

A-Level Chemistry Practice Test 17

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 magnesium contains 79.0% Mg-24, 10.0% Mg-25 and 11.0% Mg-26. What is the relative atomic mass of magnesium in this sample?

- (A) 24.3
- (B) 24.0
- (C) 24.8
- (D) 25.0

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 3
- (C) Group 2
- (D) Group 13

Q3. What is the electronic configuration of an Fe³⁺ ion? (Fe: atomic number 26)

- (A) [Ar] 4s² 3d³
- (B) [Ar] 3d⁵
- (C) [Ar] 4s¹ 3d⁴
- (D) [Ar] 3d³ 4s²

Q4. In a time-of-flight mass spectrometer, an ion with m/z = 32 takes 4.2 × 10⁻⁶ s to reach the detector. How long does an ion with m/z = 128 take, if all ions are given the same kinetic energy?

- (A) 1.05 × 10⁻⁶ s
- (B) 2.1 × 10⁻⁶ s
- (C) 16.8 × 10⁻⁶ s
- (D) 8.4 × 10⁻⁶ s

Q5. Why does the first ionisation energy decrease down Group 2?

- (A) The outer electrons are further from the nucleus and more shielded, so they are less strongly attracted
- (B) The nuclear charge decreases down the group
- (C) The outer electrons are in shells closer to the nucleus
- (D) There are fewer shielding electrons down the group

Amount of Substance

Q6. A 0.500 g sample of a gas occupies 154 cm³ at 100 kPa and 298 K. What is the molar mass of the gas? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 40 g mol⁻¹
- (B) 64 g mol⁻¹
- (C) 80 g mol⁻¹
- (D) 160 g mol⁻¹

Q7. A 25.0 cm³ sample of sodium hydroxide solution is neutralised by 22.4 cm³ of 0.150 mol dm⁻³ sulfuric acid. What is the concentration of the sodium hydroxide?

- (A) 0.134 mol dm⁻³
- (B) 0.269 mol dm⁻³
- (C) 0.336 mol dm⁻³
- (D) 0.538 mol dm⁻³

Q8. Aspirin ($M_r = 180$) is made from salicylic acid ($M_r = 138$). When 5.00 g of salicylic acid is used, 4.89 g of aspirin is obtained. What is the percentage yield?

- (A) 50.0%
- (B) 66.7%
- (C) 90.0%
- (D) 75.0%

Q9. Calcium oxide is made by heating calcium carbonate: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$. What is the atom economy for making CaO? (M_r : $\text{CaCO}_3 = 100$, $\text{CaO} = 56$)

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

Q10. A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

- (A) CHO
- (B) C₂H₄O₂
- (C) CH₂O
- (D) CH₄O

Q11. A 20 cm³ sample of a gaseous hydrocarbon is burned in excess oxygen. The products are 60 cm³ of carbon dioxide and 80 cm³ of water vapour, all volumes measured at the same temperature and pressure. What is the formula of the hydrocarbon?

- (A) C₃H₆
- (B) C₃H₈
- (C) C₂H₆
- (D) C₄H₁₀

Bonding & Structure

Q12. Which species has a tetrahedral shape?

- (A) XeF_4
- (B) BF_3
- (C) SF_4
- (D) NH_4^+

Q13. Which substance has hydrogen bonding between its molecules?

- (A) HF
- (B) HCl
- (C) H_2S
- (D) CH_4

Q14. Use the data to calculate the lattice enthalpy of formation of sodium chloride. Enthalpy of formation of $\text{NaCl} = -411 \text{ kJ mol}^{-1}$; enthalpy of atomisation of $\text{Na} = +107$; first ionisation energy of $\text{Na} = +496$; enthalpy of atomisation of $\text{Cl} = +121$; electron affinity of $\text{Cl} = -349 \text{ kJ mol}^{-1}$.

- (A) -642 kJ mol^{-1}
- (B) -858 kJ mol^{-1}
- (C) -786 kJ mol^{-1}
- (D) -494 kJ mol^{-1}

Q15. Which compound has the most ionic character?

