

A-Level Chemistry Practice Test 15

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 gallium contains 60% of the isotope with mass number 69 and 40% of the isotope with mass number 71. What is the relative atomic mass of this sample of gallium?

- (A) 69.0
- (B) 69.8
- (C) 70.0
- (D) 70.2

Q2. Which of these Period 3 elements has the highest first ionisation energy?

- (A) magnesium
- (B) aluminium
- (C) silicon
- (D) phosphorus

Q3. What is the electronic configuration of an Fe^{3+} ion?

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

Q4. An element has first, second and third ionisation energies of 738, 1451 and 7733 kJ mol^{-1} respectively. In which group of the Periodic Table is this element?

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

Q5. Which statement about the elements from sodium to argon is correct?

- (A) The atomic radius increases across the period
- (B) The first ionisation energy generally increases across the period
- (C) All of the elements conduct electricity
- (D) The melting point increases steadily across the period

Amount of Substance

Q6. A sample of gas occupies 500 cm^3 at a pressure of 100 kPa and a temperature of 300 K. How many moles of gas are present? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 0.010 mol
- (B) 0.040 mol
- (C) 0.20 mol
- (D) 0.020 mol

Q7. In an experiment, the theoretical yield of a product is 12.5 g and the actual yield obtained is 9.40 g. What is the percentage yield?

- (A) 24.8%
- (B) 133%
- (C) 75.2%
- (D) 33.0%

Q8. A 25.0 cm^3 sample of sodium hydroxide solution of concentration $0.100 \text{ mol dm}^{-3}$ is completely neutralised by 20.0 cm^3 of sulfuric acid. What is the concentration of the sulfuric acid?

- (A) $0.0625 \text{ mol dm}^{-3}$
- (B) $0.125 \text{ mol dm}^{-3}$
- (C) $0.250 \text{ mol dm}^{-3}$
- (D) $0.0313 \text{ mol dm}^{-3}$

Q9. A compound contains 40.0% carbon, 6.70% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

- (A) CHO
- (B) CH₂O
- (C) C₂H₄O₂
- (D) CH₃O

Q10. In the reaction $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$, calcium oxide is the desired product. What is the atom economy of this reaction? (M_r : $\text{CaCO}_3 = 100$, $\text{CaO} = 56$, $\text{CO}_2 = 44$)

- (A) 44%
- (B) 100%
- (C) 64%
- (D) 56%

Q11. How many molecules are there in 4.40 g of carbon dioxide? (M_r of $\text{CO}_2 = 44$; Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$)

- (A) 6.02×10^{23}
- (B) 3.01×10^{22}
- (C) 6.02×10^{22}
- (D) 1.20×10^{23}

Bonding & Structure

Q12. For sodium chloride, $\Delta H_f = -411 \text{ kJ mol}^{-1}$, enthalpy of atomisation of Na = $+107 \text{ kJ mol}^{-1}$, first ionisation energy of Na = $+496 \text{ kJ mol}^{-1}$, enthalpy of atomisation of Cl = $+121 \text{ kJ mol}^{-1}$ and electron affinity of Cl = -349 kJ mol^{-1} . What is the lattice enthalpy of formation of NaCl?

- (A) -786 kJ mol^{-1}
- (B) -603 kJ mol^{-1}
- (C) -348 kJ mol^{-1}
- (D) -972 kJ mol^{-1}

Q13. What is the H-N-H bond angle in an ammonia molecule?

- (A) 104.5°
- (B) 107°
- (C) 109.5°
- (D) 120°

Q14. Which of these compounds has hydrogen bonding between its molecules?

- (A) PH_3
- (B) H_2S
- (C) SiH_4
- (D) NH_3

Q15. Graphite conducts electricity because it

- (A) contains mobile ions between the layers
- (B) is a giant ionic lattice
- (C) contains delocalised electrons that can move along the layers
- (D) has carbon atoms that each form four covalent bonds

Q16. Which chloride has the greatest covalent character?

