

A-Level Chemistry Practice Test 9

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 boron contains 19.9% of the isotope ^{10}B and 80.1% of the isotope ^{11}B . What is the relative atomic mass of boron in this sample?

- (A) 10.20
- (B) 10.50
- (C) 10.80
- (D) 11.00

Q2. The first ionisation energies of magnesium and aluminium are 738 and 578 kJ mol^{-1} respectively. Which statement explains why aluminium has the lower value?

- (A) Aluminium atoms have fewer protons than magnesium atoms
- (B) The outer electron in aluminium is in a 3p orbital, which is higher in energy than the 3s orbital in magnesium
- (C) Aluminium has one more electron shell than magnesium
- (D) The electron removed from aluminium is paired, so it is repelled by its partner

Q3. How many unpaired electrons are there in an Fe^{3+} ion?

- (A) 3
- (B) 4
- (C) 6
- (D) 5

Q4. Which statement about atomic radius across Period 3, from sodium to argon, is correct?

- (A) It decreases, because nuclear charge increases while shielding stays similar, so the electrons are pulled closer to the nucleus
- (B) It increases, because the number of electron shells increases
- (C) It increases, because repulsion between the extra electrons pushes them further apart
- (D) It stays the same, because electrons are added to the same shell

Q5. The successive ionisation energies of an element, X, show a very large increase between the third and fourth ionisation energies. In which group of the Periodic Table is X?

- (A) Group 2
- (B) Group 13
- (C) Group 14
- (D) Group 16

Amount of Substance

Q6. A sample of 0.0250 mol of a gas occupies 600 cm³ at a pressure of 100 kPa. What is the temperature of the gas? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 273 K
- (B) 289 K
- (C) 301 K
- (D) 315 K

Q7. 25.0 cm³ of 0.120 mol dm⁻³ sodium hydroxide solution reacts exactly with 20.0 cm³ of dilute sulfuric acid. What is the concentration of the acid?

- (A) 0.150 mol dm⁻³
- (B) 0.0600 mol dm⁻³
- (C) 0.300 mol dm⁻³
- (D) 0.0750 mol dm⁻³

Q8. 2.30 g of ethanol ($M_r = 46.0$) is dehydrated to form ethene ($M_r = 28.0$). The mass of ethene obtained is 1.12 g. What is the percentage yield?

- (A) 48.7%
- (B) 68.6%
- (C) 80.0%
- (D) 87.5%

Q9. Titanium is made by the reaction $\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$. What is the atom economy for the production of titanium? (M_r : $\text{TiCl}_4 = 189.7$, $\text{Mg} = 24.3$, $\text{Ti} = 47.9$)

- (A) 20.1%
- (B) 25.3%
- (C) 50.2%
- (D) 79.9%

Q10. A compound contains 40.0% carbon, 6.67% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

- (A) CH_2O
- (B) CHO
- (C) $\text{C}_2\text{H}_4\text{O}_2$
- (D) CH_3O

Q11. A solution of sodium sulfate is fully dissociated into ions. How many ions are present in a solution containing 0.500 mol of Na_2SO_4 ?

- (A) 3.01×10^{23}
- (B) 6.02×10^{23}
- (C) 9.03×10^{23}
- (D) 1.20×10^{24}

Bonding & Structure

Q12. What are the shape and the H-N-H bond angle in an ammonia molecule?

- (A) Trigonal planar, 120°
- (B) Tetrahedral, 109.5°
- (C) Trigonal pyramidal, 104.5°
- (D) Trigonal pyramidal, 107°

Q13. Water ($M_r = 18$) boils at $100\text{ }^\circ\text{C}$, but hydrogen sulfide ($M_r = 34$) boils at $-60\text{ }^\circ\text{C}$. The main reason for this difference is that

- (A) water molecules form hydrogen bonds, but H_2S molecules do not
- (B) the covalent bonds inside water molecules are stronger than those in H_2S
- (C) H_2S molecules have stronger van der Waals forces than water molecules
- (D) water contains ionic bonds between its molecules

Q14. For sodium chloride, $\Delta H_f = -411\text{ kJ mol}^{-1}$. The enthalpy of atomisation of Na is $+107\text{ kJ mol}^{-1}$, the first ionisation energy of Na is $+496\text{ kJ mol}^{-1}$, the bond enthalpy term for $\frac{1}{2}\text{Cl}_2$ is $+121\text{ kJ mol}^{-1}$ and the electron affinity of Cl is -349 kJ mol^{-1} . What is the lattice enthalpy of formation of NaCl?

- (A) -387 kJ mol^{-1}
- (B) -611 kJ mol^{-1}
- (C) -786 kJ mol^{-1}
- (D) -1135 kJ mol^{-1}

Q15. Which molecule is linear?

