

A-Level Chemistry Practice Test 2

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 the isotopes ^{24}Mg (78.99%), ^{25}Mg (10.00%) and ^{26}Mg (11.01%). What is the relative atomic mass of this sample of magnesium?

- (A) 24.00
- (B) 25.00
- (C) 24.32
- (D) 24.85

Q2. What is the electronic configuration of a chromium atom?

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

Q3. The first ionisation energy of aluminium is lower than that of magnesium, even though aluminium has a greater nuclear charge. This is because in aluminium

- (A) there are more protons to repel the electrons
- (B) the outer electron is paired in a 3s orbital
- (C) the outer electron is shielded by fewer electrons
- (D) the outer electron is in a 3p orbital, which is higher in energy than the 3s orbital occupied in magnesium

Q4. Natural chlorine contains 75.8% of the isotope ^{35}Cl and 24.2% of the isotope ^{37}Cl . What is the relative atomic mass of chlorine?

- (A) 35.0
- (B) 35.5
- (C) 36.0
- (D) 35.9

Q5. Silicon has a very high melting point, whereas phosphorus (P_4) has a low melting point. This is because

- (A) silicon is a metal but phosphorus is a non-metal
- (B) phosphorus has covalent bonds but silicon has ionic bonds
- (C) silicon has a giant covalent structure in which every atom is held by strong covalent bonds, while phosphorus is a simple molecular substance with only weak forces between its molecules
- (D) silicon forms hydrogen bonds between its atoms

Amount of Substance

Q6. What pressure is exerted by 0.500 mol of an ideal gas in a volume of 0.0200 m³ at 300 K? (R = 8.31 J K⁻¹ mol⁻¹)

- (A) 62.3 kPa
- (B) 623 kPa
- (C) 6.23 kPa
- (D) 124 kPa

Q7. A 25.0 cm³ sample of sulfuric acid is exactly neutralised by 40.0 cm³ of 0.200 mol dm⁻³ sodium hydroxide solution. What is the concentration of the sulfuric acid?

- (A) 0.0800 mol dm⁻³
- (B) 0.320 mol dm⁻³
- (C) 0.640 mol dm⁻³
- (D) 0.160 mol dm⁻³

Q8. A hydrocarbon has an empirical formula of CH₂ and a relative molecular mass of 84. What is its molecular formula?

- (A) C₃H₆
- (B) C₆H₁₂
- (C) C₆H₆
- (D) C₅H₁₀

Q9. When 10.0 g of calcium carbonate is heated strongly it decomposes to calcium oxide and carbon dioxide. If 4.48 g of calcium oxide is obtained, what is the percentage yield? (Mr: CaCO₃ = 100, CaO = 56)

- (A) 44.8%
- (B) 56.0%
- (C) 80.0%
- (D) 125%

Q10. Iron is produced in the blast furnace by the reaction $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$. What is the atom economy for the production of iron? (Mr: Fe₂O₃ = 160, CO = 28, Fe = 56)

- (A) 45.9%
- (B) 70.0%
- (C) 54.1%
- (D) 100%

Q11. What volume of a 0.500 mol dm⁻³ solution contains 0.125 mol of solute?

- (A) 4.00 dm³
- (B) 62.5 cm³
- (C) 0.004 dm³
- (D) 250 cm³

Bonding & Structure

Q12. Which molecule is linear?

- (A) H₂O
- (B) CO₂
- (C) NH₃
- (D) CH₄

Q13. Which substance has the highest boiling point?

- (A) Methane
- (B) Hydrogen chloride
- (C) Methanol
- (D) Ethane

Q14. Which equation represents the lattice enthalpy of formation of magnesium oxide?

- (A) $\text{Mg}^{2+}(\text{g}) + \text{O}^{2-}(\text{g}) \rightarrow \text{MgO}(\text{s})$
- (B) $\text{Mg}(\text{s}) + 0.5\text{O}_2(\text{g}) \rightarrow \text{MgO}(\text{s})$
- (C) $\text{MgO}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{g}) + \text{O}^{2-}(\text{g})$
- (D) $\text{Mg}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{MgO}(\text{s})$

Q15. Which chloride has the greatest covalent character in its bonding?

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

Q16. Which molecule is polar overall?

