1 The table below shows the elements in the second period of the Periodic Table and some of their oxidation states in their most common compounds.

element	Li	Be	B	C	N	O	F	Ne
number of outer electrons	**1**	2						
oxidation state	+1	+2	+3	+4	–3	–2	–1	0

(a) (i) What does it mean when the only oxidation state of an element is zero?

.....

..... [1]

(ii) Explain why some elements have positive oxidation states but others have negative ones.

.....

..... [2]

(iii) Select **two** elements in the table which exist as diatomic molecules of the type X_2.

..... [1]

(b) Beryllium hydroxide, a white solid, is an amphoteric hydroxide.

(i) Name another metal which has an amphoteric hydroxide.

..... [1]

(ii) Suggest what you would observe when an excess of aqueous sodium hydroxide is added gradually to aqueous beryllium sulfate.

.....

..... [2]

(c) (i) Give the formulae of lithium fluoride and nitrogen fluoride.

lithium fluoride .....

nitrogen fluoride ..... [2]

(ii) Predict **two** differences in their properties.

.....

..... [2]

(iii) Explain why these two fluorides have different properties.

.....

..... [2]

[Total: 13]

2 The decomposition of hydrogen peroxide is catalysed by manganese(IV) oxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

To 50 cm^3 of aqueous hydrogen peroxide, 0.50 g of manganese(IV) oxide was added. The volume of oxygen formed was measured every 20 seconds. The average reaction rate was calculated for each 20 second interval.

time / s	0	20	40	60	80	100
volume of oxygen / cm^3	0	48	70	82	88	88
average reaction rate in cm^3 / s	2.4	1.1	.....	0.3	0.0	0.0

(a) Explain how the average reaction rate, 2.4 cm^3 / s, was calculated for the first 20 seconds.

.....

..... [2]

(b) Complete the table. [1]

(c) Explain why the average reaction rate decreases with time.

.....

..... [2]

(d) The experiment was repeated but 1.0 g of manganese(IV) oxide was added.
What effect, if any, would this have on the reaction rate and on the final volume of oxygen? Give a reason for each answer.

effect on rate ..... [1]

reason .....

..... [2]

effect on final volume of oxygen ..... [1]

reason .....

..... [2]

[Total: 11]

3 The distinctive smell of the seaside was thought to be caused by ozone, O_3.
Ozone is a form of the element oxygen.

(a) A mixture of oxygen and ozone is formed by passing electric sparks through oxygen.

$$3O_2 \rightleftharpoons 2O_3$$

Suggest a technique that might separate this mixture. Explain why this method separates the two forms of oxygen.

technique .....

explanation .....

.....

.....

..... [2]

(b) Ozone is an oxidant. It can oxidise an iodide to iodine.

$$2I^- + O_3 + 2H^+ \rightarrow I_2 + O_2 + H_2O$$

(i) What would you see when ozone is bubbled through aqueous acidified potassium iodide?

.....

.....

.....

..... [2]

(ii) Explain in terms of electron transfer why the change from iodide ions to iodine molecules is oxidation.

.....

..... [1]

(iii) Explain, using your answer to **b(ii)**, why ozone is the oxidant in this reaction.

.....

..... [1]

(c) It is now known that the smell of the seaside is due to the chemical dimethyl sulfide, $(CH_3)_2S$.

(i) Draw a diagram that shows the arrangement of the valency electrons in one molecule of this covalent compound.
Use x to represent an electron from a carbon atom.
Use o to represent an electron from a hydrogen atom.
Use ● to represent an electron from a sulfur atom.

[3]

(ii) Name the **three** compounds formed when dimethyl sulfide is burnt in excess oxygen.

.....

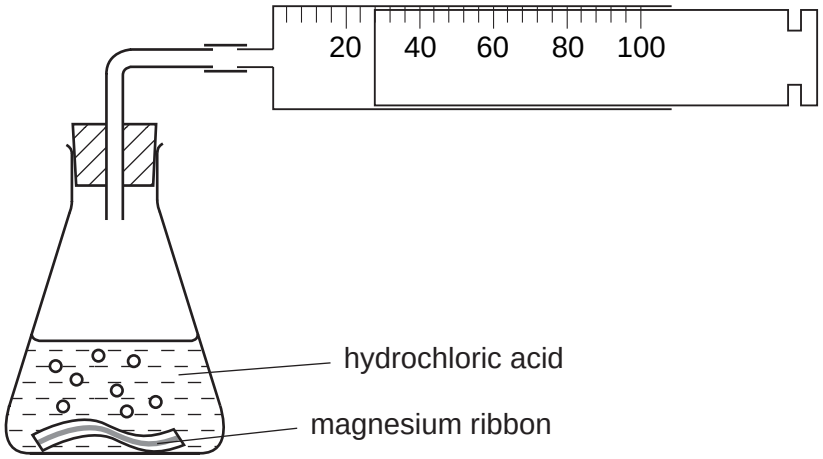
.....

