ANSWERS TO UCLSE NEW CURRICULUM CHEMISTRY PRACTICAL WORK BOOK

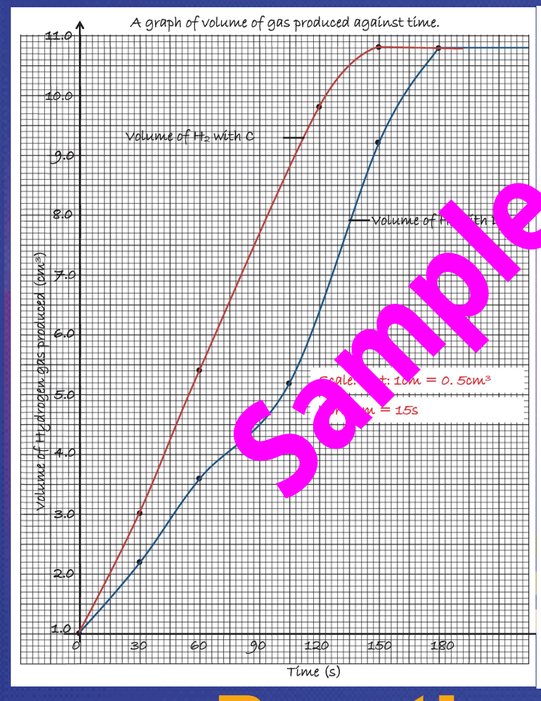
WAKATA PUBLISHERS

Answers to

UCLSE

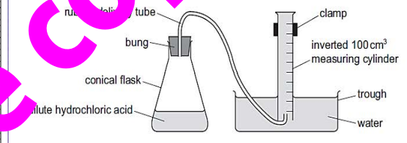
New Curriculum

Chemistry



Experiment 6

A high school scien[illegible] carr[illegible]cased v[illegible]us experiments, including one investigating the rate of hydrogen gas pro[illegible]n wh[illegible]agnes[illegible] reacts with two different solutions of dilute hydrochloric acid, la[illegible] C and D, each with varying concentrations. Participants were recomme[illegible] the [illegible]n below.



Task: Let C – more concentrated (1.0M)
D – less concentrated (0.7M)

(a) As a participant in the science fair;

(i) design an experiment to investigate the rate at which hydrogen gas is made when magnesium reacts with two different solutions of dilute hydrochloric acid, C and D, with different concentrations

Aim: To investigate the rate of evolution of Hydrogen gas when Magnesium ribbon reacts with two different acids of different concentration.

Variables:	(i) **Dependent:**	Volume of hydrogen gas produced.
	(ii) **Independent:**	Time taken during experiment
	(iii) **Controlled:**	Mass of magnesium used and volume of acid added.
Hypothesis:	The rate of evolution of hydrogen gas depends on the high concentration of the acid solution. (More concentrated acid produces high rate of hydrogen gas).	

Risk:	**Mitigation**
- Acid spilling on skin	- Be careful and clean the table
- Cut from broken glass	- wear gloves
- Choking fumes	- use face masks

Practical Workbook

WAKATA

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UCLSE

New Curriculum

Chemistry

Practical Workbook

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Experiment 1

A chemistry teacher conducted an experiment to investigate the rate of reaction between dilute hydrochloric acid and aqueous sodium thiosulphate. The experiment involved varying the volumes of the reactants to observe their impact on the rate of reaction.

