

A-Level Chemistry Practice Test 18

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. Which statement correctly defines the first ionisation energy of an element?

- (A) The energy released when one mole of gaseous atoms gains one mole of electrons
- (B) The energy needed to remove one electron from every atom in a mole of solid element
- (C) The energy needed to remove one mole of electrons from one mole of solid atoms
- (D) The energy required to remove one mole of electrons from one mole of gaseous atoms to form one mole of gaseous $1+$ ions

Q2. An element has mass spectrum peaks at m/z 28 (92.2%), 29 (4.7%) and 30 (3.1%). What is its relative atomic mass?

- (A) 28.5
- (B) 28.1
- (C) 29.0
- (D) 27.8

Q3. Why do the first ionisation energies generally increase across Period 3?

- (A) The nuclear charge increases while electrons are added to the same shell, so shielding is similar and the attraction for the outer electrons increases
- (B) The atoms become larger across the period
- (C) The shielding increases greatly across the period
- (D) The electrons are removed from a shell further from the nucleus

Q4. What is the electronic configuration of a copper atom? (Cu: atomic number 29)

- (A) $[\text{Ar}] 4s^2 3d^9$
- (B) $[\text{Ar}] 4s^2 3d^{10}$
- (C) $[\text{Ar}] 4s^1 3d^{10}$
- (D) $[\text{Ar}] 3d^{11}$

Q5. In a time-of-flight mass spectrometer, an ion with $m/z = 100$ takes 2.0×10^{-5} s to travel the flight tube. How long does an ion with $m/z = 25$ take, if all ions are given the same kinetic energy?

- (A) 4.0×10^{-5} s
- (B) 2.0×10^{-5} s
- (C) 5.0×10^{-6} s
- (D) 1.0×10^{-5} s

Amount of Substance

Q6. What amount, in moles, is there in 480 cm³ of carbon dioxide at room temperature and pressure? (Molar gas volume = 24 dm³ mol⁻¹)

- (A) 0.0200 mol
- (B) 0.0500 mol
- (C) 0.200 mol
- (D) 20.0 mol

Q7. A 25.0 cm³ sample of hydrochloric acid is exactly neutralised by 18.6 cm³ of 0.200 mol dm⁻³ sodium hydroxide. What is the concentration of the acid?

- (A) 0.100 mol dm⁻³
- (B) 0.269 mol dm⁻³
- (C) 0.149 mol dm⁻³
- (D) 0.372 mol dm⁻³

Q8. In a preparation, the theoretical yield of a product is 15.0 g and the actual yield obtained is 12.0 g. What is the percentage yield?

- (A) 20%
- (B) 80%
- (C) 125%
- (D) 75%

Q9. An oxide of iron contains 3.36 g of iron and 1.28 g of oxygen. What is the empirical formula of the oxide? (Ar: Fe = 56, O = 16)

- (A) FeO
- (B) Fe₂O₃
- (C) FeO₂
- (D) Fe₃O₄

Q10. What volume is occupied by 0.200 mol of a gas at 300 K and 100 kPa? (R = 8.31 J K⁻¹ mol⁻¹)

- (A) 4.99 dm³
- (B) 49.9 dm³
- (C) 2.49 dm³
- (D) 0.499 dm³

Q11. Which reaction has an atom economy of 100%?

- (A) CH₄ + 2O₂ → CO₂ + 2H₂O
- (B) CaCO₃ → CaO + CO₂
- (C) C₂H₄ + H₂ → C₂H₆
- (D) CH₃Cl + OH⁻ → CH₃OH + Cl⁻

Bonding & Structure

Q12. What is the shape of a ClF₃ molecule? (In ClF₃ there are three bonding pairs and two lone pairs around the central chlorine atom.)

- (A) Trigonal planar
- (B) T-shaped
- (C) Tetrahedral
- (D) Trigonal pyramidal

Q13. Which molecule is polar overall?

- (A) BF₃
- (B) CO₂
- (C) CH₄
- (D) NH₃

Q14. Which ionic compound has the most exothermic lattice enthalpy?

- (A) MgO
- (B) CaO
- (C) NaCl
- (D) KCl

Q15. Which statement about structure and melting point is correct?

- (A) Sodium chloride has a low melting point because its ions are small
- (B) Ice melts easily because hydrogen bonds are stronger than covalent bonds
- (C) Silicon dioxide has a high melting point because strong covalent bonds throughout its giant structure must be broken on melting
- (D) Iodine has a high melting point because of strong covalent bonds between its molecules

Q16. Ethanol (boiling point 78 °C) and methoxymethane (boiling point –24 °C) are isomers. Why does ethanol have the higher boiling point?

