

A-Level Chemistry Practice Test 12

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 Mg-24 (79.0%), Mg-25 (10.0%) and Mg-26 (11.0%). The relative atomic mass of magnesium in the sample is

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

Q2. The successive ionisation energies of an element are 738, 1451, 7733, 10 543 and 13 637 kJ mol⁻¹. This element is

- (A) sodium
- (B) aluminium
- (C) magnesium
- (D) silicon

Q3. The electronic configuration of a chromium atom is unusual. It is

- (A) [Ar] 4s² 3d⁴
- (B) [Ar] 4s⁰ 3d⁶
- (C) [Ar] 4s² 3d⁶
- (D) [Ar] 4s¹ 3d⁵

Q4. A sample of bromine contains Br-79 (50.7%) and Br-81 (49.3%). The relative atomic mass of bromine is

- (A) 81.0
- (B) 79.5
- (C) 80.5
- (D) 79.9

Q5. Which oxide of a Period 3 element is amphoteric?

- (A) Al₂O₃
- (B) MgO
- (C) Na₂O
- (D) SO₂

Amount of Substance

Q6. A 0.500 g sample of an unknown gas occupies 240 cm³ at 100 kPa and 298 K. (R = 8.31 J K⁻¹ mol⁻¹.) The molar mass of the gas is approximately

- (A) 26 g mol⁻¹
- (B) 13 g mol⁻¹
- (C) 104 g mol⁻¹
- (D) 52 g mol⁻¹

Q7. A 25.0 cm^3 portion of $0.150 \text{ mol dm}^{-3}$ hydrochloric acid is neutralised by 22.5 cm^3 of calcium hydroxide solution. The concentration of the calcium hydroxide solution is

- (A) $0.167 \text{ mol dm}^{-3}$
- (B) $0.0833 \text{ mol dm}^{-3}$
- (C) $0.333 \text{ mol dm}^{-3}$
- (D) $0.0417 \text{ mol dm}^{-3}$

Q8. Magnesium carbonate decomposes: $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$. (Mr: $\text{MgCO}_3 = 84$, $\text{MgO} = 40$.) The atom economy for producing MgO is

- (A) 52.4%
- (B) 100%
- (C) 47.6%
- (D) 84.0%

Q9. Methane burns in oxygen: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$. If 0.50 mol of CH_4 is mixed with 0.80 mol of O_2 , the maximum amount of CO_2 that can form is

- (A) 0.40 mol
- (B) 0.80 mol
- (C) 0.50 mol
- (D) 0.25 mol

Q10. The concentration of a $0.250 \text{ mol dm}^{-3}$ solution of sulfuric acid, expressed in g dm^{-3} , is (Mr $\text{H}_2\text{SO}_4 = 98$)

- (A) 245 g dm^{-3}
- (B) 24.5 g dm^{-3}
- (C) 2.45 g dm^{-3}
- (D) 49.0 g dm^{-3}

Q11. How many molecules are there in 0.88 g of carbon dioxide? (Mr $\text{CO}_2 = 44$; Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$)

- (A) 1.20×10^{22}
- (B) 6.02×10^{21}
- (C) 1.20×10^{24}
- (D) 3.01×10^{22}

Bonding & Structure

Q12. What is the shape of an SF_6 molecule and its bond angle?

- (A) Octahedral, 90°
- (B) Tetrahedral, 109.5°
- (C) Trigonal planar, 120°
- (D) Square planar, 90°

Q13. Which of these substances contains hydrogen bonding between its molecules?

- (A) CH_4
- (B) H_2S
- (C) SiH_4
- (D) NH_3

Q14. For MgCl_2 : $\Delta H_f = -642 \text{ kJ mol}^{-1}$; atomisation of $\text{Mg} = +150$; first + second ionisation energies of $\text{Mg} = +2188$; atomisation of Cl per mol of Cl atoms = $+121$; electron affinity of $\text{Cl} = -349 \text{ kJ mol}^{-1}$. The lattice enthalpy of formation of MgCl_2 is

- (A) $-1882 \text{ kJ mol}^{-1}$
- (B) -642 kJ mol^{-1}
- (C) $-1240 \text{ kJ mol}^{-1}$
- (D) $-2524 \text{ kJ mol}^{-1}$

Q15. Which substance has the highest boiling point?

- (A) butane
- (B) propanal
- (C) propan-1-ol
- (D) methoxyethane

Q16. Magnesium has a much higher melting point than sodium mainly because

- (A) magnesium atoms are smaller than sodium atoms
- (B) sodium has a giant covalent structure
- (C) magnesium has a full outer shell of electrons
- (D) Mg^{2+} ions and twice as many delocalised electrons per atom give stronger metallic bonding

Q17. Which statement comparing diamond and graphite is correct?

