Stewards Academy

Science KS4: Blended Learning Booklet

C2 Structure, Bonding and the properties of matter

Name:

Form:

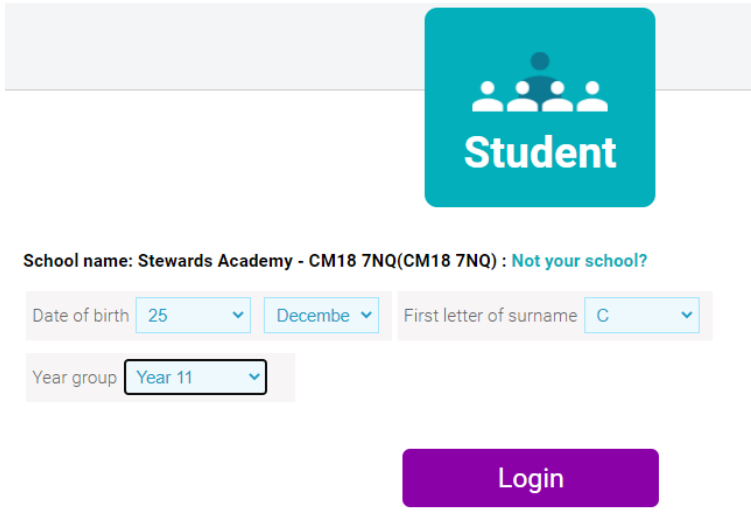
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

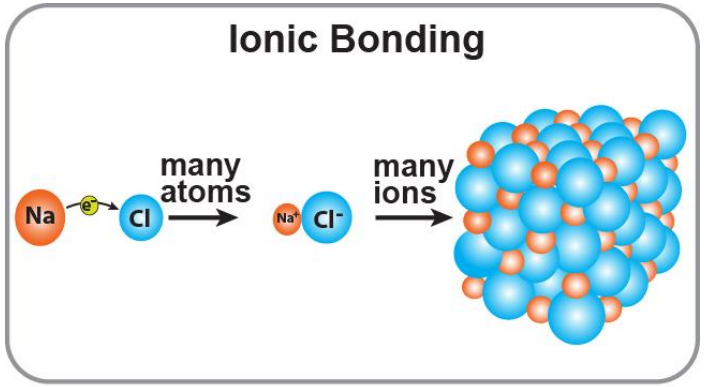
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

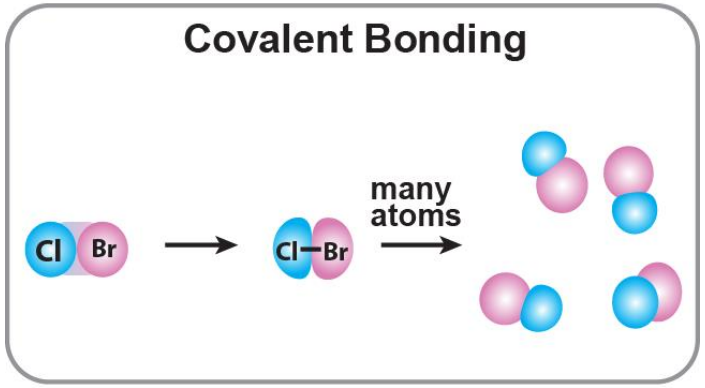
The online textbook has all the key information and vocabulary to help you with this unit

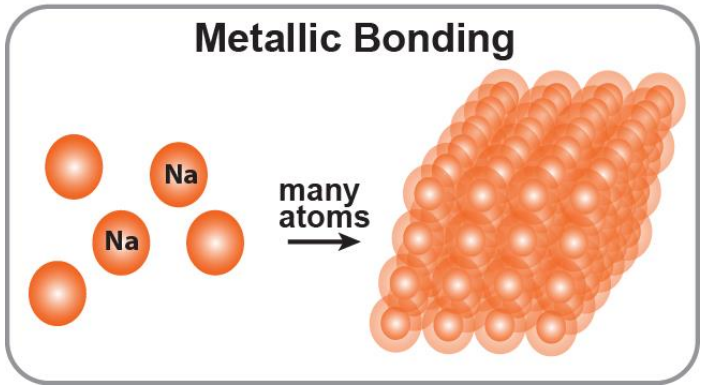
To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in "stewards" and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year









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Contents

(T) = Triple scientists only

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Atoms, element compounds & mixtures
UNIT C1
End of Unit Test
Microbes and antibiotics (T)
Respiration
Stem cells
Cell division and differentiation
Structure and function of cells
UNIT B1
Year 9

Matter

I will be able calculate the specific heat capacity of water and be able to describe the difference between the specific latent heat of vaporization and the specific latent heat of fusion. **I will** be able to explain the effect heat energy has on gas particles *and how this is related to volume (T).*

Chemical Quantities

I will be able to explain and apply the law of conservation of mass. **I will be** able to explain how we measure amounts of substances and how we can use these values to in calculations. ***I will be*** *able to determine chemical yields (T)*

Electricity

I will be able to explain *the principles behind static electricity (T)* and the key concepts in electricity. **I will** investigate and be able to describe the characteristics of electrical components. **I will** be able to explain how electricity is used safely in the home

Moving materials

I will be able to explain the difference between diffusion and active transport. **I will** be able to explain why some organisms need organ systems and different organisms move things in different ways. **I will** be able to explain how enzymes work.

