A-Level Chemistry Practice Test 5

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 20.0% of the isotope ^10B and 80.0% of the isotope ^11B. What is the relative atomic mass of this sample of boron?

(A) 10.2
(B) 10.5
(C) 10.8
(D) 11.0

Q2. The successive ionisation energies of an element X are 590, 1145, 4912 and 6474 kJ mol^-1. In which group of the Periodic Table is X?

(A) Group 2
(B) Group 1
(C) Group 13
(D) Group 14

Q3. What is the electronic configuration of an Fe^3+ ion? (Fe has atomic number 26.)

(A) [Ar] 4s^2 3d^3
(B) [Ar] 4s^1 3d^4
(C) [Ar] 3d^6
(D) [Ar] 3d^5

Q4. Which statement correctly describes the trend in atomic radius from sodium to chlorine across Period 3?

(A) It increases because more electrons are added to the same shell.
(B) It decreases because the nuclear charge increases while shielding is similar, so the electrons are pulled closer to the nucleus.
(C) It stays the same because all the atoms have the same number of shells.
(D) It decreases because the atoms lose electrons to form ions.

Q5. How many electrons are there in a ^35Cl^- ion?

(A) 18
(B) 16
(C) 17
(D) 34

Amount of Substance

Q6. What volume is occupied by 0.200 mol of an ideal gas at a pressure of 100 kPa and a temperature of 300 K? (R = 8.31 J K^-1 mol^-1)

(A) 2.49 dm^3
(B) 4.99 dm^3
(C) 6.23 dm^3
(D) 49.9 dm^3

Q7. A 25.0 cm^3 sample of 0.100 mol dm^-3 sodium hydroxide solution is exactly neutralised by 20.0 cm^3 of sulfuric acid. What is the concentration of the sulfuric acid?

(A) 0.125 mol dm^-3
(B) 0.0800 mol dm^-3
(C) 0.0313 mol dm^-3
(D) 0.0625 mol dm^-3

Q8. In a preparation, the theoretical yield of a product is 8.40 g but only 6.30 g is obtained. What is the percentage yield?

(A) 25.0%
(B) 33.3%
(C) 75.0%
(D) 80.0%

Q9. A compound contains 40.0% carbon, 6.67% hydrogen and 53.3% oxygen by mass. What is its empirical formula?

(A) CH2O
(B) C2H4O2
(C) CHO
(D) CH4O

Q10. Methane burns in oxygen: CH4 + 2O2 → CO2 + 2H2O. Carbon dioxide is the required product. What is the atom economy of this reaction? (Mr: CH4 = 16.0, O2 = 32.0, CO2 = 44.0)

(A) 36.0%
(B) 44.0%
(C) 80.0%
(D) 55.0%

Q11. A solution is made by dissolving 5.85 g of sodium chloride (Mr = 58.5) in water and making the volume up to 250 cm^3. What is the concentration of the solution?

(A) 0.100 mol dm^-3
(B) 0.400 mol dm^-3
(C) 0.0250 mol dm^-3
(D) 4.00 mol dm^-3

Bonding & Structure

Q12. What is the shape of an ammonia molecule and its H-N-H bond angle?

(A) Trigonal pyramidal, 107°
(B) Tetrahedral, 109.5°
(C) Trigonal planar, 120°
(D) Trigonal pyramidal, 90°

Q13. Use these data to calculate the lattice formation enthalpy of sodium chloride: enthalpy of atomisation of Na = +107 kJ mol^-1; first ionisation energy of Na = +496 kJ mol^-1; enthalpy of atomisation of chlorine (1/2 Cl2 → Cl) = +121 kJ mol^-1; first electron affinity of Cl = −349 kJ mol^-1; enthalpy of formation of NaCl = −411 kJ mol^-1.

(A) −375 kJ mol^-1
(B) −411 kJ mol^-1
(C) −786 kJ mol^-1
(D) −624 kJ mol^-1

Q14. Hydrogen fluoride has a much higher boiling point than hydrogen chloride. What is the main reason for this?