- (A) CO_2
- (B) H_2O
- (C) CCl_4
- (D) BF_3

Q17. Copper is malleable and can be drawn into wires because

- (A) the bonds between copper atoms are weak
- (B) copper consists of small molecules that can slide over each other
- (C) the layers of positive ions can slide over one another while the delocalised electrons still hold the structure together
- (D) the electrons escape from the metal as it is stretched

Energetics & Thermodynamics

Q18. Burning 0.0500 mol of a fuel raised the temperature of 200 g of water by 28.8 °C. What is the enthalpy of combustion of the fuel? (Specific heat capacity of water = 4.18 J g⁻¹ K⁻¹)

- (A) -482 kJ mol⁻¹
- (B) -241 kJ mol⁻¹
- (C) -24.1 kJ mol⁻¹
- (D) -120 kJ mol⁻¹

Q19. Use the enthalpies of combustion: $\text{C}_2\text{H}_4 = -1411 \text{ kJ mol}^{-1}$; $\text{H}_2 = -286 \text{ kJ mol}^{-1}$; $\text{C}_2\text{H}_6 = -1560 \text{ kJ mol}^{-1}$. What is the enthalpy change for the hydrogenation reaction $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$?

- (A) +137 kJ mol⁻¹
- (B) -1560 kJ mol⁻¹
- (C) +3257 kJ mol⁻¹
- (D) -137 kJ mol⁻¹

Q20. Which change is accompanied by a decrease in entropy?

- (A) Dissolving ammonium nitrate in water
- (B) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
- (C) The boiling of water
- (D) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

Q21. A reaction has $\Delta H = +50 \text{ kJ mol}^{-1}$ and $\Delta S = +200 \text{ J K}^{-1} \text{ mol}^{-1}$. Above what temperature is this reaction feasible?

- (A) 0.25 K
- (B) 25 K
- (C) 250 K
- (D) 2500 K

Q22. Use the 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 $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$?

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

Q23. The standard enthalpy of atomisation of an element is the enthalpy change when

- (A) 1 mole of a compound is broken up into its gaseous atoms
- (B) 1 mole of gaseous ions forms an ionic lattice
- (C) an element burns completely in oxygen
- (D) 1 mole of gaseous atoms is formed from the element in its standard state

Kinetics & Rate Equations

Q24. Initial rate experiments for a reaction gave these results: when the concentration of X was trebled (keeping everything else constant), the initial rate increased by a factor of nine. The order of reaction with respect to X is

- (A) 1
- (B) 2
- (C) 3
- (D) 0

Q25. For the rate equation $\text{rate} = k[\text{A}][\text{B}]$, the initial rate is $4.8 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$ when $[\text{A}] = 0.20 \text{ mol dm}^{-3}$ and $[\text{B}] = 0.30 \text{ mol dm}^{-3}$. What is the value of k?

- (A) $0.013 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (B) $8.0 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (C) $0.080 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (D) $0.288 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$

Q26. For a particular reaction, the rate constant is $1.0 \times 10^{-3} \text{ s}^{-1}$ at 300 K and $4.0 \times 10^{-3} \text{ s}^{-1}$ at 320 K. What is the activation energy of the reaction? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$; $\ln 4 = 1.386$)

- (A) 55 kJ mol^{-1}
- (B) 5.5 kJ mol^{-1}
- (C) 110 kJ mol^{-1}
- (D) 28 kJ mol^{-1}

Q27. Raising the temperature of a reaction mixture increases the rate of reaction mainly because

- (A) the activation energy is lowered
- (B) every molecule moves at exactly the same higher speed
- (C) the concentration of the reactants increases
- (D) a greater proportion of the molecules have energy equal to or greater than the activation energy

Q28. For a zero-order reaction, what happens to the rate if the concentration of the reactant is halved?

- (A) The rate halves
- (B) The rate stays the same
- (C) The rate doubles
- (D) The rate falls to one quarter

Equilibria (K_c & K_p)

Q29. For the esterification equilibrium $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$, a mixture started with 1.00 mol of ethanoic acid and 1.00 mol of ethanol in a 1.00 dm^3 vessel. At equilibrium, 0.667 mol of ester had formed. What is the value of K_c ?

- (A) 0.25
- (B) 2.0
- (C) 4.0
- (D) 0.50

Q30. For the equilibrium $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, the expression for K_p is

- (A) $K_p = p(\text{NH}_3)^2 / (p(\text{N}_2) \times p(\text{H}_2)^3)$
- (B) $K_p = (p(\text{N}_2) \times p(\text{H}_2)^3) / p(\text{NH}_3)^2$
- (C) $K_p = p(\text{NH}_3) / (p(\text{N}_2) \times p(\text{H}_2))$
- (D) $K_p = p(\text{NH}_3)^3 / (p(\text{N}_2) \times p(\text{H}_2)^2)$

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

- (A) It increases
- (B) It stays exactly the same
- (C) It increases, then decreases
- (D) It decreases

Q32. An equilibrium mixture contains 2.0 mol of N_2 , 6.0 mol of H_2 and 2.0 mol of NH_3 at a total pressure of 500 kPa. What is the partial pressure of the ammonia?