Chemical Bonds

I will be able to explain what happens when substances change state and why some substances need a lot of energy for a change of state to occur. **I will** be able to describe different types of chemical bond and how they give different substances different properties.

Photosynthesis

I will be able to explain how plants are adapted to survive and get what they need from the environment. **I will** be able to explain how factors affect photosynthesis . **I will** be able to describe how water moves through a plant and how other substances diffuse in/out of plant cells

Energy

I will be learning about the connections between energy and power, and energy and temperature. **I will** be able explain how energy is transferred and describe how different energy resources have an impact on the environment

Atomic Structure

I will be able **to** use a model to represent and atom and explain how the model of an atom was developed. **I will** be able to explain how we can use radioactive atoms in carbon dating and why some elements are more reactive than others based on their atomic structure. ***I will be*** *able to describe properties of transition metals (T)*

Cell Biology

I will be able to describe how scientists have developed their understanding cell structure and function. **I will** be able to explain how a fertilized egg develops into a complex organism. **I will** be able to explain how organisms get their energy from food. ***I will be able to explain how microorganisms are grown in the lab and how their growth is affected by disinfectants and antibiotics (T).***

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Structure & bonding Year: 9 Unit: C2

AIMS

Students will learn what happens to particles as substances change state and why energy is needed for this to occur. They will learn about the different types of chemical bond that hold substances together. They will use this knowledge about bonding to explain why metals conduct electricity, why diamonds are hard and graphite is soft.
Knowledge of bonding and the ability to predict the structure of a substance and its properties are key ideas in Chemistry. Students acquire a more in-depth understanding of what a 'formula' means for different substances.

DEVELOPING COURAGE

- **C** Nano particles and their contribution towards safety
- **O** To investiagete how substances are made
- **U** Understand what chemical formulas mean
- **R** Learn the basic rules that underpin all of chemistry
- **A** the differenct allotropes of Carbon
- **G** How electrons are exchanged between atoms to form compounds and achieve stability
- **E** Being able to understand the world at a molecular level.

UP NEXT

Properties of matter

- Relative formula mass
- Conservation of mass
- Mass changes
- Amounts of substances (moles)
- Atom ecconomy

CAREERS

- Synthetic Chemist
- Chemical Engineer
- Construction Engineers

PREVIOUS LEARNING

Pupils will have some knowledge of the different states of matter. That energy transfers are involved in making and breaking bonds. They understand that different substances have different properties and are able to describe the properties of metals and non-metals. . .

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. What's Chemistry All About? by Alex Frith.
2. DK: Discover the Amazing Effect Chemistry Has on Every Part of Our Lives by Ann Newmark.
3. Chemistry DeMYSTiFieD, by Linda D. Williams.

PERSONAL OBJECTIVES

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Lesson 1: C2.1 – Chemical bonds

Connection

Have a look at the topic overview and the C2 zoom in.

Populate what you know and your personal objectives.

Activation

LI: Describe the three main types of bonding, explain the role of electrons in each type and how this explains their properties

1. Video – SciShow Why atoms form bonds
2. Video – Cognito Metallic Bonding
3. Make a note of the title and the LI
4. Read pages 58-59
5. Copy the table on page 59

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.1 - Elements and Compounds

Connection

1 NA
2 NA
3 NA

Demonstration

1 Ionic bonding is between oppositely charged metal and non-metal ions. Covalent bonding is between non-metal atoms which share electrons.

2 Metallic. It cannot be covalent because it is a good electrical conductor. It cannot be ionic since it conducts when solid. Covalent substances have low melting points.

3 It carries charge and when it moves it conducts electricity.

4 Electrons in covalent substances cannot move. They do not have delocalised electrons.

5 Electrons are on the “outside” of the atom and can therefore interact with other atoms/molecules, etc. The nucleus is shielded from other atoms.

Lesson 2: C2.2 Ionic Bonding

Connection

Q1. Name the three types of chemical bonds.

Q2. Describe how you could use an electrical circuit to determine if a substance is a metal.

Activation

LI: Explain how atoms join together to form ionic molecules.
Use dot and cross diagrams to show how electrons are transferred to form ions.

1. Video – Ionic Bonding 2 min 54 s
2. Make a note of the title and the LI
3. Read pages 60-61
4. Explain how ions form and why Group 0 elements do not form them
5. Draw and label fig 2.5. Use keywords **electron transfer** and **electrostatic attraction** to explain how ionic compounds form.

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

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Consolidation

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Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

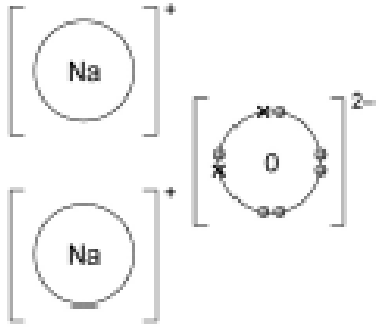
Answers: C2.2 – Ionic bonding

Connection

1. Ionic, covalent and metallic bonding
2. Make a simple series circuit with a battery and lightbulb. Place the substance between a break in the circuit so that it completes it. If the bulb lights it is a metal.