- (A) AlCl_3
- (B) MgCl_2
- (C) CaCl_2
- (D) NaCl

Q17. Magnesium oxide has a very high melting point because

- (A) it contains strong hydrogen bonds
- (B) there are strong electrostatic attractions between Mg^{2+} and O^{2-} ions in a giant lattice
- (C) its molecules are held together by strong covalent bonds
- (D) it has delocalised electrons throughout the structure

Energetics & Thermodynamics

Q18. When 0.0100 mol of a liquid fuel is burned completely, the temperature of 100 g of water rises by 12.5°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) $-52.3 \text{ kJ mol}^{-1}$
- (B) -209 kJ mol^{-1}
- (C) -418 kJ mol^{-1}
- (D) -523 kJ mol^{-1}

Q19. The standard enthalpies of combustion of carbon, hydrogen and ethanol are -394, -286 and -1367 kJ mol⁻¹ respectively. What is the standard enthalpy of formation of ethanol, C₂H₅OH, in the reaction 2C + 3H₂ + 0.5O₂ → C₂H₅OH?

- (A) +279 kJ mol⁻¹
- (B) -168 kJ mol⁻¹
- (C) -279 kJ mol⁻¹
- (D) -1367 kJ mol⁻¹

Q20. Using mean bond enthalpies (H-H = 436, O=O = 498, O-H = 464 kJ mol⁻¹), what is the enthalpy change for the reaction H₂(g) + 0.5O₂(g) → H₂O(g)?

- (A) -243 kJ mol⁻¹
- (B) +243 kJ mol⁻¹
- (C) -485 kJ mol⁻¹
- (D) -122 kJ mol⁻¹

Q21. Which reaction has a positive entropy change of the system?

- (A) H₂O(l) → H₂O(s)
- (B) CaCO₃(s) → CaO(s) + CO₂(g)
- (C) 2H₂(g) + O₂(g) → 2H₂O(l)
- (D) H⁺(aq) + OH⁻(aq) → H₂O(l)

Q22. A reaction has ΔH = -100 kJ mol⁻¹ and ΔS = -200 J K⁻¹ mol⁻¹. At which temperature is ΔG = 0 for this reaction?

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

Q23. The lattice enthalpy of dissociation of potassium chloride is +701 kJ mol⁻¹. The enthalpies of hydration of K⁺ and Cl⁻ are -322 and -364 kJ mol⁻¹ respectively. What is the enthalpy of solution of KCl?

- (A) -15 kJ mol⁻¹
- (B) -686 kJ mol⁻¹
- (C) +15 kJ mol⁻¹
- (D) +701 kJ mol⁻¹

Kinetics & Rate Equations

Q24. For the reaction with rate equation rate = k[A]², the rate is 2.0 × 10⁻⁴ mol dm⁻³ s⁻¹ when [A] = 0.10 mol dm⁻³. What is the rate constant, k?

- (A) 0.020 mol⁻¹ dm³ s⁻¹
- (B) 2.0 mol⁻¹ dm³ s⁻¹
- (C) 2.0 × 10⁻³ mol⁻¹ dm³ s⁻¹
- (D) 0.20 mol⁻¹ dm³ s⁻¹

Q25. In a series of experiments at constant temperature, doubling the concentration of X (with all other concentrations constant) increased the initial rate by a factor of four. What is the order of reaction with respect to X?

- (A) zero
- (B) second
- (C) first
- (D) third

Q26. A plot of $\ln k$ against $1/T$ for a reaction is a straight line with gradient $-1.20 \times 10^4 \text{ K}$. What is the activation energy of the reaction? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 1.00 kJ mol^{-1}
- (B) 10.0 kJ mol^{-1}
- (C) 120 kJ mol^{-1}
- (D) 100 kJ mol^{-1}

Q27. A reaction proceeds by the mechanism: Step 1 (slow): $2\text{NO}_2 \rightarrow \text{NO}_3 + \text{NO}$; 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) $\text{rate} = k[\text{CO}]$
- (C) $\text{rate} = k[\text{NO}_2]^2$
- (D) $\text{rate} = k[\text{NO}_3][\text{CO}]$

Q28. A catalyst increases the rate of a reaction because it

- (A) provides an alternative reaction pathway with a lower activation energy, so a greater proportion of collisions are successful
- (B) increases the average kinetic energy of the particles
- (C) increases the frequency of collisions between particles
- (D) increases the equilibrium yield of product

Equilibria (K_c & K_p)

Q29. For the equilibrium $\text{A} + \text{B} \rightleftharpoons 2\text{C}$, 1.00 mol of A and 1.00 mol of B are mixed in a 1.00 dm^3 vessel. At equilibrium, $[\text{C}] = 0.600 \text{ mol dm}^{-3}$. What is the value of K_c ?

