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Mastering Chemistry

From Atoms to Organic Compounds

70 MCQs

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How to read this PDF

✓ **Green row with a tick** shows the correct answer.

Amber box under each MCQ gives the explanation.

Answer key page at the end links back to every MCQ.

1 Section 1: Atomic Structure

9 MCQs | Q1 to Q9

Q1. Who discovered the electron in 1897?

A	Ernest Rutherford
B	**J. J. Thomson** ✓
C	James Chadwick
D	Niels Bohr

Answer: B. Explanation: Thomson discovered the electron through his cathode ray tube experiments.

Q2. Which experiment led to the discovery of the atomic nucleus?

A	Millikan's oil drop experiment
B	**Rutherford's gold foil experiment** ✓
C	Thomson's cathode ray experiment
D	Chadwick's beryllium experiment

Answer: B. Explanation: Most alpha particles passed through the gold foil but a few bounced back, showing a small, dense, positive nucleus.

Q3. Which particle in the nucleus carries no electric charge?

A	Proton
B	Electron
C	Positron
D	**Neutron** ✓

Answer: D. Explanation: The neutron is neutral. It was discovered by James Chadwick in 1932.

Q4. An atom has 6 protons and 8 neutrons. What is its mass number?

A	**14** ✓
B	6
C	8
D	2

Answer: A. Explanation: Mass number = protons + neutrons = 6 + 8 = 14. This is carbon-14.

Q5. What is the maximum number of electrons in the second shell (n = 2)?

A	2
B	18
C	**8** ✓
D	32

Answer: C. Explanation: A shell holds a maximum of $2n^2$ electrons, so $2 \times 2^2 = 8$.

Q6. What is the electronic configuration of oxygen (atomic number 8)?

A	$1s^2\ 2s^2\ 2p^6$
B	$1s^2\ 2s^2\ 2p^3$
C	**$1s^2\ 2s^2\ 2p^4$** ✓
D	$1s^2\ 2s^2\ 2p^5$

Answer: C. Explanation: Eight electrons fill 1s (2), 2s (2) and leave four electrons in the 2p subshell.

Q7. Which quantum number determines the shape of an orbital?

A	**Azimuthal quantum number (l)** ✓
B	Principal quantum number (n)
C	Magnetic quantum number (m)
D	Spin quantum number (s)

Answer: A. Explanation: l = 0 gives a spherical s orbital and l = 1 gives a dumbbell-shaped p orbital.

Q8. The Pauli exclusion principle states that:

A	Electrons fill the lowest energy orbitals first
B	**No two electrons in an atom can have the same set of four quantum numbers** ✓
C	Electrons occupy degenerate orbitals singly before pairing
D	Position and momentum cannot both be known exactly

Answer: B. Explanation: Because of this, an orbital can hold a maximum of two electrons, and they must have opposite spins.

Q9. How many orbitals are present in a p subshell?

A	3 ✓
B	1
C	5
D	7

Answer: A. Explanation: For l = 1, m takes the values -1, 0 and +1, giving three p orbitals that hold six electrons.

2 Section 2: The Periodic Table

9 MCQs | Q10 to Q18

Q10. The modern periodic law arranges elements by increasing:

A	Atomic mass
B	Number of neutrons
C	Density
D	**Atomic number** ✓

Answer: D. Explanation: Henry Moseley showed that atomic number, not atomic mass, is the basis of the periodic table.

Q11. Which element is the most electronegative?

A	Oxygen
B	**Fluorine** ✓
C	Chlorine
D	Nitrogen

Answer: B. Explanation: Fluorine has the highest electronegativity (4.0 on the Pauling scale).

Q12. Alkali metals belong to which group of the periodic table?

A	Group 2
B	**Group 1** ✓
C	Group 17
D	Group 18

Answer: B. Explanation: Lithium, sodium and potassium are in Group 1. They are soft and react vigorously with water.

Q13. Halogens belong to which group?

A	**Group 17**	✓
B	Group 1	
C	Group 16	
D	Group 18	

Answer: A. Explanation: Fluorine, chlorine, bromine and iodine are Group 17 elements with seven valence electrons.

