

AQA (GCSE Notes)

Chapter 1: Atomic Structure and the Periodic Table

- Q1.** What is an atom and how is it related to an element?
- Q2.** Why is an atom considered the smallest part of an element?
- Q3.** What does the symbol 'O' represent in terms of atomic structure?
- Q4.** What is meant by a chemical symbol and give two examples?
- Q5.** How many elements are approximately found in the periodic table?
- Q6.** What is the periodic table and what does it show?
- Q7.** What is a compound and how is it formed?
- Q8.** Why do chemical reactions lead to the formation of new substances?
- Q9.** What kind of energy changes can be observed during chemical reactions?
- Q10.** Why must compounds have fixed proportions of elements?
- Q11.** How are compounds represented using chemical symbols?
- Q12.** Why can't compounds be separated into elements by physical processes?
- Q13.** Describe how a chemical reaction can be represented using a word equation.
- Q14.** What is the difference between a word equation and a symbol equation?
- Q15.** Give an example of a chemical formula for a compound and explain what it shows.
- Q16.** What does it mean to balance a chemical equation?
- Q17.** What is the significance of using correct chemical symbols when writing formulae?
- Q18.** Write the symbol for an atom of sodium and an atom of chlorine.
- Q19.** Name the compound formed when magnesium reacts with oxygen.
- Q20.** Why is it important to learn the names and symbols of the first 20 elements?
- Q21.** What are Group 1 elements known as and give one of their properties?
- Q22.** What are Group 7 elements known as and give one of their properties?

- Q23.** How would you name a compound formed from potassium and bromine?
- Q24.** Write a word equation for the reaction between hydrogen and oxygen to form water.
- Q25.** Write the balanced chemical equation for the reaction between sodium and chlorine.
- Q26.** What is a half equation and when is it used?
- Q27.** What is an ionic equation and how does it differ from a full equation?
- Q28.** Define a mixture in simple terms.
- Q29.** How is a mixture different from a compound?
- Q30.** Why do the substances in a mixture keep their own chemical properties?
- Q31.** What is filtration used for in separating mixtures?
- Q32.** Describe the process of crystallisation and what it is used for.
- Q33.** When is simple distillation used to separate a mixture?
- Q34.** What is the purpose of fractional distillation?
- Q35.** Describe how chromatography works in separating mixtures.
- Q36.** Why are physical processes used to separate mixtures?
- Q37.** Explain why no new substances are formed during the separation of mixtures.
- Q38.** Suggest a method to separate salt from a saltwater solution.
- Q39.** Which separation technique would you use to separate two miscible liquids with different boiling points?
- Q40.** What technique would you use to separate the coloured components of ink?
- Q41.** Why is chromatography useful for identifying substances?
- Q42.** Give an example of when fractional distillation is used in real life.
- Q43.** What safety measures should be taken when using a Bunsen burner during separation?
- Q44.** Why is it important to use clean and dry equipment when separating mixtures?
- Q45.** What is the role of the condenser in simple distillation?
- Q46.** Describe a step-by-step method for separating a mixture of sand and salt.
- Q47.** What would you observe when sugar is separated from a sugar solution by crystallisation?

- Q48.** How would you separate iron filings from a mixture of iron and sulfur?
- Q49.** Suggest a suitable method for purifying water in a science lab.
- Q50.** Why should separation techniques be chosen based on the properties of the substances in the mixture?
- Q51.** What did scientists believe about atoms before the discovery of the electron?
- Q52.** What was the plum pudding model of the atom?
- Q53.** How did the discovery of the electron lead to the plum pudding model?
- Q54.** What did the plum pudding model suggest about the structure of the atom?
- Q55.** Describe how electrons were positioned in the plum pudding model.
- Q56.** What is the main difference between the plum pudding model and the nuclear model?
- Q57.** What experiment led to the rejection of the plum pudding model?
- Q58.** What happened during the alpha particle scattering experiment?
- Q59.** What did scientists expect to happen in the alpha scattering experiment if the plum pudding model was correct?
- Q60.** What unexpected result came from the alpha particle scattering experiment?
- Q61.** What conclusion was made about the atom's mass based on the scattering experiment?
- Q62.** What conclusion was made about the charge of the nucleus after the experiment?
- Q63.** Why did the alpha scattering experiment lead to a new model of the atom?
- Q64.** What is the main idea behind the nuclear model of the atom?
- Q65.** Who suggested that electrons orbit the nucleus at specific distances?
- Q66.** How did Niels Bohr improve the nuclear model?
- Q67.** What did Bohr's model suggest about electron movement?
- Q68.** Why was Bohr's model accepted by scientists?
- Q69.** How did Bohr's theoretical calculations support his model?
- Q70.** What name was given to the small positive particles in the nucleus?
- Q71.** What did later experiments reveal about the charge in the nucleus?

