

AQA (GCSE Notes)

Chapter 2: Bonding, Structure, and the Properties of Matter

- Q1. Describe the type of particles involved in ionic bonding.
- Q2. Explain why metals form positive ions when they react.
- Q3. Explain how a chlorine atom becomes a chloride ion.
- Q4. Why do non-metals gain electrons in ionic bonding?
- Q5. Describe what happens to the electrons when sodium reacts with chlorine.
- Q6. Why are ionic bonds described as strong electrostatic forces?
- Q7. What is the electronic structure of a magnesium ion?
- Q8. What is the electronic structure of an oxide ion?
- Q9. How does the group number of an element help predict its ion charge?
- Q10. Draw a dot and cross diagram to show the bonding in calcium chloride.
- Q11. Why do compounds made from Group 1 and Group 7 elements form ionic bonds?
- Q12. How do atoms in a covalent bond achieve a full outer shell?
- Q13. Explain the difference between single and double covalent bonds.
- Q14. Describe the bonding in a hydrogen molecule.
- Q15. How is a molecule of oxygen held together?
- Q16. Explain why nitrogen forms three covalent bonds.
- Q17. What type of bonding is found in carbon dioxide?
- Q18. Describe the electron arrangement of a fluoride ion.
- Q19. Why is magnesium oxide an ionic compound?
- Q20. Why do ionic compounds have high melting points?
- Q21. What is meant by a delocalised electron in metallic bonding?

- Q22.** Why are metals good conductors of electricity?
- Q23.** Describe the structure of a metal in terms of particles.
- Q24.** Explain how metallic bonding gives metals high melting points.
- Q25.** What is an alloy and how does its bonding differ from pure metals?
- Q26.** What ions are formed when calcium reacts with oxygen?
- Q27.** Why do Group 2 metals form ions with a 2+ charge?
- Q28.** Why do Group 7 elements form ions with a 1- charge?
- Q29.** Compare the bonding in sodium chloride and oxygen gas.
- Q30.** Describe how lithium fluoride is formed from its atoms.
- Q31.** Explain why Group 1 metals react more strongly as you go down the group.
- Q32.** Draw a dot and cross diagram to show the bonding in sodium oxide.
- Q33.** Why do ionic compounds conduct electricity when molten but not when solid?
- Q34.** Describe how potassium reacts with bromine to form an ionic compound.
- Q35.** What is the charge on the ions in aluminium chloride?
- Q36.** How does the structure of sodium chloride explain its properties?
- Q37.** Describe what happens during the formation of magnesium sulfide.
- Q38.** Why is covalent bonding found in non-metallic elements?
- Q39.** Explain why diamond is a non-metal but has a very high melting point.
- Q40.** Describe the bonding in a molecule of ammonia.
- Q41.** Why do some elements form covalent bonds instead of ionic ones?
- Q42.** What is meant by electrostatic attraction in chemical bonding?
- Q43.** Why do covalent molecules have low melting and boiling points?
- Q44.** Compare the type of bonding in magnesium and carbon dioxide.
- Q45.** How can dot and cross diagrams show the transfer of electrons in ionic bonding?



