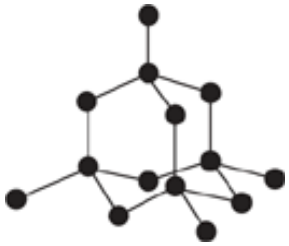
1. What happens when liquid bromine, Br_2, boils?

A Covalent bonds break
B Electrostatic forces break
C Intermolecular forces break
D Ionic bonds break

Your answer ☐ **[1]**

2(a). The diagram shows the structure of diamond.



Explain why diamond **cannot** conduct electricity.

_____

_____

_____

_____ **[2]**

(b). Some properties of forms of carbon are shown in the table.

Form of carbon	Conducts electricity?	Conducts heat?	Melting point
X	yes	yes	very high
Y	no	yes	high
Z	no	no	very high

i. Which form of carbon should you choose to use as an electrode in an electrolysis experiment with a molten electrolyte?

Explain your answer.

Form of carbon _____

Reason _____

_____ **[2]**

ii. All of the melting points in the table are high.

Why is it important that electrodes used in a **molten** electrolyte have a high melting point?

Tick (✓) **one** box.

Electrodes need to remain liquid, and not freeze at low temperatures ☐

Electrodes need to remain liquid, and not melt at high temperatures ☐

Electrodes need to remain solid, and not freeze at low temperatures ☐

Electrodes need to remain solid, and not melt at high temperatures ☐

[1]

3. The properties of four different polymer samples are shown in the table.

Polymer	Melting point of sample (°C)	Distance the sample stretches before breaking (cm)
PET	260	0.0
PVC	110	12.5
PS	240	0.1
PE	125	10.4

i. Describe the relationship between the melting point of the sample and the distance the sample stretches before breaking.

[1]

ii. The molecular formula of the monomer used to make PET is $C_{10}H_{10}O_5$.

State the **empirical** formula of the monomer used to make PET.

[1]

4. A carbon atom is 1.7×10^{-10} m wide.

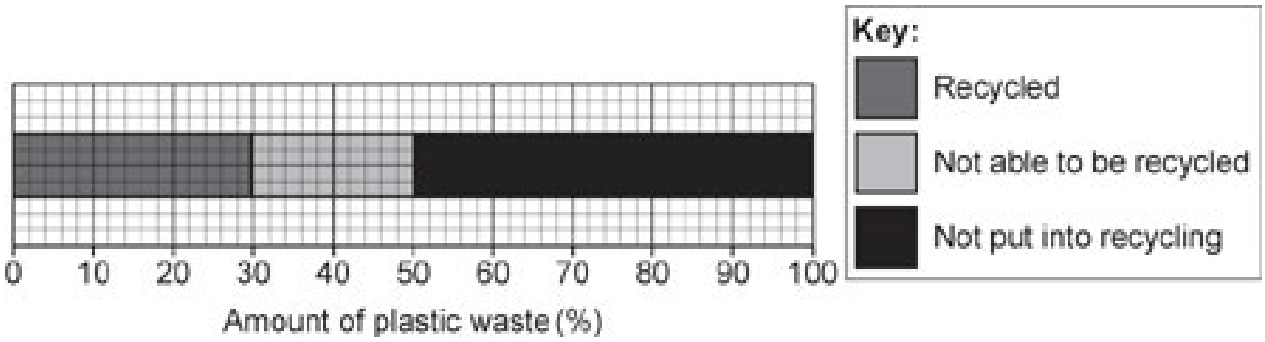
A diamond is 4.0×10^{-3} m wide.

How many **orders of magnitude** larger is the diamond than the carbon atom? Tick (✓) **one** box.

Two ☐ Four ☐ Seven ☐

[1]

5(a). The diagram shows how a town is recycling plastic waste.



The town generates a total of 45 000 kg of plastic waste in a year.

Calculate the mass of plastic waste that is **not able to be recycled** in the town.

Mass of plastic waste not able to be recycled = ... kg **[3]**

(b). Plastics are polymers. Polymers have covalent bonds between the atoms.

i. Explain what a **covalent bond** is in terms of electrons.

_____

_____ **[1]**

ii. Describe **two** differences between a polymer used to make a plastic bag and a polymer used to make a plastic bottle.

1 _____

_____

2 _____

_____ **[2]**

(c). A scientist wants to choose a polymer that is suitable for making a plastic ruler.

The scientist says that a polymer that stretches will **not** be suitable for making a ruler.

