

A-Level Chemistry Practice Test 13

60 original multiple-choice questions in AQA / Edexcel / OCR exam style (AS + A2). Choose one answer for each question. The full answer key is on the last page — worked explanations for every question are free at QuaidianPoint.com.

Name: _____ Class: _____ Score: _____ / 60

Atomic Structure & Periodicity

Q1. A sample of chlorine contains 75.8% of ^{35}Cl and 24.2% of ^{37}Cl . What is the relative atomic mass of chlorine in this sample?

- (A) 35.0
- (B) 35.5
- (C) 36.0
- (D) 36.5

Q2. The first four ionisation energies of an element are 590, 1145, 4912 and 6474 kJ mol^{-1} . In which group of the Periodic Table is this element?

- (A) Group 1
- (B) Group 13
- (C) Group 2
- (D) Group 14

Q3. What is the electronic configuration of an Fe^{3+} ion? (Atomic number of Fe = 26)

- (A) $[\text{Ar}] 4s^2 3d^3$
- (B) $[\text{Ar}] 3d^5$
- (C) $[\text{Ar}] 4s^1 3d^4$
- (D) $[\text{Ar}] 3d^6$

Q4. Which of these Period 3 elements has the highest first ionisation energy?

- (A) Na
- (B) Mg
- (C) S
- (D) Cl

Q5. In a time of flight mass spectrometer, an ion with $m/z = 40$ has a flight time of $2.0 \times 10^{-5} \text{ s}$. Under the same conditions, what is the flight time of an ion with $m/z = 90$?

- (A) $1.3 \times 10^{-5} \text{ s}$
- (B) $2.0 \times 10^{-5} \text{ s}$
- (C) $3.0 \times 10^{-5} \text{ s}$
- (D) $4.5 \times 10^{-5} \text{ s}$

Amount of Substance

Q6. What volume is occupied by 0.50 mol of a gas at 100 kPa and 300 K? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 12.5 dm^3
- (B) 6.2 dm^3
- (C) 24.9 dm^3
- (D) 0.0125 dm^3

Q7. 25.0 cm^3 of a sodium hydroxide solution is neutralised by 20.0 cm^3 of $0.100 \text{ mol dm}^{-3}$ hydrochloric acid. What is the concentration of the sodium hydroxide solution?

- (A) $0.040 \text{ mol dm}^{-3}$
- (B) $0.125 \text{ mol dm}^{-3}$
- (C) $0.100 \text{ mol dm}^{-3}$
- (D) $0.080 \text{ mol dm}^{-3}$

Q8. In a preparation, the theoretical yield of a product is 12.0 g and the actual yield obtained is 9.0 g. What is the percentage yield?

- (A) 75%
- (B) 25%
- (C) 80%
- (D) 133%

Q9. A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

- (A) $\text{C}_2\text{H}_4\text{O}_2$
- (B) CH_2O
- (C) CHO
- (D) $\text{C}_6\text{H}_{12}\text{O}_6$

Q10. What mass of anhydrous sodium carbonate ($M_r = 106$) is needed to make 500 cm^3 of a $0.100 \text{ mol dm}^{-3}$ solution?

- (A) 2.65 g
- (B) 10.6 g
- (C) 5.30 g
- (D) 0.53 g

Q11. Excess dilute hydrochloric acid is added to 0.12 g of magnesium. What volume of hydrogen gas is produced at room temperature and pressure? (Molar gas volume = $24 \text{ dm}^3 \text{ mol}^{-1}$; $A_r(\text{Mg}) = 24$)

- (A) 60 cm^3
- (B) 240 cm^3
- (C) 480 cm^3
- (D) 120 cm^3

Bonding & Structure

Q12. Which molecule has a bond angle of approximately 104.5° ?

- (A) NH_3
- (B) CH_4
- (C) H_2O
- (D) BF_3

Q13. Which substance has the highest boiling point?

- (A) CH₄
- (B) H₂S
- (C) CH₃Cl
- (D) CH₃OH

Q14. Use these data for sodium chloride: enthalpy change of formation = -411 kJ mol⁻¹; enthalpy of atomisation of Na = +107 kJ mol⁻¹; first ionisation energy of Na = +496 kJ mol⁻¹; enthalpy of atomisation of chlorine = +121 kJ mol⁻¹; electron affinity of Cl = -349 kJ mol⁻¹. What is the lattice enthalpy of NaCl?