- (A) 0.49
- (B) 0.73
- (C) 1.36
- (D) 0.36

Q30. For the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, the equilibrium partial pressure of NO_2 is 40 kPa and the equilibrium partial pressure of N_2O_4 is 60 kPa. What is the value of K_p ?

- (A) 0.0375 kPa
- (B) 1.50 kPa
- (C) 0.667 kPa
- (D) 26.7 kPa

Q31. The forward reaction in an equilibrium is exothermic. What happens to the value of K_c when the temperature is increased?

- (A) K_c increases
- (B) The equilibrium shifts to the right and K_c stays the same
- (C) K_c decreases
- (D) K_c is unchanged because temperature does not affect K_c

Q32. What is the effect of adding a catalyst on the value of K_c for a reversible reaction at constant temperature?

- (A) K_c is not affected
- (B) K_c increases
- (C) K_c decreases
- (D) K_c doubles

Q33. For the equilibrium $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, $K_c = 64$ at a given temperature. A mixture initially contains 0.50 mol of H_2 and 0.50 mol of I_2 in a 1.0 dm^3 vessel and no HI . How many moles of HI are present at equilibrium?

- (A) 0.40 mol
- (B) 0.80 mol
- (C) 0.90 mol
- (D) 1.00 mol

Redox & Electrode Potentials

Q34. What is the oxidation state of chromium in the dichromate(VI) ion, $\text{Cr}_2\text{O}_7^{2-}$?

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

Q35. Using the standard electrode potentials $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$ and $\text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$, what is the EMF of the cell $\text{Zn}(\text{s}) \mid \text{Zn}^{2+}(\text{aq}) \parallel \text{Cu}^{2+}(\text{aq}) \mid \text{Cu}(\text{s})$?

- (A) +0.42 V
- (B) -1.10 V
- (C) +1.10 V
- (D) -0.42 V

Q36. Given the standard electrode potentials $\text{I}_2/\text{I}^- = +0.54 \text{ V}$, $\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ V}$ and $\text{Br}_2/\text{Br}^- = +1.09 \text{ V}$, which is the strongest oxidising agent?

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

Q37. Using $\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ V}$ and $\text{I}_2/\text{I}^- = +0.54 \text{ V}$, will Fe^{3+} ions oxidise I^- ions?

- (A) No, because $E^\ominus_{\text{cell}} = -0.23 \text{ V}$
- (B) Yes, because $E^\ominus_{\text{cell}} = +0.23 \text{ V}$
- (C) Yes, because $E^\ominus_{\text{cell}} = +1.31 \text{ V}$
- (D) No, because $E^\ominus_{\text{cell}} = +0.23 \text{ V}$

Q38. A current of 0.50 A is passed through aqueous copper(II) sulfate for 3860 s. What mass of copper is deposited at the cathode? (Faraday constant = 96 500 C mol⁻¹; Mr of Cu = 63.5)

- (A) 0.32 g
- (B) 1.27 g
- (C) 0.16 g
- (D) 0.64 g

Acids, Bases & Buffers

Q39. What is the pH of a 0.020 mol dm⁻³ solution of sodium hydroxide at 298 K? (K_w = 1.0 × 10⁻¹⁴ mol² dm⁻⁶)

- (A) 1.70
- (B) 11.70
- (C) 12.30
- (D) 12.00

Q40. Ethanoic acid has K_a = 1.8 × 10⁻⁵ mol dm⁻³. What is the pH of a 0.100 mol dm⁻³ solution of ethanoic acid?

- (A) 2.87
- (B) 1.87
- (C) 4.74
- (D) 2.37

Q41. At 310 K, K_w for water is 2.92 × 10⁻¹⁴ mol² dm⁻⁶. What is the pH of pure water at this temperature?

- (A) 7.00
- (B) 6.77
- (C) 13.53
- (D) 6.50

Q42. A buffer solution is made from ethanoic acid (pK_a = 4.76) and sodium ethanoate. The concentration of the salt is twice the concentration of the acid. What is the pH of the buffer?

- (A) 4.46
- (B) 4.76
- (C) 4.90
- (D) 5.06

Q43. A 0.100 mol dm⁻³ solution of a weak acid HA has pH 3.00. What is the value of K_a for the acid?

