

## 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?



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- 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?



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- 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?



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- 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?



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- Q116.** What does  $1 \times 10^{-10}$  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?



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- 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?



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- 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?



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- 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?



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- 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?



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**LECTURE**

- 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?



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**LECTURE**

- 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.



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- 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?



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**LECTURE**

- 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  $\text{Na}^+$ .
- Q311.** How does the catalytic ability of nickel in hydrogenation reactions reflect typical transition-metal behaviour?
- Q312.** Chromium forms green  $\text{Cr}^{3+}$  solutions and yellow  $\text{CrO}_4^{2-}$  solutions. What does this reveal about variable oxidation states in transition elements?
- Q313.** A student adds chlorine gas to an aqueous solution of  $\text{Fe}^{2+}$  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  $\text{Mn}^{2+}$  and  $\text{MnO}_4^-$  ions, but sodium cannot form  $\text{Na}^{2+}$  or  $\text{NaO}_2^-$  ions.



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- 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  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  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.



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- 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.