- (A) -411 kJ mol⁻¹
- (B) -375 kJ mol⁻¹
- (C) -592 kJ mol⁻¹
- (D) -786 kJ mol⁻¹

Q15. Magnesium oxide has a melting point of 2852 °C. What is the main reason for this very high melting point?

- (A) The Mg²⁺ and O²⁻ ions have large charges and are held by strong electrostatic attractions throughout a giant lattice
- (B) There are strong covalent bonds between MgO molecules
- (C) The van der Waals forces between MgO molecules are very strong
- (D) Magnesium oxide has a giant covalent structure like diamond

Q16. Which molecule is polar overall?

- (A) CO₂
- (B) BF₃
- (C) CCl₄
- (D) CHCl₃

Q17. Graphite conducts electricity. Which statement explains this?

- (A) The ions in graphite are free to move
- (B) Each carbon atom is bonded to four other atoms in a rigid lattice
- (C) One electron from each carbon atom is delocalised and can move along the layers
- (D) The layers are held together by strong covalent bonds

Energetics & Thermodynamics

Q18. 50.0 cm³ of 1.00 mol dm⁻³ hydrochloric acid is mixed with 50.0 cm³ of 1.00 mol dm⁻³ sodium hydroxide in a polystyrene cup. The temperature rises by 6.8 °C. What is the enthalpy change of neutralisation? (Density of solution = 1.00 g cm⁻³; c = 4.18 J g⁻¹ K⁻¹)

- (A) -28.4 kJ mol⁻¹
- (B) -5.7 kJ mol⁻¹
- (C) -56.8 kJ mol⁻¹
- (D) -113.7 kJ mol⁻¹

Q19. Standard enthalpies of formation: $\text{CH}_4 = -75 \text{ kJ mol}^{-1}$, $\text{CO}_2 = -394 \text{ kJ mol}^{-1}$, $\text{H}_2\text{O} = -286 \text{ kJ mol}^{-1}$. What is the enthalpy change of combustion of methane?

- (A) -891 kJ mol^{-1}
- (B) -966 kJ mol^{-1}
- (C) -741 kJ mol^{-1}
- (D) -605 kJ mol^{-1}

Q20. Bond enthalpies: $\text{H-H} = 436 \text{ kJ mol}^{-1}$, $\text{Cl-Cl} = 242 \text{ kJ mol}^{-1}$, $\text{H-Cl} = 431 \text{ kJ mol}^{-1}$. What is the enthalpy change for the reaction $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$?

- (A) $+184 \text{ kJ mol}^{-1}$
- (B) -184 kJ mol^{-1}
- (C) -862 kJ mol^{-1}
- (D) -92 kJ mol^{-1}

Q21. In which reaction is the entropy change of the system positive?

- (A) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (B) $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- (C) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- (D) $\text{Na}^+(\text{g}) + \text{Cl}^-(\text{g}) \rightarrow \text{NaCl}(\text{s})$

Q22. A reaction has $\Delta H = -100 \text{ kJ mol}^{-1}$ and $\Delta S = -200 \text{ J K}^{-1} \text{ mol}^{-1}$. At what temperature does the reaction just become unfeasible ($\Delta G = 0$)?

- (A) 250 K
- (B) 500 K
- (C) 1000 K
- (D) 200 K

Q23. Standard entropies ($\text{J K}^{-1} \text{ mol}^{-1}$): $\text{N}_2 = 192$, $\text{H}_2 = 131$, $\text{NH}_3 = 193$. What is the entropy change for the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$?

- (A) $-199 \text{ J K}^{-1} \text{ mol}^{-1}$
- (B) $+199 \text{ J K}^{-1} \text{ mol}^{-1}$
- (C) $-99 \text{ J K}^{-1} \text{ mol}^{-1}$
- (D) $-405 \text{ J K}^{-1} \text{ mol}^{-1}$

Kinetics & Rate Equations

Q24. For a reaction with rate $= k[\text{A}][\text{B}]^2$, what happens to the rate if the concentrations of both A and B are doubled?

