1 **(a** A small piece of marble, calcium carbonate, was added to 5 cm^3 of hydrochloric acid at 25 °C. The time taken for the reaction to stop was measured.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Similar experiments were performed always using 5 cm^3 of hydrochloric acid.

experiment	number of pieces of marble	concentration of acid in mol / dm^3	temperature / °C	ti / min
1		1.00	25	3
2		0.50	25	7
3	1 piece crushed	1.00		1
4		1.00	35	2

Explain each of the following in terms of **collisions between reacting particles.**

(i) Why is the rate in experiment 2 slower than in experiment 1?

.....

..... [2]

(ii) Why is the rate in experiment 3 faster than in experiment 1?

.....

..... [2]

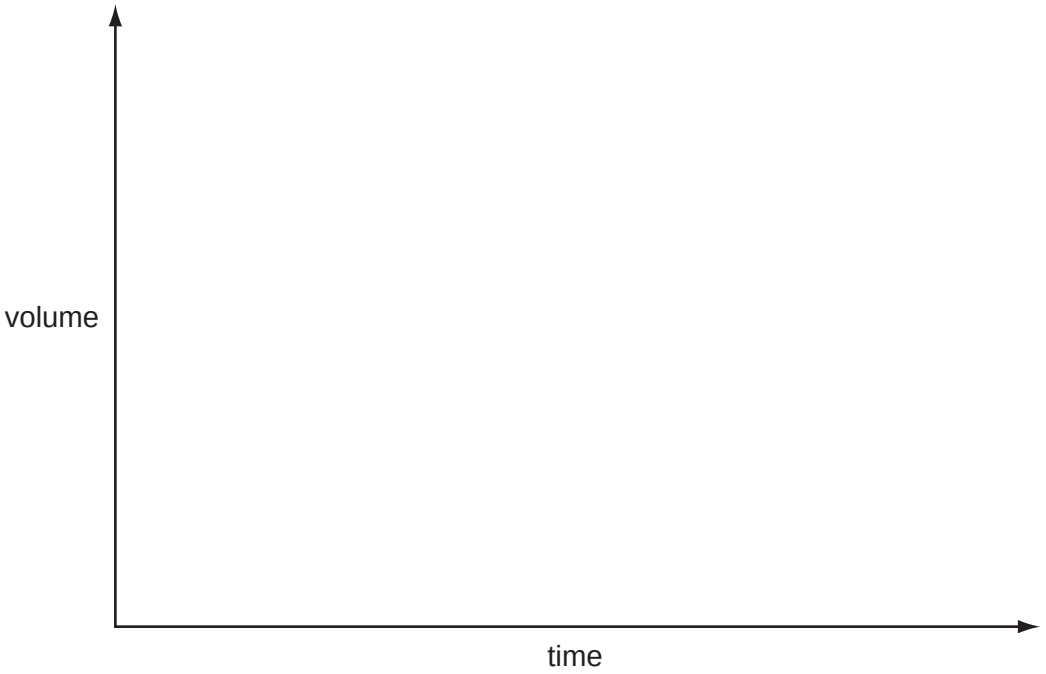
(iii) Why is the rate in experiment 4 faster than in experiment 1?

.....

..... [2]

(b) An alternative method of measuring the rate of this reaction would be to measure the volume of carbon dioxide produced at regular intervals.

(i) Sketch this graph



[2]

(ii) One piece of marble, 0.3 g, was added to 5 cm^3 of hydrochloric acid, concentration 1.00 mol / dm^3. Which reagent is in excess? Give a reason for your choice.

mass of one mole of $CaCO_3$ = 100 g

number of moles of $CaCO_3$ = ...

number of moles of HCl = ...

reagent in excess is .....

reason ..... [4]

(iii) Use your answer to **(ii)** to calculate the maximum volume of carbon dioxide produced measured at r.t.p.

..... [1]

[Total: 13]

2 Calcium carbonate is an important raw material.

(a) Name a rock which is made up of calcium carbonate.

.....

[1]

(b) When calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

(i) Calculate the relative formula mass of:

$CaCO_3$ .....

CaO .....

[2]

(ii) 7.00 kg of calcium oxide was formed. What mass of calcium carbonate was heated?

.....

.....

[2]

(c) Calcium carbonate is used to control soil acidity.

(i) Why is it important to control soil acidity?

.....

[1]

(ii) Both calcium carbonate, insoluble in water, and calcium oxide, slightly soluble, are used to increase soil pH. Suggest **two** advantages of using calcium carbonate.

.....

.....