The diagram shows the ruler before and after stretching.

Before stretching

After stretching

Explain why the scientist is **correct**.

_____

_____

_____ **[2]**

6. Fig. 18.3 shows a model of a carbon nanotube.

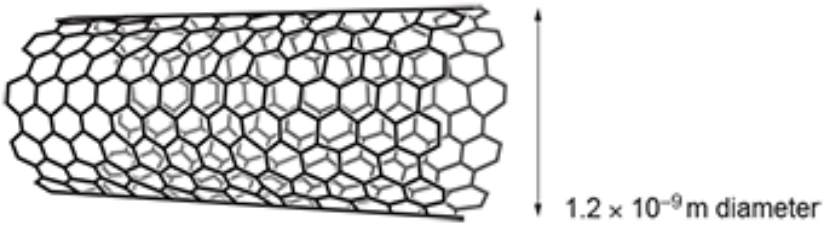


Fig. 18.3

i. What is the diameter of the carbon nanotube in **nanometres**?

_____ **[1]**

ii. **Fig. 18.4** shows a model of the structure and bonding in graphite.

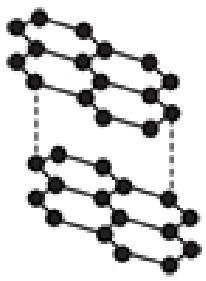


Fig. 18.4

Explain why the carbon nanotube is stronger than graphite.
Use **Fig. 18.3** and **Fig. 18.4**.

[2]

iii. A hydrogen atom has a diameter of 2.4×10^{-10}m.

Calculate how many times larger the carbon nanotube is than the hydrogen atom.

Number of times larger = ... **[2]**

7(a). The table shows the type of bonding in three substances.

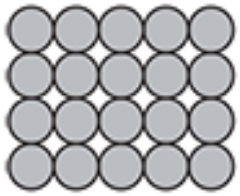
Substance	Type of bonding
Bromine, Br_2	simple molecular (covalent)
Sodium chloride, NaCl	ionic
Diamond, C	giant covalent

Describe and compare the types of bonding in these three substances.

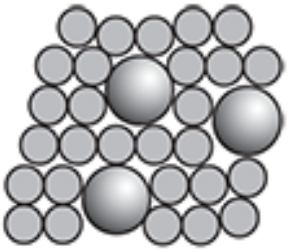
Predict which substance will have the lowest melting point.

[6]

(b). Titanium is a metal element. Metal **elements** can be mixed with other elements to form metal **alloys**.



Metal element



Metal alloy

i. Explain why a metal alloy is harder than a metal element.

[2]

ii. In medicine, titanium alloys are used in hip replacements.

The table shows some properties of alloys. Tensile strength is the amount of load a material can take before it breaks.

Alloy	Density (g / cm^3)	Tensile strength (MPa)	Does it contain any toxic elements?
1	4.43	950	yes
2	4.52	950	no
3	5.70	546	no

Which alloy would be best to use in a hip replacement?
Explain your answer.

Alloy

Reason

[3]

8. The melting point of magnesium chloride is 714 °C.

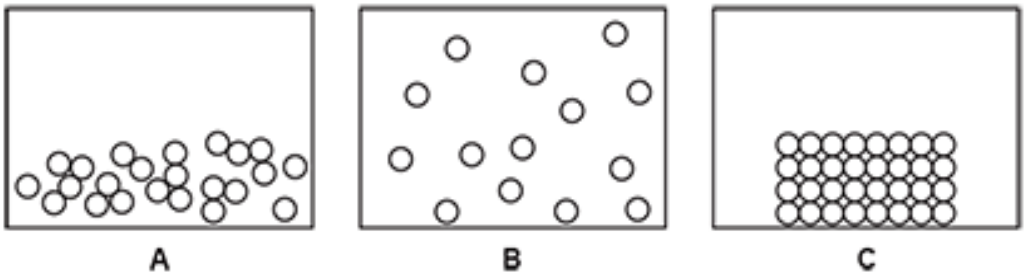
Which state symbols are used for magnesium chloride at these temperatures?

	State symbol at 25 °C	State symbol at 110 °C
A	g	g
B	s	s
C	s	g
D	g	s

Your answer ☐ **[1]**

9. Oxygen is a gas at room temperature.

i. The diagrams show three different particle models.



Which particle model represents a **gas**?

Tick (✓) **one** box.