- (A) AlCl_3
- (B) CsF
- (C) NaCl
- (D) MgO

Q16. Which species contains a dative (coordinate) covalent bond?

- (A) H_3O^+
- (B) O_2
- (C) CH_4
- (D) CO_2

Q17. Which statement about graphite is correct?

- (A) Each carbon atom is bonded to four other carbon atoms
- (B) Graphite does not conduct electricity
- (C) The layers are held together by strong covalent bonds
- (D) Each carbon atom forms three covalent bonds, and delocalised electrons allow graphite to conduct electricity along the layers

Energetics & Thermodynamics

Q18. When 0.0100 mol of ethanol is burned completely, it raises the temperature of 100 g of water by 27.3°C . What is the enthalpy of combustion of ethanol? (Specific heat capacity of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$)

- (A) -572 kJ mol^{-1}
- (B) $-1141 \text{ kJ mol}^{-1}$
- (C) -114 kJ mol^{-1}
- (D) $-2282 \text{ kJ mol}^{-1}$

Q19. Use the enthalpies of combustion to find the enthalpy of formation of methane. $\Delta H_c / \text{kJ mol}^{-1}$: C = -393 ; H_2 = -286 ; CH_4 = -890 .

- (A) -965 kJ mol^{-1}
- (B) $+75 \text{ kJ mol}^{-1}$
- (C) -185 kJ mol^{-1}
- (D) -75 kJ mol^{-1}

Q20. Use the bond enthalpies to calculate the enthalpy change for $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$. Bond enthalpies / kJ mol^{-1} : $\text{H}-\text{H}$ = 436 ; $\text{Cl}-\text{Cl}$ = 242 ; $\text{H}-\text{Cl}$ = 431 .

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

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

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

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 is $\Delta G = 0$ for this reaction?

- (A) 200 K
- (B) 500 K
- (C) 400 K
- (D) 1000 K

Q23. A reaction has $\Delta H = +50 \text{ kJ mol}^{-1}$ and $\Delta S = +100 \text{ J K}^{-1} \text{ mol}^{-1}$. What is ΔG at 298 K , and is the reaction feasible?

- (A) $\Delta G = -20.2 \text{ kJ mol}^{-1}$; feasible
- (B) $\Delta G = 0$; at equilibrium
- (C) $\Delta G = -79.8 \text{ kJ mol}^{-1}$; feasible
- (D) $\Delta G = +20.2 \text{ kJ mol}^{-1}$; not feasible

Kinetics & Rate Equations

Q24. In a series of experiments, doubling $[\text{A}]$ doubles the rate, and doubling $[\text{B}]$ quadruples the rate. What is the rate equation?

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

Q25. For a reaction that is second order overall, what are the units of the rate constant k ?

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

Q26. A plot of $\ln k$ against $1/T$ for a reaction is a straight line with gradient -7500 K . What is the activation energy? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 6.23 kJ mol^{-1}
- (B) 623 kJ mol^{-1}
- (C) $0.902 \text{ kJ mol}^{-1}$
- (D) 62.3 kJ mol^{-1}

Q27. A first-order reaction has a half-life of 20 minutes. What fraction of the reactant remains after 60 minutes?

- (A) $1/4$
- (B) $1/8$
- (C) $1/6$
- (D) $1/3$

Q28. A temperature increase changes the Maxwell-Boltzmann distribution of molecular energies. Which statement is correct?

- (A) The total area under the curve increases
- (B) The peak of the curve moves to a lower energy
- (C) The total area stays the same, and a larger proportion of molecules has energy at or above the activation energy
- (D) The activation energy decreases

Equilibria (K_c & K_p)

Q29. The equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ is set up with 1.00 mol of N_2O_4 in a 1.00 dm^3 flask. At equilibrium the mixture contains 0.20 mol of NO_2 . What is the value of K_c ?

