

A-Level Chemistry Practice Test 14

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 (79.0%), ^{25}Mg (10.0%) and ^{26}Mg (11.0%). What is the relative atomic mass of magnesium in this sample?

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

Q2. The successive ionisation energies of an element show a very large increase between the 5th and 6th ionisation energies. In which group of the Periodic Table is the element?

- (A) Group 14
- (B) Group 15
- (C) Group 16
- (D) Group 2

Q3. What is the electronic configuration of an Fe^{2+} ion? (Atomic number of Fe = 26)

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

Q4. Which statement correctly explains why the atomic radius decreases across Period 3 from sodium to chlorine?

- (A) The number of electron shells increases across the period
- (B) Shielding increases greatly across the period
- (C) The outer electrons repel each other more strongly as more are added
- (D) The nuclear charge increases while the electrons are added to the same shell with similar shielding, so the outer electrons are pulled closer to the nucleus

Q5. In a time of flight mass spectrometer, ions with $m/z = 32$ take $1.6 \times 10^{-5} \text{ s}$ to reach the detector. What time is taken by ions with $m/z = 128$ under the same conditions?

- (A) $0.8 \times 10^{-5} \text{ s}$
- (B) $3.2 \times 10^{-5} \text{ s}$
- (C) $6.4 \times 10^{-5} \text{ s}$
- (D) $1.6 \times 10^{-5} \text{ s}$

Amount of Substance

Q6. A 250 cm³ sample of carbon dioxide gas is held at 101 kPa and 298 K. What is the mass of the sample? (R = 8.31 J K⁻¹ mol⁻¹; Mr of CO₂ = 44)

- (A) 0.045 g
- (B) 0.11 g
- (C) 4.5 g
- (D) 0.45 g

Q7. 25.0 cm³ of a sulfuric acid solution is exactly neutralised by 30.0 cm³ of 0.100 mol dm⁻³ sodium hydroxide. What is the concentration of the sulfuric acid?

- (A) 0.060 mol dm⁻³
- (B) 0.120 mol dm⁻³
- (C) 0.030 mol dm⁻³
- (D) 0.240 mol dm⁻³

Q8. A hydrocarbon contains 85.7% carbon and 14.3% hydrogen by mass. Its relative molecular mass is 84. What is its molecular formula?

- (A) C₃H₆
- (B) C₆H₁₄
- (C) C₆H₁₂
- (D) CH₂

Q9. Glucose is fermented to make ethanol: C₆H₁₂O₆ → 2C₂H₅OH + 2CO₂. What is the atom economy for the ethanol? (Mr: glucose = 180; ethanol = 46)

- (A) 25.6%
- (B) 51.1%
- (C) 74.4%
- (D) 100%

Q10. 5.85 g of sodium chloride (Mr = 58.5) is dissolved in water to make 250 cm³ of solution. What is the concentration of the solution?

- (A) 0.100 mol dm⁻³
- (B) 0.250 mol dm⁻³
- (C) 0.025 mol dm⁻³
- (D) 0.400 mol dm⁻³

Q11. Magnesium burns in oxygen: 2Mg + O₂ → 2MgO. What volume of oxygen, at room temperature and pressure, is needed to burn 0.48 g of magnesium completely? (Molar gas volume = 24 dm³ mol⁻¹; Ar(Mg) = 24)

- (A) 240 cm³
- (B) 480 cm³
- (C) 120 cm³
- (D) 24 cm³

Bonding & Structure

Q12. Which molecule has a trigonal planar shape with bond angles of 120°?

- (A) NH₃
- (B) H₂O
- (C) BF₃
- (D) CH₄

Q13. The boiling point of water (100 °C) is much higher than that of hydrogen sulfide (-60 °C), even though H₂S has the larger Mr. This is because...

- (A) the covalent bonds inside water molecules are stronger than those in H₂S
- (B) water molecules form hydrogen bonds, whereas H₂S molecules have only weaker van der Waals and dipole-dipole forces between them
- (C) water is a liquid because it is ionic
- (D) H₂S molecules are much smaller than water molecules

Q14. Use these data for potassium chloride: enthalpy change of formation = -437 kJ mol⁻¹; enthalpy of atomisation of K = +89 kJ mol⁻¹; first ionisation energy of K = +418 kJ mol⁻¹; enthalpy of atomisation of chlorine = +121 kJ mol⁻¹; electron affinity of Cl = -349 kJ mol⁻¹. What is the lattice enthalpy of KCl?