- (A) It doubles
- (B) It increases by a factor of 4
- (C) It increases by a factor of 6
- (D) It increases by a factor of 8

Q25. In a series of experiments, doubling $[\text{X}]$ at constant $[\text{Y}]$ doubles the initial rate, and doubling $[\text{Y}]$ at constant $[\text{X}]$ increases the initial rate by a factor of 4. What is the rate equation?

- (A) $\text{rate} = k[\text{X}][\text{Y}]$
- (B) $\text{rate} = k[\text{X}]^2[\text{Y}]$
- (C) $\text{rate} = k[\text{X}][\text{Y}]^2$
- (D) $\text{rate} = k[\text{X}]^2[\text{Y}]^2$

Q26. What are the units of the rate constant for a reaction that is third order overall?

- (A) $\text{mol dm}^{-3} \text{s}^{-1}$
- (B) s^{-1}
- (C) $\text{dm}^3 \text{mol}^{-1} \text{s}^{-1}$
- (D) $\text{dm}^6 \text{mol}^{-2} \text{s}^{-1}$

Q27. A graph of $\ln k$ against $1/T$ for a reaction is a straight line with a gradient of -6000 K . What is the activation energy? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 49.9 kJ mol^{-1}
- (B) 4.99 kJ mol^{-1}
- (C) 6000 kJ mol^{-1}
- (D) 722 kJ mol^{-1}

Q28. Which statement about the effect of a catalyst is correct?

- (A) It increases the activation energy of the reaction
- (B) It provides an alternative pathway with a lower activation energy, so a greater proportion of collisions are successful
- (C) It raises the energy of all the reactant molecules
- (D) It increases the temperature of the reaction mixture

Equilibria (K_c & K_p)

Q29. For the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, the equilibrium mixture in a 1.00 dm^3 flask contains 0.60 mol of N_2O_4 and 0.80 mol of NO_2 . What is the value of K_c ?

- (A) 0.27 mol dm^{-3}
- (B) 1.07 mol dm^{-3}
- (C) 0.53 mol dm^{-3}
- (D) 2.13 mol dm^{-3}

Q30. For the equilibrium $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, the equilibrium partial pressures are $\text{SO}_3 = 60 \text{ kPa}$, $\text{SO}_2 = 20 \text{ kPa}$ and $\text{O}_2 = 10 \text{ kPa}$. What is the value of K_p ?

- (A) 0.90 kPa^{-1}
- (B) 1.11 kPa^{-1}
- (C) 9.0 kPa^{-1}
- (D) 0.090 kPa^{-1}

Q31. An equilibrium reaction is endothermic in the forward direction. What happens to the value of K_c when the temperature is increased?

- (A) K_c increases
- (B) K_c decreases
- (C) K_c does not change
- (D) K_c increases only if a catalyst is present

Q32. For the reaction $2\text{A}(\text{aq}) + \text{B}(\text{aq}) \rightleftharpoons \text{C}(\text{aq})$, which expression gives K_c ?

- (A) $[\text{C}] / ([\text{A}][\text{B}])$
- (B) $([\text{A}]^2[\text{B}]) / [\text{C}]$
- (C) $[\text{C}] / ([\text{A}]^2[\text{B}])$
- (D) $[\text{C}]^2 / ([\text{A}][\text{B}])$

Q33. Hydrogen and iodine react: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$. Initially 1.00 mol of H_2 and 1.00 mol of I_2 are placed in a 1.00 dm^3 flask. At equilibrium, 1.60 mol of HI is present. What is the value of K_c ?

- (A) 8
- (B) 16
- (C) 32
- (D) 64

Redox & Electrode Potentials

Q34. What is the oxidation number of chromium in $\text{K}_2\text{Cr}_2\text{O}_7$?

- (A) +3
- (B) +6
- (C) +7
- (D) +2

Q35. Standard electrode potentials: $\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$, $E = +0.77 \text{ V}$; $\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$, $E = -0.76 \text{ V}$. What is the EMF of a cell combining these two half-cells?