Q14. How does atomic size change across a period from left to right?

A	It increases	
B	It stays the same	
C	**It decreases**	✓
D	It first increases then decreases	

Answer: C. Explanation: Nuclear charge increases while the number of shells stays the same, so the nucleus pulls electrons closer.

Q15. Which element has the highest first ionisation energy?

A	Neon
B	Hydrogen
C	Fluorine
D	**Helium** ✓

Answer: D. Explanation: Helium is very small with a full first shell, so its electrons are held extremely tightly.

Q16. Noble gases are chemically unreactive because they:

A	Are all gases
B	Have a high atomic mass
C	**Have completely filled outer shells** ✓
D	Have no electrons

Answer: C. Explanation: A full outer shell (octet, or duplet in helium) gives them great stability.

Q17. Which metal is liquid at room temperature?

A	**Mercury**	✓
B	Bromine	
C	Sodium	
D	Aluminium	

Answer: A. Explanation: Mercury is the only liquid metal at room temperature. Bromine is a liquid but it is a non-metal.

Q18. Transition elements are placed in which block of the periodic table?

A	s-block	
B	**d-block**	✓
C	p-block	
D	f-block	

Answer: B. Explanation: Transition elements fill the d subshell. They form coloured compounds and often act as catalysts.

3 Section 3: Chemical Bonding

9 MCQs | Q19 to Q27

Q19. What type of bond holds the atoms together within a water molecule?

A	**Polar covalent bond**	✓
B	Ionic bond	
C	Metallic bond	
D	Hydrogen bond	

Answer: A. Explanation: Oxygen and hydrogen share electrons unequally, which gives a polar covalent bond.

Q20. What is the shape of a methane (CH_4) molecule?

A	**Tetrahedral**	✓
B	Trigonal planar	
C	Linear	
D	Octahedral	

Answer: A. Explanation: Four bond pairs and no lone pairs give a tetrahedral shape with bond angles of 109.5 degrees.

Q21. What is the shape of a water molecule?

A	Linear
B	**Bent (V-shaped)** ✓
C	Tetrahedral
D	Trigonal planar

Answer: B. Explanation: The two lone pairs on oxygen push the O-H bonds closer, giving a bond angle of about 104.5 degrees.

Q22. A triple bond consists of:

A	**One sigma bond and two pi bonds** ✓
B	Three sigma bonds
C	Two sigma bonds and one pi bond
D	Three pi bonds

Answer: A. Explanation: Only one sigma bond can exist between two atoms. Extra bonds are pi bonds, as in N_2.

Q23. Which of the following molecules is linear?

A	H_2O
B	NH_3
C	CH_4
D	**CO_2** ✓

Answer: D. Explanation: Carbon in CO_2 is sp hybridised with no lone pairs, giving a 180 degree linear shape.

Q24. What is the hybridisation of carbon in ethene (C_2H_4)?

A	sp
B	sp^3
C	**sp^2** ✓
D	sp^3d

Answer: C. Explanation: Each carbon forms three sigma bonds and one pi bond, giving a planar shape with 120 degree angles.

Q25. Which compound has the highest boiling point because of hydrogen bonding?

A	H_2S
B	CH_4
C	**H_2O** ✓
D	HCl

Answer: C. Explanation: Strong hydrogen bonds between water molecules need a lot of energy to break.

Q26. A metallic bond is the attraction between:

A	**Positive metal ions and a sea of delocalised electrons** ✓
B	A cation and an anion
C	Two non-metal atoms
D	Shared electron pairs of two atoms

Answer: A. Explanation: Free electrons explain why metals conduct electricity and heat and are malleable.

Q27. Ionic compounds conduct electricity only when they are:

A	In the solid state
B	Mixed with oil
C	**Molten or dissolved in water** ✓
D	Cooled below 0 °C

Answer: C. Explanation: Ions are fixed in the solid crystal but become free to move when molten or in solution.