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- Q46.** Why do noble gases not form chemical bonds?
- Q47.** Why is it easier to form an ion with fluorine than with oxygen?
- Q48.** Describe how bonding changes the properties of elements when they form compounds.
- Q49.** Give an example of a compound with both ionic and covalent bonds.
- Q50.** Explain why a compound made from calcium and fluorine is an ionic compound.
- Q51.** Explain why ionic compounds form giant lattice structures.
- Q52.** Describe the forces that hold ions together in an ionic lattice.
- Q53.** What is meant by the term “electrostatic attraction” in ionic bonding?
- Q54.** Why are the electrostatic forces in an ionic compound described as acting in all directions?
- Q55.** Describe how the structure of sodium chloride can be represented in 2D.
- Q56.** What information is missing from a ball and stick model of an ionic compound?
- Q57.** How can you tell from a diagram that a compound has ionic bonding?
- Q58.** What is a limitation of using a dot and cross diagram to show an ionic structure?
- Q59.** Why do ball and stick models of ionic compounds often exaggerate the distances between ions?
- Q60.** What are the limitations of using a 2D representation of an ionic lattice?
- Q61.** What is meant by the term “giant ionic structure”?
- Q62.** How can a 3D model help us understand the properties of ionic compounds?
- Q63.** Describe how to work out the empirical formula of an ionic compound from a model.
- Q64.** If a diagram shows 6 Na^+ ions and 6 Cl^- ions, what is the empirical formula?
- Q65.** What is the advantage of showing ions in different colours in a ball and stick diagram?
- Q66.** Why does sodium chloride form a regular, repeating structure?
- Q67.** Why are ions arranged in a fixed pattern in an ionic solid?
- Q68.** How does the structure of sodium chloride explain its melting point?
- Q69.** What type of bonding involves the transfer of electrons?

- Q70.** Describe the key difference between ionic and covalent bonding.
- Q71.** What happens to the outer electrons when two hydrogen atoms form a bond?
- Q72.** Why are covalent bonds considered strong?
- Q73.** What does a line between two atoms represent in a covalent molecule?
- Q74.** Draw a dot and cross diagram to show the bonding in a water molecule.
- Q75.** How is a nitrogen molecule held together?
- Q76.** What is the difference between a single and triple covalent bond?
- Q77.** Describe the bonding in a molecule of methane.
- Q78.** Why do small covalent molecules have low melting and boiling points?
- Q79.** Name two substances that consist of small covalent molecules.
- Q80.** What is the molecular formula of a chlorine molecule?
- Q81.** How can you tell if a substance is a polymer from its diagram?
- Q82.** What does the 'n' represent in a polymer diagram?
- Q83.** Explain what is meant by a repeating unit in a polymer.
- Q84.** What is the difference between a small molecule and a polymer?
- Q85.** Why are polymers usually solids at room temperature?
- Q86.** Give one example of a giant covalent structure.
- Q87.** Describe how atoms are bonded in a diamond structure.
- Q88.** Why does diamond have a high melting point?
- Q89.** How is silicon dioxide similar to diamond?
- Q90.** What type of bonding holds atoms together in a giant covalent structure?
- Q91.** Draw a dot and cross diagram for a molecule of hydrogen chloride.
- Q92.** What are the limitations of dot and cross diagrams for covalent molecules?
- Q93.** Why do ball and stick models sometimes give a misleading view of molecules?

- Q94.** Describe one limitation of using 2D diagrams to show molecular structures.
- Q95.** What is one benefit of using a 3D ball and stick model?
- Q96.** How can you deduce the molecular formula from a diagram of a covalent molecule?
- Q97.** How many covalent bonds does each carbon atom form in diamond?
- Q98.** What type of diagram is best for showing the shape of a molecule?
- Q99.** Why might different diagrams be used to show the same molecule?
- Q100.** How can the structure of a substance help identify its type of bonding?
- Q101.** Describe the arrangement of atoms in a metallic structure.
- Q102.** What is meant by a delocalised electron in metallic bonding?
- Q103.** Explain how metallic bonds hold metal atoms together.
- Q104.** Why do metals conduct electricity?
- Q105.** How does the structure of a metal contribute to its malleability?
- Q106.** Why do metals have high melting and boiling points?
- Q107.** What role do delocalised electrons play in thermal conductivity?
- Q108.** Describe the forces acting in a metallic bond.
- Q109.** Why can metals be bent and shaped?
- Q110.** How does a giant metallic lattice differ from an ionic lattice?
- Q111.** Explain why alloys are harder than pure metals.
- Q112.** How can a 2D diagram show metallic bonding?
- Q113.** What does a 3D model of a metal lattice show more clearly than a 2D model?
- Q114.** Why are giant metallic structures strong?
- Q115.** What happens to the structure of a metal when it melts?
- Q116.** State the three states of matter.
- Q117.** At what point does a solid become a liquid?



