

A-Level Chemistry Practice Test 20

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. Boron has two isotopes, ^{10}B with an abundance of 20% and ^{11}B with an abundance of 80%. What is the relative atomic mass of boron?

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

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

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

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

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

Q4. Which oxide is amphoteric?

- (A) Na_2O
- (B) Al_2O_3
- (C) SO_2
- (D) MgO

Q5. The first ionisation energy of magnesium is greater than that of sodium. This is mainly because, in magnesium...

- (A) there is one more electron shell
- (B) the atoms are larger
- (C) the electron is removed from a different subshell
- (D) the nuclear charge is greater and the atomic radius is smaller, while shielding is similar

Amount of Substance

Q6. How many molecules are there in 0.500 mol of a substance? (Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$)

- (A) 3.01×10^{23}
- (B) 6.02×10^{23}
- (C) 1.20×10^{24}
- (D) 3.01×10^{22}

Q7. A 2.00 g sample of a gas occupies a volume of 1.24 dm^3 at a pressure of 100 kPa and a temperature of 300 K. What is the relative molecular mass of the gas? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 20
- (B) 32
- (C) 40
- (D) 44

Q8. A 25.0 cm^3 sample of sulfuric acid was exactly neutralised by 25.0 cm^3 of $0.200 \text{ mol dm}^{-3}$ sodium hydroxide solution. What is the concentration of the sulfuric acid?

- (A) $0.0500 \text{ mol dm}^{-3}$
- (B) $0.100 \text{ mol dm}^{-3}$
- (C) $0.200 \text{ mol dm}^{-3}$
- (D) $0.400 \text{ mol dm}^{-3}$

Q9. The theoretical yield of a reaction is 5.00 g and the actual yield obtained is 4.60 g. What is the percentage yield?

- (A) 8.0%
- (B) 46%
- (C) 109%
- (D) 92%

Q10. A 25.0 cm^3 portion of a 2.00 mol dm^{-3} solution is diluted with water to a total volume of 250 cm^3 . What is the concentration of the diluted solution?

- (A) $0.200 \text{ mol dm}^{-3}$
- (B) $0.0200 \text{ mol dm}^{-3}$
- (C) 2.00 mol dm^{-3}
- (D) $0.500 \text{ mol dm}^{-3}$

Q11. Hydrated copper(II) sulfate has the formula $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$. When 2.87 g of the hydrated crystals were heated to constant mass, 1.84 g of anhydrous copper(II) sulfate remained. What is the value of x? ($M_r: \text{CuSO}_4 = 159.5, \text{H}_2\text{O} = 18$)

- (A) 2
- (B) 5
- (C) 7
- (D) 10

Bonding & Structure

Q12. What is the shape of a BF₃ molecule?

- (A) tetrahedral
- (B) pyramidal
- (C) T-shaped
- (D) trigonal planar

Q13. Which ion or molecule contains a coordinate (dative covalent) bond?

- (A) CH₄
- (B) HCl
- (C) NH₄⁺
- (D) O₂

Q14. The lattice enthalpy of magnesium oxide is much more exothermic than the lattice enthalpy of sodium chloride. This is because...

- (A) the Mg²⁺ and O²⁻ ions have higher charges and smaller radii than Na⁺ and Cl⁻, so the attractions between them are stronger
- (B) magnesium oxide contains covalent bonds
- (C) sodium chloride does not form a lattice
- (D) magnesium is more reactive than sodium

Q15. Which substance has hydrogen bonding between its molecules?

- (A) CH₄
- (B) NH₃
- (C) H₂S
- (D) SiH₄

Q16. Magnesium has a higher melting point and is stronger than sodium. This is because, in magnesium...

- (A) the atoms are larger
- (B) there are fewer delocalised electrons
- (C) the bonding is covalent
- (D) each atom releases two delocalised electrons and the Mg²⁺ ions have a higher charge, so the metallic bonding is stronger

Q17. The H-O-H bond angle in a water molecule is 104.5°. This is because...