4 Section 4: States of Matter & Gases

8 MCQs | Q28 to Q35

Q28. At constant temperature, the volume of a gas is inversely proportional to its pressure. This is:

A	Charles's law
B	Avogadro's law
C	Graham's law
D	**Boyle's law** ✓

Answer: D. Explanation: Boyle's law: PV = constant at constant temperature and amount of gas.

Q29. At constant pressure, the volume of a gas is directly proportional to its absolute temperature. This is:

A	Boyle's law
B	Graham's law
C	Dalton's law
D	**Charles's law** ✓

Answer: D. Explanation: Charles's law: V/T = constant, with temperature in kelvin.

Q30. What is absolute zero on the Celsius scale?

A	-100 °C
B	0 °C
C	**-273 °C** ✓
D	-373 °C

Answer: C. Explanation: Absolute zero is 0 K, which equals about -273.15 °C.

Q31. What volume does one mole of an ideal gas occupy at STP?

A	11.2 L
B	**22.4 L** ✓
C	24 L
D	44.8 L

Answer: B. Explanation: At STP (0 °C and 1 atm), one mole of any ideal gas occupies 22.4 litres.

Q32. Which equation represents the ideal gas law?

A	**PV = nRT** ✓
B	PV = nT
C	P/V = nRT
D	PT = nRV

Answer: A. Explanation: P is pressure, V is volume, n is moles, R is the gas constant and T is temperature in kelvin.

Q33. The rate of diffusion of a gas is inversely proportional to the square root of its molar mass. This is:

A	Dalton's law
B	Henry's law
C	Raoult's law
D	**Graham's law** ✓

Answer: D. Explanation: Lighter gases such as hydrogen diffuse faster than heavier gases.

Q34. Which state of matter has a definite volume but no definite shape?

A	**Liquid** ✓
B	Solid
C	Gas
D	Plasma

Answer: A. Explanation: Liquid particles are close together but can slide past each other, so liquids take the shape of the container.

Q35. The change of a solid directly into a gas is called:

A	Evaporation
B	Melting
C	**Sublimation** ✓
D	Condensation

Answer: C. Explanation: Dry ice, naphthalene and iodine are common examples of sublimation.

5 Section 5: Acids, Bases & Salts

9 MCQs | Q36 to Q44

Q36. What is the pH of a solution with a hydrogen ion concentration of 1 x 10^{-3} M?

A	**3** ✓
B	11
C	7
D	1

Answer: A. Explanation: pH = -log[H^+] = -log(10^{-3}) = 3.

Q37. Which of the following is a strong acid?

A	CH_3COOH
B	**HCl** ✓
C	H_2CO_3
D	HCN

Answer: B. Explanation: HCl ionises completely in water. The others are weak acids.

Q38. Blue litmus paper turns red in:

A	A basic solution
B	A neutral solution
C	**An acidic solution** ✓
D	Distilled water

Answer: C. Explanation: Acids turn blue litmus red. Bases turn red litmus blue.

Q39. According to the Bronsted-Lowry theory, an acid is a:

A	**Proton donor** ✓
B	Proton acceptor
C	Electron pair donor
D	Electron donor

Answer: A. Explanation: A Bronsted-Lowry acid donates H^+. A Lewis acid accepts an electron pair.

Q40. What is the chemical formula of baking soda?

A	**$NaHCO_3$** ✓
B	Na_2CO_3
C	NaOH
D	$CaCO_3$

Answer: A. Explanation: Baking soda is sodium bicarbonate (sodium hydrogen carbonate). Na_2CO_3 is washing soda.

Q41. A neutralisation reaction between an acid and a base produces:

A	Hydrogen and oxygen
B	Only salt
C	**Salt and water** ✓
D	Another acid and base

Answer: C. Explanation: For example, HCl and NaOH react to give NaCl and H_2O.

Q42. What is the pH of a 0.01 M NaOH solution?

A	2
B	10
C	14
D	**12** ✓

Answer: D. Explanation: $[OH^-] = 10^{-2}$, so pOH = 2 and pH = 14 - 2 = 12.

Q43. Which of the following is a weak base?