A ☐ **B** ☐ **B** ☐

[1]

ii. Oxygen has a melting point of –219 °C and a boiling point of –183 °C.

State a temperature at which oxygen will be a **liquid**.

_____ **[1]**

iii. Complete the sentences about the particle models.

Use words from the list.

condensing	**freezing**	**less**	**melting**	**more**

A liquid becoming a solid is called ..... . In a solid, the particles move ..... than in a liquid. In a solid, the arrangement of particles is ..... random than in a liquid.

[3]

10. Why are nanoparticles useful as catalysts in chemical reactions?

A Nanoparticles are a new technology.
B Nanoparticles have a high surface area to volume ratio.
C Nanoparticles have a large particle size.
D Nanoparticles have a low surface area to volume ratio.

Your answer ☐ **[1]**

11. A student investigates dyes.

Some dyes are nanoparticles.

i. What is the size of a nanoparticle?

Tick (✓) **one** box.

- Less than 1 nm ☐
- Between 1 and 100 nm ☐
- Between 100 and 1000 nm ☐
- Greater than 1000 nm ☐

[1]

ii. Some people think using nanoparticulate materials is dangerous. Other people want to keep using them.

State **one advantage** and **one disadvantage** of using nanoparticulate materials.

Advantage _____

_____

Disadvantage _____

_____

[2]

12(a). The table shows data about four different substances.

Substance	Melting point (°C)	Boiling point (°C)	Soluble in water?	Conducts electricity as a solid?	Conducts electricity when molten or dissolved?
A	550	1300	yes	no	yes
B	−183	−162	no	no	no
C	420	907	no	yes	yes
D	1670	>1670	no	no	no

A scientist uses the information to find out what type of bonding is present in each substance.

i. The scientist thinks substance **A** is an **ionic** compound.

Explain why the scientist is correct.

_____

_____

[2]

ii. Which of the substances is a **simple covalent** compound?

Explain your answer.

Substance _____

Reason 1 _____

Reason 2 _____

[3]

iii. What is the state of substance **B** at room temperature?
Put a (ring) around the correct answer.

Solid **Liquid** **Gas**

[1]

(b). A scientist investigates some metals and metal alloys.

i. Describe the structure and bonding in a metal.

You can include a labelled diagram in your answer.

[3]

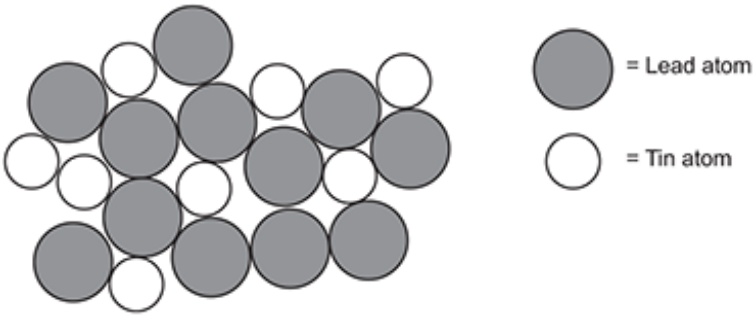
ii. Explain why metals are malleable.

[1]

iii. Explain why metals can conduct electricity

[2]

iv. The scientist has a diagram of one type of metal alloy as shown.



What is the smallest ratio of lead to tin in the alloy?

Ratio of lead to tin = ... **[2]**

v. The table shows data about other alloys made from tin, copper and silver.

	Alloy 1	**Alloy 2**	**Alloy 3**
Tin content (%)	95.5	99.0	96.5
Copper content (%)	0.7	0.7	0.5
Silver content (%)	3.8	0.3	3.0
Melting point (˚C)	217	227	220

What is the relationship between the silver content and the melting point?

---**[1]**

13. Which particles are smaller than 1×10^{-9} m?

A Nanoparticles, molecules and atoms
B Nanoparticles, neutrons and electrons
C Neutrons, atoms and electrons
D Neutrons, polymers and protons

Your answer ☐ **[1]**

14. The element mercury is a liquid at 25 ˚C.

Which row about mercury is correct?

	Melting Point (°C)	Boiling Point (°C)
A	above 25	above 25
B	below 25	below 25
C	below 25	above 25
D	above 25	below 25

Your answer ☐ **[1]**

15. Which substance has **four** covalent bonds to each carbon atom?

A Carbon nanotubes
B Diamond
C Graphene
D Graphite

Your answer ☐ **[1]**

END OF QUESTION PAPER