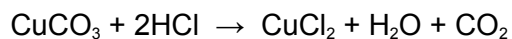


**Q1.** A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

- (a) A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:



Relative atomic masses,  $A_r$ : H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

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Mass of copper carbonate = ..... g

**(4)**

- (b) The percentage yield of copper chloride was 79.1 %.

Calculate the mass of copper chloride the student actually produced.

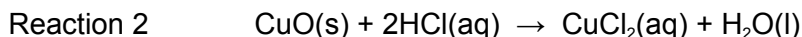
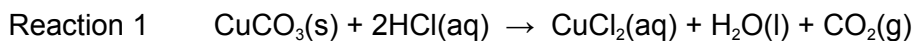
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Actual mass of copper chloride produced = ..... g

**(2)**

- (c) Look at the equations for the two reactions:



Relative formula masses:  $\text{CuO} = 79.5$ ;  $\text{HCl} = 36.5$ ;  $\text{CuCl}_2 = 134.5$ ;  $\text{H}_2\text{O} = 18$

The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

Calculate the percentage atom economy for Reaction 2.

.....

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.....

.....

Percentage atom economy = ..... %

**(3)**

- (d) The atom economy for Reaction 1 is 68.45 %.  
Compare the atom economies of the two reactions for making copper chloride.

Give a reason for the difference.

.....

.....

**(1)**

**(Total 10 marks)**

**M1.**

(a)  $M_r \text{ CuCl}_2 = 134.5$

*correct answer scores 4 marks*

1

moles copper chloride = (mass /  $M_r$  = 11 / 134.5) = 0.0817843866

1

$M_r \text{ CuCO}_3 = 123.5$

1

Mass  $\text{CuCO}_3$  (=moles  $\times M_2$  = 0.08178  $\times$  123.5) = 10.1(00)

1

*accept 10.1 with no working shown for 4 marks*

(b)  $\frac{79.1}{100} \times 11.0$

**or**

$11.0 \times 0.791$

1

8.70 (g)

1

*accept 8.70(g) with no working shown for 2 marks*

(c) Total mass of reactants = 152.5

1

134.5

152.5

*allow ecf from step 1*

1

88.20 (%)

1

*allow 88.20 with no working shown for 3 marks*

- (d) atom economy using carbonate lower because an additional product is made **or** carbon dioxide is made as well

*allow ecf*

1

**[10]**