A	NaOH
B	KOH
C	**Ammonia solution (NH_3)** ✓
D	LiOH

Answer: C. Explanation: Ammonia ionises only slightly in water. NaOH and KOH ionise almost completely.

Q44. Which acid is mainly responsible for the sour taste of lemons?

A	**Citric acid** ✓
B	Acetic acid
C	Lactic acid
D	Tartaric acid

Answer: A. Explanation: Citrus fruits such as lemons and oranges are rich in citric acid.

6 Section 6: Mole Concept

8 MCQs | Q45 to Q52

Q45. What is the value of Avogadro's number?

A	6.022×10^{-23}
B	3.011×10^{23}
C	1.602×10^{-19}
D	**6.022×10^{23}** ✓

Answer: D. Explanation: One mole of any substance contains 6.022×10^{23} particles.

Q46. What is the molar mass of water (H_2O)?

A	16 g/mol
B	10 g/mol
C	20 g/mol
D	**18 g/mol** ✓

Answer: D. Explanation: (2 x 1) + 16 = 18 g/mol.

Q47. How many moles are present in 36 g of water?

A	1 mole
B	**2 moles** ✓
C	4 moles
D	0.5 mole

Answer: B. Explanation: Moles = mass / molar mass = 36 / 18 = 2.

Q48. What is the molar mass of carbon dioxide (CO_2)?

A	**44 g/mol** ✓
B	28 g/mol
C	32 g/mol
D	12 g/mol

Answer: A. Explanation: 12 + (2 x 16) = 44 g/mol.

Q49. Which law states that matter is neither created nor destroyed in a chemical reaction?

A	Law of definite proportions
B	**Law of conservation of mass** ✓
C	Law of multiple proportions
D	Avogadro's law

Answer: B. Explanation: Lavoisier showed that the total mass of reactants equals the total mass of products.

Q50. The limiting reagent in a reaction is the reactant that:

A	Is present in excess
B	Acts as a catalyst
C	Does not react
D	**Is completely used up first** ✓

Answer: D. Explanation: It limits how much product can form.

Q51. What is the approximate percentage of oxygen by mass in water?

A	11.1%
B	**88.9%** ✓
C	50%
D	33.3%

Answer: B. Explanation: Oxygen contributes 16 of the 18 units of mass: 16 / 18 x 100 = 88.9%.

Q52. What is the empirical formula of glucose ($C_6H_{12}O_6$)?

A	$C_2H_4O_2$
B	CHO
C	CH_2O ✓
D	$C_3H_6O_3$

Answer: C. Explanation: The empirical formula shows the simplest whole-number ratio of atoms, here 1 : 2 : 1.

7 Section 7: Energy & Equilibrium

9 MCQs | Q53 to Q61

Q53. A reaction that releases heat to its surroundings is called:

A	**Exothermic** ✓
B	Endothermic
C	Isothermal
D	Adiabatic

Answer: A. Explanation: In exothermic reactions the temperature of the surroundings rises, as in combustion.

Q54. What is the sign of the enthalpy change (delta H) in an endothermic reaction?

A	**Positive**	✓
B	Negative	
C	Zero	
D	Infinite	

Answer: A. Explanation: The system absorbs heat from the surroundings, so delta H is positive.

Q55. What is the SI unit of energy?

A	Watt	
B	Pascal	
C	Newton	
D	**Joule**	✓

Answer: D. Explanation: The joule (J) is the SI unit of energy. A watt measures power.

Q56. A catalyst increases the rate of a reaction by:

A	Raising the temperature
B	Changing the enthalpy of the reaction
C	Being used up completely
D	**Lowering the activation energy** ✓

Answer: D. Explanation: A catalyst gives an alternative pathway with lower activation energy and is not consumed.

Q57. According to collision theory, an effective collision needs particles with:

A	Only high pressure
B	Only equal masses
C	**Enough energy and the correct orientation** ✓
D	Only equal speeds

Answer: C. Explanation: Particles must collide with at least the activation energy and in a suitable orientation.