..... [2]

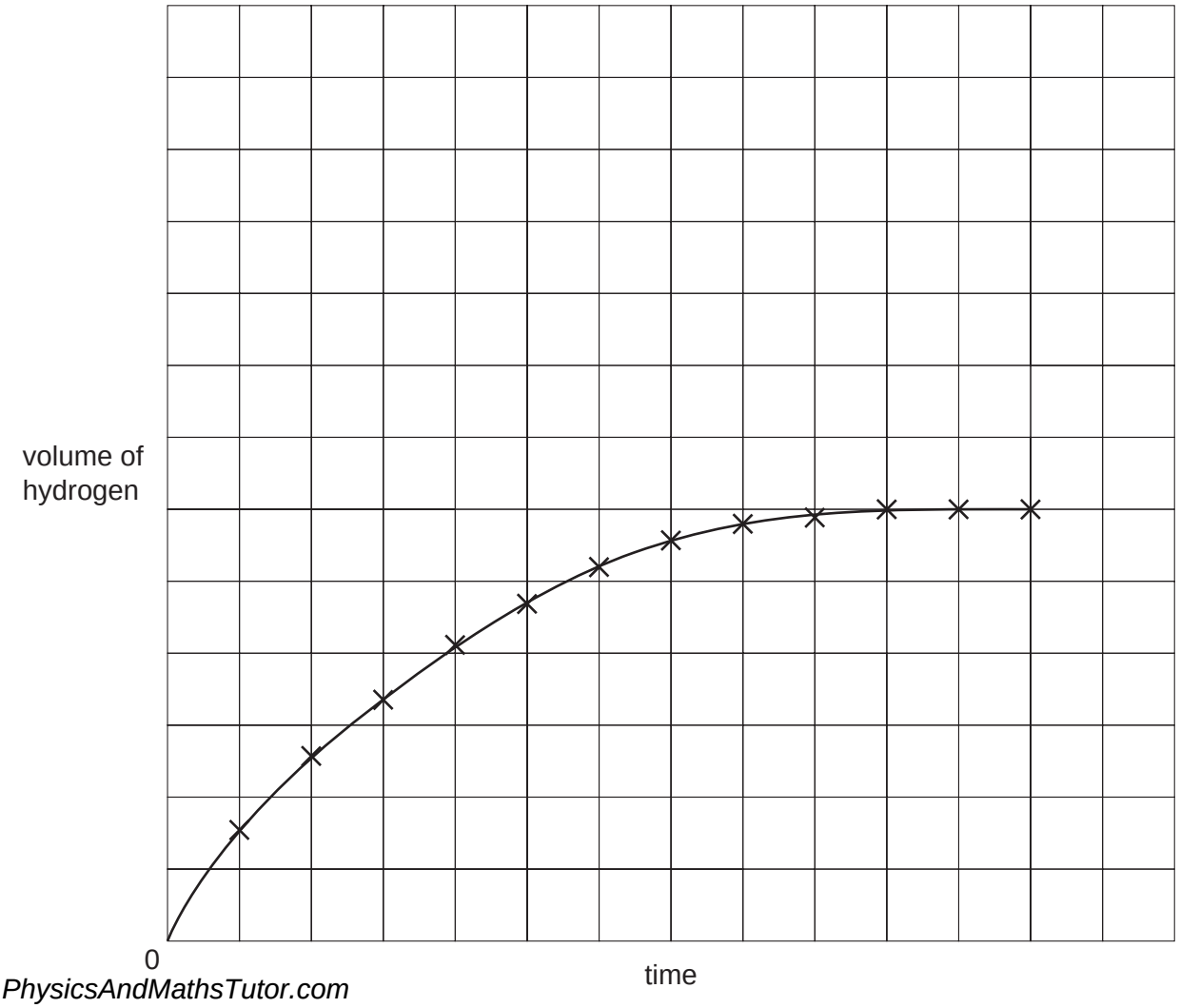
[Total: 11]

4 The rate of a reaction depends on concentration of reactants, temperature and possibly a catalyst or light.

(a) A piece of magnesium ribbon was added to 100 cm^3 of 1.0 mol/dm^3 hydrochloric acid. The hydrogen evolved was collected in a gas syringe and its volume measured every 30 seconds.



In all the experiments mentioned in this question, the acid was in excess.
The results were plotted to give a graph.



(i) The experiment was repeated. Two pieces of magnesium ribbon were added to 100 cm^3 of 1.0 mol/dm^3 hydrochloric acid. Sketch this graph on the same grid and label it X.