- Q72.** Why was the name “proton” chosen for the positively charged particles?
- Q73.** Who provided evidence for the neutron?
- Q74.** What role did James Chadwick play in atomic theory?
- Q75.** Why was the discovery of the neutron important?
- Q76.** When did James Chadwick provide evidence for neutrons?
- Q77.** What is the charge of a neutron?
- Q78.** Why did it take 20 years after the nucleus was discovered to find the neutron?
- Q79.** What does the modern atomic model include that earlier models did not?
- Q80.** Why do scientific models change over time?
- Q81.** What is meant by a scientific model?
- Q82.** Give an example of how experimental evidence can change scientific ideas.
- Q83.** Why is it important to test scientific theories with experiments?
- Q84.** What role does experimental evidence play in science?
- Q85.** Why is the development of atomic models a good example of how science works?
- Q86.** What was the main limitation of the plum pudding model?
- Q87.** How did the nuclear model explain the deflection of alpha particles?
- Q88.** How did the discovery of subatomic particles change the idea of an atom?
- Q89.** What are the three main subatomic particles?
- Q90.** Where are the protons and neutrons located in the atom?
- Q91.** Where are the electrons found in the modern atomic model?
- Q92.** What is the overall charge of a neutral atom?
- Q93.** Why did the early model describe atoms as solid spheres?
- Q94.** What was learned about atomic structure from the scattering experiment?
- Q95.** What is the significance of most alpha particles passing straight through the gold foil?
- Q96.** Why were only a few alpha particles deflected?

- Q97.** How does the modern atomic model describe electron arrangement?
- Q98.** Why are protons and neutrons in the nucleus?
- Q99.** How does the size of the nucleus compare to the size of the whole atom?
- Q100.** What charge does the nucleus have and why?
- Q101.** What does the term "relative mass" mean in atomic structure?
- Q102.** Why do scientists use relative mass instead of actual mass for subatomic particles?
- Q103.** How does the atomic number help in identifying an element?
- Q104.** Can two different elements have the same atomic number? Explain.
- Q105.** What is the significance of the mass number in an atom?
- Q106.** How is an isotope represented using standard notation?
- Q107.** Why are the physical properties of isotopes different?
- Q108.** Why is the electron's mass often considered negligible in calculations?
- Q109.** If an atom has an atomic number of 15, how many electrons does it have?
- Q110.** If an atom has 20 protons and 20 neutrons, what is its mass number?
- Q111.** What is the role of neutrons in the nucleus?
- Q112.** Why do isotopes of the same element have different mass numbers?
- Q113.** What unit is used to measure the size of atoms?
- Q114.** Convert 0.1 nanometres to metres using standard form.
- Q115.** Why is it useful to express atomic size in standard form?
- Q116.** What does 1×10^{-10} metres represent in terms of atomic structure?
- Q117.** What is the relationship between atomic radius and the size of the nucleus?
- Q118.** How do you determine the number of subatomic particles in an atom?
- Q119.** If an atom has a charge of $2+$, what does that tell you about its electrons?
- Q120.** Why do ions form from atoms?
- Q121.** What happens to the number of electrons when an atom forms a negative ion?