- (A) oxygen has only bonding pairs of electrons
- (B) the hydrogen atoms attract each other
- (C) the two lone pairs on oxygen repel more strongly than the bonding pairs, pushing the O-H bonds closer together
- (D) water molecules form hydrogen bonds with each other

Energetics & Thermodynamics

Q18. When 0.460 g of ethanol was burned completely, the heat released raised the temperature of 100 g of water by 20.0 K. What is the enthalpy of combustion of ethanol calculated from this experiment? (c = 4.18 J g⁻¹ K⁻¹; Mr of ethanol = 46)

- (A) -836 kJ mol⁻¹
- (B) -418 kJ mol⁻¹
- (C) -83.6 kJ mol⁻¹
- (D) -1672 kJ mol⁻¹

Q19. Using mean bond enthalpies C-H = 413, O=O = 498, C=O = 805 and O-H = 464 kJ mol⁻¹, calculate ΔH for the combustion of methane: $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$.

- (A) -409 kJ mol^{-1}
- (B) -590 kJ mol^{-1}
- (C) $-1236 \text{ kJ mol}^{-1}$
- (D) -818 kJ mol^{-1}

Q20. For a certain reaction, the total entropy of the reactants is $200 \text{ J K}^{-1} \text{ mol}^{-1}$ and the total entropy of the products is $350 \text{ J K}^{-1} \text{ mol}^{-1}$. What is the entropy change of the system, ΔS ?

- (A) $-150 \text{ J K}^{-1} \text{ mol}^{-1}$
- (B) $+150 \text{ J K}^{-1} \text{ mol}^{-1}$
- (C) $+550 \text{ J K}^{-1} \text{ mol}^{-1}$
- (D) $-550 \text{ J K}^{-1} \text{ mol}^{-1}$

Q21. A reaction has $\Delta H = +120 \text{ kJ mol}^{-1}$ and $\Delta S = +300 \text{ J K}^{-1} \text{ mol}^{-1}$. Above what temperature does this reaction become feasible?

- (A) 0.40 K
- (B) 40 K
- (C) 400 K
- (D) 4000 K

Q22. Enthalpies of combustion are: C = -394 kJ mol^{-1} and CO = -283 kJ mol^{-1} . What is the enthalpy of formation of carbon monoxide?

- (A) -111 kJ mol^{-1}
- (B) -677 kJ mol^{-1}
- (C) $+111 \text{ kJ mol}^{-1}$
- (D) -283 kJ mol^{-1}

Q23. For sodium chloride, the enthalpy of formation is -411 kJ mol^{-1} . Other data: enthalpy of atomisation of Na = +108, first ionisation energy of Na = +500, enthalpy of atomisation of Cl = +121 and electron affinity of Cl = -364 kJ mol^{-1} . What is the lattice enthalpy of sodium chloride?

- (A) -46 kJ mol^{-1}
- (B) -365 kJ mol^{-1}
- (C) -650 kJ mol^{-1}
- (D) -776 kJ mol^{-1}

Kinetics & Rate Equations

Q24. In rate experiments, doubling the concentration of A increases the rate by a factor of 4, while doubling the concentration of B doubles the rate. What is the rate equation for the reaction?

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

Q25. For a reaction with rate = $k[A]^2[B]$, the rate is $2.0 \times 10^{-4} \text{ mol dm}^{-3} \text{ s}^{-1}$ when $[A] = 0.10 \text{ mol dm}^{-3}$ and $[B] = 0.10 \text{ mol dm}^{-3}$. What is the value of the rate constant, k ?

- (A) $0.020 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$
- (B) $2.0 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$
- (C) $0.20 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$
- (D) $20 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$

Q26. In the Arrhenius equation $k = Ae^{(-E_a/RT)}$, the term $e^{(-E_a/RT)}$ represents...

- (A) the fraction of collisions that have energy greater than or equal to the activation energy
- (B) the total frequency of collisions between molecules
- (C) the activation energy of the reaction
- (D) the rate constant itself

Q27. A catalyst is added to a reaction mixture at constant temperature. On a Maxwell-Boltzmann distribution of molecular energies, the effect of the catalyst is that...

- (A) fewer molecules have high energies
- (B) the total area under the curve doubles
- (C) the activation energy increases
- (D) the activation energy is lowered, so a greater proportion of molecules have sufficient energy to react

Q28. What are the units of the rate constant, k , for a first-order reaction?