[2]

(ii) The experiment was repeated using one piece of magnesium ribbon and 100 cm^3 of 1.0 mol/dm^3 ethanoic acid. Describe how the **shape** of this graph would differ from the one given on the grid.

.....

..... [2]

(b) Reaction rate increases when concentration or temperature is increased.
Using the idea of reacting particles, explain why;

increasing concentration increases reaction rate,

.....

..... [2]

increasing temperature increases reaction rate.

.....

..... [2]

(c) The rate of a photochemical reaction is affected by light. A reaction, in plants, between carbon dioxide and water is photochemical.

(i) Name the **two** products of this reaction.

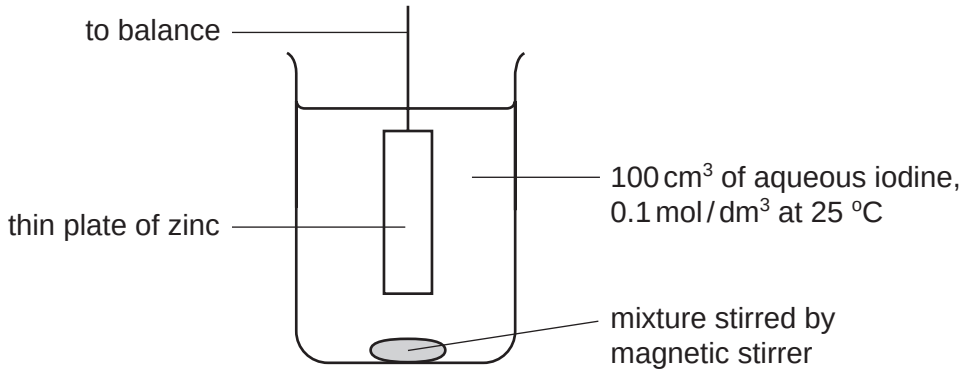
.....

..... [2]

(ii) This reaction will only occur in the presence of light and another chemical. Name this chemical.

..... [1]

5 The following apparatus was used to measure the rate of the reaction between zinc and iodine.



The mass of the zinc plate was measured every minute until the reaction was complete.

(a) Write an ionic equation for the redox reaction that occurred between zinc atoms and iodine molecules.

.....

[2]

(b) Describe how you could show by adding aqueous sodium hydroxide and aqueous ammonia that a solution contained zinc ions.

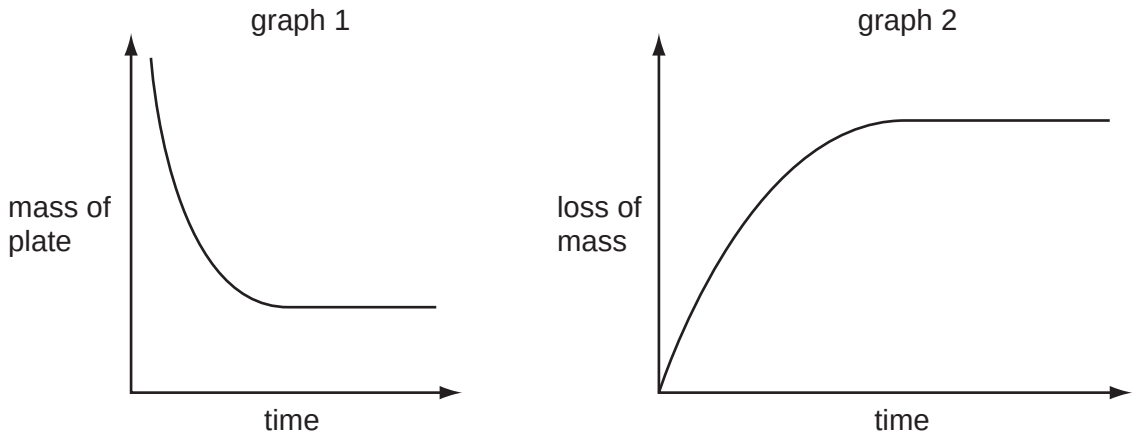
result with sodium hydroxide .....

excess sodium hydroxide .....

result with aqueous ammonia .....

excess aqueous ammonia ..... [3]

(c) From the results of this experiment two graphs were plotted.



(i) Which reagent iodine or zinc was in excess? Give a reason for your choice.

.....

[1]

(ii) Describe how the shape of graph 1 would change if 100cm^3 of 0.05 mol/dm^3 iodine had been used.

.....

.....

[2]

(iii) On graph 2, sketch the shape if the reaction had been carried out using 100 cm^3 of 0.1 mol/dm^3 iodine at 35 °C instead of at 25 °C. [2]