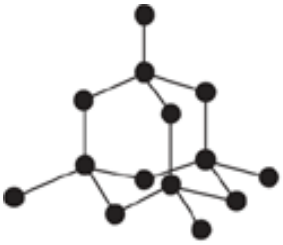
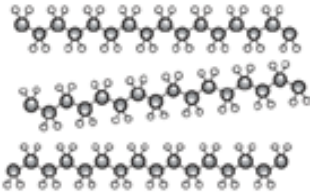
1(a). The structures of diamond, chlorine, Cl_2, and poly(ethene) are shown



Diamond

Chlorine, Cl_2



Poly(ethene)

All the substances contain covalent bonds between the atoms.

Explain which substance has the highest melting point.

Use your knowledge of structure and bonding.

[6]

(b).

i. Magnesium chloride is an ionic compound.

Explain why ionic compounds can conduct electricity when dissolved in water, but not when solid.

[3]

ii. Construct the dot and cross diagram for the ions in magnesium chloride, $MgCl_2$.

Show the outer electron shells only.

Dot and cross diagram:

[2]

2. At 25 °C, fluorine is a gas, bromine is a liquid and iodine is a solid.

Which statement is correct?

A At 25 °C, bromine does not have enough heat energy to melt.
B At 25 °C, fluorine does not have enough heat energy to condense.
C Bromine has a higher boiling point than fluorine and a higher melting point than iodine.
D Iodine has a higher boiling point than bromine and a higher melting point than fluorine.

Your answer ☐ **[1]**

3. Graphite and graphene are allotropes of carbon.

Which statement is correct about graphite and graphene?

A Graphite has delocalised electrons, graphene uses all electrons in bonding.
B Graphite has four bonds from each carbon atom, graphene only has three.
C Graphite is a giant covalent structure, graphene is not.
D Graphite is made up of layers, graphene is a single layer.

Your answer ☐ **[1]**

4(a). Table 21.1 shows information about four different substances.

Table 21.1

Substance	Melting point (°C)	Appearance	Electrical conductor?
1	1085	shiny solid	yes
2	770	white crystals	yes when dissolved in water
3	120	flexible solid	no
4	78	white crystals	no

Which of the substances is a polymer?

Explain your answer.

Substance _____

Reason _____

_____

_____

[3]

(b). Fig. 21.1 shows two different polymer structures.

Fig. 21.1

Explain why polymers without cross-links can stretch more than polymers with cross-links.

_____

_____

[2]

(c). Fig. 21.2 shows an electrical cable.

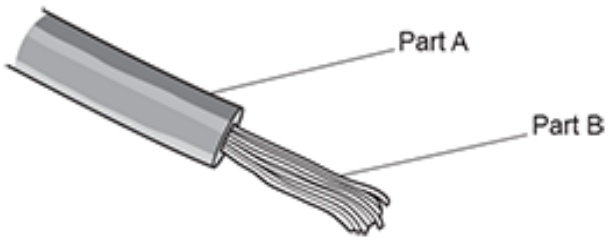


Fig. 21.2

Which substance from **Table 21.1** would be best to use to make each part of the electrical cable?

Explain your answers.

Part A _____

Reason _____

Part B _____

Reason _____

[3]

5.

i. At –78 °C, and 0.1 MPa pressure, carbon dioxide changes state from a solid to a gas.

Changing state from a solid to a gas is called **subliming**.

Describe what happens to the **movement** and **arrangement** of the particles when a solid turns into a gas. Use the particle model.

_____

_____

_____

_____

[3]

ii. Carbon dioxide can be a liquid at different pressures and temperatures.

Pressure (MPa)	Melting point (°C)	Boiling point (°C)	Sublimation point (°C)
0.1			–78
1.0	–56	–40	

State a temperature and a pressure at which carbon dioxide is a **liquid**.

Explain your answer.

Temperature _____ °C Pressure _____ MPa

Reason _____

_____

_____

[3]

6. Which row explains how the structure of graphene is different from the structure of graphite?

	Graphene	Graphite
A	3 covalent bonds to each carbon atom	4 covalent bonds to each carbon atom
B	covalent bonds in 3D	covalent bonds in one 2D plane
C	intermolecular forces	no intermolecular forces
D	one layer	many layers

Your answer ☐ **[1]**

7. Which term is a correct description of ice turning from a solid to a liquid?

A Chemical change
B Evaporation
C Freezing
D Physical change

Your answer ☐ **[1]**

8. A carbon nanotube is 1.4×10^{-9} m wide. A human hair is 1.4×10^{-4} m wide.

How many times wider is the hair compared to the nanotube?

A 100
B 1000
C 10 000
D 100 000

Your answer ☐ **[1]**

9. Some information about phosphorus compounds is shown in the table.

Name	Formula	Melting point (°C)	Boiling point (°C)	State at room temperature
Phosphorus trichloride	PCl_3	−94	76	
Phosphorus pentachloride	PCl_5	161	167	
Phosphorus trifluoride	PF_3	−152	−102	

i. Complete the table.

[2]

ii. Put a (ring) around the compound with the weakest intermolecular forces.

Phosphorus trichloride

Phosphorus pentachloride

Phosphorus trifluoride

Explain your answer using information from the table.

[3]

iii. The scientist thinks phosphorus trichloride is a **giant covalent** compound.

Explain why the scientist is incorrect.

[2]

10.

Zinc oxide, ZnO, is a compound containing zinc.

The table shows some information about four different zinc oxide particles.

Particle	Size of zinc oxide particles (m)	Cost per gram (£ / g)	Purity (%)
A	1.85×10^{-7}	0.05	95.00
B	6.54×10^{-9}	0.31	95.99
C	8.52×10^{-7}	0.87	99.99
D	4.02×10^{-8}	1.84	99.99

i. Which particles are nanoparticles?

Tick (✓) **two** boxes.

A ☐

B ☐

C ☐

D ☐

[1]

ii. A scientist wants to buy some zinc oxide particles to use in suncream. A large surface area to volume ratio is important.

Which particle, **A**, **B**, **C** or **D**, would be the most suitable for use in suncream?

Explain your answer.

Particle _____

Explanation _____

_____

_____

_____

[3]

11. Why do some polymers have different flexibilities?

A They are more flexible because they contain covalent bonds.
B They are more flexible as they do not have strong cross-links.
C They are more rigid because they contain ionic bonds.
D They are more rigid because they have weak intermolecular forces.

Your answer ☐ **[1]**

12. Which statement about carbon allotropes is correct?

A Buckminsterfullerene is a type of carbon nanotube.
B Carbon atoms in diamond and graphite form 4 covalent bonds.
C Graphene and graphite both have carbon atoms arranged in layers.
D Strong covalent bonds cause diamond to have a high melting point.

Your answer ☐ **[1]**

END OF QUESTION PAPER