

A-Level Chemistry Practice Test 1

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 neon contains the isotopes ^{20}Ne , ^{21}Ne and ^{22}Ne with percentage abundances of 90.5%, 0.3% and 9.2% respectively. What is the relative atomic mass of this sample of neon?

- (A) 20.00
- (B) 20.19
- (C) 20.90
- (D) 21.02

Q2. The first four ionisation energies of an element X are 578, 1817, 2745 and 11 578 kJ mol⁻¹. How many electrons does an atom of X have in its outer shell?

- (A) 2
- (B) 4
- (C) 3
- (D) 5

Q3. Which ion has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$?

- (A) Fe^{2+}
- (B) Fe^{3+}
- (C) Co^{2+}
- (D) Cr^{3+}

Q4. Which trend is correct across Period 3 from sodium to argon?

- (A) The atomic radius increases
- (B) The elements become stronger reducing agents
- (C) The first ionisation energy decreases steadily
- (D) The bonding in the oxides changes from ionic to covalent

Q5. In a time-of-flight mass spectrometer, a singly charged ion travels along a flight tube of length 2.00 m in a time of 1.20×10^{-5} s. What is the speed of the ion?

- (A) $6.00 \times 10^4 \text{ m s}^{-1}$
- (B) $1.67 \times 10^5 \text{ m s}^{-1}$
- (C) $2.40 \times 10^5 \text{ m s}^{-1}$
- (D) $1.20 \times 10^6 \text{ m s}^{-1}$

Amount of Substance

Q6. What volume, in dm^3 , is occupied by 0.250 mol of an ideal gas at 298 K and a pressure of 100 kPa? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 0.619
- (B) 5.92
- (C) 6.19
- (D) 61.9

Q7. A 25.0 cm^3 sample of sodium hydroxide solution is exactly neutralised by 23.40 cm^3 of $0.100 \text{ mol dm}^{-3}$ hydrochloric acid. What is the concentration of the sodium hydroxide solution?

- (A) $0.0936 \text{ mol dm}^{-3}$
- (B) $0.0855 \text{ mol dm}^{-3}$
- (C) $0.107 \text{ mol dm}^{-3}$
- (D) $0.936 \text{ mol dm}^{-3}$

Q8. A compound contains 40.0% carbon, 6.67% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

- (A) CH_4O
- (B) CH_2O_2
- (C) $\text{C}_2\text{H}_4\text{O}$
- (D) CH_2O

Q9. In a synthesis, the theoretical yield of a product is 40.0 g but only 30.0 g of pure product is obtained. What is the percentage yield?

- (A) 25.0%
- (B) 75.0%
- (C) 80.0%
- (D) 133%

Q10. What is the atom economy for the production of ethanol by the reaction $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH}$?

- (A) 46%
- (B) 78%
- (C) 100%
- (D) 61%

Q11. What mass of sodium carbonate, Na_2CO_3 ($M_r = 106$), is needed to make 250 cm^3 of a $0.200 \text{ mol dm}^{-3}$ solution?

- (A) 5.30 g
- (B) 2.65 g
- (C) 10.6 g
- (D) 21.2 g

Bonding & Structure

Q12. Which molecule has a bond angle of approximately 107° ?

- (A) CH_4
- (B) BF_3
- (C) BeCl_2
- (D) NH_3

Q13. Hydrogen fluoride has a much higher boiling point than hydrogen chloride. This is because

- (A) the H-F bond is weaker than the H-Cl bond
- (B) HF molecules form hydrogen bonds but HCl molecules do not
- (C) fluorine atoms are larger than chlorine atoms
- (D) HF is an acid but HCl is not

Q14. Use the data: $\Delta H_f(\text{NaCl}) = -411 \text{ kJ mol}^{-1}$; enthalpy of atomisation of sodium = $+108 \text{ kJ mol}^{-1}$; first ionisation energy of sodium = $+496 \text{ kJ mol}^{-1}$; enthalpy of atomisation of chlorine (per mole of Cl atoms) = $+121 \text{ kJ mol}^{-1}$; electron affinity of chlorine = -349 kJ mol^{-1} . What is the lattice enthalpy of sodium chloride?

- (A) -376 kJ mol^{-1}
- (B) -411 kJ mol^{-1}
- (C) -787 kJ mol^{-1}
- (D) $-1574 \text{ kJ mol}^{-1}$

Q15. Which substance consists of a giant covalent structure?

- (A) Silicon(IV) oxide
- (B) Ice
- (C) Iodine
- (D) Sodium chloride

Q16. Which bond is the most polar?

