

A-Level Chemistry Practice Test 16

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. Chlorine consists of two isotopes, Cl-35 (75% abundance) and Cl-37 (25% abundance). In the mass spectrum of Cl₂, what are the approximate relative intensities of the peaks at $m/z = 70$, 72 and 74?

- (A) 1 : 2 : 1
- (B) 3 : 1 : 1
- (C) 9 : 6 : 1
- (D) 1 : 1 : 1

Q2. An element has successive ionisation energies, in kJ mol^{-1} , of 578, 1817, 2745 and 11 577. In which group of the Periodic Table is this element?

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

Q3. What is the electronic configuration of a chromium atom?

- (A) $[\text{Ar}] 3d^4 4s^2$
- (B) $[\text{Ar}] 3d^6$
- (C) $[\text{Ar}] 3d^{10}$
- (D) $[\text{Ar}] 3d^5 4s^1$

Q4. In a time-of-flight mass spectrometer, the time taken for an ion to reach the detector is proportional to the square root of its m/z value. An ion with $m/z = 28$ takes 1.0 unit of time. How long does an ion with $m/z = 112$ take, if all other conditions are the same?

- (A) 1.0 unit
- (B) 2.0 units
- (C) 4.0 units
- (D) 0.5 units

Q5. The ions F^- , Na^+ , Mg^{2+} and Al^{3+} are isoelectronic (they all have the electron configuration $1s^2 2s^2 2p^6$). Which ion has the smallest radius?

- (A) F^-
- (B) Na^+
- (C) Al^{3+}
- (D) Mg^{2+}

Amount of Substance

Q6. A gas sample of mass 0.29 g occupies a volume of 120 cm³ at a pressure of 100 kPa and a temperature of 290 K. What is the molar mass of the gas? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 58 g mol⁻¹
- (B) 29 g mol⁻¹
- (C) 44 g mol⁻¹
- (D) 116 g mol⁻¹

Q7. Complete combustion of 0.60 g of an organic compound produced 0.88 g of carbon dioxide and 0.36 g of water. What is the empirical formula of the compound?

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

Q8. A 20.0 cm³ sample of aqueous sodium hydroxide of concentration 0.0500 mol dm⁻³ is exactly neutralised by 25.0 cm³ of ethanoic acid. What is the concentration of the ethanoic acid?

- (A) 0.0250 mol dm⁻³
- (B) 0.0400 mol dm⁻³
- (C) 0.0500 mol dm⁻³
- (D) 0.0625 mol dm⁻³

Q9. In the esterification $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightarrow \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$, the ester is the desired product. What is the atom economy of this reaction? (Mr: $\text{CH}_3\text{COOH} = 60$, $\text{C}_2\text{H}_5\text{OH} = 46$, $\text{CH}_3\text{COOC}_2\text{H}_5 = 88$, $\text{H}_2\text{O} = 18$)

- (A) 100%
- (B) 73%
- (C) 83%
- (D) 49%

Q10. How many chloride ions are there in 0.050 mol of calcium chloride, CaCl_2 ? (Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$)

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

Q11. 6.0 g of magnesium (Mr = 24) is added to a solution containing 0.40 mol of hydrochloric acid. The equation is $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$. What volume of hydrogen is produced at room temperature and pressure? (Molar gas volume = 24 dm³ mol⁻¹)

- (A) 2.4 dm³
- (B) 6.0 dm³
- (C) 9.6 dm³
- (D) 4.8 dm³

Bonding & Structure

Q12. The H-O-H bond angle in a water molecule is 104.5°. This is smaller than the tetrahedral angle of 109.5° because

- (A) the oxygen atom is larger than a carbon atom
- (B) the two lone pairs on oxygen repel the bonding pairs more strongly than the bonding pairs repel each other
- (C) hydrogen bonding pulls the hydrogen atoms closer together
- (D) the O-H covalent bonds are weak

Q13. For lithium fluoride, $\Delta H_f = -594 \text{ kJ mol}^{-1}$, enthalpy of atomisation of Li = $+159 \text{ kJ mol}^{-1}$, first ionisation energy of Li = $+520 \text{ kJ mol}^{-1}$, enthalpy of atomisation of F = $+79 \text{ kJ mol}^{-1}$ and electron affinity of F = -328 kJ mol^{-1} . What is the lattice enthalpy of formation of LiF?

