Higher Still Notes
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Higher Chemistry

HSN14310
Unit 3 PPAs

Contents

Hess's Law

State the aim of the experiment.

To confirm Hess's Law.

Procedure

Use equations to describe the two routes whereby you converted solid potassium hydroxide into potassium chloride solution and label them with appropriate ΔH values.

$$KOH_{(s)} + HCl_{(aq)} \longrightarrow KCl_{(aq)} + H_2O_{(l)} \qquad \Delta H_1$$

or

$$KOH_{(s)} + (aq) \longrightarrow KOH_{(aq)} \qquad \Delta H_{2a}$$

$$KOH_{(aq)} + HCl_{(aq)} \longrightarrow KCl_{(aq)} + H_2O_{(l)} \qquad \Delta H_{2b}$$

Write down the relationship between the ΔH values for Hess's Law to hold true.

$$\Delta H_1 = \Delta H_{2a} + \Delta H_{2b}$$

Results

Present your results in an appropriate manner.

1		Mass of KOH	=	1.29	g
		Temperature of acid	=	22.75	°C
		Temperature of reaction	=	38.5	°C
2	a	Mass of KOH	=	1.24	g
		Temperature of water	=	20.3	°C
		Temperature of reaction	=	25.75	°C
	b	Temperature of acid	=	23	°C
		Temperature of KOH solution	=	24.4	°C
		Temperature of reaction	=	28.75	°C

Calculation/Conclusion

Carry out a calculation to show the confirmation of Hess's Law.

$\Delta T_1 = 15.75°C$

$E = cm\Delta T$

$= 4.18 \times 0.025 \times 15.75$

$= 1.65\ kJ$

1.29 g KOH gave 1.65 kJ

so 56.1 g (1 mole) would give 71.76 kJ

$\Delta H_1 = -71.76\ kJ\ mol^{-1}$

$\Delta T_{2a} = 5.45°C$

$E = cm\Delta T$

$= 4.18 \times 0.025 \times 5.45$

$= 0.57\ kJ$

1.24 g KOH gave 0.57 kJ

so 56.1 g (1 mole) would give 25.77 kJ

$\Delta H_{2a} = -25.77\ kJ\ mol^{-1}$

$\Delta T_{2b} = 5.05°C$

$E = cm\Delta T$

$= 4.18 \times 0.05 \times 5.05$

$= 1.06\ kJ$

1.24 g KOH gave 1.06 kJ

so 56.1 g (1 mole) would give 47.75 kJ

$\Delta H_{2b} = -47.75\ kJ\ mol^{-1}$

$\Delta H_1 = -71.76\ kJ\ mol^{-1}$

$\Delta H_{2a} + \Delta H_{2b} = -25.77 - 47.75$

$= -73.52\ kJ\ mol^{-1}$

The experiment has confirmed Hess's Law with reasonable accuracy.

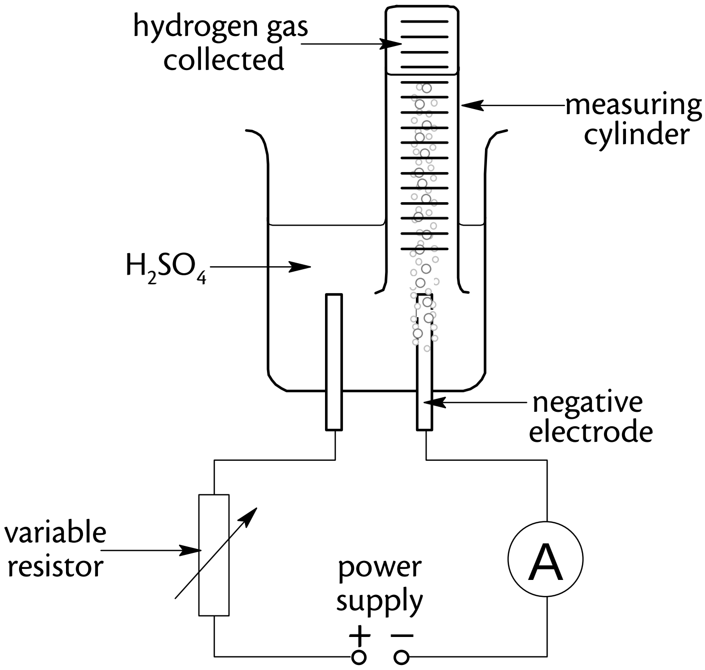
Quantitative Electrolysis

State the aim of the experiment.

To confirm the charge of a mole of electrons by determining the quantity of electricity required to produce 1 mole of hydrogen through electrolysing dilute sulphuric acid.

Procedure

Draw a labelled diagram of the circuit.



List all the measurements that were made during the experiment.

- *The volume of hydrogen collected in the measuring cylinder*
- *The current*
- *The time*

Results

Present your results in an appropriate manner.

Volume of hydrogen	=	*42ml*
Current	=	*0.5A*
Time	=	*645s*

Calculation/Conclusion

Carry out a calculation to determine the quantity of electricity required to produce one mole of hydrogen. Assume the molar volume of hydrogen to be 24.1 litres mol^{-1}.

$Q = It$

$= 0.5 \times 645$

$= 322.5C$

0.042l were produced by 322.5 C

so 24.1l would be produced by 185053.6C

Evaluation

In theory, 193000C are required to produce one mole of hydrogen by electrolysis.

Suggest sources of error which could account for any difference between your result and the theoretical one.

- *Inaccurate timing*
- *Inaccurate measurement of volume*
- *Current changing throughout experiment*
- *Hydrogen may dissolve in the water slightly, or be held in the electrode*

A Redox Titration

State the aim of the experiment.

To find the mass of vitamin C in a tablet, using a solution of iodine, and starch as an indicator.

Using the molecular formula for vitamin C write equations for the oxidation and reduction half-reactions and hence write a balanced equation for the redox reaction between vitamin C and iodine.

$$C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+_{(aq)} + 2e^- \quad \text{oxidation}$$

$$I_{2(aq)} + 2e^- \longrightarrow 2I^-_{(aq)} \quad \text{reduction}$$

$$C_6H_8O_6 + I_{2(aq)} \longrightarrow C_6H_6O_6 + 2H^+_{(aq)} + 2I^-_{(aq)} \quad \text{redox}$$

Procedure

Write a brief description of the experimental procedure you carried out to determine the mass of vitamin C in a tablet.

- *The vitamin C tablet was dissolved in deionised water and made up to the mark in a standard flask.*
- *25cm^3 was pipetted into a conical flask, along with a few drops of starch.*
- *Iodine solution was run into the flask using a burette, until the blue/black colour just remained.*
- *The volume of iodine used was noted, and the procedure repeated until concordant results were obtained.*

Results

Record your results in an appropriate manner.

	1st try	2nd try	3rd try
1st reading (ml)	0.45	12.25	23.70
2nd reading (ml)	12.25	23.70	35.25
Titre (ml)	11.80	11.45	11.55

Average Titre = 11.50ml

Calculation/Conclusion

Carry out a calculation to determine the mass of vitamin C in the tablet.

0.025 mol l^{-1} means 1000ml contains 0.025 moles I_2

so 11.5ml contains $0.025 \times \frac{11.5}{1000}$

$= 0.0002875$ *moles* I_2

In the conical flask there were 0.0002875 moles vitamin C

So in the 250ml of vitamin C solution there were 0.002875 moles vitamin C
So in 1 tablet there are 0.002875 moles vitamin C

1 mole of vitamin C has mass 176g

So 0.002875 moles of vitamin C has mass 176×0.002875

$= 0.506\text{g}$