- (A) C-H
- (B) O-H
- (C) C-Cl
- (D) H-F

Q17. Ionic compounds conduct electricity when molten but not when solid because

- (A) the ions are smaller in the molten state
- (B) in the liquid the ions are free to move, but in the solid they are held in fixed positions in the lattice
- (C) electrons become delocalised when the compound melts
- (D) the ionic bonds are broken completely on melting

Energetics & Thermodynamics

Q18. In a calorimetry experiment, burning 0.200 mol of a liquid fuel raised the temperature of 500 g of water by 15.0 °C. What is the enthalpy of combustion of the fuel? (Specific heat capacity of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$)

- (A) $-31.4 \text{ kJ mol}^{-1}$
- (B) $-78.4 \text{ kJ mol}^{-1}$
- (C) -157 kJ mol^{-1}
- (D) -313 kJ mol^{-1}

Q19. Use the enthalpies of combustion: C = -394 kJ mol^{-1} ; H₂ = -286 kJ mol^{-1} ; CH₄ = -890 kJ mol^{-1} . What is the enthalpy of formation of methane?

- (A) -76 kJ mol^{-1}
- (B) $+76 \text{ kJ mol}^{-1}$
- (C) $-1856 \text{ kJ mol}^{-1}$
- (D) -17 kJ mol^{-1}

Q20. Which process is accompanied by an increase in entropy?

- (A) $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- (B) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- (C) $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$
- (D) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

Q21. A reaction has $\Delta H = -100 \text{ kJ mol}^{-1}$ and $\Delta S = -200 \text{ J K}^{-1} \text{ mol}^{-1}$. At what temperature is $\Delta G = 0$ for this reaction?

- (A) 200 K
- (B) 500 K
- (C) 0.50 K
- (D) 1000 K

Q22. Use the mean bond enthalpies: C-H = 412; O=O = 496; C=O = 743; O-H = 463 kJ mol^{-1} . What is the enthalpy change for $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$?

- (A) $+698 \text{ kJ mol}^{-1}$
- (B) $-2640 \text{ kJ mol}^{-1}$
- (C) -698 kJ mol^{-1}
- (D) -349 kJ mol^{-1}

Q23. The enthalpy change when 1 mole of an ionic compound is formed from its gaseous ions under standard conditions is the

- (A) lattice enthalpy of formation
- (B) enthalpy of atomisation
- (C) enthalpy of hydration
- (D) enthalpy of solution

Kinetics & Rate Equations

Q24. In some experiments on the reaction $\text{P} + \text{Q} \rightarrow \text{products}$, doubling [P] (with [Q] constant) doubled the initial rate, and doubling [Q] (with [P] constant) quadrupled the initial rate. What is the rate equation?

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

Q25. The units of the rate constant for an overall second-order reaction are

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

Q26. A first-order reaction has a frequency factor $A = 1.0 \times 10^{11} \text{ s}^{-1}$ and an activation energy of 80 kJ mol^{-1} . What is the value of the rate constant at 300 K? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 1.16 s^{-1}
- (B) $8.62 \times 10^{-11} \text{ s}^{-1}$
- (C) $1.16 \times 10^{-3} \text{ s}^{-1}$
- (D) $3.11 \times 10^{-2} \text{ s}^{-1}$

Q27. A first-order reaction has a half-life of 20 s. Starting from a given concentration, how long does it take for the concentration to fall to one eighth of its initial value?

- (A) 60 s
- (B) 40 s
- (C) 160 s
- (D) 6.7 s

Q28. The mechanism for the reaction $2\text{NO}_2 + \text{CO} \rightarrow 2\text{NO} + \text{CO}_2$ is proposed as: Step 1 (slow): $\text{NO}_2 + \text{NO}_2 \rightarrow \text{NO}_3 + \text{NO}$; Step 2 (fast): $\text{NO}_3 + \text{CO} \rightarrow \text{NO}_2 + \text{CO}_2$. What is the rate equation for this reaction?

- (A) $\text{rate} = k[\text{NO}_2][\text{CO}]$
- (B) $\text{rate} = k[\text{NO}_3][\text{CO}]$
- (C) $\text{rate} = k[\text{NO}_2]$
- (D) $\text{rate} = k[\text{NO}_2]^2$

Equilibria (K_c & K_p)

Q29. For the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, 2.00 mol of N_2O_4 was placed in a 2.00 dm^3 vessel. At equilibrium the mixture contained 0.800 mol of NO_2 . What is the value of K_c ?