Demonstration

1 It loses its outer shell electrons and forms a stable positive ion.
2 Sodium loses an outer electron. This is transferred to chlorine which gains an electron. Positive sodium ions (Na^+) attract negative chloride ions (Cl^-) and a lattice is formed.
3 2,8
4 1
5 It has gained one electron. It has 17 protons in the nucleus and 18 electrons in shells around the nucleus. Overall it has a charge of 1–.
6



Lesson 3: C2.3 – Ionic compounds

Connection

Q1. What are the names of the ions in the compound sodium chloride?
Q2. Describe how electrons were transferred when sodium chloride formed from the elements sodium and chlorine.
Q3. What force holds the ions together in ionic compounds?

Activation

LI: Identify ionic compounds from their structure and describe how to work out the empirical formula of an ionic compound from the charges on the ions

1. https://www.youtube.com/watch?v=PNKsbnH1vw8
2. Make a note of the title and the LI
3. Read pages 62-63
4. Describe the advantages and disadvantages of ball and stick and close-packed diagrams
5. Explain how we can work out the empirical formula of an ionic compound from the charges on the ions

Demonstration

Attempt questions 1-5.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
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Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

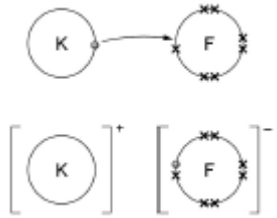
Answers: C2.3 – Ionic compounds

Connection

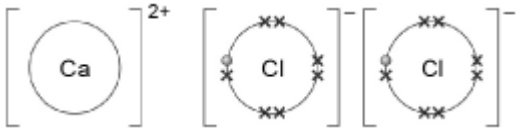
1 Sodium ion and chloride ion
2 An electron is lost from the sodium atom and is transferred to the outer shell of the chlorine atom
3 Electrostatic attraction

Demonstration

1 (ii)
2



3 Potassium atoms have one outer shell electron which they can donate to sulfur. In doing so they become 1+ ions. Sulfur has 6 outer shell electrons and can accept 2 electrons to become a 2– ion. The ions are stable with the electronic structure of a noble gas. So 2 potassium atoms donate an electron each to 1 sulfur atom. The empirical formula is therefore K_2S
4 Empirical formula is $CaCl_2$.



5 a Na_3N
b Al_2O_3

Lesson 4: C2.4 – Covalent bonding

Connection

Q1. Sodium forms the ion Na^+ and oxygen forms the ion O^{2-}.
Calculate the formula of sodium oxide.

Activation

LI: Explain how non-metal atoms form covalent bonds and draw dot and cross diagrams to represent these.

1. https://www.youtube.com/watch?v=5I_1jRGSR9E
2. Make a note of the title and the LI
3. Read pages 64 - 65
4. Describe how a covalent bond forms
5. Draw dot and cross diagrams for hydrogen chloride, chlorine, water, ammonia and methane and multiple bonds in oxygen

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Extension

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Purple questions to GCSE Level 9

Answers: C2.4 – Covalent bonding

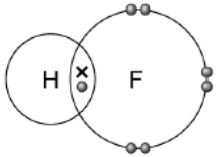
Connection

Q1. Both positive and negative charges on the sodium and oxygen ions must cancel each other out, so the formula for sodium oxide is Na_2O

Demonstration

1 H-F

2



3 3 bonding pairs (and 1 non-bonding pair).

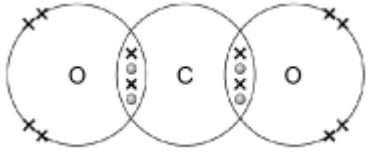
4 CH4

5 Same as H2O with O replaced by S.
Draw outer shell only for sulfur.

6 Oxygen has a double covalent bond which is 4 electrons (2 shared pairs). This means that each oxygen atom has a share in 8 electrons - full shell stability.

7 Nitrogen has a triple covalent bond which is 6 electrons (3 shared pairs). This means that each nitrogen atom has a share in 8 electrons - full shell stability.

8



Lesson 5: C2.5 – Metallic bonding

Connection

Q1. List the properties of covalent compounds.
Q2. How are covalent bonds different from ionic bonds?

Activation

LI: Describe how metals form giant structures made up from metal ions and delocalised electrons

1. https://www.youtube.com/watch?v=b1y2Q6YX1bQ&t=141s
2. Make a note of the title and the LI
3. Read pages 66 - 67
4. Draw figure 2.11 and describe what it shows
5. Explain how this structure allows metals to conduct electricity and have high melting and boiling points

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.5 – Metallic bonding

Connection

Q1. Small molecules, low melting and boiling points and formed between atoms of non-metals

Q2. In covalent bonds the electrons are shared by the bonding atoms, in ionic bonds the electrons are transferred