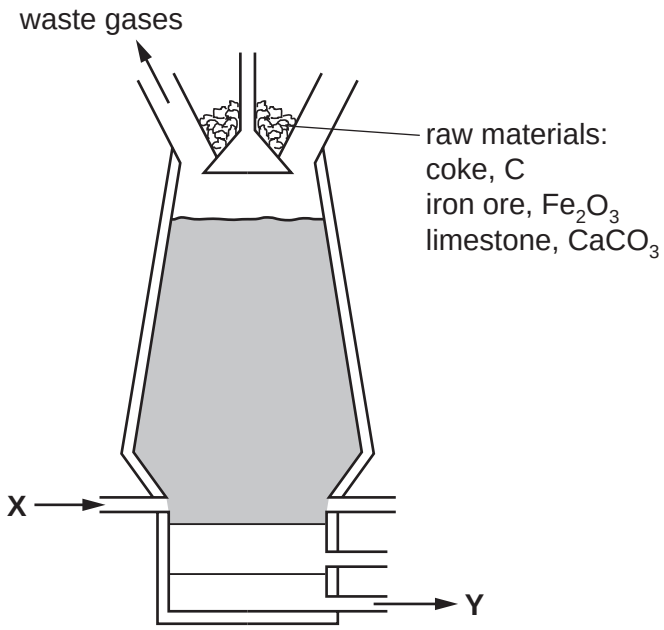
[2]

(iii) Give **one** use of calcium carbonate other than for making calcium oxide and controlling soil pH.

.....

[1]

2 The diagram shows a blast furnace.



(a) The following equations represent reactions which take place in the blast furnace.

A $C + O_2 \rightarrow CO_2$

B $CaCO_3 \rightarrow CaO + CO_2$

C $CaO + SiO_2 \rightarrow CaSiO_3$

D $CO_2 + C \rightarrow 2CO$

E $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

(i) Which reaction is used to increase the temperature inside the blast furnace? ..... [1]

(ii) Which reaction is an example of thermal decomposition? ..... [1]

(iii) In which reaction is carbon both oxidised and reduced? ..... [1]

(iv) Which equation shows the removal of an impurity from the iron? ..... [1]

(v) Which equation shows the reaction of an acidic substance with a basic substance?

..... [1]

(b) Use the diagram of the blast furnace to help you answer these questions.

(i) What enters the blast furnace at **X**?

..... [1]

(ii) What leaves the blast furnace at **Y**?

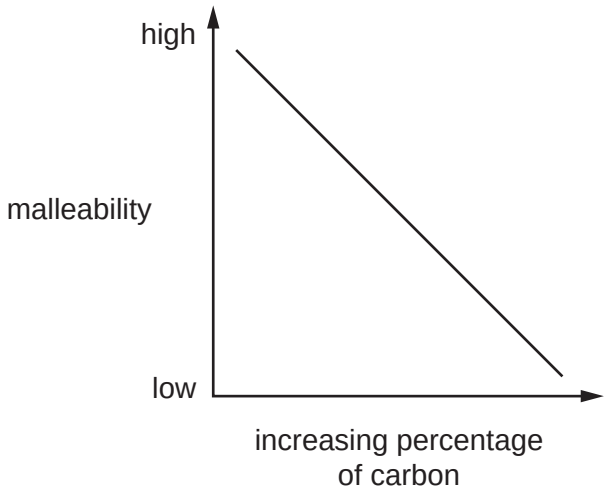
..... [1]

(iii) Name **two** waste gases that leave the blast furnace.

1. .....

2. .....
[2]

(c) The graph shows how the malleability of iron changes as the percentage of carbon in the iron changes.



(i) Describe how the malleability of iron changes as the percentage of carbon changes.

.....

..... [1]

(ii) Iron obtained from the blast furnace contains high levels of carbon.

Explain how the amount of carbon in the iron can be decreased.

.....

.....

..... [2]

[Total: 12]

4 Iron from the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, silicon and phosphorus, which have to be removed when this iron is converted into steel.

(a) Explain how the addition of oxygen and calcium oxide removes these impurities. Include an equation for a reaction of oxygen and a word equation for a reaction of calcium oxide in this process.

.....

.....

.....

.....

.....

.....

[5]

(b) Mild steel is the most common form of steel. Mild steel contains a maximum of 0.3% of carbon.

High carbon steel contains 2% of carbon. It is less malleable and much harder than mild steel.

(i) Give a use of mild steel.

..... [1]

(ii) Suggest a use of high carbon steel.

..... [1]

(iii) Explain why metals are malleable.

.....

.....

.....

..... [3]

(iv) Suggest an explanation why high carbon steel is less malleable and harder than mild steel.

.....

.....

..... [2]

[Total: 12]