- (A) $0.100 \text{ mol dm}^{-3}$
- (B) $0.200 \text{ mol dm}^{-3}$
- (C) $0.400 \text{ mol dm}^{-3}$
- (D) 5.00 mol dm^{-3}

Q30. For the equilibrium $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$, an equilibrium mixture contains 0.20 mol PCl_5 , 0.30 mol PCl_3 and 0.30 mol Cl_2 at a total pressure of 100 kPa. What is the value of K_p ?

- (A) 0.563 kPa
- (B) 5.63 kPa
- (C) 56.3 kPa
- (D) 563 kPa

Q31. In the Haber process, $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ ($\Delta H = -92 \text{ kJ mol}^{-1}$), which change increases both the rate of reaction and the equilibrium yield of ammonia?

- (A) Increasing the pressure
- (B) Increasing the temperature
- (C) Adding an iron catalyst
- (D) Decreasing the pressure

Q32. For the equilibrium $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, the units of K_c are

- (A) mol dm^{-3}
- (B) no units
- (C) $\text{mol}^2 \text{ dm}^{-6}$
- (D) $\text{mol}^{-1} \text{ dm}^3$

Q33. Which statement about a system in dynamic equilibrium is correct?

- (A) The concentrations of the reactants and products are equal
- (B) The rate of the forward reaction is equal to the rate of the reverse reaction
- (C) Both reactions have stopped
- (D) The concentration of products is always greater than that of reactants

Redox & Electrode Potentials

Q34. What is the oxidation state of sulfur in Na₂S₂O₃?

- (A) -2
- (B) +4
- (C) +2
- (D) +6

Q35. Use the standard electrode potentials: Fe²⁺ + 2e⁻ → Fe, E = -0.44 V; Cu²⁺ + 2e⁻ → Cu, E = +0.34 V. What is the EMF of the cell Fe | Fe²⁺ || Cu²⁺ | Cu under standard conditions?

- (A) +0.78 V
- (B) -0.78 V
- (C) +0.10 V
- (D) -0.10 V

Q36. Use the standard electrode potentials: Fe³⁺ + e⁻ → Fe²⁺, E = +0.77 V; Cl₂ + 2e⁻ → 2Cl⁻, E = +1.36 V; Br₂ + 2e⁻ → 2Br⁻, E = +1.07 V; I₂ + 2e⁻ → 2I⁻, E = +0.54 V. Which species is the strongest reducing agent?

- (A) Cl⁻
- (B) Fe³⁺
- (C) Br⁻
- (D) I⁻

Q37. A current of 2.00 A is passed through copper(II) sulfate solution for 16.1 minutes. What mass of copper is deposited at the cathode? (Faraday constant = 96 500 C mol⁻¹; Ar of Cu = 63.5)

- (A) 0.318 g
- (B) 0.635 g
- (C) 1.27 g
- (D) 6.35 g

Q38. Use the standard electrode potentials: Zn²⁺ + 2e⁻ → Zn, E = -0.76 V; Cu²⁺ + 2e⁻ → Cu, E = +0.34 V; 2H⁺ + 2e⁻ → H₂, E = 0.00 V; Fe³⁺ + e⁻ → Fe²⁺, E = +0.77 V; I₂ + 2e⁻ → 2I⁻, E = +0.54 V. Which reaction is NOT feasible under standard conditions?

- (A) Zn + Cu²⁺ → Zn²⁺ + Cu
- (B) 2Fe³⁺ + 2I⁻ → 2Fe²⁺ + I₂
- (C) Cu + 2H⁺ → Cu²⁺ + H₂
- (D) Zn + 2H⁺ → Zn²⁺ + H₂

Acids, Bases & Buffers

Q39. What is the pH of 0.0500 mol dm⁻³ hydrochloric acid?

- (A) 1.30
- (B) 1.00
- (C) 2.30
- (D) 0.70

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

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

Q41. A buffer solution contains 0.100 mol dm⁻³ ethanoic acid and 0.200 mol dm⁻³ sodium ethanoate. K_a for ethanoic acid = 1.74×10^{-5} mol dm⁻³. What is the pH of this buffer?

- (A) 4.46
- (B) 5.06
- (C) 4.76
- (D) 5.36

Q42. At 50 °C, $K_w = 5.5 \times 10^{-14}$ mol² dm⁻⁶. What is the pH of pure water at this temperature?

- (A) 7.00
- (B) 7.26
- (C) 6.63
- (D) 13.26

Q43. Which mixture will act as a buffer solution?