- (A) 1.53 V
- (B) 0.01 V
- (C) 0.77 V
- (D) -1.53 V

Q36. Standard electrode potentials: $\text{Cl}_2/\text{Cl}^- = +1.36 \text{ V}$; $\text{Br}_2/\text{Br}^- = +1.09 \text{ V}$; $\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ V}$; $\text{I}_2/\text{I}^- = +0.54 \text{ V}$. Which of these species is the strongest oxidising agent?

- (A) Br_2
- (B) I_2
- (C) Fe^{3+}
- (D) Cl_2

Q37. A current of 0.50 A is passed through aqueous copper(II) sulfate for 1930 s using inert electrodes. What mass of copper is deposited at the cathode? (Faraday constant = $96\,500 \text{ C mol}^{-1}$; $A_r(\text{Cu}) = 63.5$)

- (A) 0.159 g
- (B) 0.318 g
- (C) 0.635 g
- (D) 1.27 g

Q38. Chlorine reacts with cold, dilute sodium hydroxide: $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O}$. What are the oxidation numbers of chlorine in NaCl and in NaClO respectively?

- (A) -1 and +1
- (B) -1 and -1
- (C) +1 and +3
- (D) 0 and +1

Acids, Bases & Buffers

Q39. What is the pH of 0.010 mol dm⁻³ nitric acid?

- (A) 1.00
- (B) 2.00
- (C) 12.00
- (D) 0.01

Q40. A 0.100 mol dm⁻³ solution of a weak acid has $K_a = 1.8 \times 10^{-5}$ mol dm⁻³. What is its pH?

- (A) 1.00
- (B) 4.74
- (C) 2.87
- (D) 3.74

Q41. What is the pH of 0.050 mol dm⁻³ sodium hydroxide solution? ($K_w = 1.00 \times 10^{-14}$ mol² dm⁻⁶ at 25 °C)

- (A) 1.30
- (B) 12.00
- (C) 12.70
- (D) 13.30

Q42. A buffer solution contains 0.200 mol dm⁻³ ethanoic acid and 0.100 mol dm⁻³ sodium ethanoate. The K_a of ethanoic acid is 1.8×10^{-5} mol dm⁻³ ($pK_a = 4.74$). What is the pH of the buffer?

- (A) 4.44
- (B) 5.05
- (C) 4.74
- (D) 3.44

Q43. What is the pH of a 1.0×10^{-3} mol dm⁻³ solution of calcium hydroxide? ($K_w = 1.00 \times 10^{-14}$ mol² dm⁻⁶ at 25 °C)

- (A) 2.70
- (B) 3.00
- (C) 11.00
- (D) 11.30

Inorganic Chemistry

Q44. Which statement about the Group 2 elements and their compounds is correct?

- (A) The solubility of the Group 2 hydroxides decreases down the group
- (B) The solubility of the Group 2 hydroxides increases down the group, and Mg(OH)₂ is sparingly soluble
- (C) Magnesium does not react with water in any form
- (D) The Group 2 carbonates become less stable to heating down the group

Q45. Which reaction does NOT take place?

- (A) $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$
- (B) $\text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2$
- (C) $\text{I}_2 + 2\text{KBr} \rightarrow 2\text{KI} + \text{Br}_2$
- (D) $\text{Br}_2 + 2\text{KI} \rightarrow 2\text{KBr} + \text{I}_2$

Q46. Excess concentrated hydrochloric acid is added to a blue solution containing copper(II) ions. What colour is the final solution, and which complex ion is formed?

- (A) Deep blue; $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$
- (B) Pink; $[\text{CuCl}_4]^{2-}$
- (C) Colourless; $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$
- (D) Yellow-green; $[\text{CuCl}_4]^{2-}$

Q47. In a flame test, which colour is produced by calcium ions?

- (A) Brick red (orange-red)
- (B) Crimson red
- (C) Lilac
- (D) Blue-green

Q48. Which substance is used as the catalyst in the Contact process for making sulfuric acid?

- (A) Iron
- (B) Nickel
- (C) Vanadium(V) oxide, V_2O_5
- (D) Manganese(IV) oxide

Organic Chemistry I

Q49. Methane reacts with chlorine in ultraviolet light. Which step is a propagation step?