- (A) Ethanol molecules are heavier than methoxymethane molecules
- (B) Ethanol has weaker intermolecular forces than methoxymethane
- (C) Methoxymethane forms hydrogen bonds but ethanol does not
- (D) Ethanol molecules form hydrogen bonds with each other, which need extra energy to break

Q17. The boiling points of the halogens increase down Group 7 (Cl₂ < Br₂ < I₂). This is because...

- (A) The covalent bonds within the molecules become stronger down the group
- (B) The molecules contain more electrons, so the van der Waals (London) forces between the molecules become stronger
- (C) The molecules become more polar down the group
- (D) Hydrogen bonding between the molecules increases down the group

Energetics & Thermodynamics

Q18. 50.0 cm³ of 1.00 mol dm⁻³ hydrochloric acid is mixed with 50.0 cm³ of 1.00 mol dm⁻³ sodium hydroxide in a calorimeter, and the temperature rises by 6.8 °C. What is the enthalpy of neutralisation? (Take the total mass of solution as 100 g; c = 4.18 J g⁻¹ K⁻¹)

- (A) –56.8 kJ mol⁻¹
- (B) –28.4 kJ mol⁻¹
- (C) –5.68 kJ mol⁻¹
- (D) –113.6 kJ mol⁻¹

Q19. Calculate the enthalpy of formation of ethene, C₂H₄, from these enthalpies of combustion: C = -393; H₂ = -286; C₂H₄ = -1411 kJ mol⁻¹.

- (A) -1358 kJ mol⁻¹
- (B) -53 kJ mol⁻¹
- (C) +53 kJ mol⁻¹
- (D) -731 kJ mol⁻¹

Q20. Use bond enthalpies to find the enthalpy change for N₂ + 3H₂ → 2NH₃. Bond enthalpies / kJ mol⁻¹: N≡N = 945; H-H = 436; N-H = 391.

- (A) -2346 kJ mol⁻¹
- (B) +93 kJ mol⁻¹
- (C) -2253 kJ mol⁻¹
- (D) -93 kJ mol⁻¹

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

- (A) NH₄NO₃(s) → N₂O(g) + 2H₂O(g)
- (B) 3O₂(g) → 2O₃(g)
- (C) CaCO₃(s) → CaO(s) + CO₂(g)
- (D) H₂O(s) → H₂O(l)

Q22. A reaction has ΔH = +120 kJ mol⁻¹ and ΔS = +300 J K⁻¹ mol⁻¹. Above what temperature is the reaction feasible?

- (A) 400 K
- (B) 200 K
- (C) 40 K
- (D) 4000 K

Q23. A reaction has ΔH = -50 kJ mol⁻¹ and ΔS = -100 J K⁻¹ mol⁻¹. What is ΔG at 298 K, and is the reaction feasible?

- (A) ΔG = -79.8 kJ mol⁻¹; feasible
- (B) ΔG = +20.2 kJ mol⁻¹; not feasible
- (C) ΔG = -20.2 kJ mol⁻¹; feasible
- (D) ΔG = 0; at equilibrium

Kinetics & Rate Equations

Q24. In the reaction between substances X and Y, doubling [X] quadruples the rate, while doubling [Y] has no effect on the rate. What are the orders of reaction?

- (A) First order in X and first order in Y
- (B) Second order in X and first order in Y
- (C) First order in X and zero order in Y
- (D) Second order in X and zero order in Y

Q25. For the rate equation rate = k[A]², the rate is 4.0 × 10⁻³ mol dm⁻³ s⁻¹ when [A] = 0.20 mol dm⁻³. What is the value of k?

- (A) 0.020 mol⁻¹ dm³ s⁻¹
- (B) 0.10 mol⁻¹ dm³ s⁻¹
- (C) 0.80 mol⁻¹ dm³ s⁻¹
- (D) 2.0 mol⁻¹ dm³ s⁻¹

Q26. According to the Arrhenius equation, $k = A e^{(-E_a/RT)}$. Why does k increase when the temperature rises?

- (A) The fraction of collisions with energy at least equal to E_a increases, so the term $e^{(-E_a/RT)}$ becomes larger
- (B) The activation energy decreases as the temperature rises
- (C) The pre-exponential factor A decreases as the temperature rises
- (D) The molecules collide less frequently at higher temperatures

Q27. Which observation is characteristic of a zero-order reaction?

- (A) The half-life is constant
- (B) The rate doubles when the concentration doubles
- (C) A plot of concentration against time is a straight line with a constant gradient
- (D) A plot of $\ln(\text{concentration})$ against time is a straight line

Q28. A catalyst is added to a reaction mixture. Which statement is correct?