- (A) Both conduct electricity
- (B) Diamond is soft because its layers can slide
- (C) In diamond each carbon forms four bonds; in graphite each carbon forms three bonds within a layer
- (D) Graphite has a higher density than diamond because its atoms are closer together

Energetics & Thermodynamics

Q18. Burning 0.460 g of ethanol (0.0100 mol) raises the temperature of 100 g of water by 32.6 K. ($c = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$.) The enthalpy change of combustion of ethanol is approximately

- (A) $-13.6 \text{ kJ mol}^{-1}$
- (B) -136 kJ mol^{-1}
- (C) $-2720 \text{ kJ mol}^{-1}$
- (D) $-1360 \text{ kJ mol}^{-1}$

Q19. Given $\Delta H_f(\text{C}_2\text{H}_4) = +52 \text{ kJ mol}^{-1}$ and $\Delta H_f(\text{C}_2\text{H}_6) = -85 \text{ kJ mol}^{-1}$, the enthalpy change for $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$ is

- (A) $+137 \text{ kJ mol}^{-1}$
- (B) -33 kJ mol^{-1}
- (C) -85 kJ mol^{-1}
- (D) -137 kJ mol^{-1}

Q20. Using bond enthalpies (kJ mol^{-1}): $\text{N}\equiv\text{N} = 945$, $\text{H}-\text{H} = 436$, $\text{N}-\text{H} = 391$, the enthalpy change for $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ is

- (A) -93 kJ mol^{-1}
- (B) $+93 \text{ kJ mol}^{-1}$
- (C) $-2346 \text{ kJ mol}^{-1}$
- (D) $+2253 \text{ kJ mol}^{-1}$

Q21. Which change involves a decrease in the entropy of the system?

- (A) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (B) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- (C) $\text{NH}_4\text{NO}_3(\text{s})$ dissolving in water
- (D) a solid melting

Q22. A reaction has $\Delta H = -50 \text{ kJ mol}^{-1}$ and $\Delta S = -100 \text{ J K}^{-1} \text{ mol}^{-1}$. The reaction is feasible only at temperatures

- (A) above 500 K
- (B) below 500 K
- (C) above 5000 K
- (D) at all temperatures

Q23. Using standard entropies ($\text{J K}^{-1} \text{ mol}^{-1}$): $\text{SO}_2 = 248$, $\text{O}_2 = 205$, $\text{SO}_3 = 257$, the entropy change for $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$ is

- (A) $+187 \text{ J K}^{-1} \text{ mol}^{-1}$
- (B) $-196 \text{ J K}^{-1} \text{ mol}^{-1}$
- (C) $-187 \text{ J K}^{-1} \text{ mol}^{-1}$
- (D) $+9 \text{ J K}^{-1} \text{ mol}^{-1}$

Kinetics & Rate Equations

Q24. A reaction has a constant half-life of 40 s at a fixed temperature, whatever the starting concentration. The reaction is

- (A) zero order
- (B) third order
- (C) second order
- (D) first order

Q25. In rate experiments, doubling $[\text{A}]$ doubled the rate, and doubling $[\text{B}]$ had no effect on the rate. The rate equation is

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

Q26. For a zero-order reaction, the experimentally measured rate is $4.0 \times 10^{-5} \text{ mol dm}^{-3} \text{ s}^{-1}$. The rate constant k is

- (A) $4.0 \times 10^{-5} \text{ mol dm}^{-3} \text{ s}^{-1}$
- (B) $4.0 \times 10^{-5} \text{ s}^{-1}$
- (C) $4.0 \times 10^{-5} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- (D) impossible to state without the concentration

Q27. A graph of $\ln k$ against $1/T$ has a gradient of -6000 K . The activation energy of the reaction is ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) 7.22 kJ mol^{-1}
- (B) 49.9 kJ mol^{-1}
- (C) 6000 kJ mol^{-1}
- (D) $0.722 \text{ kJ mol}^{-1}$

Q28. A reaction proceeds in two steps. Step 1 (slow): $A + B \rightarrow C$. Step 2 (fast): $C + B \rightarrow D$. The rate equation for the overall reaction is

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

Equilibria (K_c & K_p)

Q29. For the esterification $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$, the expression for K_c is

- (A) $K_c = [\text{ester}][\text{H}_2\text{O}] / ([\text{acid}][\text{alcohol}])$
- (B) $K_c = [\text{acid}][\text{alcohol}] / ([\text{ester}][\text{H}_2\text{O}])$
- (C) $K_c = [\text{ester}] / ([\text{acid}][\text{alcohol}])$
- (D) $K_c = [\text{acid}][\text{alcohol}] / [\text{ester}]$

Q30. For $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ at equilibrium, the partial pressures are: $\text{SO}_3 = 40 \text{ kPa}$, $\text{SO}_2 = 20 \text{ kPa}$, $\text{O}_2 = 10 \text{ kPa}$. The value of K_p is