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- Q118.** What does the particle model use to represent particles?
- Q119.** Describe the arrangement of particles in a solid.
- Q120.** How are particles arranged in a liquid?
- Q121.** Explain the movement of gas particles in the particle model.
- Q122.** What changes occur to particles during melting?
- Q123.** What happens to the energy of particles during boiling?
- Q124.** Why do substances with strong bonds have higher boiling points?
- Q125.** How does the type of bonding affect melting point?
- Q126.** Describe what happens when a gas condenses.
- Q127.** Why does energy need to be transferred for a solid to melt?
- Q128.** How does particle theory explain the freezing process?
- Q129.** What is the melting point of a substance?
- Q130.** What is the boiling point of a substance?
- Q131.** How can you predict the state of a substance at a given temperature?
- Q132.** What type of bonding is found in substances with very high boiling points?
- Q133.** How does particle movement differ between solids and liquids?
- Q134.** Describe the energy changes during condensation.
- Q135.** Why do gases expand to fill their container?
- Q136.** What are the main limitations of the simple particle model?
- Q137.** Why is it incorrect to show particles as solid spheres?
- Q138.** How does the simple model fail to show forces between particles?
- Q139.** Why is the particle model useful despite its limitations?
- Q140.** Explain why atoms do not have the same properties as bulk materials.
- Q141.** What happens to the particle spacing when a solid melts?



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- Q142.** What is meant by the term "state change"?
- Q143.** Why does boiling require more energy than melting?
- Q144.** How can bonding explain the difference in melting points between sodium and magnesium?
- Q145.** Why does a covalent molecular substance have a low boiling point?
- Q146.** Describe how you could identify a substance's state at room temperature using its melting and boiling points.
- Q147.** Why does increasing temperature make particles move faster?
- Q148.** How do strong forces between particles affect the physical state?
- Q149.** What happens to the kinetic energy of particles as a liquid cools and freezes?
- Q150.** How does the structure of a substance influence its state at a specific temperature?
- Q151.** What state symbol would you use for sodium chloride dissolved in water?
- Q152.** Why do we include state symbols in chemical equations?
- Q153.** What does the state symbol (g) represent in a chemical equation?
- Q154.** What is the meaning of the state symbol (aq)?
- Q155.** When does an ionic compound conduct electricity?
- Q156.** Why do solid ionic compounds not conduct electricity?
- Q157.** Explain why molten ionic compounds can conduct electricity.
- Q158.** What is a giant ionic lattice?
- Q159.** Describe the forces that hold ions together in an ionic compound.
- Q160.** Why do ionic compounds have high boiling points?
- Q161.** How does the structure of an ionic compound explain its melting point?
- Q162.** What happens to the ions in an ionic compound when it dissolves in water?
- Q163.** Why is sodium chloride a poor conductor when solid but a good conductor when molten?
- Q164.** Why is a large amount of energy needed to melt an ionic compound?



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- Q165.** What type of bonding is found in sodium bromide?
- Q166.** Describe the movement of ions in a liquid ionic compound.
- Q167.** What determines the strength of the electrostatic forces in an ionic compound?
- Q168.** Why do small molecules have low melting and boiling points?
- Q169.** What are intermolecular forces?
- Q170.** How do intermolecular forces affect boiling point?
- Q171.** Why are substances with small molecules usually gases or liquids?
- Q172.** Why do small covalent molecules not conduct electricity?
- Q173.** What happens to intermolecular forces as molecule size increases?
- Q174.** Explain why covalent bonds are not broken when molecular substances melt.
- Q175.** Compare the strength of intermolecular forces with covalent bonds.
- Q176.** Why do substances with strong intermolecular forces have higher melting points?
- Q177.** Give one example of a substance that consists of small molecules.
- Q178.** How can the structure of a molecule help predict its physical state?
- Q179.** Why can molecular substances not carry electric current?
- Q180.** Describe the bonding in a polymer.
- Q181.** What type of bonds hold atoms together in a polymer chain?
- Q182.** Why are polymers usually solids at room temperature?
- Q183.** What is the repeating unit of a polymer?
- Q184.** How do the intermolecular forces between polymer chains affect melting point?
- Q185.** Why do polymers have higher melting points than simple molecular substances?
- Q186.** How can you recognise a polymer from its structural diagram?
- Q187.** What is the role of covalent bonds in polymer chains?
- Q188.** Why can polymers be soft or hard depending on their structure?