- (A) Ethanoic acid and sodium ethanoate
- (B) Hydrochloric acid and sodium chloride
- (C) Sodium hydroxide and sodium chloride
- (D) Nitric acid and potassium nitrate

Inorganic Chemistry

Q44. Which statement about Group 2 chemistry is correct?

- (A) Magnesium hydroxide is more soluble in water than barium hydroxide
- (B) Barium sulfate is soluble in water
- (C) The reactivity of the Group 2 elements decreases down the group
- (D) The solubility of the Group 2 hydroxides increases down the group

Q45. When chlorine reacts with cold, dilute sodium hydroxide solution, the products include sodium chloride and sodium chlorate(I). In this reaction, chlorine is

- (A) only oxidised
- (B) both oxidised and reduced
- (C) only reduced
- (D) neither oxidised nor reduced

Q46. When excess concentrated ammonia solution is added to aqueous copper(II) sulfate, a deep blue solution forms. The deep blue colour is due to the complex ion

- (A) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$
- (B) $[\text{CuCl}_4]^{2-}$
- (C) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$
- (D) $[\text{Cu}(\text{NH}_3)_6]^{2+}$

Q47. A solution of a metal ion gives an orange-brown precipitate when sodium hydroxide solution is added, and the precipitate does not dissolve in excess sodium hydroxide. The metal ion is

- (A) Fe^{3+}
- (B) Fe^{2+}
- (C) Cu^{2+}
- (D) Al^{3+}

Q48. Which property is shown by transition metals but not by the Group 1 metals?

- (A) They are shiny when cut
- (B) They conduct electricity
- (C) They are soft and easily cut
- (D) They form compounds with variable oxidation states

Organic Chemistry I

Q49. In the chlorination of methane in ultraviolet light, the initiation step involves

- (A) heterolytic fission of the Cl-Cl bond to form ions
- (B) homolytic fission of the Cl-Cl bond to form free radicals
- (C) electrophilic attack by Cl^+ on methane
- (D) nucleophilic attack by Cl^- on methane

Q50. Which halogenoalkane is hydrolysed most rapidly by aqueous sodium hydroxide?

- (A) Fluoromethane
- (B) Chloromethane
- (C) Iodomethane
- (D) Bromomethane

Q51. Propene reacts with hydrogen bromide to give a mixture of products. The major product is

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

Q52. Propan-1-ol is heated under reflux with excess acidified potassium dichromate(VI). The main organic product is

- (A) propanal
- (B) propanone
- (C) propane
- (D) propanoic acid

Q53. Decane, $C_{10}H_{22}$, is cracked to give ethene and one other product: $C_{10}H_{22} \rightarrow C_2H_4 + X$. What is the formula of X?

- (A) C_8H_{16}
- (B) C_8H_{18}
- (C) C_6H_{14}
- (D) C_8H_{20}

Q54. When butan-2-ol is dehydrated by heating with concentrated phosphoric acid, the major alkene product is

- (A) but-1-ene
- (B) 2-methylpropene
- (C) but-2-ene
- (D) cyclobutane

Organic Chemistry II & Analysis

Q55. Which reagent would distinguish between propanal and propanone?

- (A) Tollens' reagent
- (B) Sodium hydrogencarbonate solution
- (C) Sodium metal
- (D) Calcium carbonate

Q56. Ethyl ethanoate is hydrolysed by refluxing with dilute sulfuric acid. The organic products are

- (A) ethanoic acid and methanol
- (B) ethanol and methanoic acid
- (C) ethene and water
- (D) ethanol and ethanoic acid

Q57. In the nitration of benzene using concentrated nitric acid and concentrated sulfuric acid, the electrophile is

- (A) NO_2
- (B) NO_2^+
- (C) HNO_3
- (D) NO^+

Q58. Which compound is the strongest base?

- (A) Phenylamine
- (B) Ammonia
- (C) Ethylamine
- (D) Ethanamide

Q59. A compound with molecular formula C_3H_6O shows a strong infrared absorption at about 1720 cm^{-1} but no broad absorption between 3200 and 3600 cm^{-1} . The compound is most likely

- (A) propanone
- (B) propan-1-ol
- (C) propene
- (D) chloropropane

Q60. In the mass spectrum of a compound with $M_r = 58$, there is a peak at $m/z = 43$. This peak corresponds to the loss, from the molecular ion, of

- (A) an OH group (mass 17)
- (B) a C₂H₅ group (mass 29)
- (C) an H₂O molecule (mass 18)
- (D) a CH₃ group (mass 15)

Answer Key

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

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