- Q122.** Why does the nucleus remain unchanged when an atom becomes an ion?
- Q123.** What keeps the electrons in orbit around the nucleus?
- Q124.** Why is most of the atom considered empty space?
- Q125.** What causes atoms to have different chemical properties?
- Q126.** How can atoms of the same element differ in mass?
- Q127.** What is the typical diameter of a nucleus in standard form?
- Q128.** How much of an atom's mass is due to electrons?
- Q129.** How many electrons are in a fluoride ion?
- Q130.** If an atom of aluminium has 13 protons and 10 electrons, what is its charge?
- Q131.** What is the name of the particle with no charge found in the nucleus?
- Q132.** How does the number of electrons change in a positive ion?
- Q133.** What holds protons and neutrons together in the nucleus?
- Q134.** Why is it useful to use atomic models in science?
- Q135.** What information is needed to draw a nuclear symbol?
- Q136.** How do we know atoms are mostly empty space?
- Q137.** Why do atoms of noble gases not easily form ions?
- Q138.** If two atoms have the same number of protons but different electrons, are they the same element?
- Q139.** What is the difference between a hydrogen atom and a hydrogen ion?
- Q140.** How do you find the total number of particles in the nucleus?
- Q141.** Which subatomic particle determines the chemical identity of an atom?
- Q142.** What does it mean if an element has a mass number of 1?
- Q143.** How are atoms arranged in the periodic table?
- Q144.** What does a nuclear model diagram show?
- Q145.** How does the nuclear model explain atomic mass?
- Q146.** What is the value of nano in standard form?

- Q147.** Why can't neutrons be used to identify elements?
- Q148.** How do scientists measure the mass of subatomic particles?
- Q149.** What is meant by the term "mass number minus atomic number"?
- Q150.** Why do models of the atom keep improving over time?
- Q151.** What is meant by the term relative atomic mass?
- Q152.** Why is the relative atomic mass of an element often not a whole number?
- Q153.** How do you calculate the relative atomic mass from isotope abundances?
- Q154.** What is percentage abundance in relation to isotopes?
- Q155.** Why do isotopes affect the average atomic mass of an element?
- Q156.** What two pieces of data are needed to calculate relative atomic mass?
- Q157.** What would happen to the relative atomic mass if one isotope was more abundant?
- Q158.** How can you calculate the relative atomic mass when an element has two isotopes?
- Q159.** If an element has three isotopes, how would you calculate the average atomic mass?
- Q160.** Why do chemists use relative atomic mass instead of actual atomic mass?
- Q161.** What is meant by electronic structure?
- Q162.** What does the electronic structure 2,8,1 tell you about an atom?
- Q163.** How are electrons arranged in energy levels?
- Q164.** What is the maximum number of electrons in the first energy level?
- Q165.** How many electrons can be held in the second energy level?
- Q166.** Why do electrons fill the lowest energy levels first?
- Q167.** How does the electronic structure relate to the period number in the periodic table?
- Q168.** What do all elements in the same group of the periodic table have in common?
- Q169.** What is the electronic structure of a magnesium atom?
- Q170.** What is the electronic structure of a nitrogen atom?
- Q171.** What do the numbers in the electronic structure represent?

- Q172.** How is the number of outer electrons related to the group number?
- Q173.** How can the electronic structure be shown in a diagram?
- Q174.** Why are electronic structures important in predicting chemical behaviour?
- Q175.** What is the link between reactivity and electronic configuration?
- Q176.** How does the electronic structure of noble gases explain their lack of reactivity?
- Q177.** What happens to the electronic structure when an atom becomes an ion?
- Q178.** Why do metals lose electrons and non-metals gain electrons?
- Q179.** How does the periodic table arrange elements?
- Q180.** Why is the periodic table called "periodic"?
- Q181.** What does the group number tell you about an element?
- Q182.** What does the period number tell you about an element?
- Q183.** How can the position of an element in the periodic table help predict its reactivity?
- Q184.** Which side of the periodic table contains metals?
- Q185.** Why are elements in Group 1 so reactive?
- Q186.** Why do Group 7 elements become less reactive down the group?
- Q187.** What type of ions do Group 1 elements form?
- Q188.** What type of ions do Group 7 elements form?
- Q189.** How is the modern periodic table different from early versions?
- Q190.** Why are transition metals placed in a separate block in the periodic table?
- Q191.** What property is shared by elements in Group 0?
- Q192.** How can you predict the properties of an unknown element using the periodic table?
- Q193.** What happens to the number of protons as you move across a period?
- Q194.** What happens to the number of electron shells as you go down a group?
- Q195.** Why do elements in the same group have similar reactions?
- Q196.** What element is in Group 2 and Period 3 of the periodic table?