Q58. Raising the temperature generally makes a reaction:

A	Slower
B	**Faster** ✓
C	Unchanged
D	Stop completely

Answer: B. Explanation: More particles have energy greater than the activation energy, and collisions are more frequent.

Q59. Le Chatelier's principle states that a system at equilibrium subjected to a stress will:

A	Stop reacting
B	**Shift to oppose the change** ✓
C	Always favour the products
D	Never respond

Answer: B. Explanation: The system adjusts its position to partly cancel the effect of a change in concentration, pressure or temperature.

Q60. At chemical equilibrium:

A	The reaction stops completely
B	All reactants have been used up
C	**The rates of the forward and reverse reactions are equal** ✓
D	Concentrations of reactants and products are equal

Answer: C. Explanation: Equilibrium is dynamic. Reactions continue, but concentrations stay constant.

Q61. Entropy is a measure of the:

A	Heat content of a system
B	Pressure of a gas
C	**Disorder (randomness) of a system** ✓
D	Mass of a substance

Answer: C. Explanation: Entropy increases as a substance changes from solid to liquid to gas.

8 Section 8: Organic & Redox

9 MCQs | Q62 to Q70

Q62. What is the general formula of alkanes?

A	C_nH_{2n}
B	C_nH_{2n-2}
C	C_nH_n
D	**C_nH_{2n+2}** ✓

Answer: D. Explanation: Alkanes are saturated hydrocarbons, such as CH_4 and C_2H_6.

Q63. Which is the simplest alkane?

A	Ethane
B	**Methane** ✓
C	Ethene
D	Propane

Answer: B. Explanation: Methane (CH_4) has just one carbon atom.

Q64. What is the functional group of alcohols?

A	Carboxyl group (-COOH)
B	Aldehyde group (-CHO)
C	Amino group (-NH_2)
D	**Hydroxyl group (-OH)** ✓

Answer: D. Explanation: Ethanol (C_2H_5OH) and methanol (CH_3OH) contain the -OH group.

Q65. What is the functional group of carboxylic acids?

A	Hydroxyl group (-OH)
B	Aldehyde group (-CHO)
C	Ketone group (C=O)
D	**Carboxyl group (-COOH)** ✓

Answer: D. Explanation: Ethanoic (acetic) acid, CH_3COOH, is a common example.

Q66. Which of the following is an unsaturated hydrocarbon?

A	Methane
B	**Ethene** ✓
C	Ethane
D	Propane

Answer: B. Explanation: Ethene contains a carbon-carbon double bond, which makes it unsaturated.

Q67. What is the main component of natural gas?

A	Ethane
B	**Methane** ✓
C	Butane
D	Propane

Answer: B. Explanation: Natural gas is mostly methane, usually more than 85%.

Q68. In terms of electrons, oxidation is the:

A	Gain of electrons
B	Sharing of electrons
C	**Loss of electrons** ✓
D	Decrease in atomic number

Answer: C. Explanation: Remember OIL RIG: Oxidation Is Loss, Reduction Is Gain of electrons.

Q69. In electrolysis, reduction takes place at the:

A	Anode
B	Salt bridge
C	Electrolyte
D	**Cathode** ✓

Answer: D. Explanation: Positive ions move to the cathode and gain electrons. Remember: reduction at the cathode.

Q70. Which metal is used to coat iron in galvanisation to prevent rusting?

A	Copper
B	**Zinc** ✓
C	Gold
D	Lead

Answer: B. Explanation: Zinc is more reactive than iron, so it corrodes first and protects the iron beneath.

Quick Answer Key

Tap a question number to jump back to it

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6 : C	7 : A	8 : B	9 : A	10 : D
11 : B	12 : B	13 : A	14 : C	15 : D
16 : C	17 : A	18 : B	19 : A	20 : A
21 : B	22 : A	23 : D	24 : C	25 : C
26 : A	27 : C	28 : D	29 : D	30 : C
31 : B	32 : A	33 : D	34 : A	35 : C
36 : A	37 : B	38 : C	39 : A	40 : A
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SESSION COMPLETE



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