Demonstration

1 Magnesium has a configuration of 2,8,2. The 2 outer electrons are "spare" and can be delocalised
2 Lithium has 1 outer shell electron (configuration 2,1) which is free to move (delocalised) throughout the lithium ion lattice. It is a sea of electrons in a positive lithium ion lattice.
3 Delocalised electrons are electrons that are not associated with a single atom or a particular covalent bond. Delocalised electrons can move freely through a metal. A metal can conduct electricity because delocalised electrons within its structure can move
easily through it.
4 Silver has delocalised electrons which can move throughout the positive ion lattice. This movement is an electrical current. Silver oxide is an ionic compound. It does not have delocalised electrons and the ions cannot move when solid.
5 As the metal is heated, the ions in the lattice vibrate more and move apart (they occupy a greater volume). The higher the temperature the greater the expansion. However, the strong attraction between the delocalised electrons and the positive ions means that the metallic
bonds do not break (until it reaches its melting point).
6 Aluminium has 3 outer shell electrons that can be delocalised whereas sodium only has 1 outer shell electron. So aluminium has more charge carriers and therefore has a greater electrical conductivity.

Lesson 6: C2.6 – Three states of matter

Connection

Q1. What property of metallic bonding enables metals to conduct electricity?

Q2. Why do metals have high melting points?

Q3. How do the melting points of metals with only one delocalised electron compare with those with two?

Activation

LI: Describe the three states of matter and how we show these in chemical reactions and how we can use data to predict the state of a substance.

1. https://www.youtube.com/watch?v=21CR01rlmv4
2. Make a note of the title and the LI
3. Read pages 68 - 69
4. Draw figure 2.13
5. Explain how forces between particles affects the melting and boiling point of a substance

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:
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Purple questions to GCSE Level 9

Answers: C2.6 – Three states of matter

Connection

Q1. They have delocalised electrons which can move and allow a current to flow

Q2. There are strong forces of attraction between the delocalised electrons and the metal ions

Q3. Their melting points are lower

Demonstration

1 X = solid.
Y = gas
Z = gas

2 –28 °C - W is a solid. Particles vibrate about fixed positions. –18 °C - Melting point. The vibrational energy is enough to overcome the forces between particles. Particles start moving. W is becoming a liquid. –14 °C - W is now a liquid. Distance between particles
has increased. Particles have enough energy to overcome these forces of attraction and move around. 25 and 38 °C - Particles move around faster with more energy and liquid expands. Some particles have enough energy to escape from the surface (evaporate).
42 °C - Boiling point. The particles now have enough energy to overcome the forces of attraction between them and they escape from the liquid to become gas particles.
46 °C - W is now a gas. The particles are far apart and move randomly and energetically.

3 a) Aqueous / Aqueous / Aqueous / Solid.
b) Solid / Solid / Gas.

Answers: C2.6 – Three states of matter

Demonstration

4 The forces between the delocalised electrons and lattice of positive ions are strong so the energy required to overcome these forces is large.

5 The forces between molecules of ethanol are greater than the forces between propane molecules. So for ethanol, more energy is needed to break the forces and become a gas. Therefore ethanol has a higher boiling point.

6
- If there were no forces between gas particles, they could never condense to become a liquid.
- Molecules come in all shapes and sizes which will affect the forces of attraction and the forces on collision. This will affect the temperature at which they condense and the energy released when they do so. It will also affect the way they pack together as a liquid.
- Molecules are not solid and inelastic. They are flexible and elastic. This will also affect the forces between particles and forces on collision. This will affect the temperature at which they condense and the energy released when they do so.

Lesson 7 C2.7 – Properties of ionic compounds

Connection

Q1. Write down the states of matter symbol for a:
gas
liquid
solid
ion in solution

Activation

LI: Explain how their properties are related to their bonding and state when they will conduct electricity

1. https://www.youtube.com/watch?v=leVxy7cjZMU
2. Make a note of the title and the LI
3. Read pages 70-71
4. Copy out the table above figure 2.17 which describes a property and explains why it has this property. Add in the additional information from the text above figure 2.18 on page 71
5. Watch the Collins video to get an overview of ionic compounds and their properties

Demonstration

Attempt questions 1-4
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.7 – Properties of ionic compounds

Connection

Q1.

(g)

(l)

(s)

(aq)

Demonstration

1 There are strong forces of attraction between oppositely charged ions. Much energy is needed to overcome these forces. All of these forces of attractions need to be overcome before melting can occur.
2 Ionic compounds have high melting points. However, they do not conduct when solid but do when liquid. So D cannot be an ionic compound.
3 The ions are fixed in the lattice and cannot move.
4 The charge on the magnesium ion is 2+ and on the oxygen ion 2–. The higher the charge the greater the forces of attraction between the ions. Sodium and potassium ions have a 1+ charge and chloride ions a 1– charge. So more energy is needed to separate the ions in magnesium oxide.

Lesson 8: C2.8 – Properties of small molecules

Connection

Q1. When do ionic compounds form?

Q2. When do ionic compounds conduct electricity?

Q3. Why don't they conduct electricity when they are solid?

Activation

LI: Identify a small molecule from its chemical formula and explain why they have the properties they do

1. https://www.youtube.com/watch?v=DECGNyC-x_s
2. Make a note of the title and the LI
3. Read pages 72-73
4. Write out the explanation of what a small molecule is, give examples and why they have low melting and boiling points and do not conduct electricity
5. Describe the differences between covalent bonds and intermolecular forces
6. Explain why it can be difficult to predict the properties of small molecules

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.8 – Properties of small molecules

Connection

Q1. When a metal and a non-metal element form a compound together.