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- Q189.** Compare the forces between molecules in small molecules and polymers.
- Q190.** What does 'n' represent in a polymer structure diagram?
- Q191.** Describe the bonding in a giant covalent structure.
- Q192.** Why does diamond have a very high melting point?
- Q193.** What type of bonding is found in silicon dioxide?
- Q194.** Why are giant covalent structures hard and rigid?
- Q195.** How is graphite different from diamond in structure?
- Q196.** Why can graphite conduct electricity?
- Q197.** Describe the structure of diamond using a diagram.
- Q198.** What makes silicon dioxide similar to diamond?
- Q199.** Why do atoms in giant covalent structures not move freely?
- Q200.** How can you tell from a diagram that a substance has a giant covalent structure?
- Q201.** Why do metals have high melting points?
- Q202.** What is meant by a giant metallic structure?
- Q203.** Explain how delocalised electrons allow metals to conduct electricity.
- Q204.** Why are metals good conductors of thermal energy?
- Q205.** Describe how the structure of a metal allows it to be bent and shaped.
- Q206.** Why are pure metals often too soft for everyday use?
- Q207.** What is an alloy and how is it formed?
- Q208.** Explain why alloys are harder than pure metals.
- Q209.** What happens to the layers of atoms in a metal when it is alloyed?
- Q210.** Why does adding another metal to a pure metal make it less malleable?
- Q211.** How does the arrangement of atoms change when a pure metal becomes an alloy?
- Q212.** Give an example of an alloy and describe its use.

- Q213.** Why do delocalised electrons play a key role in metallic bonding?
- Q214.** What are the physical properties shared by most metals?
- Q215.** Explain why metals are shiny.
- Q216.** Describe the bonding that holds a metal together.
- Q217.** Why are delocalised electrons free to move in metals?
- Q218.** What causes the metallic bond to be strong?
- Q219.** Describe what happens to the atoms in a metal when it is stretched.
- Q220.** Why do different metals have different melting points?
- Q221.** Compare the electrical conductivity of copper and iron and explain the difference.
- Q222.** What is the difference between thermal conductivity and electrical conductivity in metals?
- Q223.** Why is copper often used in electrical wiring?
- Q224.** Explain the role of mobile electrons in metal conductivity.
- Q225.** What is meant by a 'sea of electrons' in metallic bonding?
- Q226.** Why does diamond not conduct electricity?
- Q227.** What type of structure does diamond have?
- Q228.** Why is diamond so hard?
- Q229.** How many covalent bonds does each carbon atom form in diamond?
- Q230.** Why does diamond have a high melting point?
- Q231.** Describe the arrangement of atoms in a diamond crystal.
- Q232.** How does the bonding in diamond make it useful in cutting tools?
- Q233.** Compare the bonding in diamond and graphite.
- Q234.** Why can graphite conduct electricity but diamond cannot?
- Q235.** How many covalent bonds does each carbon atom form in graphite?
- Q236.** What gives graphite its slippery feel?