- (A) -437 kJ mol⁻¹
- (B) -158 kJ mol⁻¹
- (C) -628 kJ mol⁻¹
- (D) -716 kJ mol⁻¹

Q15. Sodium, magnesium and aluminium are metals in Period 3. Which of them has the strongest metallic bonding and so the highest melting point?

- (A) Aluminium
- (B) Sodium
- (C) Magnesium
- (D) All three have equally strong metallic bonding

Q16. Which bond is the most polar?

- (A) H-Cl
- (B) H-Br
- (C) H-F
- (D) H-I

Q17. Which statement about graphite is correct?

- (A) The layers are held together by strong covalent bonds
- (B) The layers are held together by weak van der Waals forces, so they can slide over each other
- (C) Graphite cannot conduct electricity
- (D) Each carbon atom in graphite forms four single bonds

Energetics & Thermodynamics

Q18. 0.46 g of ethanol is burned completely and heats 100 g of water by 32.7 °C. What is the enthalpy change of combustion of ethanol? (c = 4.18 J g⁻¹ K⁻¹; Mr of ethanol = 46)

- (A) -1367 kJ mol⁻¹
- (B) -136.7 kJ mol⁻¹
- (C) -683 kJ mol⁻¹
- (D) -2733 kJ mol⁻¹

Q19. Standard 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 reaction $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$?

- (A) $+137 \text{ kJ mol}^{-1}$
- (B) $-1697 \text{ kJ mol}^{-1}$
- (C) $-2871 \text{ kJ mol}^{-1}$
- (D) -137 kJ mol^{-1}

Q20. Bond enthalpies: $\text{C-H} = 413 \text{ kJ mol}^{-1}$, $\text{O=O} = 498 \text{ kJ mol}^{-1}$, C=O (in CO_2) = 805 kJ mol^{-1} , $\text{O-H} = 464 \text{ kJ mol}^{-1}$. What is the enthalpy change for the combustion of methane, $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$, calculated from these bond enthalpies?

- (A) -409 kJ mol^{-1}
- (B) $-3466 \text{ kJ mol}^{-1}$
- (C) -818 kJ mol^{-1}
- (D) $+818 \text{ kJ mol}^{-1}$

Q21. A reaction is endothermic and has a positive entropy change ($\Delta H > 0$ and $\Delta S > 0$). Under which conditions is the reaction feasible?

- (A) At all temperatures
- (B) Only at high temperatures, when $T\Delta S$ is greater than ΔH
- (C) Only at low temperatures
- (D) At no temperature

Q22. 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 ?

- (A) $-79.8 \text{ kJ mol}^{-1}$
- (B) $-50.0 \text{ kJ mol}^{-1}$
- (C) $+20.2 \text{ kJ mol}^{-1}$
- (D) $-20.2 \text{ kJ mol}^{-1}$

Q23. The enthalpy change of neutralisation of any strong acid by any strong alkali is always about -57 kJ mol^{-1} . This is because in every case the reaction that actually takes place is...

- (A) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- (B) the formation of a salt from its ions
- (C) the breaking of the covalent bonds in the alkali
- (D) the ionisation of the acid molecules

Kinetics & Rate Equations

Q24. For a reaction with rate = $k[\text{A}]^2[\text{B}]$, the concentration of A is halved and the concentration of B is doubled. What happens to the rate?

- (A) It doubles
- (B) It is unchanged
- (C) It halves
- (D) It decreases by a factor of 4

Q25. A reaction is second order with respect to A and zero order with respect to all other reactants. When $[A] = 0.10 \text{ mol dm}^{-3}$, the initial rate is $4.0 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$. What is the value of the rate constant?

- (A) 0.40 s^{-1}
- (B) $0.40 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (C) $4.0 \times 10^{-4} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (D) $0.040 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$

Q26. What are the units of the rate constant for a first order reaction?

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

Q27. A graph of $\ln k$ against $1/T$ for a reaction is a straight line with a gradient of -9000 K . What is the activation energy? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 9.0 kJ mol^{-1}
- (B) 1083 kJ mol^{-1}
- (C) 7.48 kJ mol^{-1}
- (D) 74.8 kJ mol^{-1}

Q28. The half-life of a reaction is measured at several different starting concentrations and is found to be constant. What is the order of the reaction?

- (A) Zero order
- (B) Second order
- (C) First order
- (D) Third order

Equilibria (K_c & K_p)

Q29. Ethanoic acid and ethanol react to form an ester: $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$. At equilibrium, a mixture contains 0.30 mol of acid, 0.30 mol of ethanol, 0.70 mol of ester and 0.70 mol of water, all in the same volume. What is the value of K_c ?

