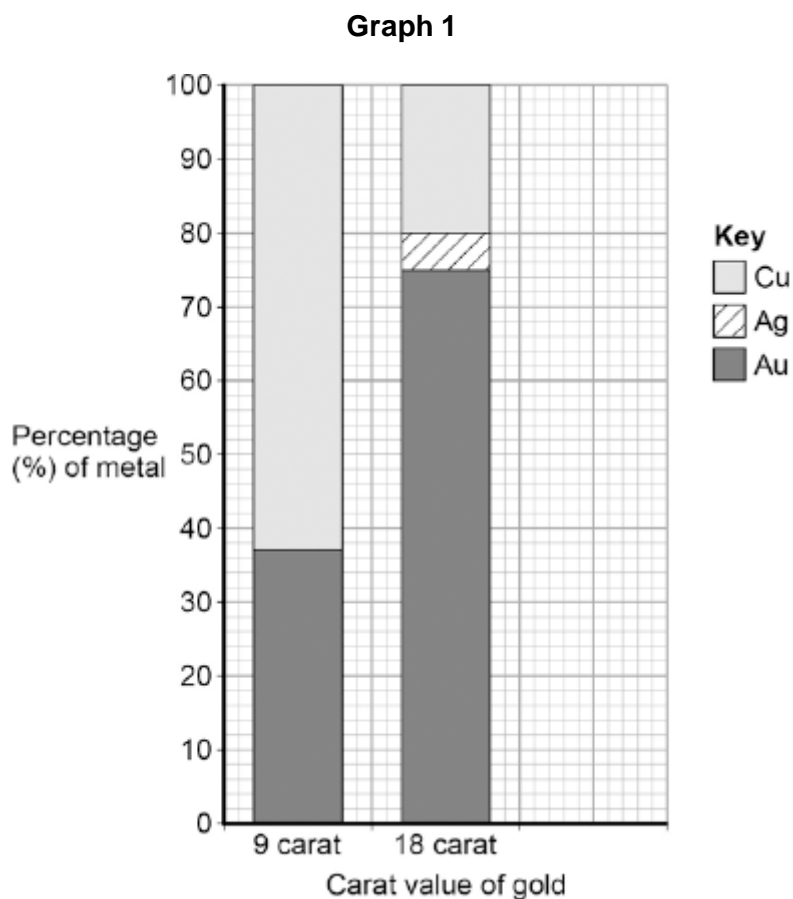


4-2 / 5-2 Bonding, structure and the properties of matter – Chemistry

1.0 This question is about mixtures of metals.

Gold is mixed with other metals to make jewellery.

Graph 1 below shows the composition of different carat values of gold.



1.1 What is the carat value for 92 % gold?

[1 mark]

Tick **one** box.

12 20 22 24

1.2 What is the ratio of gold to copper (Cu) in 9 carat gold?

[1 mark]

Gold : copper ratio = _____ : _____

1.3 What is the composition of 18 carat gold?

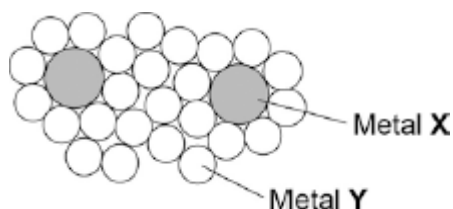
[3 marks]

1.4 Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

[2 marks]

1.5 **Figure 1** shows the structure of a different mixture of metals.

Figure 1



What percentage of the atoms in the metal mixture are atoms of **X**?

Give your answer to 2 significant figures.

[2 marks]

Percentage of **X** atoms in mixture = _____ %

1.6 What are mixtures of metals called?

[1 mark]

Tick **one** box.

Alloy

Compound

Element

Polymer

2.0 This question is about bonding and atomic structure.

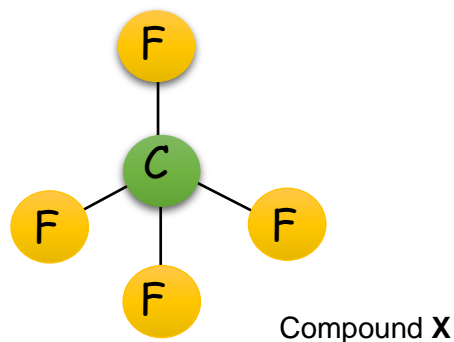
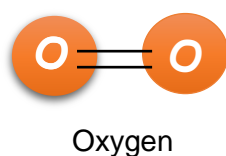
2.1 Draw one line from each type of bonding to the description of bonding.

[2 marks]

Type of bonding	Description of bonding
Covalent bonding	Positive ions surrounded by delocalised electrons
Metallic bonding	Strong electrostatic forces of attraction
Ionic bonding	Sharing of electrons

Figure 2 shows the structure of two small molecules, oxygen and compound X.

Figure 2



2.2 Oxygen (O_2) is described as a diatomic element.

Suggest what is meant by the term “*diatomic element*”.

