Structure and Bonding

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science - Synergy
Exam Board	AQA
Topic	4.6 Interactions over Small and Large Distances
Sub-Topic	Structure and Bonding
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: **59 minutes**

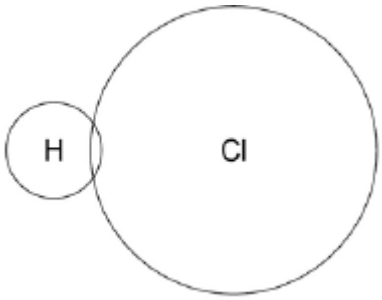
Score: **/ 56**

Percentage: **/100**

Grade Boundaries:

Q1. Hydrogen chloride (HCl) is a gas.

(a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



(1)

(b) Hydrochloric acid is a strong acid.
Ethanoic acid is a weak acid.

Describe a reaction that could be used to show the difference between a weak acid and a strong acid.

You should explain why the weak acid and the strong acid give different results.

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(6)
(Total 7 marks)

Q2. Sulfur dioxide (SO_2) is used to manufacture sulfuric acid.

(a) Explain why sulfur dioxide has a low boiling point.

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(3)

(b) The equation shows one stage in the manufacture of sulfuric acid from sulfur dioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The reaction is exothermic in the forward direction.

Use Le Chatelier's Principle to predict the effect of increasing the temperature on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

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(2)

(c) Use Le Chatelier's Principle to predict the effect of increasing the pressure on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

(2)
(Total 7 marks)

Q3. Carbon nanotubes are cylindrical fullerenes.

Explain the properties of carbon nanotubes.

Answer in terms of structure and bonding.

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(Total 6 marks)

Q4. The elements in Group 1 of the periodic table are metals.

(a) The elements in Group 1 are called the alkali metals.

Why are they called the alkali metals?

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(b) Explain the increase in reactivity of elements further down the group.

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(4)

(c) Lithium oxide is an ionic compound.

Draw a dot and cross diagram to show how lithium and oxygen combine to form lithium oxide.

Only show the electrons in the outer shell of each atom.

Give the charges on the ions formed.

(4)
(Total 10 marks)

Q5. This question is about copper.

(a) Copper can be extracted by smelting copper-rich ores in a furnace.

The equation for one of the reactions in the smelting process is:

$$Cu_2S(s) + O_2(g) \longrightarrow 2\ Cu(s) + SO_2(g)$$

Explain why there would be an environmental problem if sulfur dioxide gas escaped into the atmosphere.

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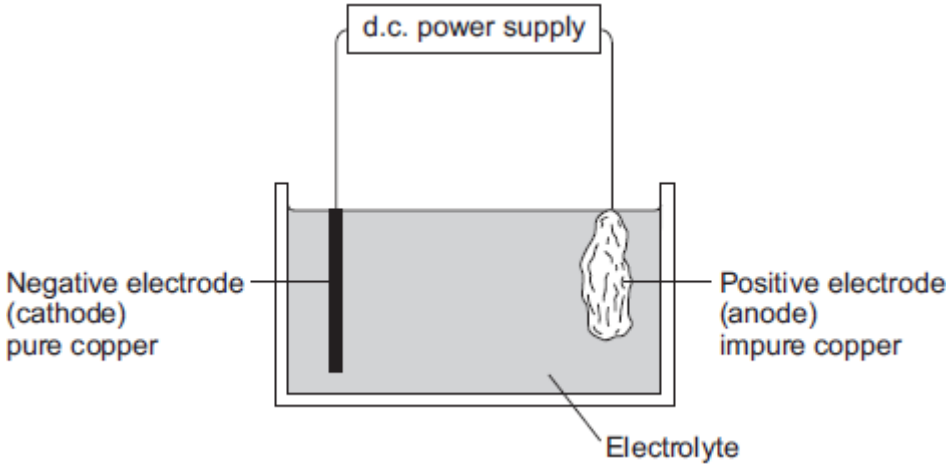
(2)

(b) The impure copper produced by smelting is purified by electrolysis, as shown below.



Copper atoms are oxidised at the positive electrode to Cu^{2+} ions, as shown in the half equation.

$$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$$

(i) How does the half equation show that copper atoms are oxidised?

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(1)

(ii) The Cu^{2+} ions are attracted to the negative electrode, where they are reduced to produce copper atoms.

Write a balanced half equation for the reaction at the negative electrode.

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(1)

(iii) Suggest a suitable electrolyte for the electrolysis.

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(1)

(c) Copper metal is used in electrical appliances.

Describe the bonding in a metal, and explain why metals conduct electricity.

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(d) Soil near copper mines is often contaminated with low percentages of copper compounds.

Phytomining is a new way to extract copper compounds from soil.

Describe how copper compounds are extracted by phytomining.

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(3)

(e) A compound in a copper ore has the following percentage composition by mass:

55.6% copper, 16.4% iron, 28.0% sulfur.

Calculate the empirical formula of the compound.

Relative atomic masses (A_r): S = 32; Fe = 56; Cu = 63.5

You must show all of your working.

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Empirical formula = ...

(4)
(Total 16 marks)

Q6. This question is about compounds.

(a) The table gives information about the solubility of some compounds.

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from the table to answer these questions.

(i) Name a soluble compound that contains silver ions.

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(1)

(ii) Name a soluble compound that contains carbonate ions.

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(1)

(b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

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(1)

(c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

(i) State how solid lead nitrate can be obtained from lead nitrate solution.

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(1)

(ii) Balance the equation for the reaction.

$PbO + HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

(1)

(iii) Give the total number of atoms in the formula $Pb(NO_3)_2$

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(1)

(d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (A_r): O = 16; Pb = 207

You must show your working to gain full marks.

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Empirical formula = ...

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(Total 10 marks)