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

Equilibria (K_c & K_p)

Q29. Ethanoic acid and ethanol react reversibly: $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$. A mixture initially containing 1.00 mol of the acid and 1.00 mol of ethanol reaches equilibrium when 0.33 mol of the acid remains. What is the value of K_c for this reaction?

- (A) 0.24
- (B) 2.03
- (C) 4.12
- (D) 0.49

Q30. For the equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, what are the units of K_p ?

- (A) kPa^{-1}
- (B) no units
- (C) kPa^{-2}
- (D) kPa

Q31. An equilibrium has an exothermic forward reaction. What happens to the value of K_c when the temperature is increased?

- (A) K_c decreases
- (B) K_c increases
- (C) K_c does not change
- (D) K_c becomes zero

Q32. When concentrated hydrochloric acid is added to a pink solution of aqueous cobalt(II) ions, the solution turns blue. This is because...

- (A) the cobalt is oxidised to cobalt(III)
- (B) chloride ions replace water ligands, forming the blue $[\text{CoCl}_4]^{2-}$ complex
- (C) the water is removed by the acid
- (D) cobalt(II) chloride precipitates out of solution

Q33. In an equilibrium mixture at a total pressure of 300 kPa, the mole fraction of ammonia is 0.20. What is the partial pressure of ammonia in the mixture?

- (A) 15 kPa
- (B) 30 kPa
- (C) 60 kPa
- (D) 150 kPa

Redox & Electrode Potentials

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

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

Q35. Which reaction is a disproportionation reaction?

- (A) $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$
- (B) $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$
- (C) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
- (D) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

Q36. Standard electrode potentials are: $\text{Ag}^+/\text{Ag} = +0.80 \text{ V}$ and $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$. What is the EMF of a standard cell made from these two half-cells?

- (A) +0.04 V
- (B) +1.56 V
- (C) -1.56 V
- (D) +0.80 V

Q37. In an alkaline hydrogen fuel cell, what is the half-equation for the reaction at the negative electrode (anode)?

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

Q38. In the electrolysis of aqueous copper(II) sulfate using inert electrodes, 0.100 mol of electrons is passed through the cell. What mass of copper is deposited at the cathode? (Mr of Cu = 63.5)

- (A) 6.35 g
- (B) 1.59 g
- (C) 12.7 g
- (D) 3.18 g

Acids, Bases & Buffers

Q39. What is the pH of 0.200 mol dm⁻³ hydrochloric acid?

- (A) 0.70
- (B) 0.20
- (C) 1.00
- (D) 13.30

Q40. What is the pH of a 0.100 mol dm⁻³ solution of propanoic acid, which has $K_a = 1.3 \times 10^{-5}$ mol dm⁻³?

- (A) 1.00
- (B) 2.94
- (C) 4.89
- (D) 5.89

Q41. A buffer solution is made containing 0.200 mol dm⁻³ of a weak acid ($pK_a = 4.00$) and 0.100 mol dm⁻³ of its sodium salt. What is the pH of the buffer?

- (A) 4.30
- (B) 4.00
- (C) 3.70
- (D) 3.40

Q42. A weak acid is titrated with a strong base (sodium hydroxide solution). Which statement about the equivalence point of this titration is correct?

- (A) The pH at the equivalence point is less than 7, and methyl orange is a suitable indicator
- (B) The pH at the equivalence point is exactly 7, and litmus is a suitable indicator
- (C) The pH at the equivalence point is less than 7, and phenolphthalein is a suitable indicator
- (D) The pH at the equivalence point is greater than 7, and phenolphthalein is a suitable indicator

Q43. As the temperature increases, the value of K_w for water increases. What does this mean for a sample of pure water at 50°C?

- (A) Its pH is less than 7, but the water is still neutral
- (B) Its pH is exactly 7 and it is alkaline
- (C) Its pH is less than 7 and it is acidic
- (D) $[H^+]$ is less than $[OH^-]$

Inorganic Chemistry

Q44. Calcium reacts with cold water. What are the products of this reaction?