[1 mark]

2.3 Give the molecular formula of compound X

[1 mark]

2.4 Complete the sentence by putting a ring around the correct word.

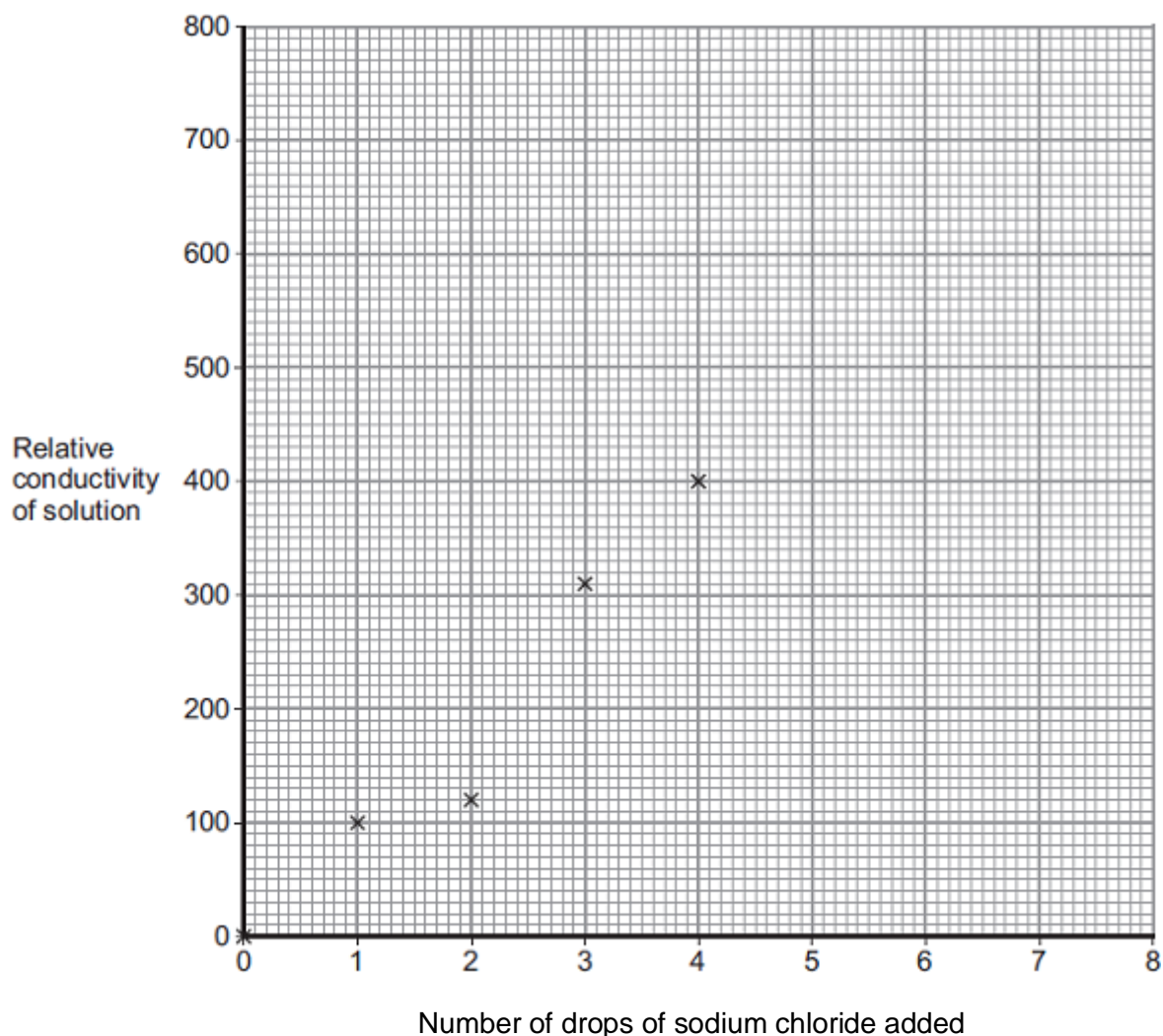
[1 mark]

Chemicals with small molecules usually have a **low / medium / high** melting point.

3.0 A student investigated the conductivity of different concentrations of sodium chloride solution. The student's results are shown below.

Number of drops of sodium chloride solution added	Relative conductivity of solution
0	0
1	100
2	120
3	310
4	400
5	510
6	590
7	710
8	800

The student plotted some of the results on the graph shown in **Figure 3** below.



3.1 On the graph:

- Plot the remaining results
- Draw a line of best fit.

[2 marks]

3.2 Draw a ring around the anomalous point.

[1 mark]

3.3 The student compared the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable the student should keep constant when measuring the conductivity of the two solutions.

[1 mark]

3.4 Explain why sodium chloride solution conducts electricity.

[3 marks]

5.0 Sodium chloride is an ionic compound.

5.1 Explain why ionic compounds are usually solid at room temperature.

[2 marks]

5.2 Recent research has developed a new type of substance, ionic liquids. Ionic liquids have melting points at close to or below room temperature. Ionic liquids are used in batteries as they conduct electricity.