- Q197.** What element is in Group 6 and Period 2 of the periodic table?
- Q198.** How can you use atomic number to place an element in the periodic table?
- Q199.** Why do elements in Group 1 react violently with water?
- Q200.** How can electronic structure help explain trends in reactivity?
- Q201.** Describe how Mendeleev arranged elements in his periodic table.
- Q202.** Why did Mendeleev leave gaps in his periodic table?
- Q203.** How did Mendeleev use predictions to support his periodic table?
- Q204.** What was unusual about the way Mendeleev arranged some elements?
- Q205.** Why did Mendeleev not always follow the order of atomic weight?
- Q206.** How did the discovery of isotopes support Mendeleev's decisions?
- Q207.** What is the importance of testing scientific predictions?
- Q208.** Give an example of how a scientific idea can be supported by experiment.
- Q209.** How can predictions be used to test a new scientific theory?
- Q210.** What does it mean when a scientific prediction is refuted?
- Q211.** Why were early periodic tables considered incomplete?
- Q212.** What made Mendeleev's periodic table more successful than earlier ones?
- Q213.** How did the discovery of new elements confirm Mendeleev's ideas?
- Q214.** What is meant by the term "atomic weight"?
- Q215.** How does atomic number differ from atomic weight?
- Q216.** Why is the modern periodic table arranged by atomic number?
- Q217.** Where are metals found on the periodic table?
- Q218.** Where are non-metals located in the periodic table?
- Q219.** Why do metals tend to form positive ions?
- Q220.** Why do non-metals usually not form positive ions?
- Q221.** How does the position of an element relate to its reactivity?

- Q222.** Explain how electron arrangement affects how an element reacts.
- Q223.** Why do elements in the same group react in similar ways?
- Q224.** What is the link between group number and number of outer electrons?
- Q225.** How does atomic structure influence whether an element is a metal or non-metal?
- Q226.** Why are most elements in the periodic table metals?
- Q227.** How can you tell if an element is likely to be a metal from its position?
- Q228.** What are some physical properties typical of metals?
- Q229.** What are some physical properties typical of non-metals?
- Q230.** Describe a key chemical property of metals.
- Q231.** Describe a key chemical property of non-metals.
- Q232.** How does the electronic structure of a metal relate to its chemical properties?
- Q233.** How does the electronic structure of a non-metal relate to its chemical properties?
- Q234.** What happens to reactivity as you move down Group 1?
- Q235.** What happens to reactivity as you move up Group 7?
- Q236.** Why are Group 0 elements unreactive?
- Q237.** What type of bonding do metals usually form?
- Q238.** What type of bonding do non-metals usually form?
- Q239.** How does the number of shells change as you go down a group?
- Q240.** Why do Group 1 metals react more violently down the group?
- Q241.** How does the size of an atom affect how easily it loses electrons?
- Q242.** How does the attraction between nucleus and outer electrons affect reactivity?
- Q243.** What do elements in the same period have in common?
- Q244.** What do elements in the same group have in common?
- Q245.** Why are transition metals placed in the centre of the periodic table?
- Q246.** How are the properties of transition metals different from Group 1 metals?