- (A) -164 kJ mol^{-1}
- (B) -594 kJ mol^{-1}
- (C) $-1024 \text{ kJ mol}^{-1}$
- (D) $-1454 \text{ kJ mol}^{-1}$

Q14. The boiling points of the halogens increase in the order $\text{Cl}_2 < \text{Br}_2 < \text{I}_2$ because

- (A) the number of electrons in the molecules increases, so the van der Waals forces between molecules become stronger
- (B) the halogen-halogen covalent bond becomes weaker down the group
- (C) hydrogen bonding between the molecules increases down the group
- (D) the molecules become polar lower down the group

Q15. Ice floats on water because

- (A) the molecules in ice move faster than in liquid water
- (B) water contracts when it freezes
- (C) all the hydrogen bonds break when water freezes
- (D) hydrogen bonding holds the water molecules in an open lattice structure, so ice is less dense than liquid water

Q16. Carbon dioxide has polar C=O bonds, yet the CO_2 molecule has no overall dipole because

- (A) the C=O bonds are in fact non-polar
- (B) the molecule is linear, so the two equal bond dipoles act in opposite directions and cancel out
- (C) carbon dioxide contains no lone pairs of electrons
- (D) the intermolecular forces between CO_2 molecules are very strong

Q17. The lattice enthalpy of magnesium oxide is much more exothermic than that of sodium chloride mainly because

- (A) magnesium is a metal but sodium chloride contains no metal
- (B) magnesium oxide has a partly covalent structure
- (C) the Mg^{2+} and O^{2-} ions carry double charges and are small, so the electrostatic attraction between them is very strong
- (D) sodium chloride exists as separate molecules

Energetics & Thermodynamics

Q18. In an experiment, 50.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid is mixed with 50.0 cm^3 of 1.00 mol dm^{-3} sodium hydroxide solution in a polystyrene cup. The temperature rises by 6.8°C . What is the enthalpy of neutralisation? (Assume the mixture has a total mass of 100 g and specific heat capacity $4.18 \text{ J g}^{-1} \text{ K}^{-1}$)

- (A) -57 kJ mol^{-1}
- (B) -28 kJ mol^{-1}
- (C) -114 kJ mol^{-1}
- (D) -5.7 kJ mol^{-1}

Q19. The standard enthalpies of combustion of carbon, hydrogen and methane are -394 , -286 and -890 kJ mol^{-1} respectively. What is the standard enthalpy of formation of methane, CH_4 , in the reaction $\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$?

- (A) -890 kJ mol^{-1}
- (B) $-1486 \text{ kJ mol}^{-1}$
- (C) $+76 \text{ kJ mol}^{-1}$
- (D) -76 kJ mol^{-1}

Q20. The standard entropies are: $\text{H}_2(\text{g}) = 131$, $\text{O}_2(\text{g}) = 205$ and $\text{H}_2\text{O}(\text{l}) = 70 \text{ J K}^{-1} \text{ mol}^{-1}$. What is the entropy change for the reaction $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$?