- (A) 4.0 kPa^{-1}
- (B) 0.40 kPa^{-1}
- (C) 0.040 kPa^{-1}
- (D) 2.5 kPa

Q31. The forward reaction of an equilibrium is exothermic. As the temperature is increased, the value of K_c will

- (A) increase
- (B) stay the same
- (C) decrease
- (D) first increase, then decrease

Q32. $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$. Initially 2.00 mol of PCl_5 is placed in a 1.00 dm^3 vessel; at equilibrium 1.20 mol of PCl_5 remains. The value of K_c is

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

Q33. Increasing the total pressure on a gaseous equilibrium at constant temperature will

- (A) increase the value of K_p
- (B) decrease the value of K_p
- (C) leave K_p unchanged, though the position of equilibrium may shift
- (D) always shift the equilibrium to the right

Redox & Electrode Potentials

Q34. The oxidation state of chromium in $K_2Cr_2O_7$ is

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

Q35. When chlorine is dissolved in cold dilute sodium hydroxide, chlorine is both oxidised and reduced. This type of reaction is called

- (A) disproportionation
- (B) hydrolysis
- (C) neutralisation
- (D) esterification

Q36. Standard electrode potentials: $Fe^{2+}/Fe = -0.44\text{ V}$ and $Ag^+/Ag = +0.80\text{ V}$. The EMF of the cell $Fe | Fe^{2+} || Ag^+ | Ag$ is

- (A) +0.36 V
- (B) +1.24 V
- (C) -1.24 V
- (D) +1.68 V

Q37. Given half-cell potentials, which is the strongest oxidising agent?

- (A) Cl_2 ($Cl_2/Cl^- = +1.36\text{ V}$)
- (B) Fe^{3+} ($Fe^{3+}/Fe^{2+} = +0.77\text{ V}$)
- (C) Cu^{2+} ($Cu^{2+}/Cu = +0.34\text{ V}$)
- (D) H^+ ($H^+/H_2 = 0.00\text{ V}$)

Q38. Concentrated aqueous sodium chloride is electrolysed with inert electrodes. The products are

- (A) sodium at the cathode and oxygen at the anode
- (B) hydrogen at the cathode and chlorine at the anode
- (C) sodium at the cathode and chlorine at the anode
- (D) hydrogen at the cathode and oxygen at the anode

Acids, Bases & Buffers

Q39. The pH of a 0.200 mol dm^{-3} solution of nitric acid is

- (A) 0.70
- (B) 1.70
- (C) 0.20
- (D) 2.70

Q40. 25.0 cm^3 of 0.100 mol dm^{-3} HCl is mixed with 25.0 cm^3 of $0.0500\text{ mol dm}^{-3}$ NaOH. The pH of the resulting solution is

- (A) 1.30
- (B) 2.60
- (C) 0.60
- (D) 1.60

Q41. A weak acid HA of concentration $0.100 \text{ mol dm}^{-3}$ has a pH of 3.00. The value of K_a for the acid is approximately

- (A) $1.0 \times 10^{-6} \text{ mol dm}^{-3}$
- (B) $1.0 \times 10^{-5} \text{ mol dm}^{-3}$
- (C) $1.0 \times 10^{-3} \text{ mol dm}^{-3}$
- (D) $1.0 \times 10^{-4} \text{ mol dm}^{-3}$

Q42. Which indicator is most suitable for the titration of ethanoic acid (a weak acid) with sodium hydroxide solution?

- (A) Methyl orange
- (B) Phenolphthalein
- (C) No indicator works for this titration
- (D) Litmus

Q43. A $0.0100 \text{ mol dm}^{-3}$ solution of ethanoic acid has $K_a = 1.74 \times 10^{-5} \text{ mol dm}^{-3}$. Its pH is approximately

- (A) 2.00
- (B) 4.76
- (C) 3.38
- (D) 2.87

Inorganic Chemistry

Q44. Which statement about chlorine and the other halogens is correct?

- (A) Chlorine is a weaker oxidising agent than bromine
- (B) Fluorine is less reactive than chlorine
- (C) Iodine will displace bromine from potassium bromide solution
- (D) The oxidising power of the halogens decreases down the group

Q45. The solubility of the Group 2 hydroxides in water, going down the group,

- (A) decreases steadily
- (B) stays the same
- (C) increases steadily
- (D) increases, then decreases

Q46. When concentrated hydrochloric acid is added to aqueous copper(II) sulfate, the blue solution turns yellow-green because

- (A) the copper is oxidised to Cu^{3+}
- (B) water ligands are replaced by chloride ligands, forming $[\text{CuCl}_4]^{2-}$
- (C) copper metal is precipitated
- (D) the solution becomes more concentrated

Q47. When sodium hydroxide solution is added to a solution containing Fe^{2+} ions, the precipitate formed is

- (A) orange-brown
- (B) white
- (C) green
- (D) blue

Q48. Which Group 2 carbonate is the most difficult to decompose on heating?

