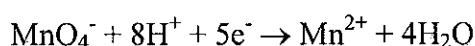
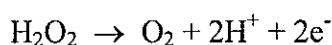


For Examiner's Use	
1	
2	
Total	

1. Hydrogen peroxide is sold commercially as an aqueous solution. Hydrogen peroxide solution decomposes slowly under normal conditions. A student was asked to carry out an experiment to find the concentration of a given aqueous solution.

The concentration of a solution of hydrogen peroxide can be determined by titration with a solution of potassium manganate (VII) in the presence of dilute sulphuric acid. Half-equations for the redox reactions occurring are given below.



The student diluted the commercial hydrogen peroxide by transferring a 25.0 cm^3 sample to a 250 cm^3 volumetric flask using a pipette. The sample in the flask was made up to the mark with deionised water and shaken well to ensure complete mixing.

A 25.0 cm^3 portion of the diluted hydrogen peroxide solution was transferred to a conical flask using a pipette. This solution was acidified with dilute sulphuric acid and titrated with a $0.0200 \text{ mol dm}^{-3}$ solution of potassium manganate (VII). The titration was repeated three times and the results are shown in the table.

Titration number	1	2	3	4
Final burette reading / cm^3	28.10	46.10	27.90	48.75
Initial burette reading / cm^3	0.00	18.20	0.05	20.90
Titre / cm^3				

- (a) Deduce an overall equation for the reaction between hydrogen peroxide and manganate (VII) ions in the presence of dilute sulphuric acid.

.....
[1]

- (b) State the colour change that occurs at the end point.

.....
[1]

- (c) Identify all the consistent results in the table and use these to determine the mean titre.

[1]

- (d) Use your answers from parts (a) and (b) to calculate the number of moles of hydrogen peroxide in 25.0 cm^3 of the diluted solution.

[2]

- (e) Use your answer from part (c) to calculate the concentration of hydrogen peroxide in the undiluted commercial solution.
(If you could not complete the calculation in part (c), you should assume a value of $1.45 \times 10^{-3} \text{ mol}$. This is not the correct value).

- (f) Use your answer from part (d) to calculate the concentration, in g dm^{-3} , of hydrogen peroxide in the undiluted commercial solution.
[Ar : H, 1.0; O, 16.0]

[1]

[Turn Over]

- (g) Assume that the maximum errors for the apparatus used in this experiment were

Volumetric flask $\pm 1 \text{ cm}^3$

Pipette $\pm 0.1 \text{ cm}^3$ (from dilution and titration)

Burette total error $\pm 0.15 \text{ cm}^3$ (from two readings and an end point error)

Calculate the maximum percentage error in using each piece of apparatus and hence the maximum overall apparatus error. Use the mean titre to calculate the error in using the burette.

[2]

- (h) Comment on the consistency of the titration results given in the table on page 2.

.....

[2]

- (i) According to the supplier, the commercial solution of hydrogen peroxide had concentration of $0.815 \text{ mol dm}^{-3}$. Apart from the apparatus error, suggest **two** reasons why the student's value is **lower** than the supplier's value. Assume that the supplier's figure is correct.

Reason 1

.....

.....

Reason 2

.....

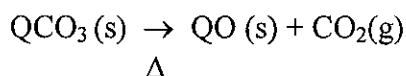
.....

[2]

[Total : 14]

[Turn Over

2. Group II carbonates are white solids which are decomposed by heat. In the equation below Q represents the symbol of any Group II element from Magnesium to Strontium.



You are required to plan an experiment, which makes use of this decomposition, to find the relative atomic mass of Q and hence identify the Group II element in the carbonates. The only apparatus and materials available are:

- a test tube and a test tube holder, Bunsen burner, matches and a heat proof mat.
- a specimen tube containing a suitable mass of group II carbonate;
- a balance.

You must include in your plan

- (a) the procedure of the experiment; [3]
- (b) the measurements and results you would tabulate; [3]
- (c) calculations of how the results would be used to identify the Group II element, Q; [Ar : C, 12.0; O, 16.0] [4]
- (d) discussion of **two** possible errors; [2]
- (e) suggest **another** procedure which allows you to identify Q by measuring the volume of CO₂ evolved. Your answer should include a labeled diagram of the apparatus used and a brief description of the method. [4]

[Total : 16]

[Turn Over