- (A) H_2S
- (B) CO_2
- (C) SO_2
- (D) OF_2

Q16. Which molecule has a permanent dipole?

- (A) CO_2
- (B) CCl_4
- (C) BF_3
- (D) CH_3Cl

Q17. Graphite conducts electricity because

- (A) it has delocalised electrons within its layers that are free to move along them
- (B) it contains mobile ions in its structure
- (C) the carbon atoms are free to move through the lattice
- (D) it has weak forces between its layers that carry charge

Energetics & Thermodynamics

Q18. 50.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid is neutralised by 50.0 cm^3 of 1.00 mol dm^{-3} sodium hydroxide. The temperature rises by 6.8 K . What is the enthalpy of neutralisation? ($c = 4.18\text{ J g}^{-1}\text{ K}^{-1}$; assume the total mass of solution is 100 g)

- (A) -28.4 kJ mol^{-1}
- (B) -56.8 kJ mol^{-1}
- (C) -62.7 kJ mol^{-1}
- (D) $-113.6\text{ kJ mol}^{-1}$

Q19. The enthalpies of combustion are: $\text{C} = -394\text{ kJ mol}^{-1}$, $\text{H}_2 = -286\text{ kJ mol}^{-1}$ and $\text{CH}_3\text{OH(l)} = -726\text{ kJ mol}^{-1}$. What is the enthalpy of formation of methanol?

- (A) -106 kJ mol^{-1}
- (B) -136 kJ mol^{-1}
- (C) -332 kJ mol^{-1}
- (D) -240 kJ mol^{-1}

Q20. In which process is the entropy change of the system positive?

- (A) $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- (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) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

Q21. A reaction has $\Delta H = -110 \text{ kJ mol}^{-1}$ and $\Delta S = -140 \text{ J K}^{-1} \text{ mol}^{-1}$. At what temperature is $\Delta G = 0$ for this reaction?

- (A) 786 K
- (B) 127 K
- (C) 273 K
- (D) 1064 K

Q22. Using mean bond enthalpies ($\text{C-H} = 412$, $\text{O=O} = 498$, $\text{C=O} = 805$, $\text{O-H} = 463 \text{ kJ mol}^{-1}$), what is the enthalpy change for $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$?

- (A) -664 kJ mol^{-1}
- (B) -818 kJ mol^{-1}
- (C) $+818 \text{ kJ mol}^{-1}$
- (D) -890 kJ mol^{-1}

Q23. For a reaction, $\Delta H = +50.0 \text{ kJ mol}^{-1}$ and $\Delta S = +200 \text{ J K}^{-1} \text{ mol}^{-1}$. What is the value of ΔG at 298 K?

- (A) $+9.6 \text{ kJ mol}^{-1}$
- (B) $-59.6 \text{ kJ mol}^{-1}$
- (C) $+109.6 \text{ kJ mol}^{-1}$
- (D) -9.6 kJ mol^{-1}

Kinetics & Rate Equations

Q24. A reaction has the rate equation $\text{rate} = k[\text{A}][\text{B}]^2$. When $[\text{A}] = 0.100 \text{ mol dm}^{-3}$ and $[\text{B}] = 0.200 \text{ mol dm}^{-3}$, the rate is $4.00 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$. What is the value and unit of k ?

- (A) $1.00 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (B) $0.200 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$
- (C) $1.00 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$
- (D) $4.00 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$

Q25. Initial rates were measured for a reaction between X and Y: $[\text{X}] = 0.10$, $[\text{Y}] = 0.10$, $\text{rate} = 2.0 \times 10^{-3}$; $[\text{X}] = 0.20$, $[\text{Y}] = 0.10$, $\text{rate} = 8.0 \times 10^{-3}$; $[\text{X}] = 0.10$, $[\text{Y}] = 0.20$, $\text{rate} = 2.0 \times 10^{-3}$ (concentrations in mol dm^{-3} , rates in $\text{mol dm}^{-3} \text{ s}^{-1}$). What is the rate equation?

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

Q26. The rate of a reaction doubles when the temperature is increased from 300 K to 310 K. Estimate the activation energy of the reaction. ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 5.4 kJ mol^{-1}
- (B) 53.6 kJ mol^{-1}
- (C) 107 kJ mol^{-1}
- (D) 536 kJ mol^{-1}

Q27. A first-order reaction has a rate constant of 0.0693 s^{-1} . What is its half-life?

