

- 1 (a) The table shows possible percentages of some of the gases in the Earth's early atmosphere.

gas	percentage in early atmosphere (%)
oxygen	small amount
nitrogen	small amount
carbon dioxide	12
water vapour	77

- (i) Some time after the early atmosphere had been formed, oceans appeared on the Earth's surface.

State how these oceans were formed.

(1)

- (ii) The amount of carbon dioxide in today's atmosphere is much lower than that in the early atmosphere.

State how the formation of the oceans caused this reduction.

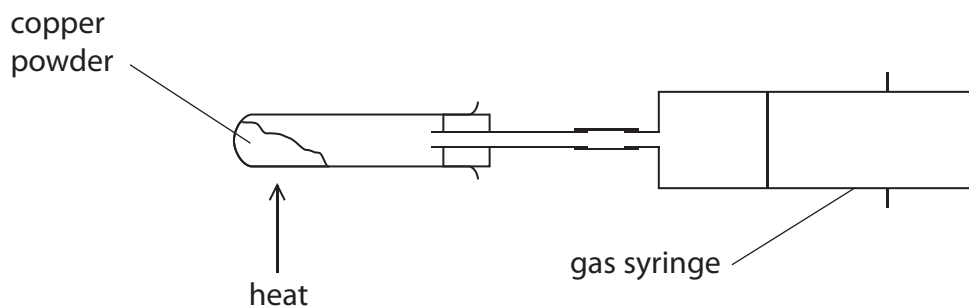
(1)

- (iii) The amount of oxygen in today's atmosphere is much higher than that in the early atmosphere.

Describe the process that has caused this increase.

(2)

(b) John was doing an experiment to find the percentage of oxygen in air at room temperature. He used this apparatus.



The copper powder in the test tube was heated strongly so that it could react with oxygen in the air in the apparatus. John stopped heating the copper when there was no further change in the reading on the gas syringe.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

At the end of the experiment the apparatus was allowed to cool before the final reading on the syringe was recorded.

This is because

(1)

- A** reading the volume while the apparatus is hot is dangerous
- B** the apparatus must be left to allow the reaction to finish
- C** the gas must be at room temperature when its volume is measured
- D** the copper expands when it is hot

(ii) At the end of the experiment not all of the copper had reacted.

Suggest a reason for this.

(1)

- (iii) John's results were  
initial volume of gas in syringe =  $32 \text{ cm}^3$   
final volume of gas in syringe =  $24 \text{ cm}^3$

Calculate the percentage decrease in the volume of gas originally in the syringe.

(2)

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.....  
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percentage decrease = .....

- (iv) The percentage of oxygen in air at room temperature is 21%.  
John thought the answer to part (iii) was the percentage of oxygen in air and was surprised that the value was too high.

John confirmed that he had not made an error when doing his experiment.  
Suggest why the answer calculated in part (iii) is higher than John expected.

(1)

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**(Total for Question 1 = 9 marks)**

2 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

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(b) Another product of the Solvay Process is calcium chloride.

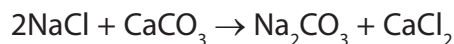
Calculate the relative formula mass of calcium chloride,  $\text{CaCl}_2$ .  
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

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relative formula mass = .....

(c) The overall equation for the Solvay Process is



Calculate the maximum mass of sodium carbonate that could be formed by reacting 40 kg of calcium carbonate with an excess of sodium chloride solution.  
(Relative formula masses:  $\text{CaCO}_3 = 100$ ;  $\text{Na}_2\text{CO}_3 = 106$ )

(2)

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mass of sodium carbonate = ..... kg

(d) Sodium carbonate was made in a laboratory experiment.  
The theoretical yield of the experiment was 15.0 g.  
The actual yield of the experiment was 10.4 g.

(i) Calculate the percentage yield of sodium carbonate in this experiment.

(2)

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percentage yield = .....

(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 .....

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reason 2 .....

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**(Total for Question 2 = 10 marks)**

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