- (A) 0.18
- (B) 5.4
- (C) 2.3
- (D) 0.43

Q30. In the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, the equilibrium mixture at a total pressure of 200 kPa has a mole fraction of 0.25 for N_2O_4 and 0.75 for NO_2 . What is the value of K_p ?

- (A) 450 kPa
- (B) 225 kPa
- (C) 45 kPa
- (D) 900 kPa

Q31. A catalyst is added to a mixture of reactants and products that has already reached equilibrium. Which statement is correct?

- (A) The value of K_c increases
- (B) The position of equilibrium shifts towards the products
- (C) The position of equilibrium shifts towards the reactants
- (D) Equilibrium is reached faster if the mixture is disturbed, but the catalyst has no effect on K_c or on the position of equilibrium

Q32. For the equilibrium $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$, what are the units of K_c ?

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

Q33. Carbon monoxide and steam react: $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$. Initially 1.00 mol of CO and 1.00 mol of H_2O are placed in a 1.00 dm^3 vessel. At equilibrium, 0.60 mol of CO_2 is present. What is the value of K_c ?

- (A) 0.44
- (B) 2.25
- (C) 1.50
- (D) 0.67

Redox & Electrode Potentials

Q34. What is the average oxidation number of sulfur in sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$?

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

Q35. Standard electrode potentials: $\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$, $E = +0.80 \text{ V}$; $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$, $E = +0.34 \text{ V}$. What is the EMF of a cell combining these two half-cells?

- (A) 0.46 V
- (B) 1.14 V
- (C) -0.46 V
- (D) 0.34 V

Q36. Standard electrode potentials: $\text{Br}_2/\text{Br}^- = +1.09 \text{ V}$; $\text{I}_2/\text{I}^- = +0.54 \text{ V}$. Which reaction is feasible?

- (A) $\text{I}_2 + 2\text{Br}^- \rightarrow 2\text{I}^- + \text{Br}_2$
- (B) Br^- ions reduce I_2 to I^-
- (C) $\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$
- (D) Neither reaction can occur

Q37. A current of 2.0 A is passed through silver nitrate solution for 965 s. What mass of silver is deposited at the cathode? (Faraday constant = $96\,500\text{ C mol}^{-1}$; $A_r(\text{Ag}) = 107.9$)

- (A) 1.08 g
- (B) 2.16 g
- (C) 4.32 g
- (D) 0.54 g

Q38. Which set of conditions applies when standard electrode potentials are measured using a standard hydrogen electrode?

- (A) 273 K, 100 kPa, solutions of 0.10 mol dm^{-3}
- (B) 298 K, 200 kPa, solutions of 1.00 mol dm^{-3}
- (C) 298 K, 100 kPa, solutions of any concentration
- (D) 298 K, 100 kPa, solutions of 1.00 mol dm^{-3}

Acids, Bases & Buffers

Q39. A solution has a hydrogen ion concentration of $2.5 \times 10^{-3}\text{ mol dm}^{-3}$. What is its pH?

- (A) 2.60
- (B) 3.40
- (C) 2.50
- (D) 11.40

Q40. A 0.100 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) $1.0 \times 10^{-4}\text{ mol dm}^{-3}$

Q41. A strong acid is titrated against a strong alkali and the pH is measured throughout. Which statement about this titration is correct?

- (A) The pH at the equivalence point is always about 4
- (B) The pH curve has a steep, almost vertical section spanning roughly pH 3 to pH 11, so either methyl orange or phenolphthalein is a suitable indicator
- (C) No indicator can be used for this titration
- (D) The end point always occurs when exactly 25.0 cm^3 of alkali has been added

Q42. A buffer solution contains 0.100 mol dm^{-3} ethanoic acid and 0.300 mol dm^{-3} sodium ethanoate. The K_a of ethanoic acid is $1.8 \times 10^{-5}\text{ mol dm}^{-3}$ ($pK_a = 4.74$). What is the pH of this buffer?

- (A) 4.74
- (B) 4.26
- (C) 4.44
- (D) 5.22

Q43. What is the pH of 0.020 mol dm⁻³ potassium hydroxide solution? ($K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 25 °C)

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

Inorganic Chemistry

Q44. Which statement about the sulfates of the Group 2 elements is correct?