- (A) 50 kPa
- (B) 100 kPa
- (C) 200 kPa
- (D) 300 kPa

Q33. For the equilibrium $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, the equilibrium concentrations are $[\text{H}_2] = 0.10$, $[\text{I}_2] = 0.10$ and $[\text{HI}] = 0.80 \text{ mol dm}^{-3}$. What is the value of K_c ?

- (A) 8.0
- (B) 0.64
- (C) 64
- (D) 640

Redox & Electrode Potentials

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

- (A) +6
- (B) +3
- (C) +12
- (D) -6

Q35. Use the standard electrode potentials: $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$, $E = -0.76 \text{ V}$; $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$, $E = +0.80 \text{ V}$. What is the EMF of the cell $\text{Zn} | \text{Zn}^{2+} || \text{Ag}^+ | \text{Ag}$ under standard conditions?

- (A) +0.04 V
- (B) -1.56 V
- (C) +1.10 V
- (D) +1.56 V

Q36. Use the standard electrode potentials: $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$, $E = -0.76 \text{ V}$; $\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$, $E = -0.44 \text{ V}$; $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$, $E = +0.34 \text{ V}$; $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$, $E = +0.80 \text{ V}$. Which species is the strongest oxidising agent?

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

Q37. A current of 1.50 A is passed for 30.0 minutes through silver nitrate solution. What mass of silver is deposited at the cathode? (Faraday constant = $96\,500 \text{ C mol}^{-1}$; Ar of Ag = 108)

- (A) 1.51 g
- (B) 6.04 g
- (C) 3.02 g
- (D) 0.756 g

Q38. Use the standard electrode potentials: $\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$, $E = +0.77 \text{ V}$; $\text{Sn}^{4+} + 2\text{e}^- \rightarrow \text{Sn}^{2+}$, $E = +0.15 \text{ V}$; $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$, $E = +0.34 \text{ V}$; $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$, $E = 0.00 \text{ V}$; $\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$, $E = +1.07 \text{ V}$; $\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$, $E = +0.54 \text{ V}$. Which reaction will occur under standard conditions?

- (A) $2\text{Fe}^{3+} + \text{Sn}^{2+} \rightarrow 2\text{Fe}^{2+} + \text{Sn}^{4+}$
- (B) $2\text{Fe}^{2+} + \text{Sn}^{4+} \rightarrow 2\text{Fe}^{3+} + \text{Sn}^{2+}$
- (C) $\text{Cu} + 2\text{H}^+ \rightarrow \text{Cu}^{2+} + \text{H}_2$
- (D) $2\text{Br}^- + \text{I}_2 \rightarrow \text{Br}_2 + 2\text{I}^-$

Acids, Bases & Buffers

Q39. A solution of a strong acid has a hydrogen ion concentration of $3.16 \times 10^{-3} \text{ mol dm}^{-3}$. What is the pH of the solution?

- (A) 3.16
- (B) 11.5
- (C) 3.50
- (D) 2.50

Q40. What is the pH of a $0.0200 \text{ mol dm}^{-3}$ solution of sodium hydroxide at 25°C ? ($K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$)

- (A) 1.70
- (B) 12.30
- (C) 13.70
- (D) 12.00

Q41. A $0.100 \text{ mol dm}^{-3}$ solution of a weak acid HA has a pH of 3.00. What is the value of K_a for the acid?

- (A) $1.0 \times 10^{-3} \text{ mol dm}^{-3}$
- (B) $1.0 \times 10^{-6} \text{ mol dm}^{-3}$
- (C) $1.0 \times 10^{-5} \text{ mol dm}^{-3}$
- (D) $1.0 \times 10^{-4} \text{ mol dm}^{-3}$

Q42. An ethanoic acid / sodium ethanoate buffer resists changes in pH when a small amount of alkali is added because

- (A) the hydroxide ions react with ethanoic acid molecules to form ethanoate ions and water
- (B) the hydroxide ions react with the ethanoate ions to form ethanoic acid
- (C) the alkali is completely neutralised by the sodium ions
- (D) the pH of a buffer solution can never change at all

Q43. At 25°C , $K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$. What is the hydroxide ion concentration in $0.00100 \text{ mol dm}^{-3}$ hydrochloric acid?