Q2. When they are molten or in solution.

Q3. The ions needed to carry the charge are locked in the crystal lattice and unable to move.

Demonstration

1 There are weak forces of attraction between CO_2 molecules. So not much energy is required to separate the molecules.
2 Carbon dioxide is a larger molecule than carbon monoxide so the intermolecular forces are stronger.
3 Butane is a larger molecule than propane. Therefore the intermolecular forces between butane molecules are greater. It takes more energy to separate butane molecules than propane molecules.
4 When nitrogen boils only very weak intermolecular forces have to be broken. Not much energy is needed. The covalent bond within nitrogen is much stronger than the intermolecular forces and is not broken when nitrogen boils.
5 Pure water does not contain (enough) ions to conduct. Sea water contains ions which can move and carry charge so can conduct.
6 Pentane. The molecules can get closer to each other so the intermolecular forces are greater. Spheres cannot get as close together so the intermolecular forces are weaker.
7 The intermolecular forces between chlorine molecules are greater than those between fluorine molecules. This is because chlorine has more electrons than fluorine. So more energy is required to separate chlorine molecules.

Lesson 9: C2.9 – Polymer structures

Connection

Q1. What are the main properties of small molecules?

Q2. What are the weak forces between the molecules called?

Q3. Why can it be tricky to predict the boiling point of small molecules?

Activation

LI: Identify a polymer from a formula and explain some of their properties

1. https://www.youtube.com/watch?v=QWoxwCJZ8j0
2. For triple only https://www.youtube.com/watch?v=QBuSFPOtcJ4
3. Make a note of the title and the LI
4. Read pages 74-75
5. Describe what a polymer molecule is and why they can be stretched
6. Describe the differences between the strength of bonds in polymer molecules and between polymer molecules
7. Explain why some polymers are stretchy and have low melting points where others are rigid and have high melting points
8. Describe the differences between addition and condensation polymers (TRIPLE)

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
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Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.9 – Polymer structures (Higher/Triple)

Connection

Q1. They have low melting and boiling points.

Q2. Intermolecular forces

Q3. It depends on the shape of the molecule as well as its size.

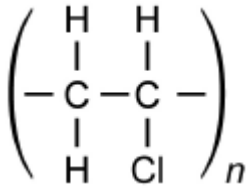
Demonstration

1 Intermolecular forces are weak. However, because polythene has long chains, the intermolecular forces are stronger so polythene is a solid.

2 Intermolecular forces are relatively weak in poly(ethene). Therefore these forces can be broken and the chains can slide over each other.

3 The strands of polymer are connected by cross-links, so the strands cannot slip past each other.

4



5 a Condensation. 2 different molecules react together.

b The intermolecular forces are relatively strong.

Lesson 10: C2.10 – Giant covalent structures

Connection

Q1. Why are some polymers stretchy?

Q2. Benches in science labs are made of polymer. Why are they rigid and have high heat resistance?

Activation

LI: Identify giant covalent structures, describe some of their properties and the different forms of carbon

1. Make a note of the title and the LI
2. https://www.youtube.com/watch?v=nPV6WM08wjY
3. Read pages 76-77
4. Describe the bonding in giant covalent structures, what property this gives them and name two examples
5. Explain why graphite is different to diamond despite both being made from carbon atoms
6. Explain why these structures rarely conduct electricity

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.10 – Giant covalent structures

Connection

Q1. Their molecules can slide over one another easily.

Q2. The polymer in lab benches have strong cross linked covalent bonds between them.

Demonstration

1 Similarity: Silicon and carbon atoms have 4 covalent bonds. Same shape (tetrahedral) around silicon and carbon atom. Difference: Only carbon atoms in diamond (element). Silicon and oxygen atoms in silicon dioxide (compound).
2 Molecules are atoms covalently bonded together into relatively small units. Silicon dioxide is a giant lattice of huge numbers of covalently bonded Si and O atoms
3 They both have the same giant covalent structure – a network of strong covalent bonds.
4 It is extremely hard and has a high melting point. The latter allows it to withstand the high temperatures generated in the cutting tool due to friction.
5 The bonds in graphite do not act in all directions. It has a layered structure and the forces between the layers are weaker so the layers can slide over each other.
6 Graphite is a giant covalent substance and has a very high melting point. It can therefore withstand high temperatures in furnaces.
7 Graphite has a very high melting point and can therefore withstand high temperatures. Graphite can also conduct electricity, which is needed in an electrode.
8 They do not have any mobile / delocalised electrons. All the electrons are being used to form covalent bonds.

Lesson 11: C2.11 – Properties of metals and alloys

Connection

Q1. Why does silicon dioxide have such a high melting point?

Q2. Why are diamond and silicon dioxide so hard and graphite soft?

