3 This question is about copper and compounds of copper.

(a) **(i)** Describe the bonding in a metallic element such as copper.

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..... [3]

(ii) Explain how solid copper conducts electricity.

..... [1]

(b) Copper is in alloys such as brass.

(i) State **one** reason why alloys are more useful than pure metals.

..... [1]

(ii) Name the substance that is present in brass, other than copper.

..... [1]

(c) Copper(II) sulfate crystals are made by the reaction between copper(II) carbonate and dilute sulfuric acid, using the following steps.

The sulfuric acid has a concentration of 0.100 mol / dm^3.

step 1 Powdered copper(II) carbonate is added to dilute sulfuric acid. The mixture is stirred. A reaction occurs.

step 2 More copper(II) carbonate is added, with stirring, until the reaction stops.

step 3 Unreacted copper(II) carbonate is separated from aqueous copper(II) sulfate by filtration.

step 4 Aqueous copper(II) sulfate is heated until some of the water evaporates.

step 5 The remaining solution is allowed to cool and crystallise.

step 6 The crystals are removed and dried.

(i) Give **two** observations in **step 1**.

1 .....

2 .....
[2]

(ii) State why the reaction stops in **step 2**.

..... [1]

(iii) Name the residue in **step 3**.

..... [1]

(iv) Name a substance, other than copper(II) carbonate, that can be added to dilute sulfuric acid to produce aqueous copper(II) sulfate.

..... [1]

(v) The solution at the end of **step 4** contains the maximum amount of copper(II) sulfate that will dissolve at that temperature.

State the term used to describe this type of solution.

..... [1]

(vi) **Step 1** is repeated using sulfuric acid of concentration 0.200 mol / dm^3 instead of 0.100 mol / dm^3.

All other conditions are the same.

The rate of reaction increases.

Explain why the rate of reaction increases. Give your answer in terms of particles.

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..... [2]

(vii) Copper(II) sulfate crystals have the formula $CuSO_4 \cdot 5H_2O$.

State the term used to describe a substance that is chemically combined with water.

..... [1]

[Total: 15]