- (A) magnesium carbonate
- (B) barium carbonate
- (C) calcium carbonate
- (D) strontium carbonate

Organic Chemistry I

Q49. In the initiation step of the chlorination of methane, the Cl–Cl bond breaks

- (A) heterolytically, forming Cl^+ and Cl^-
- (B) homolytically, forming two $\text{Cl}^\bullet$ radicals under UV light
- (C) to form chlorine molecules with a double bond
- (D) only when a catalyst is present

Q50. Which statement about the burning of alkanes is correct?

- (A) In a limited supply of oxygen, carbon monoxide and carbon may be formed
- (B) Alkanes cannot burn because they are saturated
- (C) Complete combustion of an alkane produces only carbon dioxide
- (D) Incomplete combustion produces hydrogen

Q51. When ethene is shaken with bromine, the orange colour disappears because

- (A) ethene reduces bromine to hydrogen bromide
- (B) a substitution reaction replaces a hydrogen atom
- (C) electrophilic addition across the $\text{C}=\text{C}$ bond forms dibromoethane
- (D) the bromine evaporates

Q52. Which halogenoalkane undergoes nucleophilic substitution fastest with aqueous alkali?

- (A) 1-chlorobutane
- (B) a primary bromoalkane
- (C) a tertiary iodoalkane
- (D) a tertiary chloroalkane

Q53. 2-Methylpropan-2-ol is not oxidised by acidified potassium dichromate(VI) because it is

- (A) a primary alcohol
- (B) a secondary alcohol
- (C) a tertiary alcohol with no hydrogen on the carbon carrying the $-\text{OH}$ group
- (D) an aldehyde

Q54. When 2-bromobutane is refluxed with potassium hydroxide dissolved in ethanol, the major organic product is

- (A) butan-2-ol
- (B) but-1-ene only
- (C) but-2-ene
- (D) butane

Organic Chemistry II & Analysis

Q55. Brady's reagent (2,4-dinitrophenylhydrazine) gives an orange precipitate with

- (A) both aldehydes and ketones
- (B) ketones only
- (C) aldehydes only
- (D) carboxylic acids

Q56. Ethanoic acid can be distinguished from ethanol by adding sodium carbonate, because ethanoic acid

- (A) turns the mixture blue
- (B) gives effervescence of carbon dioxide
- (C) forms a silver mirror
- (D) has a higher boiling point

Q57. When bromine is added to phenylamine dissolved in water, the observation is

- (A) no reaction
- (B) the bromine is slowly decolourised with no precipitate
- (C) an orange solution forms
- (D) the bromine is rapidly decolourised and a white precipitate of 2,4,6-tribromophenylamine forms

Q58. In a solid amino acid such as glycine (2-aminoethanoic acid), the molecule normally exists as

- (A) a neutral molecule, $\text{NH}_2\text{CH}_2\text{COOH}$
- (B) a zwitterion, $^+\text{H}_3\text{NCH}_2\text{COO}^-$
- (C) a radical
- (D) a polymer

Q59. Terylene (PET) is a polyester formed from a diol and a dicarboxylic acid. This type of polymerisation is called

- (A) addition polymerisation
- (B) free-radical polymerisation
- (C) condensation polymerisation
- (D) electrophilic substitution

Q60. A carboxylic acid can be recognised in its infrared spectrum by

- (A) a sharp peak at 1720 cm^{-1} only
- (B) a peak at 3300 cm^{-1} identical to that of an alcohol
- (C) the absence of any peak above 1600 cm^{-1}
- (D) a very broad absorption in the range $2500\text{--}3300\text{ cm}^{-1}$ due to the O–H bond, together with a C=O peak near 1700 cm^{-1}

Answer Key

Q1: A	Q11: A	Q21: B	Q31: C	Q41: B	Q51: C
Q2: C	Q12: A	Q22: B	Q32: A	Q42: B	Q52: C
Q3: D	Q13: D	Q23: C	Q33: C	Q43: C	Q53: C
Q4: D	Q14: D	Q24: D	Q34: D	Q44: D	Q54: C

Q5: A	Q15: C	Q25: D	Q35: A	Q45: C	Q55: A
Q6: D	Q16: D	Q26: A	Q36: B	Q46: B	Q56: B
Q7: B	Q17: C	Q27: B	Q37: A	Q47: C	Q57: D
Q8: C	Q18: D	Q28: A	Q38: B	Q48: B	Q58: B
Q9: A	Q19: D	Q29: A	Q39: A	Q49: B	Q59: C
Q10: B	Q20: A	Q30: B	Q40: D	Q50: A	Q60: D

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