(A) The H-F covalent bond is stronger than the H-Cl bond.
(B) There are hydrogen bonds between HF molecules.
(C) HF molecules have more electrons than HCl molecules.
(D) Fluorine atoms form ionic bonds with hydrogen.

Q15. Which molecule is polar overall?

(A) CO2
(B) CCl4
(C) BF3
(D) CH3Cl

Q16. Which statement best explains why metals are malleable?

(A) Layers of positive ions can slide over each other while the delocalised electrons hold the structure together.
(B) The covalent bonds between metal atoms can break and reform easily.
(C) The atoms in a metal are held together by weak van der Waals forces.
(D) Metals contain layers of molecules that slide over each other.

Q17. Which compound would be expected to have the most exothermic lattice enthalpy?

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

Energetics & Thermodynamics

Q18. When 0.0500 mol of a fuel is burned, the energy released heats 50.0 g of water by 12.5 K. What is the enthalpy change of combustion of the fuel? (c = 4.18 J g^-1 K^-1)

(A) −26.1 kJ mol^-1
(B) −261 kJ mol^-1
(C) −5.23 kJ mol^-1
(D) −52.3 kJ mol^-1

Q19. Use these standard enthalpies of formation (kJ mol^-1): CO2 = −394; H2O = −286; CH4 = −75. What is the enthalpy change for the reaction CH4 + 2O2 → CO2 + 2H2O?

(A) −75 kJ mol^-1
(B) −891 kJ mol^-1
(C) −966 kJ mol^-1
(D) −605 kJ mol^-1

Q20. Which reaction is accompanied by an increase in entropy?

(A) CaCO3(s) → CaO(s) + CO2(g)
(B) H2O(l) → H2O(s)
(C) NH3(g) + HCl(g) → NH4Cl(s)
(D) 2H2(g) + O2(g) → 2H2O(l)

Q21. A reaction has ΔH = −100 kJ mol^-1 and ΔS = −200 J K^-1 mol^-1. At what temperature is ΔG = 0 for this reaction?

(A) 200 K
(B) 400 K
(C) 500 K
(D) 1000 K

Q22. Use these bond enthalpies (kJ mol^-1): H-H = 436; Cl-Cl = 242; H-Cl = 431. What is the enthalpy change for the reaction H2(g) + Cl2(g) → 2HCl(g)?

(A) +184 kJ mol^-1
(B) −184 kJ mol^-1
(C) −431 kJ mol^-1
(D) −92 kJ mol^-1

Q23. A reaction has ΔH = +50 kJ mol^-1 and ΔS = +200 J K^-1 mol^-1. Which statement about the feasibility of this reaction is correct?

(A) It is never feasible.
(B) It is feasible only at temperatures below 250 K.
(C) It is feasible at all temperatures.
(D) It becomes feasible at temperatures above 250 K.

Kinetics & Rate Equations

Q24. For a reaction between A and B, doubling the concentration of A doubles the rate, and doubling the concentration of B quadruples the rate. What is the rate equation?

(A) rate = k[A][B]
(B) rate = k[A]^2[B]
(C) rate = k[A][B]^2
(D) rate = k[A]^2[B]^2

Q25. A reaction is second order overall. What are the units of its rate constant, k?

(A) mol^-1 dm^3 s^-1
(B) s^-1
(C) mol dm^-3 s^-1
(D) mol^-2 dm^6 s^-1

Q26. A reaction has an activation energy of 50.0 kJ mol^-1. By what factor does the rate constant increase when the temperature rises from 300 K to 310 K? (R = 8.31 J K^-1 mol^-1)

(A) 1.1
(B) 10
(C) 1.5
(D) 1.9

Q27. In experiments on the reaction X + Y → products, the results were: [X] = 0.10, [Y] = 0.10, rate = 0.020; [X] = 0.20, [Y] = 0.10, rate = 0.040; [X] = 0.10, [Y] = 0.20, rate = 0.160 (concentrations in mol dm^-3, rates in mol dm^-3 s^-1). What is the value of the rate constant, k?