- (A) $0.022 \text{ mol dm}^{-3}$
- (B) $0.044 \text{ mol dm}^{-3}$
- (C) 0.40 mol dm^{-3}
- (D) 22.5 mol dm^{-3}

Q30. What is the expression for K_p for the equilibrium $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$?

- (A) $K_p = p(\text{SO}_3) / (p(\text{SO}_2) \times p(\text{O}_2))$
- (B) $K_p = p(\text{SO}_2)^2 \times p(\text{O}_2) / p(\text{SO}_3)^2$
- (C) $K_p = p(\text{SO}_3)^2 \times p(\text{O}_2) / p(\text{SO}_2)^2$
- (D) $K_p = p(\text{SO}_3)^2 / (p(\text{SO}_2)^2 \times p(\text{O}_2))$

Q31. For the exothermic equilibrium $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, what happens to the yield of ammonia and to K_c when the temperature is increased?

- (A) Yield decreases and K_c decreases
- (B) Yield increases and K_c increases
- (C) Yield decreases and K_c is unchanged
- (D) Yield increases and K_c decreases

Q32. For the equilibrium $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$, the equilibrium partial pressures are: $\text{PCl}_5 = 60 \text{ kPa}$, $\text{PCl}_3 = 40 \text{ kPa}$ and $\text{Cl}_2 = 40 \text{ kPa}$. What is the value of K_p ?

- (A) 0.0375 kPa^{-1}
- (B) 0.667 kPa
- (C) 26.7 kPa
- (D) 1600 kPa

Q33. What is the effect of adding a catalyst to a reversible reaction that is at equilibrium?

- (A) K_c increases
- (B) K_c is unchanged and equilibrium is reached faster
- (C) The equilibrium shifts towards the products
- (D) K_c decreases

Redox & Electrode Potentials

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

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

Q35. Calculate the EMF of a $\text{Zn}|\text{Zn}^{2+}(\text{aq})||\text{Cu}^{2+}(\text{aq})|\text{Cu}$ cell. $E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$; $E^\circ(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$.

- (A) $+1.10 \text{ V}$
- (B) $+0.42 \text{ V}$
- (C) -1.10 V
- (D) -0.42 V

Q36. Using $E^\circ(\text{Cl}_2/\text{Cl}^-) = +1.36 \text{ V}$ and $E^\circ(\text{Br}_2/\text{Br}^-) = +1.07 \text{ V}$, which reaction is feasible?

- (A) $\text{Br}_2(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq})$
- (B) $\text{I}_2(\text{aq}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{I}^-(\text{aq})$
- (C) $\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{Cl}^-(\text{aq})$
- (D) $\text{Br}_2(\text{aq}) + 2\text{F}^-(\text{aq}) \rightarrow \text{F}_2(\text{g}) + 2\text{Br}^-(\text{aq})$

Q37. A current of 0.50 A is passed through copper(II) sulfate solution for 1930 s . What mass of copper is deposited at the cathode? ($F = 96500 \text{ C mol}^{-1}$; Ar of Cu = 63.5)

- (A) 0.159 g
- (B) 0.318 g
- (C) 0.635 g
- (D) 3.18 g

Q38. Which statement about standard electrode potentials is correct?

- (A) A positive E° always means that the metal is a strong reducing agent
- (B) E° values are measured with gases at 1 kPa pressure
- (C) The standard hydrogen electrode has $E^\circ = +1.00 \text{ V}$
- (D) The more negative the E° , the stronger the reducing agent on the right-hand side of the half-equation

Acids, Bases & Buffers

Q39. What is the pH of 0.0100 mol dm⁻³ hydrochloric acid?