- Q247.** How does the periodic table help predict the properties of elements?
- Q248.** Why was arranging elements by atomic number more accurate than by atomic weight?
- Q249.** What role did the understanding of subatomic particles play in improving the periodic table?
- Q250.** How can the periodic table be used to predict the type of ion an element will form?
- Q251.** Why are the elements in Group 0 called noble gases?
- Q252.** Why are noble gases generally unreactive?
- Q253.** What is the outer electron configuration of helium?
- Q254.** What is the outer electron configuration of neon?
- Q255.** Why does helium only have two electrons in total?
- Q256.** How does the full outer shell make noble gases stable?
- Q257.** What is the trend in boiling points of Group 0 elements as you go down the group?
- Q258.** Why do the boiling points of noble gases increase down the group?
- Q259.** How does relative atomic mass affect the boiling point in Group 0?
- Q260.** Predict the boiling point trend for a newly discovered noble gas below radon.
- Q261.** How do noble gases exist at room temperature?
- Q262.** Why do noble gases not form molecules under normal conditions?
- Q263.** How can the trend in boiling points help identify an unknown noble gas?
- Q264.** What would you expect about the density of noble gases down the group?
- Q265.** Why does the density of noble gases increase as you go down the group?
- Q266.** How are the noble gases used in everyday life due to their unreactivity?
- Q267.** Why are noble gases used in light bulbs?
- Q268.** Why is helium used in balloons instead of hydrogen?
- Q269.** Describe the appearance and state of xenon at room temperature.
- Q270.** What would be the expected chemical reaction of argon with sodium?
- Q271.** Why do Group 1 elements have similar chemical properties?

- Q272.** How many electrons are in the outer shell of a Group 1 element?
- Q273.** What is meant by the term “alkali metals”?
- Q274.** Describe what happens when lithium reacts with water.
- Q275.** Describe what happens when sodium reacts with water.
- Q276.** How is the reaction of potassium with water different from that of lithium?
- Q277.** What gas is produced when Group 1 metals react with water?
- Q278.** What type of solution is formed when Group 1 metals react with water?
- Q279.** Write a word equation for the reaction between sodium and water.
- Q280.** Why does reactivity increase down Group 1?
- Q281.** How does the atomic structure of potassium explain its higher reactivity?
- Q282.** Describe the reaction of sodium with chlorine.
- Q283.** Why is it dangerous to store alkali metals in air?
- Q284.** What precaution is taken when storing alkali metals?
- Q285.** What is observed when lithium reacts with oxygen?
- Q286.** Why do Group 1 metals form +1 ions?
- Q287.** What is the product when potassium reacts with chlorine?
- Q288.** How does the size of Group 1 atoms affect their reactivity?
- Q289.** Predict the reactivity of rubidium with water based on the group trend.
- Q290.** What happens when Group 1 metals react with non-metals?
- Q291.** How do halogens exist at room temperature?
- Q292.** Why do halogens form diatomic molecules?
- Q293.** How many electrons are in the outer shell of a Group 7 element?
- Q294.** Why do halogens have similar chemical properties?
- Q295.** Describe what happens when chlorine reacts with iron.
- Q296.** What kind of compounds do halogens form with metals?

Q297. Why does reactivity decrease down Group 7?

Q298. What happens when chlorine is added to a solution of potassium iodide?

Q299. What is observed when bromine displaces iodine in a solution?

Q300. Predict the outcome of a reaction between fluorine and potassium chloride.

Q301. Explain why the melting point of iron is much higher than that of sodium.

Q302. How does the density of copper compare with that of potassium, and what does this show about their atomic structures?

Q303. Describe one practical method a student could use to compare the hardness of chromium and lithium.

Q304. Why is manganese considered stronger than any Group 1 metal when both are subjected to the same mechanical force?

Q305. Discuss how cobalt's reactivity with cold water differs from that of sodium under the same conditions.

Q306. Outline why nickel does not catch fire in air as quickly as potassium does.

Q307. State the reaction products when copper is heated strongly in oxygen and compare this with the reaction of lithium under the same conditions.

Q308. Suggest a reason why iron filings rust in damp air but lithium turns dull grey much faster.

Q309. Describe the colour change seen when an iron(II) salt is oxidised to iron(III) and explain the change in ion charge.

Q310. Explain why transition metals such as cobalt form more than one stable ion, whereas sodium forms only Na^+ .

Q311. How does the catalytic ability of nickel in hydrogenation reactions reflect typical transition-metal behaviour?