(A) 0.20 mol^-2 dm^6 s^-1
(B) 20 mol^-2 dm^6 s^-1
(C) 2.0 mol^-2 dm^6 s^-1
(D) 200 mol^-2 dm^6 s^-1

Q28. A reaction proceeds by this mechanism: NO2 + NO2 → NO3 + NO (slow); NO3 + CO → NO2 + CO2 (fast). What is the rate equation for the overall reaction?

(A) rate = k[NO2][CO]
(B) rate = k[NO3][CO]
(C) rate = k[NO2]^2
(D) rate = k[NO2][NO3]

Equilibria (Kc & Kp)

Q29. The equilibrium N2O4(g) ⇌ 2NO2(g) is set up starting with N2O4 at a concentration of 1.00 mol dm^-3. At equilibrium the concentration of N2O4 is 0.80 mol dm^-3. What is the value of Kc?

(A) 0.20 mol dm^-3
(B) 0.25 mol dm^-3
(C) 0.50 mol dm^-3
(D) 5.0 mol dm^-3

Q30. For the equilibrium N2(g) + 3H2(g) ⇌ 2NH3(g), which expression is correct for Kp?

(A) Kp = pNH3/(pN2 × pH2)
(B) Kp = (pN2 × pH2^3)/pNH3^2
(C) Kp = pNH3^2/(pN2 × pH2)
(D) Kp = pNH3^2/(pN2 × pH2^3)

Q31. In the Haber process the pressure is increased while the temperature is kept constant. What happens to the value of Kp and to the equilibrium yield of ammonia?

(A) Kp increases and the yield increases.
(B) Kp is unchanged and the yield increases.
(C) Kp is unchanged and the yield decreases.
(D) Kp decreases and the yield decreases.

Q32. For the equilibrium 2SO2(g) + O2(g) ⇌ 2SO3(g), what are the units of Kc?

(A) mol dm^-3
(B) No units
(C) dm^3 mol^-1
(D) mol^2 dm^-6

Q33. An equilibrium mixture for N2(g) + 3H2(g) ⇌ 2NH3(g), at a total pressure of 200 kPa, has mole fractions of 0.20 N2, 0.60 H2 and 0.20 NH3. What is the value of Kp?

(A) 2.31 × 10^-5 kPa^-2
(B) 2.31 × 10^-2 kPa^-2
(C) 4.32 × 10^4 kPa^2
(D) 0.0231 kPa^-2

Redox & Electrode Potentials

Q34. What is the oxidation state of chromium in K2Cr2O7?

(A) +3
(B) +2
(C) +7
(D) +6

Q35. Standard electrode potentials: Zn^2+(aq)/Zn(s) = −0.76 V and Cu^2+(aq)/Cu(s) = +0.34 V. What is the EMF of a cell made from these two half-cells?

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

Q36. Standard electrode potentials: Cl2/Cl^- = +1.36 V; Br2/Br^- = +1.07 V; I2/I^- = +0.54 V. Which is the strongest oxidising agent?

(A) Br2
(B) I2
(C) Cl2
(D) Cl^-

Q37. A current of 2.00 A is passed through aqueous copper(II) sulfate for 30.0 minutes using inert electrodes. What mass of copper is deposited at the cathode? (Cu^2+ + 2e^- → Cu; Mr of Cu = 63.5; F = 96500 C mol^-1)

(A) 1.18 g
(B) 2.37 g
(C) 0.59 g
(D) 4.74 g

Q38. Which of the following is NOT one of the standard conditions used when measuring a standard electrode potential?

(A) A temperature of 298 K
(B) A pressure of 100 kPa for any gases involved
(C) Solutions of concentration 1.00 mol dm^-3
(D) A current of 1.00 A flowing in the circuit

Acids, Bases & Buffers

Q39. What is the pH of 0.0200 mol dm^-3 hydrochloric acid?

(A) 1.00
(B) 1.70
(C) 2.00
(D) 1.30

Q40. A 0.100 mol dm^-3 solution of a weak acid HA has a pH of 3.00. What is the value of Ka for this acid?