- (A) 2.5 s
- (B) 5.0 s
- (C) 20 s
- (D) 10 s

Q28. The reaction $\text{NO}_2 + \text{CO} \rightarrow \text{NO} + \text{CO}_2$ is proposed to occur by this mechanism: Step 1 (slow): $2\text{NO}_2 \rightarrow \text{NO}_3 + \text{NO}$; Step 2 (fast): $\text{NO}_3 + \text{CO} \rightarrow \text{NO}_2 + \text{CO}_2$. What is the rate equation for the reaction?

- (A) $\text{rate} = k[\text{NO}_2][\text{CO}]$
- (B) $\text{rate} = k[\text{NO}_3][\text{CO}]$
- (C) $\text{rate} = k[\text{NO}_2]^2$
- (D) $\text{rate} = k[\text{NO}_2]$

Equilibria (K_c & K_p)

Q29. At equilibrium for the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, the concentrations are $[\text{N}_2] = 0.100 \text{ mol dm}^{-3}$, $[\text{H}_2] = 0.300 \text{ mol dm}^{-3}$ and $[\text{NH}_3] = 0.400 \text{ mol dm}^{-3}$. What is the value of K_c ?

- (A) $5.93 \text{ mol}^{-2} \text{ dm}^6$
- (B) $59.3 \text{ mol}^{-2} \text{ dm}^6$
- (C) $0.0169 \text{ mol}^2 \text{ dm}^{-6}$
- (D) $148 \text{ mol}^{-2} \text{ dm}^6$

Q30. 1.00 mol of ethanoic acid and 1.00 mol of ethanol are mixed and reach equilibrium: $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$. $K_c = 4.00$. How many moles of the ester are present at equilibrium?

- (A) 0.667 mol
- (B) 0.500 mol
- (C) 0.800 mol
- (D) 0.250 mol

Q31. For the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, a sample of N_2O_4 is 20.0% dissociated at a total pressure of 100 kPa. What is the value of K_p ?

- (A) 4.17 kPa
- (B) 8.33 kPa
- (C) 16.7 kPa
- (D) 33.3 kPa

Q32. For the equilibrium $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$, what is the correct expression for K_c ?

- (A) $K_c = [\text{CO}_2]$
- (B) $K_c = [\text{CaO}][\text{CO}_2] / [\text{CaCO}_3]$
- (C) $K_c = 1 / [\text{CO}_2]$
- (D) $K_c = [\text{CO}_2] / [\text{CaCO}_3]$

Q33. The forward reaction in a reversible reaction at equilibrium is exothermic. Which change occurs when the temperature is increased?

- (A) K_c increases and more product is formed
- (B) K_c is unchanged but the rate increases
- (C) The equilibrium shifts to the right
- (D) K_c decreases and the equilibrium shifts to the left

Redox & Electrode Potentials

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

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

Q35. The standard electrode potentials are $E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$ and $E^\circ(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$. What is the standard EMF of the cell $\text{Zn}(\text{s})|\text{Zn}^{2+}(\text{aq})||\text{Cu}^{2+}(\text{aq})|\text{Cu}(\text{s})$?

- (A) +0.42 V
- (B) -1.10 V
- (C) +1.10 V
- (D) +0.76 V

Q36. The standard electrode potentials are $E^\circ(\text{Cl}_2/\text{Cl}^-) = +1.36 \text{ V}$, $E^\circ(\text{Br}_2/\text{Br}^-) = +1.09 \text{ V}$, $E^\circ(\text{Fe}^{3+}/\text{Fe}^{2+}) = +0.77 \text{ V}$ and $E^\circ(\text{I}_2/\text{I}^-) = +0.54 \text{ V}$. Which halogen cannot oxidise Fe^{2+} ions to Fe^{3+} ions?

- (A) Iodine
- (B) Chlorine
- (C) Bromine
- (D) Fluorine

Q37. Given $E^\circ(\text{Fe}^{3+}/\text{Fe}^{2+}) = +0.77 \text{ V}$ and $E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$, what is the value of $E^\circ(\text{Fe}^{3+}/\text{Fe})$?

- (A) +0.33 V
- (B) +0.11 V
- (C) -0.11 V
- (D) -0.04 V

Q38. A current of 5.00 A is passed through aqueous copper(II) sulfate using inert electrodes. How long is needed to deposit 0.500 mol of copper? ($F = 96500 \text{ C mol}^{-1}$)

- (A) 9650 s
- (B) 19300 s
- (C) 38600 s
- (D) 48250 s

Acids, Bases & Buffers

Q39. Assuming both protons of sulfuric acid are fully ionised in dilute solution, what is the pH of $0.0250 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$?

- (A) 1.30
- (B) 1.60
- (C) 2.30
- (D) 0.30

Q40. The acid dissociation constant of ethanoic acid is $K_a = 1.74 \times 10^{-5} \text{ mol dm}^{-3}$. What is the pH of a $0.100 \text{ mol dm}^{-3}$ solution of ethanoic acid?