- (A) 2.00
- (B) 1.00
- (C) 10.00
- (D) 12.00

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

- (A) 1.00
- (B) 2.87
- (C) 2.37
- (D) 4.74

Q41. What is the pH of 0.100 mol dm⁻³ sodium hydroxide solution? ($K_w = 1.00 \times 10^{-14}$ mol² dm⁻⁶ at 298 K)

- (A) 1.00
- (B) 7.00
- (C) 12.00
- (D) 13.00

Q42. A buffer solution contains 0.100 mol dm⁻³ ethanoic acid ($K_a = 1.8 \times 10^{-5}$ mol dm⁻³) and 0.0500 mol dm⁻³ sodium ethanoate. What is the pH of the buffer?

- (A) 4.74
- (B) 5.04
- (C) 4.44
- (D) 3.74

Q43. 25.0 cm³ of 0.100 mol dm⁻³ hydrochloric acid is mixed with 50.0 cm³ of 0.100 mol dm⁻³ sodium hydroxide solution. What is the pH of the resulting solution?

- (A) 12.52
- (B) 7.00
- (C) 11.52
- (D) 13.00

Inorganic Chemistry

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

- (A) The solubility of the Group 2 sulfates increases down the group
- (B) The solubility of the Group 2 hydroxides increases down the group
- (C) The Group 2 carbonates become less thermally stable down the group
- (D) The first ionisation energy of the Group 2 elements increases down the group

Q45. Chlorine reacts with cold, dilute sodium hydroxide solution, forming sodium chlorate(I), NaClO. What is the oxidation state of chlorine in NaClO?

- (A) -1
- (B) 0
- (C) +1
- (D) +5

Q46. Excess concentrated hydrochloric acid is added to a blue solution containing $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ ions, and $[\text{CuCl}_4]^{2-}$ ions are formed. What is the colour of the $[\text{CuCl}_4]^{2-}$ solution?

- (A) Yellow
- (B) Colourless
- (C) Deep blue
- (D) Pink

Q47. Which ion forms a brown precipitate when aqueous sodium hydroxide is added?

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

Q48. In the Contact process, sulfur dioxide is converted into sulfur trioxide. Which catalyst is used, and what type of catalysis is involved?

- (A) Iron; homogeneous
- (B) Platinum; heterogeneous
- (C) Vanadium(V) oxide; heterogeneous
- (D) Vanadium(V) oxide; homogeneous

Organic Chemistry I

Q49. Which of the following is a propagation step in the free-radical substitution of methane by chlorine?

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

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

- (A) CH_3I
- (B) CH_3F
- (C) CH_3Cl
- (D) CH_3Br

Q51. Propene reacts with hydrogen bromide. What is the major product?

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

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

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

Q53. 2-bromopropane is heated with ethanolic potassium hydroxide. What is the major organic product?

- (A) Propan-2-ol
- (B) Propane
- (C) 1-bromopropane
- (D) Propene

Q54. What volume of oxygen is needed for the complete combustion of 10 cm³ of propane gas, all volumes measured at the same temperature and pressure? $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

- (A) 50 cm³
- (B) 30 cm³
- (C) 10 cm³
- (D) 5 cm³

Organic Chemistry II & Analysis

Q55. Which compound gives a silver mirror when warmed with Tollens' reagent?

- (A) Propanone
- (B) Ethanal
- (C) Ethanoic acid
- (D) Ethanol

Q56. Ethanoic acid reacts with propan-1-ol in the presence of an acid catalyst. What is the name of the ester formed?

- (A) Ethyl propanoate
- (B) Methyl propanoate
- (C) Propyl methanoate
- (D) Propyl ethanoate

Q57. In the nitration of benzene, which species acts as the electrophile?

- (A) NO_2^-
- (B) HNO_3
- (C) NO_2^+
- (D) SO_3

Q58. Which of the following is the strongest base?

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

Q59. A compound shows a broad absorption at 2500-3300 cm⁻¹ and a sharp absorption at about 1700 cm⁻¹ in its infrared spectrum. What is the compound most likely to be?

- (A) An ester
- (B) An alcohol
- (C) A carboxylic acid
- (D) An amine

Q60. How many peaks are there in the ¹³C NMR spectrum of butan-2-one, CH₃COCH₂CH₃?

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

Answer Key

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

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