- (A) $1.0 \times 10^{-3} \text{ mol dm}^{-3}$
- (B) $1.0 \times 10^{-7} \text{ mol dm}^{-3}$
- (C) $1.0 \times 10^{-17} \text{ mol dm}^{-3}$
- (D) $1.0 \times 10^{-11} \text{ mol dm}^{-3}$

Inorganic Chemistry

Q44. The thermal stability of the Group 2 nitrates increases down the group. Which nitrate decomposes most readily on heating?

- (A) $\text{Ba}(\text{NO}_3)_2$
- (B) $\text{Mg}(\text{NO}_3)_2$
- (C) $\text{Ca}(\text{NO}_3)_2$
- (D) $\text{Sr}(\text{NO}_3)_2$

Q45. Which statement about the halogens and their compounds is correct?

- (A) Fluorine can be extracted by electrolysis of aqueous hydrofluoric acid
- (B) Iodine is a black liquid at room temperature
- (C) A more reactive halogen will displace a less reactive halogen from an aqueous solution of its halide
- (D) Silver iodide forms a white precipitate when silver nitrate solution is added to iodide ions

Q46. When concentrated hydrochloric acid is added to aqueous copper(II) sulfate, the solution turns yellow-green because it now contains mainly the complex ion

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

Q47. A metal ion in solution gives a white precipitate with aqueous ammonia. The precipitate does not dissolve in excess ammonia, but it does dissolve in excess sodium hydroxide solution. The metal ion is

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

Q48. Which is an example of a transition metal (or its compound) acting as a heterogeneous catalyst?

- (A) Concentrated sulfuric acid catalysing an esterification
- (B) Iron catalysing the Haber process
- (C) Hydrogen ions catalysing the hydrolysis of an ester
- (D) An enzyme catalysing a reaction in the body

Organic Chemistry I

Q49. Which equation shows a termination step in the free-radical chlorination of methane?

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

Q50. When bromoethane is heated under reflux with concentrated potassium hydroxide dissolved in ethanol, the main organic product is

- (A) ethene
- (B) ethanol
- (C) ethane
- (D) ethanoic acid

Q51. Ethene is converted into ethanol industrially by reaction with steam and a phosphoric acid catalyst. Propene reacts in a similar way. The product from propene is

- (A) propan-1-ol
- (B) propanone
- (C) propane
- (D) propan-2-ol

Q52. Butan-2-ol is warmed with acidified potassium dichromate(VI). The main organic product is

- (A) butanoic acid
- (B) butanone
- (C) butanal
- (D) but-2-ene

Q53. Which equation represents the incomplete combustion of methane to form carbon monoxide and water only?

- (A) $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- (B) $\text{CH}_4 + \text{O}_2 \rightarrow \text{C} + 2\text{H}_2\text{O}$
- (C) $2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$
- (D) $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2$

Q54. Ethanol vapour passed over heated aluminium oxide forms ethene and water. This reaction is an example of

- (A) elimination
- (B) addition
- (C) substitution
- (D) oxidation

Organic Chemistry II & Analysis

Q55. Which compound gives a brick-red precipitate when warmed with Fehling's solution?

- (A) Propanone
- (B) Ethanoic acid
- (C) Methyl ethanoate
- (D) Ethanal

Q56. Ethanol is warmed with ethanoic acid and a few drops of concentrated sulfuric acid. The product is

- (A) ethanoic anhydride
- (B) ethyl ethanoate
- (C) diethyl ether
- (D) ethanoyl chloride

Q57. In the Friedel-Crafts acylation of benzene using ethanoyl chloride and an aluminium chloride catalyst, the electrophile that attacks the benzene ring is

- (A) CH_3COCl
- (B) AlCl_3
- (C) CH_3CO^+
- (D) CH_3^+

Q58. When phenylamine is treated with bromine water, the product is

- (A) 2,4,6-tribromophenylamine
- (B) bromobenzene
- (C) phenylammonium bromide
- (D) 4-bromophenylamine only

Q59. Nylon-6,6 is a polyamide made by condensation polymerisation of hexanedioic acid with

- (A) hexane-1,6-diol
- (B) ethanedioic acid
- (C) hexanoic acid
- (D) 1,6-diaminohexane

Q60. How many different hydrogen environments (and so peaks) are there in the ^1H NMR spectrum of ethyl ethanoate, $\text{CH}_3\text{COOCH}_2\text{CH}_3$?

- (A) 2
- (B) 3
- (C) 4
- (D) 6

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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