Q312. Chromium forms green Cr^{3+} solutions and yellow CrO_4^{2-} solutions. What does this reveal about variable oxidation states in transition elements?

Q313. A student adds chlorine gas to an aqueous solution of Fe^{2+} ions. Predict the main observations and justify your answer.

Q314. Why does copper not react vigorously with dilute hydrochloric acid while potassium does?

Q315. Outline an experiment to compare the rate at which magnesium ribbon and iron filings react with oxygen at room temperature.

- Q316.** Explain why cobalt can act as a catalyst in the Fischer–Tropsch process, whereas lithium cannot.
- Q317.** State the observations when nickel metal is placed in cold water for one hour.
- Q318.** Why does iron(III) chloride appear yellow-brown in solution, whereas sodium chloride is colourless?
- Q319.** Describe how the strength of a chromium bar can be tested and compared with that of a potassium rod.
- Q320.** Give a reason why manganese can form both Mn^{2+} and MnO_4^- ions, but sodium cannot form Na^{2+} or NaO_2^- ions.
- Q321.** Predict what would happen if a piece of copper is lowered into molten sodium bromide and explain your reasoning.
- Q322.** How does the hardness of nickel influence its use in everyday objects compared with the softness of Group 1 metals?
- Q323.** Suggest why copper pipes resist corrosion better than iron pipes in ordinary tap water.
- Q324.** Describe a simple test that distinguishes between aqueous Fe^{2+} and Fe^{3+} ions using sodium hydroxide solution.
- Q325.** Explain how ligand exchange reactions in transition metals give rise to colour changes, using aqueous copper complexes as an example.
- Q326.** Compare the behaviour of chromium and sodium when both are exposed to dry chlorine gas at room temperature.
- Q327.** Why do transition metals generally have higher tensile strength than Group 1 metals?
- Q328.** Outline why the density trend across Cr, Mn, Fe, Co, Ni, Cu does not mirror the trend in Group 1 metals.
- Q329.** Describe the effect of adding ammonia to a solution of copper(II) sulfate and explain the colour changes observed.
- Q330.** Explain why potassium must be stored under oil but copper can be left in air without serious risk.
- Q331.** Discuss how variable oxidation states in iron contribute to its role in biological systems such as haemoglobin.
- Q332.** A student heats cobalt metal in steam. Predict the main chemical change and write a word equation.

Q333. Why are transition-metal ions often coloured, while most Group 1 metal ions are colourless in solution?

Q334. Evaluate the suitability of manganese dioxide as a catalyst in the decomposition of hydrogen peroxide compared with a Group 1 metal compound.

Q335. State two properties of nickel that make it useful in making stainless steel.

Q336. Compare the lattice energies of sodium chloride and iron(III) oxide and relate these to their melting points.

Q337. Suggest why the electrical conductivity of copper is higher than that of lithium even though both are metals.

Q338. Describe how the reactivity of iron with dilute acids differs from that of potassium and explain why.

Q339. Explain the term “complex ion” and give an example involving chromium(III).

Q340. Predict the products when iron reacts with bromine vapour and justify your answer in terms of oxidation states.

Q341. Why does adding chloride ions to a cobalt(II) solution change its colour from pink to blue?

Q342. Discuss the significance of high density in copper when it is used for electrical wiring.

Q343. Outline an investigation to compare the catalytic actions of cobalt and nickel in the hydrogenation of vegetable oils.

Q344. Explain why transition metals show magnetic properties, using iron as an example.

Q345. Describe what is meant by disproportionation and give an example involving manganese compounds.

Q346. Compare the behaviour of chromium and lithium in a flame test and account for any colour observed.

Q347. Why is copper sulphate solution blue, and how would the colour change if the copper(II) ions were reduced to copper(I)?

Q348. State why sodium ions do not act as catalysts in industrial chemical processes, but iron ions do.

Q349. Predict how the hardness of cobalt affects its machinability compared with the softness of sodium.

Q350. Explain why adding a small amount of carbon can further strengthen iron, whereas similar alloying with potassium is not feasible.

Grade Up