- Q237.** Describe the arrangement of layers in graphite.
- Q238.** Why are there no covalent bonds between layers in graphite?
- Q239.** How do delocalised electrons behave in graphite?
- Q240.** Why is graphite used as a lubricant?
- Q241.** Compare the melting points of diamond and graphite and explain any similarity.
- Q242.** Describe how the bonding in graphite is similar to metals.
- Q243.** Why does graphite have a high melting point?
- Q244.** What is the shape of the carbon rings in graphite?
- Q245.** Explain how the structure of graphite allows it to be used in pencils.
- Q246.** What is meant by delocalised electron in the context of graphite?
- Q247.** How does the bonding in diamond differ from that in graphite?
- Q248.** What makes graphite soft even though it has strong covalent bonds?
- Q249.** Why does diamond not have layers like graphite?
- Q250.** What makes both diamond and graphite examples of giant covalent structures?
- Q251.** What is graphene and how is it related to graphite?
- Q252.** Describe the bonding in graphene.
- Q253.** Explain why graphene can conduct electricity.
- Q254.** Why is graphene strong even though it is only one atom thick?
- Q255.** Describe one use of graphene in electronics.
- Q256.** How does the structure of graphene affect its properties?
- Q257.** What are fullerenes made of?
- Q258.** Describe the structure of Buckminsterfullerene (C_{60}).
- Q259.** How are the atoms arranged in a fullerene?
- Q260.** What types of rings are found in fullerenes?



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- Q261.** What is a carbon nanotube?
- Q262.** Describe the shape and size ratio of carbon nanotubes.
- Q263.** Explain why carbon nanotubes are useful in nanotechnology.
- Q264.** What are some uses of fullerenes in medicine?
- Q265.** Why are fullerenes good lubricants?
- Q266.** How can carbon nanotubes be used in electronics?
- Q267.** Describe one difference between graphene and fullerenes.
- Q268.** What makes carbon nanotubes strong?
- Q269.** Why are carbon nanotubes good conductors of electricity?
- Q270.** Compare the properties of graphene and carbon nanotubes.
- Q271.** What is meant by the term nanoscience?
- Q272.** How small is a nanoparticle compared to an atom?
- Q273.** What is the size range of nanoparticles?
- Q274.** What is the typical size range of fine particles (PM_{2.5})?
- Q275.** What is the typical size range of coarse particles (PM₁₀)?
- Q276.** Why do nanoparticles have different properties compared to bulk materials?
- Q277.** How does the surface area to volume ratio change as particle size decreases?
- Q278.** Why are nanoparticles useful in medicine?
- Q279.** Give an example of a use of nanoparticles in sunscreen.
- Q280.** Explain how nanoparticles can improve the effectiveness of catalysts.
- Q281.** Why are smaller amounts of nanoparticles needed compared to bulk materials?
- Q282.** What is the risk of using nanoparticles in consumer products?
- Q283.** Describe one advantage of using nanoparticles in electronics.
- Q284.** Explain the potential environmental concern with nanoparticles.



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- Q285.** Compare the properties of bulk silver and silver nanoparticles.
- Q286.** How can nanoparticles be used in drug delivery?
- Q287.** What makes nanoparticles more reactive than larger particles?
- Q288.** Why do scientists study the surface properties of nanoparticles?
- Q289.** Estimate the number of atoms across a nanoparticle 10 nm wide if each atom is 0.1 nm.
- Q290.** Describe the relationship between particle size and surface area to volume ratio.
- Q291.** What kind of bonding is present in graphene and fullerenes?
- Q292.** Why is a high surface area useful in catalytic applications?
- Q293.** How are nanoparticles different from molecules?
- Q294.** Explain why some nanoparticles are used in antimicrobial coatings.
- Q295.** Give a reason why nanoparticles are effective in delivering medicine directly to cells.
- Q296.** What is the standard form of 0.000000002 m?
- Q297.** Calculate the surface area of a cube-shaped nanoparticle with 2 nm sides.
- Q298.** Calculate the surface area to volume ratio of a cube with 1 nm sides.
- Q299.** What is the standard form of a coarse particle with diameter 2.5×10^{-6} m?
- Q300.** Why do nanoparticles show different colours than larger particles made of the same element?
- Q301.** What is a potential benefit of using nanoparticles in drug delivery systems?
- Q302.** Why might nanoparticles be more effective than bulk materials in some applications?
- Q303.** What property of nanoparticles makes them suitable for use in sun creams?
- Q304.** How could the small size of nanoparticles be helpful in electronics?
- Q305.** Give one reason why nanoparticles are studied in medical research.
- Q306.** Why is it important to test nanoparticles before they are used in consumer products?
- Q307.** Describe one possible risk of using nanoparticles in cosmetics.
- Q308.** What makes nanoparticles useful as catalysts?