Activation

LI: Identify metals and alloys and explain why we use alloys more often than pure metals

1. https://www.youtube.com/watch?v=A-wTpLPICd0
2. Make a note of the title and the LI
3. Read pages 78-79
4. State what an alloy is and some common alloys and their properties
5. Explain why alloys are often stronger than the pure metal
6. Describe how aluminium is alloyed to make it stronger
7. View slideshows 1 and 2

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-9
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.11 – Properties of metals and alloys

Connection

Q1. They are both held together by strong covalent bonds between the atoms.
Q2. Graphite is made up from sheets of carbon atoms held together by weak intermolecular forces rather than covalent bonds.

Demonstration

1 Brass is composed of copper and zinc. Bronze is composed of copper and tin.
2 Steel is harder than iron (the distortion in the layers in steel means that they cannot as easily slide over each other). Steel does not rust as easily as iron. This means that steel is a very useful construction material.
3 False. Steel is an alloy containing carbon. Carbon is a non-metal.
4 The layers of atoms in copper can slide over each other. Therefore, copper can be pulled into wires.
5 Delocalised electrons can move through the structure
6 a Pure silver. The presence of copper distorts the layers and makes it more difficult for them to slide past each other.
b 0.075 g.

Answers: C2.11 – Properties of metals and alloys

Demonstration

7 When different metal atoms are in the main metal lattice, they distort the layers. This makes it more difficult for the layers to slide over each other. So the alloy is harder. Other properties of alloys are also different e.g. melting points are lower. The ability to change the properties of an alloy is very useful.
8 When copper atoms are added to the main metal lattice, they distort the layers. This makes it more difficult for the layers to slide over each other. So the alloy is harder.
9 The movement of delocalised electrons through the lattice is disrupted. This is due to the metal added to the copper.

Lesson 12: C2.12 – Metals and non-metals

Connection

Q1. What alloy is used to make electrical connections? What property makes it ideal for this job?

Q2. Why is aluminium alloyed when used to make aircraft?

Activation

LI: Explain why diamond is so hard when compared with graphite

1. https://www.youtube.com/watch?v=tGH0mXCcEFU
2. Make a note of the title and the LI
3. Read pages 82-83
4. Explain how the structure of diamond gives it it's properties and state what these are
5. Describe how these properties make diamond useful and state what these uses are
6. Watch the slideshow

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.12 – Diamond

Connection

Q1. Solder, an alloy of lead and tin. It has a much lower melting point than either pure metal.

Q2. Duralumin the alloy is stronger than pure aluminium.

Demonstration

1 Each carbon atom shares its electron orbits with electron orbits from four other carbon atoms forming four covalent bonds.
2 The carbon atoms in diamond form strong covalent bonds in all directions
3 The (Si-O) bonds in silicon dioxide are weaker than the (C-C) bonds in diamond. So less energy is required to break the Si-O bonds.
4 Diamond has no free electrons - they are all locked in covalent bonds so cannot move. Graphite has delocalised electrons between layers which can move. When electrons move, a current flows.
5 Carbon has 4 outer shell electrons. It can accept four more electrons, one from each carbon. It then has 8 electrons in its outer shell which is full shell stability.
6 The network of strong covalent bonds makes diamond very hard and therefore it is capable of grinding other materials. Also, it has a very high melting point which means it will not be affected by the heat generated during grinding.

Lesson 13: C2.13 – Graphite

Connection

Q1. Why is diamond so hard?

Q2. Why is it harder than silicon dioxide, despite both having similar structures?

Activation

LI: Describe the structure and properties of graphite and some similarities to metals

1. https://www.youtube.com/watch?v=tGH0mXCcEFU
2. Make a note of the title and the LI
3. Read pages 82-83
4. Describe two of graphite's properties and uses
5. Describe the structure of graphite and why it has delocalised electrons
6. Explain why graphite can be used as an electrode, lubricant and thermal conductor

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.13 – Graphite

Connection

Q1. It has four very strong covalent bonds linking other carbon atoms in a super stable tetrahedral arrangement.
Q2. The covalent bonds between C – C atoms are stronger than the Si – O bonds in silicon dioxide.

Demonstration

1 a 4
b 3
2 The forces between layers are weak – the layers can slide over each other.
3 Diamond: Shared electron pair between carbons for each of the four covalent bonds per carbon atom. No spare delocalised electrons.
Graphite: Shared electron pair between carbons for each of the three covalent bonds per carbon atom. Spare electron delocalised between layers.
4 The delocalised electrons can carry heat energy. So when one part of graphite is heated, the delocalised electrons transmit the energy to the other parts.

Lesson 14: C1.14 – Graphene and Fullerenes (HT and TRIPLE)

Connection

Q1. List the properties which make graphite a good high temperature lubricant.

Q2. Explain why graphite can conduct electricity.

Activation

LI: Describe the structure and uses of graphene and fullerenes

1. https://www.youtube.com/watch?v=4ZEtS5qLOHs
2. Make a note of the title and the LI
3. Read pages 84-85
4. Describe the structure and shapes of graphene and fullerenes
5. Write down the properties of carbon nanotubes and their uses
6. Write down the unique properties of graphene
7. Watch the Collins video

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.14 – Graphene and fullerenes (Higher/Triple)

Connection

Q1. It forms layers of atoms which slide past one another and has a very high melting point.
Q2. There are delocalised electrons between the sheets of graphite atoms which can carry an electric current.