- (A) 1.0 × 10⁻³ mol dm⁻³
- (B) 1.0 × 10⁻⁶ mol dm⁻³
- (C) 1.0 × 10⁻⁵ mol dm⁻³
- (D) 1.0 × 10⁻⁴ mol dm⁻³

Inorganic Chemistry

Q44. Which of the Group 2 sulfates is the least soluble in water?

- (A) BaSO₄
- (B) MgSO₄
- (C) CaSO₄
- (D) SrSO₄

Q45. Chlorine is bubbled through cold, dilute sodium hydroxide solution. Which statement about this reaction is correct?

- (A) Chlorine is only oxidised
- (B) Chlorine is both oxidised and reduced (disproportionation), forming NaCl and NaClO
- (C) The products are NaCl and NaClO₃
- (D) There is no reaction in the cold

Q46. When excess concentrated ammonia solution is added to aqueous copper(II) sulfate, the final observation is

- (A) the pale blue precipitate dissolves to give a colourless solution
- (B) a brown precipitate forms
- (C) a yellow-green solution of [CuCl₄]²⁻ forms
- (D) the blue precipitate dissolves to give a deep blue solution of [Cu(NH₃)₄(H₂O)₂]²⁺

Q47. Which precipitate is formed when sodium hydroxide solution is added to aqueous iron(III) chloride?

- (A) A white precipitate
- (B) A green precipitate
- (C) A brown (orange-brown) precipitate
- (D) No precipitate

Q48. Which of these aqueous ions is colourless?

- (A) Zn²⁺
- (B) Cu²⁺
- (C) Fe³⁺
- (D) Cr³⁺

Organic Chemistry I

Q49. In the chlorination of methane in ultraviolet light, which step is the initiation step?

- (A) CH₄ + Cl• → CH₃• + HCl
- (B) Cl₂ → 2Cl•
- (C) CH₃• + Cl₂ → CH₃Cl + Cl•
- (D) CH₃• + Cl• → CH₃Cl

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

- (A) chloromethane
- (B) bromoethane
- (C) 1-iodopropane
- (D) 2-bromo-2-methylpropane

Q51. What is the major organic product when hydrogen bromide reacts with propene?

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

Q52. Propan-1-ol is warmed with acidified potassium dichromate(VI) and the product is distilled off as it forms. What is the product?

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

Q53. What is the organic product when butan-1-ol is heated with concentrated sulfuric acid at 170 °C?

- (A) butane
- (B) but-1-ene
- (C) butanone
- (D) butanoic acid

Q54. Which product is formed when methane burns in a limited supply of oxygen?

- (A) carbon dioxide and water only
- (B) carbon only
- (C) hydrogen
- (D) carbon monoxide and water

Organic Chemistry II & Analysis

Q55. Which statement correctly describes the use of Tollens' reagent?

- (A) It gives a silver mirror with both aldehydes and ketones
- (B) It gives no reaction with aldehydes or ketones
- (C) Aldehydes give a silver mirror, but ketones give no reaction
- (D) Ketones give a silver mirror, but aldehydes give no reaction

Q56. What are the products when ethyl ethanoate is heated with aqueous sodium hydroxide?

- (A) sodium ethanoate and ethanol
- (B) ethanoic acid and ethanol
- (C) sodium ethoxide and ethanoic acid
- (D) ethanoate ions and ethane

Q57. Which reagents and conditions are used for the nitration of benzene?

- (A) dilute HNO₃ at 20 °C
- (B) concentrated HNO₃ and concentrated H₂SO₄ at about 50 °C
- (C) HNO₃ with an AlCl₃ catalyst
- (D) fuming HNO₃ at 150 °C

Q58. Which of these nitrogen compounds is the strongest base?

- (A) ammonia
- (B) phenylamine
- (C) ethanamide
- (D) ethylamine

Q59. In a strongly alkaline solution, glycine ($\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$) exists mainly as

- (A) a zwitterion, $^+\text{H}_3\text{N}-\text{CH}_2-\text{COO}^-$
- (B) the cation, $^+\text{H}_3\text{N}-\text{CH}_2-\text{COOH}$
- (C) the anion, $\text{H}_2\text{N}-\text{CH}_2-\text{COO}^-$
- (D) the neutral molecule, $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$

Q60. How many peaks are there in the carbon-13 NMR spectrum of 2-methylpropane, $(\text{CH}_3)_3\text{CH}$?

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

Answer Key

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

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