- (A) $+327 \text{ J K}^{-1} \text{ mol}^{-1}$
- (B) $-327 \text{ J K}^{-1} \text{ mol}^{-1}$
- (C) $-163 \text{ J K}^{-1} \text{ mol}^{-1}$
- (D) $-88 \text{ J K}^{-1} \text{ mol}^{-1}$

Q21. A reaction has $\Delta H = +100 \text{ kJ mol}^{-1}$ and $\Delta S = +200 \text{ J K}^{-1} \text{ mol}^{-1}$. This reaction becomes feasible at temperatures

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

Q22. The standard enthalpy of formation of a compound is the enthalpy change when

- (A) one mole of the compound is formed from its elements in their standard states, under standard conditions
- (B) one mole of the compound is burned completely in oxygen under standard conditions
- (C) one mole of the compound is formed from its elements at any temperature and pressure
- (D) one mole of gaseous atoms is formed from the compound under standard conditions

Q23. Using mean bond enthalpies ($\text{N}\equiv\text{N} = 945$, $\text{H}-\text{H} = 436$, $\text{N}-\text{H} = 391 \text{ kJ mol}^{-1}$), what is the enthalpy change for the reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$?

- (A) $+93 \text{ kJ mol}^{-1}$
- (B) $-2253 \text{ kJ mol}^{-1}$
- (C) $-46.5 \text{ kJ mol}^{-1}$
- (D) -93 kJ mol^{-1}

Kinetics & Rate Equations

Q24. In a kinetics experiment, doubling the concentration of A (with B constant) increased the rate by a factor of four, and doubling the concentration of B (with A constant) doubled the rate. The rate equation is $\text{rate} = k[\text{A}]^2[\text{B}]$. What is the overall order of the reaction?

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

Q25. A first-order reaction has a half-life of 20 s. What is the value of the rate constant, k ?

- (A) 13.9 s^{-1}
- (B) 0.693 s^{-1}
- (C) 0.0347 s^{-1}
- (D) 0.0500 s^{-1}

Q26. A plot of $\ln k$ against $1/T$ for a reaction has a gradient of -6500 K . What is the activation energy? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 54 kJ mol^{-1}
- (B) 5.4 kJ mol^{-1}
- (C) 6500 kJ mol^{-1}
- (D) 78 kJ mol^{-1}

Q27. In a Maxwell-Boltzmann distribution for a gas, what happens to the curve when the temperature is increased?

- (A) The peak moves to lower energy and becomes higher
- (B) The total area under the curve decreases
- (C) Fewer molecules have energy greater than the activation energy
- (D) The peak moves to higher energy and becomes lower, and a greater proportion of molecules have energy greater than the activation energy

Q28. For a zero-order reaction, a graph of concentration of reactant against time is

- (A) a curve with an increasingly steep negative gradient
- (B) a straight line with a constant negative gradient
- (C) a horizontal straight line
- (D) a curve that decays exponentially

Equilibria (K_c & K_p)

Q29. At equilibrium in the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, the concentrations are $[\text{SO}_2] = 0.20$, $[\text{O}_2] = 0.10$ and $[\text{SO}_3] = 0.80 \text{ mol dm}^{-3}$. What is the value of K_c ?

- (A) $1.6 \text{ mol}^{-1} \text{ dm}^3$
- (B) $16 \text{ mol}^{-1} \text{ dm}^3$
- (C) $160 \text{ mol}^{-1} \text{ dm}^3$
- (D) $0.00625 \text{ mol}^{-1} \text{ dm}^3$

Q30. For a gaseous equilibrium system, the value of K_p changes only when

- (A) the temperature is changed
- (B) the overall pressure is changed
- (C) a catalyst is added
- (D) the concentrations of the reactants are changed

Q31. In an esterification equilibrium $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$, the equilibrium mixture in a sealed vessel contains 0.33 mol of ethanoic acid, 0.33 mol of ethanol, 0.67 mol of the ester and 0.67 mol of water. What is the value of K_c ?

- (A) 0.24
- (B) 0.49
- (C) 2.0
- (D) 4.1

Q32. For the equilibrium $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, what is the effect of increasing the pressure on the position of equilibrium?