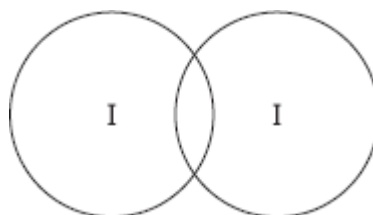
Explain why ionic liquids are used in batteries but solid ionic compounds are not.

[3 marks]

6.0 Iodine is in Group 7.

6.1 Complete the diagram below to show the bonding in iodine, I₂.
Show the outer electrons only.

[2 marks]



6.2 Explain, in terms of particles, why liquid iodine does not conduct electricity.

[3 marks]

6.3 Many people do not have enough iodine in their diet.

Some scientists recommend that salt should have a compound of iodine added.

Give **one** ethical reason why a compound of iodine should **not** be added to food.

[1 mark]

7.0 A student was investigating a compound, **X**.

The student decided that compound X was an ionic compound.

Give **three** properties of ionic compounds that the student may have found.

[3 marks]

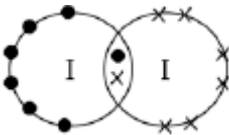
MARK SCHEME

Qu No.		Extra Information	Marks
1.1	22		1
1.2	37.5 : 62.5	Allow 4 : 6	1
1.3	Gold / Au 75 % Copper / Cu 20 % Silver / Ag 5 %	Max of 2 marks if elements are not named If no other mark obtained allow 1 mark for gold, silver and copper	1 1 1
1.4	any two from: • 9 carat gold is harder • 9 carat gold is cheaper • different colour / appearance	Allow pure gold is too soft Allow pure gold is too expensive	2
1.5	$\frac{2}{27} \times 100$ 7.4 (%)	Allow 7.4074074 An answer of 7.4 % without working can be awarded 2 marks	1 1
1.6	Alloy		1

Qu No.		Extra Information	Marks
2.1	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Covalent bonding</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Metallic bonding</div> <div style="border: 1px solid black; padding: 5px;">Ionic bonding</div> </div> <div style="display: flex; flex-direction: column; align-items: flex-start; margin-left: 20px;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Positive ions surrounded by delocalised electrons</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Strong electrostatic forces of attraction</div> <div style="border: 1px solid black; padding: 5px;">Sharing of electrons</div> </div>	Do not allow 2 lines from one type of bonding. Allow 1 mark for 1/2 correct	2
2.2	Molecule containing two atoms	Allow 2 atoms bonded together	1
2.3	CF ₄		1
2.4	low		1

Qu No.		Extra Information	Marks
3.1	Points correctly plotted	Allow tolerance of $\pm \frac{1}{2}$ small square	1
	Line of best fit		1
3.2	2 drops, 120 relative conductivity		1
3.3	Any one from: <ul style="list-style-type: none"> • concentration (of solution) • volume (of drops) of solution added 	Allow reasonable alternatives	1
3.4	<u>Ions</u> in sodium chloride solution	Allow Na^+ and Cl^-	1
	can move		1
	and carry the charge / current		1
Qu No.		Extra Information	Marks
4.1			
Level 3:	A detailed and coherent comparison is given, which considers a range of relevant points and demonstrates a broad understanding of the key scientific ideas. The response comes to a conclusion consistent with the reasoning.		5-6
Level 2:	An attempt to relate relevant points and come to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.		3-4
Level 1:	Simple statements are made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.		1-2
Level 0	No relevant content		0
Indicative content			
<p>Graphite properties</p> <ul style="list-style-type: none"> • conducts electricity • soft • slippery • brittle • high melting point <p>Copper properties</p> <ul style="list-style-type: none"> • can be bent or malleable • ductile or can be shaped into wires • strong / not brittle • conducts electricity • high melting point <p>Conclusion Copper would be more suitable with a justification</p>			
4.2	Conductivity will decrease		1
	as an ionic compound formed		1
	which will not conduct electricity when solid		1

Qu No.		Extra Information	Marks
5.1	Strong electrostatic forces	Allow strong forces between oppositely charged ions	1
	which require a lot of energy to overcome		1
5.2	In ionic liquids, ions are able to move		1
	(so) ions carry charge		1
	(however) in a solid, ions are unable to move		1

Qu No.		Extra Information	Marks
6.1	one bonding pair of electrons		1
	6 unbonded electrons on each atom	accept dot, cross or e or – or any combination, eg	1
			
6.2	Iodine has no delocalised / free electrons	Allow iodine molecules have no overall charge for 1 mark if MP 1 and 2 not awarded.	1
	iodine has no ions		1
	so cannot carry charge / current		1
6.3	any one from: people should have right to choose insufficient evidence of effect on people individuals may need different amounts	allow too much could be harmful ignore cost / religious reasons ignore reference to allergies	1

Qu No.		Extra Information	Marks
7	High melting point	Any three properties that could be reasonably found from experiment	1
	Conducts electricity when molten / dissolved		1
	Does not conduct when solid		1