- (A) $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
- (B) $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{CH}_3\cdot + \text{HCl}$
- (C) $\text{CH}_3\cdot + \text{CH}_3\cdot \rightarrow \text{C}_2\text{H}_6$
- (D) $\text{Cl}\cdot + \text{CH}_3\cdot \rightarrow \text{CH}_3\text{Cl}$

Q50. Which halogenoalkane is hydrolysed fastest by aqueous sodium hydroxide?

- (A) 1-chlorobutane
- (B) 1-bromobutane
- (C) 1-fluorobutane
- (D) 1-iodobutane

Q51. Hydrogen bromide is added to propene. What is the major product?

- (A) 2-bromopropane
- (B) 1-bromopropane
- (C) 1,2-dibromopropane
- (D) 2-bromopropene

Q52. Which observation shows that a hydrocarbon is an alkene rather than an alkane?

- (A) It burns with a smoky flame
- (B) It forms carbon dioxide and water on complete combustion
- (C) It decolourises bromine water when shaken with it
- (D) It is insoluble in water

Q53. Propan-1-ol is heated under reflux with acidified potassium dichromate(VI). What is the main organic product?

- (A) Propanal
- (B) Propanoic acid
- (C) Propene
- (D) Propanone

Q54. Bromoethane is heated with potassium hydroxide dissolved in ethanol. What is the main organic product?

- (A) Ethanol
- (B) Ethanoic acid
- (C) Ethene
- (D) Ethane

Organic Chemistry II & Analysis

Q55. Which reagent gives a positive result with an aldehyde but not with a ketone, and so can be used to distinguish them?

- (A) 2,4-dinitrophenylhydrazine solution
- (B) Tollens' reagent
- (C) Bromine water
- (D) Sodium hydrogencarbonate solution

Q56. Hydrogen cyanide adds to propanal to form a hydroxynitrile. The product is formed as a racemic mixture because...

- (A) the cyanide ion is a weak nucleophile
- (B) propanal already contains a chiral carbon atom
- (C) the reaction is very fast
- (D) the carbonyl group is planar, so the nucleophile attacks with equal probability from either side, forming equal amounts of two enantiomers

Q57. Ethanoyl chloride is added to water. Which statement is correct?

- (A) A vigorous reaction occurs, producing ethanoic acid and misty fumes of HCl
- (B) No reaction occurs because acyl chlorides are unreactive
- (C) Ethanol and hydrochloric acid are slowly formed
- (D) A sweet-smelling ester is formed

Q58. In the nitration of benzene, the electrophile that attacks the benzene ring is...

- (A) HNO_3
- (B) H_2SO_4
- (C) NO_2^+ , the nitronium ion
- (D) NO_2

Q59. Which is the correct order of basicity (strongest base first)?

- (A) Phenylamine > ammonia > ethylamine
- (B) Ethylamine > ammonia > phenylamine
- (C) Ammonia > ethylamine > phenylamine
- (D) Ethylamine > phenylamine > ammonia

Q60. How many peaks are there in the proton (^1H) NMR spectrum of ethanoic acid, CH_3COOH ?

- (A) 1
- (B) 3
- (C) 4
- (D) 2

Answer Key

Q1: B	Q11: D	Q21: A	Q31: A	Q41: C	Q51: A
Q2: C	Q12: C	Q22: B	Q32: C	Q42: A	Q52: C
Q3: B	Q13: D	Q23: A	Q33: D	Q43: D	Q53: B
Q4: D	Q14: D	Q24: D	Q34: B	Q44: B	Q54: C
Q5: C	Q15: A	Q25: C	Q35: A	Q45: C	Q55: B
Q6: A	Q16: D	Q26: D	Q36: D	Q46: D	Q56: D
Q7: D	Q17: C	Q27: A	Q37: B	Q47: A	Q57: A
Q8: A	Q18: C	Q28: B	Q38: A	Q48: C	Q58: C
Q9: B	Q19: A	Q29: B	Q39: B	Q49: B	Q59: B
Q10: C	Q20: B	Q30: A	Q40: C	Q50: D	Q60: D

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