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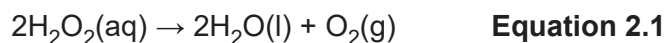
A Level Chemistry A

H432/03 Unified chemistry

Question Set 7

1 This question looks at reactions of hydrogen peroxide and of cobalt(II) ions.

(a) Aqueous hydrogen peroxide decomposes as shown in **equation 2.1**.



The reaction is catalysed by manganese(IV) oxide, MnO_2 .

A student investigates the decomposition of a hydrogen peroxide solution as outlined below.

- The student adds 50.00 cm^3 of $\text{H}_2\text{O}_2(\text{aq})$ to a conical flask.
- The student adds a small spatula measure of MnO_2 and quickly connects the flask to a gas syringe.
- The student measures the volume of oxygen every 200 seconds.

Results

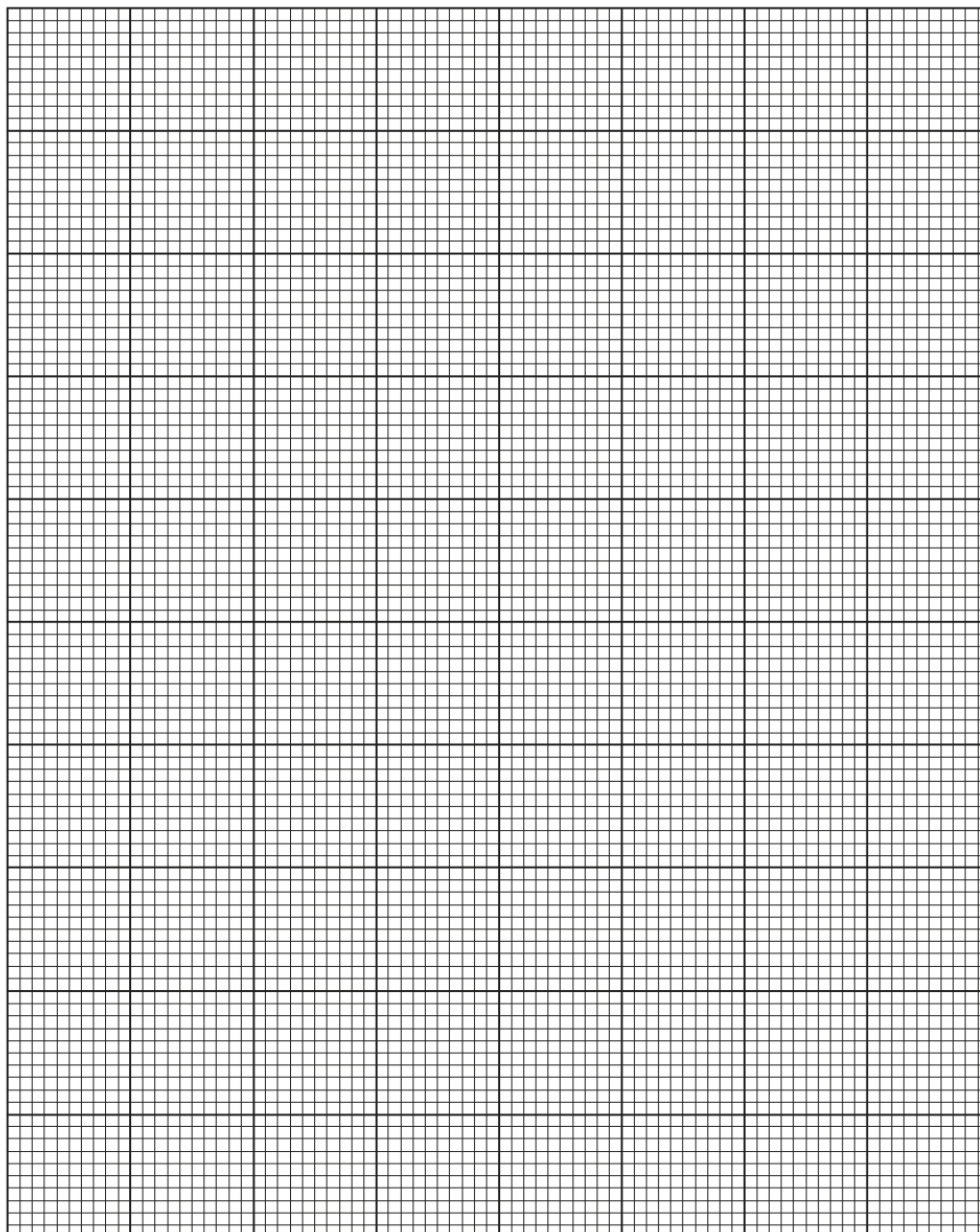
Time/s	Volume of O_2/cm^3
0	0
200	15
400	28
600	36
800	41
1000	46
1200	48
1400	50

(i) Process the results as outlined below.

- On the next page, plot a graph of **volume of O_2** against **time**.
- Use your graph to find the rate of the reaction, in cm^3s^{-1} , at $t = 500\text{ s}$.

Show your working on the graph and in the space below.

rate = cm^3s^{-1}



[5]

(ii) The student allows the reaction in **equation 2.1** to proceed until no more gas is evolved.

The volume of O_2 in the syringe is now 55 cm^3 , measured at RTP.

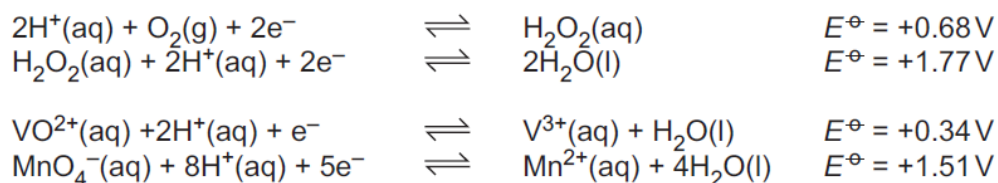
Calculate the initial concentration of the H_2O_2 , in mol dm^{-3} .

Give your answer to **two** significant figures.

[3]

(b) Hydrogen peroxide can act as an oxidising agent or as a reducing agent.

Some standard electrode potentials are shown below.



Use this information to write an equation for a reaction in which hydrogen peroxide acts as a reducing agent. [2]

(c) Cobalt(II) forms complex ions with water ligands and with chloride ligands.

- With water ligands, cobalt(II) forms a pink octahedral complex ion, $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$.
- With chloride ligands, cobalt(II) forms a blue tetrahedral complex ion.

A student dissolves cobalt(II) sulfate in water in a boiling tube. A pink solution forms.

Experiment 1

The student places the boiling tube in a water bath at 100 °C.
Concentrated hydrochloric acid is added dropwise.
The colour of the solution changes from pink to blue.

Experiment 2

The student places the boiling tube from **experiment 1** in an ice/water bath at 0 °C.
The colour of the solution changes from blue to pink.

- (i) Write the equilibrium equation for the reaction that takes place when the colour of the solution changes. [1]
- (ii) Explain the observations and predict whether the formation of the blue colour is exothermic or endothermic. [2]

Total Marks for Question Set 7: 13

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