(A) 1.0 × 10^-3 mol dm^-3
(B) 1.0 × 10^-6 mol dm^-3
(C) 1.0 × 10^-5 mol dm^-3
(D) 1.0 × 10^-4 mol dm^-3

Q41. A buffer solution contains equal concentrations of ethanoic acid (Ka = 1.8 × 10^-5 mol dm^-3) and sodium ethanoate. What is the pH of this buffer?

(A) 4.74
(B) 4.44
(C) 5.04
(D) 7.00

Q42. What is the pH of 0.0100 mol dm^-3 sodium hydroxide solution at 298 K? (Kw = 1.00 × 10^-14 mol^2 dm^-6)

(A) 2.00
(B) 11.00
(C) 13.00
(D) 12.00

Q43. A buffer is prepared at the half-neutralisation point of a weak acid with Ka = 1.6 × 10^-5 mol dm^-3. What is the pH of this buffer?

(A) 4.20
(B) 4.80
(C) 5.40
(D) 7.00

Inorganic Chemistry

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

(A) They become more soluble down the group.
(B) Magnesium sulfate is the least soluble.
(C) They become less soluble down the group.
(D) They are all equally soluble.

Q45. What are the products when chlorine is passed into cold, dilute sodium hydroxide solution?

(A) NaCl and NaClO
(B) NaCl and NaClO3
(C) NaClO3 and H2O only
(D) NaCl and H2

Q46. Which aqueous ion is colourless?

(A) [Fe(H2O)6]^3+
(B) [Cu(H2O)6]^2+
(C) Cr2O7^2-
(D) [Zn(H2O)6]^2+

Q47. A solution containing Fe^2+ ions is treated with sodium hydroxide solution. What is observed?

(A) A red-brown precipitate
(B) A green precipitate
(C) A blue precipitate
(D) A white precipitate that redissolves in excess alkali

Q48. Concentrated hydrochloric acid is added to a blue solution containing [Cu(H2O)6]^2+ ions. What colour does the solution become?

(A) It stays blue.
(B) Colourless
(C) Yellow (often appearing yellow-green)
(D) Pink

Organic Chemistry I

Q49. In the chlorination of methane, which step is the initiation step?

(A) Cl2 → 2Cl•
(B) Cl2 → Cl^+ + Cl^-
(C) Cl• + CH4 → CH3• + HCl
(D) CH3• + Cl2 → CH3Cl + Cl•

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

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

Q51. What is the major product when hydrogen bromide reacts with propene?

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

Q52. Propan-1-ol is heated under reflux with an excess of acidified potassium dichromate(VI). What is the main organic product?

(A) Propene
(B) Propanone
(C) Propanoic acid
(D) Propanal

Q53. Which alkene can exist as E/Z isomers?

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

Q54. Ethene is prepared from bromoethane by elimination. Which conditions are used?

(A) Aqueous KOH, warm
(B) Aqueous silver nitrate, warm
(C) Ammonia in ethanol, sealed tube
(D) Ethanolic KOH, heated

Organic Chemistry II & Analysis

Q55. Which compound gives a silver mirror when warmed with Tollens' reagent?

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

Q56. What are the products when ethyl ethanoate is heated with aqueous sodium hydroxide?

(A) Ethanoic acid and ethanol
(B) Sodium ethanoate and water
(C) Sodium ethanoate and ethanol
(D) Ethanoic acid and sodium ethanoate

Q57. Benzene is nitrated using concentrated nitric acid and concentrated sulfuric acid at about 50°C. What is the electrophile in this reaction?

(A) NO2^+
(B) NO2^-
(C) HNO3
(D) NO^+

Q58. Which of these compounds is the strongest base?

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

Q59. How many different proton (hydrogen) environments are there in a molecule of ethanol, CH3CH2OH?

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

Q60. Which statement about amino acids in the solid state is correct?

(A) They exist as neutral molecules with separate NH2 and COOH groups.
(B) They exist as anions.
(C) They exist as zwitterions with both NH3^+ and COO^- groups.
(D) They exist as cations.

Answer Key

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

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