Demonstration

1 Similarities: Composed of carbon atoms only (the are forms of the element carbon). Contain hexagonal rings. Covalent bond between carbons.
Differences: Graphene is a single layer of atoms and one atom thick. Fullerenes form hollow 3D shapes. Fullerenes can contain 5 or 7 membered carbon rings.
2 Diamond: Giant covalent. Network of strong covalent bonds. 4 covalent bonds per carbon
Graphite: Giant covalent. Strong covalent bonds within layers. 3 covalent bonds per carbon within layers. Weaker forces between layers. Fullerenes: Simple molecular structures e.g. C60. They form hollow shapes. For instance Buckminsterfullerene is spherical. They contain rings of 6 carbons (and often 5 or 7 membered rings). 3 covalent bonds per carbon.
3 The network of carbon-carbon bonds are very strong. So a great deal of force is required to break the bonds.

Answers: C2.14 – Graphene and fullerenes (Higher/Triple)

Demonstration

4 Lower than diamond. Buckminsterfullerene is a molecule. The intermolecular forces between the C60 molecules are much weaker than the network of strong covalent bonds in diamond. So it takes much less energy to separate C60 molecules than to break diamond's covalent bonds.

5 Graphite: Giant covalent layered structure. Strong covalent bonds within layers. 3 covalent bonds per carbon within layers. Weaker forces between layers. Graphene: Single layer of graphite, one atom thick. Hexagonal rings of carbon are connected to each other by strong covalent bonds. 3 covalent bonds per carbon.

6 Graphite is soft because the carbon layers inside a stick of graphite slide over each other very easily. However, graphene is like a single layer of graphite. The bonds in graphene (and in the graphite layer) are very strong and require lots of energy to break them.

Lesson 15: C2.15 – Nanoparticles, their properties and uses (TRIPLE)

Connection

Q1. Why are there so few uses of graphene and fullerenes?

Q2. What properties of carbon nanotubes make them so special?

Activation

LI: Describe what nanoparticles are, their size uses and the risks they present

1. https://www.youtube.com/watch?v=-6eTx9YhJPI
2. Make a note of the title and the LI
3. Read pages 86-87
4. Describe some examples of nanoparticles, their uses and relative size
5. Explain how their small size makes them dangerous
6. Explain how making particles smaller increases their surface area

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.15 – Nanoparticles, their properties and uses

Triple Only

Connection

Q1. They have only been discovered and made quite recently.
Q2. Carbon nanotubes are stronger than steel and have high electrical and thermal conductivity.

Demonstration

1 Between 1and 100 nanometres
2 100 times smaller
3 Free nanoparticles could get into our lungs causing health problems. They can be used in sunscreens to prevent health problems from excess sun exposure.
4 12:1
5 Have a higher surface area to volume ratio More surface for action as a catalyst.

Lesson 16: C2.16 – Key Concept: Sizes of particles and orders of magnitude

Connection

Q1. How long has mankind used nanoparticles?
Q2. Why can nanoparticles be dangerous?

Activation

LI: Identify scales of length and their conversion to metres

1. https://www.youtube.com/watch?v=g0Pgg7FdqT0
2. Make a note of the title and the LI
3. Read pages 88-89
4. Define the units micrometre and nanometre
5. Define the units used to describe the scale of atoms and subatomic particles

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C2.16 – Key Concept: Sizes of particles and orders of magnitude

Connection

Q1. Thousands of years.

Q2. They can get deep into the lungs and cause damage to the fine structures there.

Demonstration

1 1000/0.25 = 4,000
2 5 × 105
3 2.5 × 10–11/ 1.75 × 10–15 = 14,286
4 1 × 10–12
5 The lithium atom has one outer shell electron. It loses this electron when it becomes an ion. So it has lost a whole shell. So Li^+ is smaller then Li. Also, because there is one less electron in Li^+, the repulsion amongst the remaining electrons is less so they can be pulled
closer to the nucleus.
6 The fluorine atom has seven outer shell electrons. It gains one electron when it becomes a negative ion. The nucleus cannot hold the 10 electrons in the F– ion as tightly as the 9 electrons in the F atom. Also, the extra electron in the ion causes more repulsion. Both
these factors mean that the negative ion is larger.
7 Li to Rb = 244/152 = 1.61. Be to Sr = 215/111 = 1.94. So Be to Sr shows the greatest increase in radii.

Lesson 17 Revision

Connection

Q1. Write 1 000 000 000 in standard form

Q2. Write the number form of 1×10^{8}

Q3. Write out the number form of 1×10^{-9}

Q4. Write out 152pm in metres using standard form.

Activation

LO: Create a topic summary sheet

1. Fold an A3 sheet so it is divided into 8 sections
2. Look back over your lessons and group them into 8 main headings
3. Summarise the key points into each section, use keywords and diagrams and symbols rather than sentences

Demonstration

Test yourself by working with the person sitting next to you by talking though each box on your summary sheet and seeing how many key facts you can remember.