- (A) calcium oxide and hydrogen
- (B) no reaction takes place
- (C) calcium hydroxide and hydrogen
- (D) calcium hydroxide and oxygen

Q45. Sodium iodide is added to concentrated sulfuric acid. The iodide ions are strong enough reducing agents to reduce the sulfur in sulfuric acid (oxidation state +6) all the way to which product?

- (A) SO₂
- (B) H₂S
- (C) S
- (D) H₂SO₃

Q46. Which compound is used as the catalyst in the Contact process for making sulfuric acid?

- (A) iron
- (B) nickel
- (C) platinum
- (D) vanadium(V) oxide, V₂O₅

Q47. What is observed when aqueous sodium hydroxide is added to a solution containing Cu²⁺ ions, first dropwise and then in excess?

- (A) a pale blue precipitate forms, which does not dissolve in excess sodium hydroxide
- (B) a pale blue precipitate forms, which dissolves in excess to give a deep blue solution
- (C) a deep blue solution forms immediately and no precipitate is seen
- (D) a white precipitate forms, which dissolves in excess sodium hydroxide

Q48. When aqueous sodium hydroxide is added to a solution containing Fe²⁺ ions, what is observed?

- (A) a red-brown precipitate
- (B) a blue precipitate
- (C) a green precipitate
- (D) a white precipitate

Organic Chemistry I

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

- (A) Cl₂ → 2Cl•
- (B) CH₄ + Cl• → CH₃• + HCl
- (C) CH₃• + CH₃• → C₂H₆
- (D) CH₃• + Cl• → CH₃Cl

Q50. Which halogenoalkane is hydrolysed fastest by aqueous sodium hydroxide, reacting mainly by an S_N1 mechanism?

- (A) 1-bromobutane
- (B) 2-bromobutane
- (C) bromoethane
- (D) 2-bromo-2-methylpropane

Q51. Ethene is shaken with cold, dilute potassium manganate(VII) solution. What happens?

- (A) The purple colour fades and ethane-1,2-diol is formed
- (B) The purple colour fades and ethanoic acid is formed
- (C) There is no reaction
- (D) A brown precipitate forms and the ethene is unchanged

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

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

Q53. Bromoethane is warmed with aqueous potassium hydroxide. What is the main organic product?

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

Q54. Chlorofluorocarbons (CFCs) damage the ozone layer in the stratosphere because...

- (A) they absorb carbon dioxide
- (B) they dissolve in rain to form acid rain
- (C) they react with nitrogen in the air
- (D) ultraviolet radiation breaks the C-Cl bond, releasing chlorine radicals that catalyse the breakdown of ozone

Organic Chemistry II & Analysis

Q55. Ethanal reacts with hydrogen cyanide in the presence of a small amount of alkali. What is the product of this nucleophilic addition?

- (A) 2-hydroxypropanenitrile
- (B) propanenitrile
- (C) 2-aminopropanoic acid
- (D) propanoic acid

Q56. Which conditions are used to prepare ethyl ethanoate by reacting ethanoic acid with ethanol?

- (A) aqueous sodium hydroxide and reflux
- (B) dilute sulfuric acid in the cold
- (C) concentrated sulfuric acid and gentle warming
- (D) phosphorus pentachloride at room temperature

Q57. Benzene does not readily undergo addition reactions, unlike ethene, mainly because...

- (A) the C-C bonds in benzene are too strong to break
- (B) addition would destroy the delocalised pi electron system and the extra stability it gives the ring
- (C) benzene contains no pi bonds at all
- (D) benzene molecules are too large to react

Q58. Phenylamine is prepared in the laboratory by...

- (A) nitrating benzene with concentrated nitric and sulfuric acids
- (B) reducing nitrobenzene with tin and concentrated hydrochloric acid
- (C) heating phenol with ammonia under pressure
- (D) brominating benzene with bromine and iron(III) bromide

Q59. Nylon-6,6 is a condensation polymer. Which pair of monomers is used to make it?

- (A) hexanedioic acid and hexane-1,6-diamine
- (B) ethene and ethene
- (C) ethanediol and benzene-1,4-dicarboxylic acid
- (D) glycine and alanine

Q60. How many different proton (¹H) environments are there in propanone, CH₃COCH₃?

- (A) 2
- (B) 3
- (C) 1
- (D) 6

Answer Key

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

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