks)

1. $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$.
2. Manganese changes from +7 to +2, gaining five electrons per ion.

20. Name the complex (2 marks)

1. The complex ion is +2. With one inner Cl- and neutral NH3 ligands, cobalt is +3.
2. Pentaamminechloridocobalt(III) chloride.

21. Aryl and alkyl halides (2 marks)

1. Resonance gives the aryl C-Cl bond partial double-bond character, making cleavage more difficult.
2. The carbon bearing chlorine is sp2-hybridised, giving a shorter, stronger C-Cl bond than in the comparable alkyl chloride.

OR: alternative marking points

1. Aqueous KOH gives ethanol through substitution.
2. Alcoholic KOH on heating gives ethene through elimination.

22. Osmotic pressure (3 marks)

1. Molar concentration c = 0.010 mol L^-1.
2. For a non-electrolyte, osmotic pressure pi = cRT.
3. pi = 0.010 x 0.0821 x 298 = 0.244658 atm, approximately 0.245 atm.

23. A non-standard cell (3 marks)

1. The reaction is Zn + Cu2+ 'Zn2+ + Cu, so n = 2.
2. Q = [Zn2+]/[Cu2+] = 0.10. Pure solids do not appear in Q.
3. E = 1.10 - (0.0591/2)(-1) = 1.12955 V, approximately 1.130 V.

24. Concentration and time (3 marks)

1. The constant 10-minute half-life is consistent with the stated first-order model.
2. k = 0.693/10 = 0.0693 min^-1.
3. For 90% consumption, [A]0/[A] = 10, so t = 2.303/0.0693 = 33.2 min approximately.

25. Configurations and radii (3 marks)

1. Mn2+ has a stable half-filled 3d5 configuration; forming Mn3+ removes an electron from it.
2. Fe3+ is 3d5 after losing the two 4s electrons and one 3d electron.
3. Lanthanoid contraction reduces the size of Hf, making its radius close to that of Zr.

26. Ligands and magnetism (3 marks)

1. Both contain Ni2+, with a 3d8 configuration.
2. Cl- is a weak-field ligand: [NiCl4]2- is tetrahedral (sp3) and has two unpaired electrons.
3. CN- is a strong-field ligand: [Ni(CN)4]2- is square-planar (dsp2) and diamagnetic with no unpaired electrons.

27. Substitution and stereochemistry (3 marks)

1. $CH_3CH_2Br + KOH(aq) \rightarrow CH_3CH_2OH + KBr$.
2. $CH_3CH_2Br + KOH(alc)$, heat $\rightarrow CH_2=CH_2 + KBr + H_2O$.
3. Backside attack and simultaneous leaving-group departure invert the arrangement at the reacting chiral centre.

28. Three unlabelled samples (3 marks)

1. Sodium hydrogencarbonate gives effervescence of CO_2 with ethanoic acid, identifying the acid.
2. Of the remaining carbonyl samples, ethanal gives a silver mirror with Tollens' reagent; propanone does not under usual test conditions.
3. The remaining sample is propanone; its positive iodoform test is consistent with a methyl ketone. Ethanal also gives that test, so it is not unique to propanone.

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

1. P is ethanal.
2. Q is ethanoic acid.
3. R is propan-2-ol, a secondary alcohol.
4. Reduction of ethanal with $NaBH_4$ gives ethanol.

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

1. Hydrolysis yields glucose and fructose.
2. Both anomeric centres participate in sucrose's glycosidic linkage; hydrolysis frees reducing forms of the monosaccharides under the relevant test conditions.
3. A peptide (amide) linkage, -CO-NH-, joins the amino acid units.
4. Denaturation disrupts secondary/tertiary organisation and biological function; the primary peptide sequence generally remains intact.

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

1. Anode: Zn ’Zn2+ + 2e-.
2. Cathode: Cu2+ + 2e- ’Cu.
3. E0(cell) = 0.34 - (-0.76) = 1.10 V.
4. Delta G0 = -nFE0 = -2 x 96500 x 1.10 = -212300 J mol^-1 = -212.3 kJ mol^-1.
5. m = MQ/(nF) = 63.5 x 1930/(2 x 96500) = 0.635 g.

OR: alternative marking points

1. Electrons flow from zinc to copper through the external wire.
2. The salt bridge permits ion migration and maintains electrical neutrality while completing the circuit.
3. Delta G0 = -2 x 96500 x 1.10 = -212.3 kJ mol^-1.
4. Q increases, so E decreases according to the Nernst equation.
5. E = 0 at equilibrium.

32. Phenols and ethers (5 marks)

1. Phenoxide is resonance-stabilised; ethoxide lacks equivalent resonance stabilisation, making phenol more acidic.
2. Phenol + NaOH gives sodium phenoxide and water.
3. C2H5ONa + C2H5Br ’C2H5OC2H5 + NaBr.
4. Anisole + HI gives phenol and CH3I by cleavage at the methyl-oxygen bond.
5. Oxidation of propan-2-ol gives propanone.

OR: alternative marking points

1. Bromine water decolourises and a white precipitate forms.
2. The precipitate is 2,4,6-tribromophenol.
3. Dehydration of ethanol gives ethene.
4. Complete oxidation gives ethanoic acid.
5. Initial cleavage gives methyl iodide and ethanol, with attack at the less hindered methyl group.

33. Aromatic amine transformations (5 marks)

1. Reduce nitrobenzene with Sn/HCl, followed by alkaline work-up, to obtain aniline.
2. $NaNO_2$ and HCl at 273-278 K produce benzenediazonium chloride.
3. Warming with water produces phenol with evolution of nitrogen (and HCl).
4. Acylation gives N-phenylethanamide (acetanilide).
5. Ethylamine > ammonia > aniline. Aniline's lone pair is delocalised into the ring and less available for protonation.

OR: alternative marking points

1. Heat the primary amine with chloroform and alcoholic KOH.
2. A foul-smelling isocyanide forms in the carbylamine test.
3. A primary amine gives a sulfonamide with an N-H group that dissolves in alkali.
4. A secondary amine gives a sulfonamide without that acidic N-H group, so it is insoluble in alkali.
5. Low temperature (273-278 K) helps preserve the aromatic diazonium salt and limits its decomposition.