- (A) It shifts to the right, producing more HI
- (B) There is no effect, because there are equal numbers of moles of gas on each side of the equation
- (C) It shifts to the left, producing more H_2 and I_2
- (D) K_c increases

Q33. The forward reaction in a gaseous equilibrium is endothermic. What happens to K_c when the temperature is increased?

- (A) K_c decreases
- (B) K_c stays the same
- (C) K_c increases
- (D) The equilibrium shifts to the left

Redox & Electrode Potentials

Q34. What is the oxidation state of manganese in the manganate(VII) ion, MnO_4^- ?

- (A) +7
- (B) +5
- (C) +6
- (D) +4

Q35. Using the standard electrode potentials $\text{Fe}^{2+}/\text{Fe} = -0.44 \text{ V}$ and $\text{Ag}^+/\text{Ag} = +0.80 \text{ V}$, what is the EMF of a cell made from an Fe/Fe^{2+} electrode and an Ag/Ag^+ electrode under standard conditions?

- (A) +0.36 V
- (B) -1.24 V
- (C) +0.44 V
- (D) +1.24 V

Q36. Given the standard electrode potentials $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$, $\text{Fe}^{2+}/\text{Fe} = -0.44 \text{ V}$ and $\text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$, which is the strongest reducing agent?

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

Q37. Using $\text{Br}_2/\text{Br}^- = +1.09 \text{ V}$ and $\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ V}$, which statement about the reaction of bromine with iron(II) ions is correct?

- (A) The reaction is not feasible because $E^\ominus_{\text{cell}} = -0.32 \text{ V}$
- (B) The reaction is feasible because $E^\ominus_{\text{cell}} = +1.86 \text{ V}$
- (C) The reaction is feasible because $E^\ominus_{\text{cell}} = +0.32 \text{ V}$
- (D) The reaction is not feasible because $E^\ominus_{\text{cell}} = +0.32 \text{ V}$

Q38. In the electrolysis of molten aluminium oxide, a charge of 0.30 mol of electrons is passed. How many moles of aluminium are produced at the cathode?

- (A) 0.10 mol
- (B) 0.30 mol
- (C) 0.90 mol
- (D) 0.15 mol

Acids, Bases & Buffers

Q39. 50.0 cm³ of 0.100 mol dm⁻³ hydrochloric acid is mixed with 25.0 cm³ of 0.100 mol dm⁻³ sodium hydroxide solution. What is the pH of the resulting solution?

- (A) 1.00
- (B) 2.48
- (C) 1.18
- (D) 1.48

Q40. A weak acid has $K_a = 1.7 \times 10^{-5} \text{ mol dm}^{-3}$. What is the pH of a 0.050 mol dm⁻³ solution of this acid?

- (A) 2.03
- (B) 3.03
- (C) 4.77
- (D) 3.53

Q41. Sodium ethanoate is the salt of a weak acid (K_a of ethanoic acid = $1.8 \times 10^{-5} \text{ mol dm}^{-3}$; $K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$). What is the pH of a 0.100 mol dm⁻³ solution of sodium ethanoate?

- (A) 2.87
- (B) 5.13
- (C) 8.87
- (D) 11.13

Q42. Which indicator is most suitable for the titration of a strong acid against a weak base such as ammonia?

- (A) methyl orange
- (B) phenolphthalein
- (C) universal indicator
- (D) litmus

Q43. At 50 °C, K_w for water is $5.48 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$. What is the pH of pure water at this temperature?

- (A) 7.00
- (B) 6.85
- (C) 13.26
- (D) 6.63

Inorganic Chemistry

Q44. Which Group 2 carbonate decomposes at the lowest temperature on heating?

- (A) BaCO_3
- (B) MgCO_3
- (C) CaCO_3
- (D) SrCO_3

Q45. A solution gives a white precipitate when acidified silver nitrate solution is added. The precipitate dissolves in dilute ammonia solution. Which ion was present in the original solution?

- (A) Br^-
- (B) I^-
- (C) Cl^-
- (D) SO_4^{2-}

Q46. What is the shape of the complex ion in cisplatin, $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$?