Consolidation

Look though the relevant past paper questions for this topic - From the C2 DIP file – see if you can complete any additional questions

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Connection Answers

1 1×10^{9}

2 100,000,000

3 0.000000001

4 100pm = $1x10^{-10}$m so
152pm = $1.52x10^{-10}$m

Diamonds are Flammable! How to Safeguard Your Jewellery

Diamonds are the hardest substance known to man. Formed millions of years ago, these natural stones have become the symbol of lasting love because of their indestructibility. Once you buy a diamond, you need never worry about breaking it. But, what about fire? Are diamonds flammable?

As it turns out, **diamonds are flammable**, though burning one is not an easy task. To do so requires extreme heat and plenty of oxygen. You can't inadvertently set your diamond ring on fire with a cigarette lighter. But, because diamonds are pure carbon, they do react with oxygen by burning. Burning a diamond requires liquid oxygen and a very hot torch. But, the reaction is quite amazing. A diamond will burn very brightly, and then completely disappear.

Aside from the fact that most of us don't want to burn up our diamonds, there are other reasons you should not attempt this experiment. When diamonds get very hot, these can burst, sending diamonds shards flying, which can be extremely dangerous.

Diamond is a form of the element carbon. They both have giant structures of carbon atoms, joined together by covalent bonds. However, their structures are different so some of their properties are different.

Structure and bonding

Diamond is a giant covalent structure in which:

- each carbon atom is joined to four other carbon atoms by strong covalent bonds
- the carbon atoms form a regular tetrahedral network structure
- there are no free electrons

Properties and uses

The rigid network of carbon atoms, held together by strong covalent bonds, makes diamond very hard. This makes it useful for cutting tools, such as diamond-tipped glass cutters and oil rig drills.

Like silica, diamond has a very high melting point and it does not conduct electricity.

References: http://www.dmia.net/diamonds-are-flammable/
https://www.bbc.co.uk/bitesize/guides/zgq8b82/revision/1

Questions

1. How many bonds do atoms form in diamond?
2. Which element is diamond made up of?
3. State a practical use for diamonds

4. Explain why diamond has such a high melting point
5. Suggest what the products are when a diamond is burned
6. Explain why carbon atoms in diamond forms four bonds

7. Evaluate the use of diamond in drills and cutters
8. Use information from the text to explain why diamond does not conduct electricity
9. What information would you use to support the view "Diamond is the hardest substance known to man"

DART C2 Diamond: Answers

Answers

1. Atoms in diamond have a valence of 4 therefore they form 4 bonds
2. Diamond is made up of Carbon
3. Diamond can used for cutting tools, such as diamond-tipped glass cutters and oil rig drills.

1. Carbon atoms in diamond ae held together by 4 strong covalent bonds so therefore require a lot of energy in order to separate them

1. If diamond is burned in oxygen then it will form Carbon dioxide, Carbon monoxide and Carbon (soot)

1. Since Carbon has 4 electrons in its outer shell, it has space for 4 more electrons in its outer shell. Because of this, it can share 4 electrons **with** other elements and 4 electrons **from** other elements giving a total of 4 shared pairs of electrons. In diamond, one pair is shared with each carbon atom atom bonded to it.

1. Diamond is extremely hard and can be cut to make it sharp making it very useful in drills and cutters. A disadvantage is that diamond is very rare and therefore expensive.

1. From the text:

   "there are no free electrons"

   Free (or delocalised) electrons are required in order to conduct electricity. Since diamond has none, it cannot conduct electricity

1. From the text:

"because of their indestructibility. Once you buy a diamond, you need never worry about breaking it."

"The rigid network of carbon atoms, held together by strong covalent bonds, makes diamond very hard."

"diamond has a very high melting point "

These excerpts could be used to support the idea that Diamond is a very hard substance. However a good conclusion would say that it is impossible to say this statement is true just from reading the text. More evidence would be needed

Attainment Band :	C2 Structure, bonding and the properties of matter (AQA)
	Knowledge and Understanding
Yellow Plus/ Yellow	Explain how bonding and properties are linked. Work out the charge on the ions of metal and non-metals from the group number of the element. Work out the empirical formula of an ionic compound. Deduce molecular formula from models and diagrams. Explain how metallic bonding is enabled by the delocalisation of electrons. Use state symbols in chemical equations. Explain when ionic compounds can conduct electricity. Relate the intermolecular forces to the bulk properties of a substance. Explain the strength of covalent bonds. Explain why alloys have different properties to elements. Explain the similarity of graphite to metals.
Blue	Explain how electrons are used in the three types of bonding. Draw a dot and cross diagram for ionic compounds. Explain the limitations of diagrams and models. Draw dot and cross diagrams for small molecules. Explain how metal ions are held together. Explain the changes of state. Relate their melting points to forces between ions. Identify polymers from their unit formula.
	Explain the properties of giant covalent structures. Describe the purpose of a lead–tin alloy. Explain why diamond differs from graphite. Explain the structure and uses of fullerenes.
Green	Describe three main types of bonding. Represent an ionic bond with a diagram. Identify ionic compounds from structures. Identify single bonds in molecules and structure. Describe that metals form giant structures. Use data to predict the states of substances. Describe the properties of ionic compounds. Identify small molecules from formulae. Recognise giant covalent structures from diagrams. Identify metal elements and metal alloys. Explain how the properties relate to the bonding in diamond. Describe the structure of graphene.
White	Some elements of the above have been achieved