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- Q309.** Why is it difficult to predict the long-term effects of nanoparticles?
- Q310.** How could nanoparticles help improve the delivery of medicine to target areas in the body?
- Q311.** Suggest one reason nanoparticles are useful in deodorants.
- Q312.** Why might nanoparticles be harmful to the environment?
- Q313.** What feature of nanoparticles allows them to penetrate biological membranes?
- Q314.** How could the high surface area to volume ratio of nanoparticles help in medical uses?
- Q315.** Why is there uncertainty about the safety of nanoparticles in some applications?
- Q316.** Describe how nanoparticles can improve the performance of electronic devices.
- Q317.** What type of research is needed before nanoparticles can be used widely in food packaging?
- Q318.** Explain why nanoparticles might be more reactive than larger particles.
- Q319.** What is one ethical concern about using nanoparticles in consumer products?
- Q320.** How might nanoparticles behave differently inside the human body compared to larger particles?
- Q321.** What kind of testing should be done to check the safety of nanoparticles in sunscreens?
- Q322.** Suggest one reason why some scientists are cautious about using nanoparticles in the environment.
- Q323.** What does it mean when we say nanoparticles have a large surface area to volume ratio?
- Q324.** Why is surface area important when considering how effective a nanoparticle is?
- Q325.** Give one reason why the public may be concerned about the use of nanoparticles in food.
- Q326.** What benefit might nanoparticles provide in detecting diseases early?
- Q327.** Describe a situation where nanoparticles could be more harmful than helpful.
- Q328.** Why is ongoing research into nanoparticle safety important?
- Q329.** How might the use of nanoparticles in cosmetics affect people with sensitive skin?
- Q330.** Give one reason why smaller amounts of nanoparticles are needed in reactions compared to bulk materials.

- Q331.** Why is it important to understand how nanoparticles move through the body?
- Q332.** What could happen if nanoparticles enter water supplies?
- Q333.** Describe one advantage and one disadvantage of using nanoparticles in sun creams.
- Q334.** Why might manufacturers choose nanoparticles over traditional ingredients?
- Q335.** How might the cost of producing nanoparticles affect their use in industry?
- Q336.** What makes nanoparticles potentially useful in targeted cancer treatments?
- Q337.** Why is public education important in the use of nanoparticle-based products?
- Q338.** What role does government regulation play in the safe use of nanoparticles?
- Q339.** How can nanoparticles be used in antibacterial treatments?
- Q340.** Why might the use of nanoparticles raise questions about long-term health?
- Q341.** Describe one way nanoparticles could improve environmental cleanup methods.
- Q342.** Why is it important to balance benefits and risks when developing new nanoparticle applications?
- Q343.** How could nanoparticles affect air quality if released during manufacturing?
- Q344.** Give an example of how nanoparticles could reduce waste in industry.
- Q345.** What kind of information should scientists share with the public about nanoparticles?
- Q346.** How does the use of nanoparticles in sport equipment relate to material strength?
- Q347.** Why is it important to know if nanoparticles can build up in body tissues?
- Q348.** What is the role of peer-reviewed studies in understanding nanoparticle safety?
- Q349.** Describe one reason why nanoparticles may be more useful in research than in everyday products.
- Q350.** What does it mean to evaluate the use of nanoparticles for a specific purpose?