- (A) Their solubility increases down the group
- (B) Barium sulfate is soluble in water
- (C) Their solubility decreases down the group, and barium sulfate is insoluble
- (D) Magnesium sulfate is insoluble in water

Q45. A white precipitate forms when silver nitrate solution is added to a solution containing chloride ions, after acidifying with dilute nitric acid. How can this precipitate be confirmed as silver chloride?

- (A) It turns yellow in daylight
- (B) It dissolves in dilute ammonia solution
- (C) It dissolves in dilute hydrochloric acid
- (D) It gives a lilac flame colour

Q46. A few drops of sodium hydroxide solution are added to a solution containing Fe³⁺ ions. What is observed?

- (A) A green precipitate
- (B) A blue precipitate
- (C) A deep blue solution and no precipitate
- (D) An orange-brown precipitate

Q47. Which of these ligands is bidentate?

- (A) Ethane-1,2-diamine, NH₂CH₂CH₂NH₂
- (B) Water
- (C) Ammonia
- (D) Chloride ions

Q48. What colour is a solution containing VO₂⁺ ions (vanadium in oxidation state +5)?

- (A) Violet
- (B) Blue
- (C) Yellow
- (D) Green

Organic Chemistry I

Q49. Methane reacts with chlorine in ultraviolet light by free radical substitution. Which step is the initiation step?

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

Q50. Bromoethane is heated with potassium cyanide dissolved in ethanol. What is the organic product, and why is the reaction useful?

- (A) Ethylamine; it converts the halogenoalkane into an amine
- (B) Ethane; it reduces the halogenoalkane
- (C) Ethanol; it substitutes the bromine with an -OH group
- (D) Propanenitrile; it increases the length of the carbon chain by one carbon atom

Q51. Ethanol is manufactured industrially by the hydration of ethene. Which conditions are used?

- (A) Steam at about 300 °C and 6000-7000 kPa (60-70 atm) with a concentrated phosphoric(V) acid catalyst
- (B) Yeast at about 30 °C in the absence of air
- (C) Bromine water at room temperature
- (D) Reflux with acidified potassium dichromate(VI)

Q52. What is the monomer used to make poly(propene)?

- (A) Propane
- (B) Propan-1-ol
- (C) Propene
- (D) Propanoic acid

Q53. Which alcohol is NOT oxidised when heated with acidified potassium dichromate(VI)?

- (A) Propan-1-ol
- (B) 2-methylpropan-2-ol
- (C) Propan-2-ol
- (D) Ethanol

Q54. Ethanol vapour is passed over heated aluminium oxide. What is the organic product?

- (A) Ethanoic acid
- (B) Ethyl ethanoate
- (C) Ethane
- (D) Ethene

Organic Chemistry II & Analysis

Q55. Fehling's solution is warmed with an aldehyde. What is observed?

- (A) A brick-red precipitate of copper(I) oxide forms
- (B) A silver mirror forms on the inside of the tube
- (C) The blue solution is decolourised completely
- (D) Effervescence, and the gas turns limewater cloudy

Q56. Chloroethanoic acid is a stronger acid than ethanoic acid. This is because...

- (A) chlorine is a larger atom than hydrogen
- (B) chloroethanoic acid has a higher relative molecular mass
- (C) the electron-withdrawing chlorine atom pulls electron density away from the -COO^- group, stabilising the carboxylate anion so the acid ionises more readily
- (D) chloroethanoic acid is more soluble in water

Q57. Which ester is formed when methanol reacts with propanoic acid?

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

Q58. Benzene does not decolourise bromine water, but cyclohexene does. Which statement explains this difference?

- (A) Benzene contains no pi bonds
- (B) Bromine is insoluble in benzene
- (C) Cyclohexene has a ring of delocalised electrons
- (D) The pi electrons in benzene are delocalised around the ring, making addition unfavourable; benzene reacts by substitution instead, which preserves the delocalised system

Q59. Glycine (aminoethanoic acid) is dissolved in a strongly acidic solution. Which form of glycine is present in the greatest amount?

- (A) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH}$
- (B) $\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-$
- (C) $\text{H}_2\text{NCH}_2\text{COO}^-$
- (D) $\text{H}_2\text{NCH}_2\text{COOH}$

Q60. How many peaks are there in the carbon-13 (^{13}C) NMR spectrum of propanone, CH_3COCH_3 ?

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

Answer Key

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

Q9: B	Q19: D	Q29: B	Q39: A	Q49: B	Q59: A
Q10: D	Q20: C	Q30: A	Q40: C	Q50: D	Q60: C

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