- (A) 1.00
- (B) 3.76
- (C) 4.76
- (D) 2.88

Q41. At 50°C , $K_w = 5.48 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$. What is the pH of pure water at 50°C ?

- (A) 7.00
- (B) 6.63
- (C) 6.13
- (D) 7.37

Q42. A buffer solution is made by dissolving 0.200 mol of ethanoic acid and 0.300 mol of sodium ethanoate in water to give 1.00 dm^3 of solution. K_a for ethanoic acid is $1.74 \times 10^{-5} \text{ mol dm}^{-3}$. What is the pH of the buffer?

- (A) 4.58
- (B) 4.76
- (C) 4.94
- (D) 5.12

Q43. 25.0 cm^3 of $0.100 \text{ mol dm}^{-3}$ ammonia solution is titrated with $0.100 \text{ mol dm}^{-3}$ hydrochloric acid. At the equivalence point the total volume is 50.0 cm^3 . K_b for NH_3 is $1.80 \times 10^{-5} \text{ mol dm}^{-3}$. What is the pH at the equivalence point?

- (A) 5.28
- (B) 7.00
- (C) 8.72
- (D) 3.28

Inorganic Chemistry

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

- (A) Reactivity with water decreases down the group
- (B) The solubility of the sulfates increases down the group
- (C) The thermal stability of the carbonates decreases down the group
- (D) The solubility of the hydroxides increases down the group

Q45. Silver nitrate solution is added to separate solutions of chloride, bromide and iodide ions. Which precipitate dissolves in dilute aqueous ammonia?

- (A) AgBr (cream)
- (B) AgCl (white)
- (C) AgI (yellow)
- (D) All three dissolve

Q46. Which complex ion has a coordination number of 6 and a metal oxidation state of +3?

- (A) $[\text{CuCl}_4]^{2-}$
- (B) $[\text{Ag}(\text{NH}_3)_2]^+$
- (C) $[\text{Fe}(\text{CN})_6]^{3-}$
- (D) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$

Q47. Excess sodium hydroxide solution is added to a solution containing Al^{3+} ions. What is observed?

- (A) A brown precipitate forms
- (B) A blue precipitate forms and then dissolves
- (C) A white precipitate forms and stays undissolved
- (D) A white precipitate forms and then dissolves in the excess alkali

Q48. Chlorine reacts with cold, dilute sodium hydroxide to form sodium chloride, sodium chlorate(I) and water. In this reaction, chlorine

- (A) is both oxidised and reduced
- (B) is only oxidised
- (C) is only reduced
- (D) acts as a catalyst

Organic Chemistry I

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

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

Q50. Which halogenoalkane is hydrolysed most rapidly by aqueous sodium hydroxide?

- (A) 1-chlorobutane
- (B) 1-bromobutane
- (C) 1-iodobutane
- (D) 1-fluorobutane

Q51. 1-bromopropane is heated with ethanolic potassium hydroxide. What is the main organic product?

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

Q52. Propene reacts with hydrogen bromide in the absence of peroxides. What is the main product?

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

Q53. Propan-1-ol is oxidised with acidified potassium dichromate(VI), and the organic product is distilled off as it forms. What is the product?

- (A) Propanoic acid
- (B) Propene
- (C) Propanal
- (D) Carbon dioxide and water

Q54. Which alkene shows E-Z isomerism?

- (A) But-1-ene
- (B) But-2-ene
- (C) 2-methylpropene
- (D) Propene

Organic Chemistry II & Analysis

Q55. Which reagent can be used to distinguish between propanal and propanone because it forms a silver mirror with one of them?

- (A) Fehling's solution
- (B) Acidified potassium dichromate(VI)
- (C) 2,4-dinitrophenylhydrazine
- (D) Tollens' reagent

Q56. Ethanoyl chloride reacts with ethanol. What are the products?

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

Q57. Benzene is converted into nitrobenzene using

- (A) dilute nitric acid at room temperature
- (B) concentrated nitric acid with an iron catalyst
- (C) concentrated nitric acid and concentrated sulfuric acid at about 50 °C
- (D) concentrated nitric acid with aluminium chloride as catalyst

Q58. Which of these nitrogen compounds is the strongest base?

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

Q59. How many signals are there in the proton NMR spectrum of propanal, CH₃CH₂CHO?

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

Q60. A compound shows a very broad absorption between 2500 and 3300 cm⁻¹ in its infra-red spectrum. Which functional group does this indicate?

- (A) C=O in a ketone
- (B) N-H in an amine
- (C) O-H in a carboxylic acid
- (D) C-H in an alkane

Answer Key

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

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