- (A) The total area under the Maxwell-Boltzmann curve increases
- (B) The shape of the Maxwell-Boltzmann curve changes completely
- (C) The activation energy of the uncatalysed route increases
- (D) The Maxwell-Boltzmann curve is unchanged, but the activation energy is lower, so a larger proportion of molecules can react

Equilibria (K_c & K_p)

Q29. For the equilibrium $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the equilibrium concentrations are $[H_2] = 0.10$, $[I_2] = 0.10$ and $[HI] = 0.80 \text{ mol dm}^{-3}$. What is the value of K_c ?

- (A) 64
- (B) 8.0
- (C) 0.80
- (D) 640

Q30. What is the expression for K_p for the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$?

- (A) $K_p = p(NH_3) / (p(N_2) \times p(H_2))$
- (B) $K_p = p(N_2) \times p(H_2)^3 / p(NH_3)^2$
- (C) $K_p = p(NH_3)^2 / (p(N_2) \times p(H_2)^3)$
- (D) $K_p = p(NH_3)^2 / (p(N_2) \times p(H_2))$

Q31. 2.00 mol of gas A is placed in a 2.00 dm^3 container and the equilibrium $A(g) \rightleftharpoons B(g) + C(g)$ is established. At equilibrium, 1.20 mol of A remains. What is the value of K_c ?

- (A) $0.533 \text{ mol dm}^{-3}$
- (B) $0.267 \text{ mol dm}^{-3}$
- (C) 1.07 mol dm^{-3}
- (D) $0.800 \text{ mol dm}^{-3}$

Q32. What is the effect of increasing the total pressure on the value of K_p for a gas-phase equilibrium?

- (A) K_p increases
- (B) K_p decreases
- (C) K_p increases only if the forward reaction is exothermic
- (D) K_p is unchanged; only temperature changes the value of K_p

Q33. More of a product is added to a reversible reaction mixture at equilibrium, so the equilibrium position shifts to the left. What happens to the value of K_c ?

- (A) K_c is unchanged
- (B) K_c increases
- (C) K_c decreases
- (D) K_c falls to zero

Redox & Electrode Potentials

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

- (A) +4
- (B) +6
- (C) +2
- (D) 0

Q35. Calculate the EMF of an $\text{Fe}|\text{Fe}^{2+}(\text{aq})||\text{Cu}^{2+}(\text{aq})|\text{Cu}$ cell. $E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$; $E^\circ(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$.

- (A) +0.10 V
- (B) +0.78 V
- (C) -0.78 V
- (D) +1.56 V

Q36. $E^\circ(\text{Fe}^{3+}/\text{Fe}^{2+}) = +0.77 \text{ V}$. Which species can oxidise Fe^{2+} ions to Fe^{3+} ions?

- (A) $\text{Zn}(\text{s})$; $E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$
- (B) $\text{Cu}^{2+}(\text{aq})$; $E^\circ = +0.34 \text{ V}$
- (C) I_2 ; $E^\circ = +0.54 \text{ V}$
- (D) Acidified MnO_4^- ions; $E^\circ = +1.51 \text{ V}$

Q37. A current of 2.00 A is passed through molten aluminium oxide for 4825 s. What mass of aluminium is produced? ($F = 96500 \text{ C mol}^{-1}$; Ar of Al = 27.0)

- (A) 0.900 g
- (B) 2.70 g
- (C) 0.450 g
- (D) 27.0 g

Q38. In a hydrogen-oxygen fuel cell with an acidic electrolyte, what is the reaction at the negative electrode?

- (A) $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$
- (B) $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$
- (C) $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
- (D) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

Acids, Bases & Buffers

Q39. What is the pH of 0.00100 mol dm⁻³ sulfuric acid, assuming that both protons are fully ionised?

- (A) 3.00
- (B) 2.00
- (C) 3.30
- (D) 2.70

Q40. A weak acid has $K_a = 4.0 \times 10^{-4}$ mol dm⁻³. What is the pK_a of the acid?

- (A) 3.40
- (B) 4.40
- (C) 3.00
- (D) 10.60

Q41. A buffer solution is made from ethanoic acid and sodium ethanoate. What happens when a small amount of hydrochloric acid is added to the buffer?

- (A) The pH falls sharply to below 2
- (B) The added H⁺ ions react with ethanoate ions to form ethanoic acid, so the pH changes only slightly
- (C) The added H⁺ ions react with the ethanoic acid molecules
- (D) Nothing reacts; the added acid is simply diluted

Q42. 50.0 cm³ of 0.200 mol dm⁻³ hydrochloric acid is mixed with 25.0 cm³ of 0.200 mol dm⁻³ sodium hydroxide solution. What is the pH of the mixture?