- (A) square planar
- (B) tetrahedral
- (C) octahedral
- (D) linear

Q47. What is observed when sodium hydroxide solution is added to aqueous iron(II) sulfate?

- (A) No precipitate forms
- (B) A white precipitate forms
- (C) An orange-brown precipitate forms immediately
- (D) A green precipitate forms, which turns brown on standing in air

Q48. Vanadium(V) oxide, V_2O_5 , is used as a catalyst in which industrial process?

- (A) The Haber process
- (B) The Contact process
- (C) The cracking of hydrocarbons
- (D) The hydrogenation of alkenes

Organic Chemistry I

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

- (A) $\text{Cl}_2 \rightarrow 2\text{Cl}^\bullet$
- (B) $\text{CH}_3^\bullet + \text{Cl}^\bullet \rightarrow \text{CH}_3\text{Cl}$
- (C) $\text{CH}_3^\bullet + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}^\bullet$
- (D) $\text{Cl}^\bullet + \text{Cl}^\bullet \rightarrow \text{Cl}_2$

Q50. When a halogenoalkane is heated under reflux with ethanolic potassium hydroxide, the main reaction that occurs is

- (A) elimination, forming an alkene
- (B) substitution, forming an alcohol
- (C) addition across a double bond
- (D) esterification

Q51. Ethene is shaken with cold, dilute acidified potassium manganate(VII) solution. What is observed, and what is the organic product?

- (A) No change is observed
- (B) An orange solution forms and ethanoic acid is produced
- (C) A brown precipitate forms and ethanal is produced
- (D) The purple colour is discharged and ethane-1,2-diol is formed

Q52. What is observed when 2-methylpropan-2-ol is warmed with acidified potassium dichromate(VI)?

- (A) The mixture turns green and a carboxylic acid is formed
- (B) The mixture stays orange and no reaction occurs
- (C) The mixture turns green and a ketone is formed
- (D) Vigorous effervescence occurs

Q53. Butan-2-ol is dehydrated by heating with concentrated phosphoric acid. What is the major alkene product?

- (A) but-1-ene
- (B) butane
- (C) but-2-ene
- (D) butanone

Q54. Which step in the chlorination of methane is the termination step that produces ethane?

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

Organic Chemistry II & Analysis

Q55. What is the product when propanone is reduced with NaBH_4 in aqueous solution?

- (A) propanal
- (B) propanoic acid
- (C) propane
- (D) propan-2-ol

Q56. Which reagents are used to convert benzene into $\text{C}_6\text{H}_5\text{COCH}_3$ by Friedel-Crafts acylation?

- (A) CH_3COOH and concentrated H_2SO_4
- (B) CH_3COCl with an AlCl_3 catalyst
- (C) CH_3Cl with an Fe catalyst
- (D) $(\text{CH}_3\text{CO})_2\text{O}$ with a nickel catalyst

Q57. Which of these compounds produces effervescence when sodium carbonate solution is added?

- (A) ethanol
- (B) ethyl ethanoate
- (C) ethanoic acid
- (D) phenol

Q58. Which of these is a condensation polymer?

- (A) Terylene (a polyester)
- (B) poly(ethene)
- (C) poly(chloroethene) (PVC)
- (D) poly(propene)

Q59. Phenylamine is cooled in ice and treated with nitrous acid (NaNO_2 and dilute HCl) at about 5°C . What is formed?

- (A) phenol directly
- (B) nitrobenzene
- (C) an azo dye immediately, with no intermediate
- (D) a benzene diazonium salt, which can then be coupled to form azo dyes

Q60. How many peaks are there in the proton (^1H) NMR spectrum of propanone, CH_3COCH_3 ?

- (A) Two peaks, in the ratio 1:1
- (B) One peak only
- (C) Two peaks, in the ratio 3:1
- (D) Three peaks

Answer Key

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

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