- (A) 0.70
- (B) 1.48
- (C) 1.18
- (D) 2.00

Q43. At 50 °C, the value of K_w is larger than at 25 °C. Which statement is correct?

- (A) Water is no longer neutral at 50 °C
- (B) The pH of pure water at 50 °C is greater than 7
- (C) The concentration of H⁺ ions in pure water decreases at 50 °C
- (D) Pure water is still neutral, but its pH is less than 7 because [H⁺] = [OH⁻] is larger

Inorganic Chemistry

Q44. Which Group 2 hydroxide is the most soluble in water?

- (A) Barium hydroxide
- (B) Magnesium hydroxide
- (C) Calcium hydroxide
- (D) Strontium hydroxide

Q45. Which displacement reaction will occur?

- (A) $I_2 + 2KBr \rightarrow Br_2 + 2KI$
- (B) $Br_2 + 2KI \rightarrow I_2 + 2KBr$
- (C) $Cl_2 + 2NaF \rightarrow F_2 + 2NaCl$
- (D) $I_2 + 2KCl \rightarrow Cl_2 + 2KI$

Q46. $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ions are pink in aqueous solution. When concentrated hydrochloric acid is added, $[\text{CoCl}_4]^{2-}$ ions are formed. What is the colour change, and how does the coordination number change?

- (A) Pink to pink; 6 to 6
- (B) Pink to yellow; 6 to 4
- (C) Pink to blue; 6 to 4
- (D) Blue to pink; 4 to 6

Q47. Which reagent is used to test for sulfate ions in a solution?

- (A) Silver nitrate solution and nitric acid
- (B) Sodium hydroxide solution
- (C) Limewater
- (D) Barium chloride solution and hydrochloric acid

Q48. Which statement about transition metals is NOT correct?

- (A) They have low melting points compared with most other metals
- (B) They form coloured ions
- (C) They and their compounds can act as catalysts
- (D) They show variable oxidation states

Organic Chemistry I

Q49. Bromoethane reacts with potassium cyanide in ethanol. What is the product, and how does its carbon chain compare with that of bromoethane?

- (A) Ethanenitrile; the chain is the same length
- (B) Propanenitrile; the chain is one carbon longer
- (C) Propylamine; the chain is one carbon longer
- (D) Ethylamine; the chain is the same length

Q50. Propene reacts with steam in the presence of a phosphoric acid catalyst. What is the major product?

- (A) Propan-1-ol
- (B) Propanone
- (C) Propan-2-ol
- (D) Propanoic acid

Q51. Which of the following is a tertiary alcohol?

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

Q52. Ethanol is heated with concentrated sulfuric acid at 170 °C. What is the organic product?

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

Q53. Which step is a termination step in the free-radical substitution of methane by chlorine?

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

Q54. Which equation represents the incomplete combustion of methane?

- (A) $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- (B) $2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$
- (C) $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$
- (D) $\text{CH}_4 \rightarrow \text{C} + 2\text{H}_2$

Organic Chemistry II & Analysis

Q55. Ethanoyl chloride is added to ethanol. Which pair of products is formed?

- (A) Ethyl ethanoate and water
- (B) Ethanoic acid and chloroethane
- (C) Ethyl methanoate and hydrogen chloride
- (D) Ethyl ethanoate and hydrogen chloride

Q56. Which reagent will reduce ethanoic acid to ethanol?

- (A) NaBH_4 in methanol
- (B) LiAlH_4 in dry ether
- (C) Acidified potassium dichromate(VI)
- (D) Fehling's solution

Q57. In the paper chromatography of a mixture of amino acids, the colourless amino acids are located on the chromatogram by...

- (A) Viewing the paper under ultraviolet light only
- (B) Measuring the melting points of the spots
- (C) Spraying with ninhydrin, which produces purple spots
- (D) Adding Fehling's solution to the paper

Q58. Nylon-6,6 is a polyamide made by condensation polymerisation. Which pair of monomers is used to make it?

- (A) Ethene and ethene
- (B) Hexane-1,6-diamine and hexanedioyl dichloride
- (C) Ethane-1,2-diol and benzene-1,4-dicarboxylic acid
- (D) Two different amino acids

Q59. How many different proton (hydrogen) environments are there in ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, as shown by its ^1H NMR spectrum?

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

Q60. In a chromatography experiment, a spot moves 4.5 cm from the baseline and the solvent front moves 9.0 cm. What is the R_f value of the substance?

- (A) 2.0
- (B) 0.25
- (C) 0.50
- (D) 4.5

Answer Key

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

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