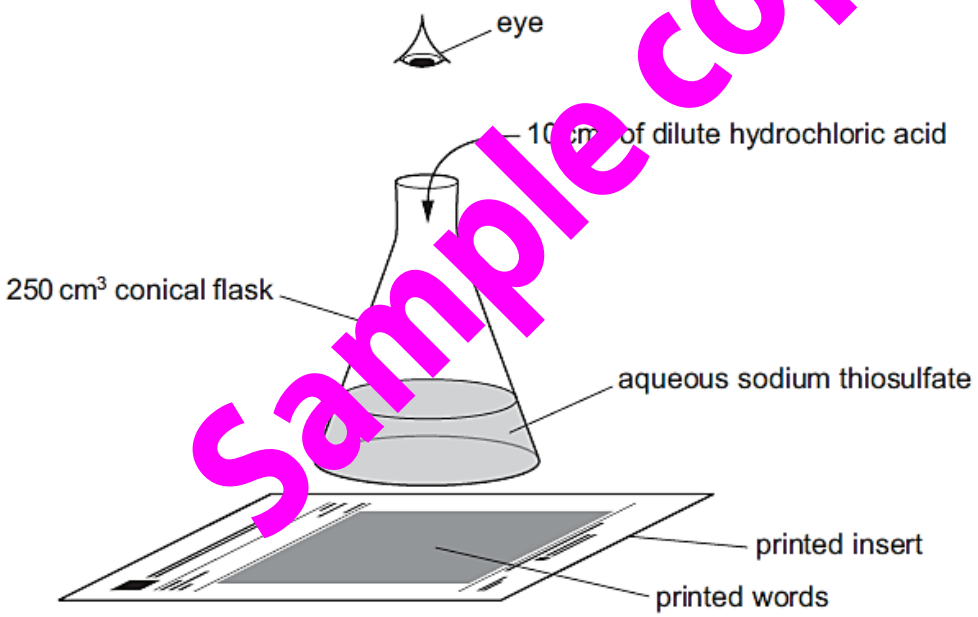
Sodium thiosulphate reacts with hydrochloric acid according to the following equation.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + H_2O(l) + SO_2(g)$$

Task:

(a) As a student conducting the experiment;

(i) design an experiment to measure the rate of reaction between dilute hydrochloric acid and aqueous sodium thiosulphate. The setup below may be useful to you.



Bases of assessment:

Aim: To investigate /measure the reaction between $Na_2S_2O_3$ and HCl at different concentrations.

Variables:

(i) Dependent variable: Time taken for the cross to disappear.

(ii) Independent variable: Volume of sodium sulphate used.

(iii) Controlled variable: Volume of acid (BA2) added.

Hypothesis: The rate of chemical reaction between $Na_2S_2O_3$ and HCl increases with increase in the concentration of the thiosulphate.

OR: The rate of chemical reaction between $Na_2S_2O_3$ and HCl decreases with increase in dilution or with decrease in the concentration

Apparatus:

- Stop clock or stop watch
- Beakers
- Measuring cylinder
- Conical flask

Risks:	Mitigation
- Spilling solution on table	Be careful
- Acids can burn	Use / wear protective gears

Procedure:

- Mark a cross (x) with a blue or black ink on the filter paper.
- Using a measuring cylinder, measure about $50cm^3$ of BA1 (Sodium thiosulphate into a clean conical flask.
- Add $10cm^3$ of HCl (BA2) to BA1 in the conical flask and at the same time start the stop clock.
- Shake /swall the conical flask gently for the solution to mix and place it on the filter paper over the cross (x).
- Watch close through the solution from above the conical flask. Stop the stop clock when the cross disappears and note the time taken for the cross to disappear.
- Pour away the mixture and thoroughly rinse the conical flask.
- Then measure $40cm^3$ of BA1 followed by $10cm^3$ of water into the conical flask.
- Add $10cm^3$ of BA2 and at the same time start the stop clock. Follow the procedures from the first one again.
- Repeat the procedure with other 3 conical flasks and by measuring 30, 20 and $10cm^3$ of BA1 followed by 20, 30, 40 cm^3 of water. The water should be added to BA1 before adding BA2. In each case keep the volume of BA2 the same.

(ii) carry out the experiment and record your findings.

Flask No.	1	2	3	4	5
Volume of BA1 (cm^3)	50	40	30	20	10
Volume of water (cm^3)	0	10	20	30	40
Volume of BA2 (cm^3)	10	10	10	10	10
Time, t in seconds	17.0	24.0	30.0	64.0	106.0
$\frac{1}{t}(s^{-1})$	0.059	0.042	0.033	0.0156	0.009

(iii) Describe the appearance of the mixture in the conical flask at the end of each experiment.

The mixture turns yellow. This is because the reaction between sodium thiosulphate and hydrochloric acid produces sulphur (colloidal) which covers the cross during the reaction.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + H_2O(l) + SO_2(g)$$

(iv) Explain, in terms of particles, why the rate of reaction was greatest in this experiment.

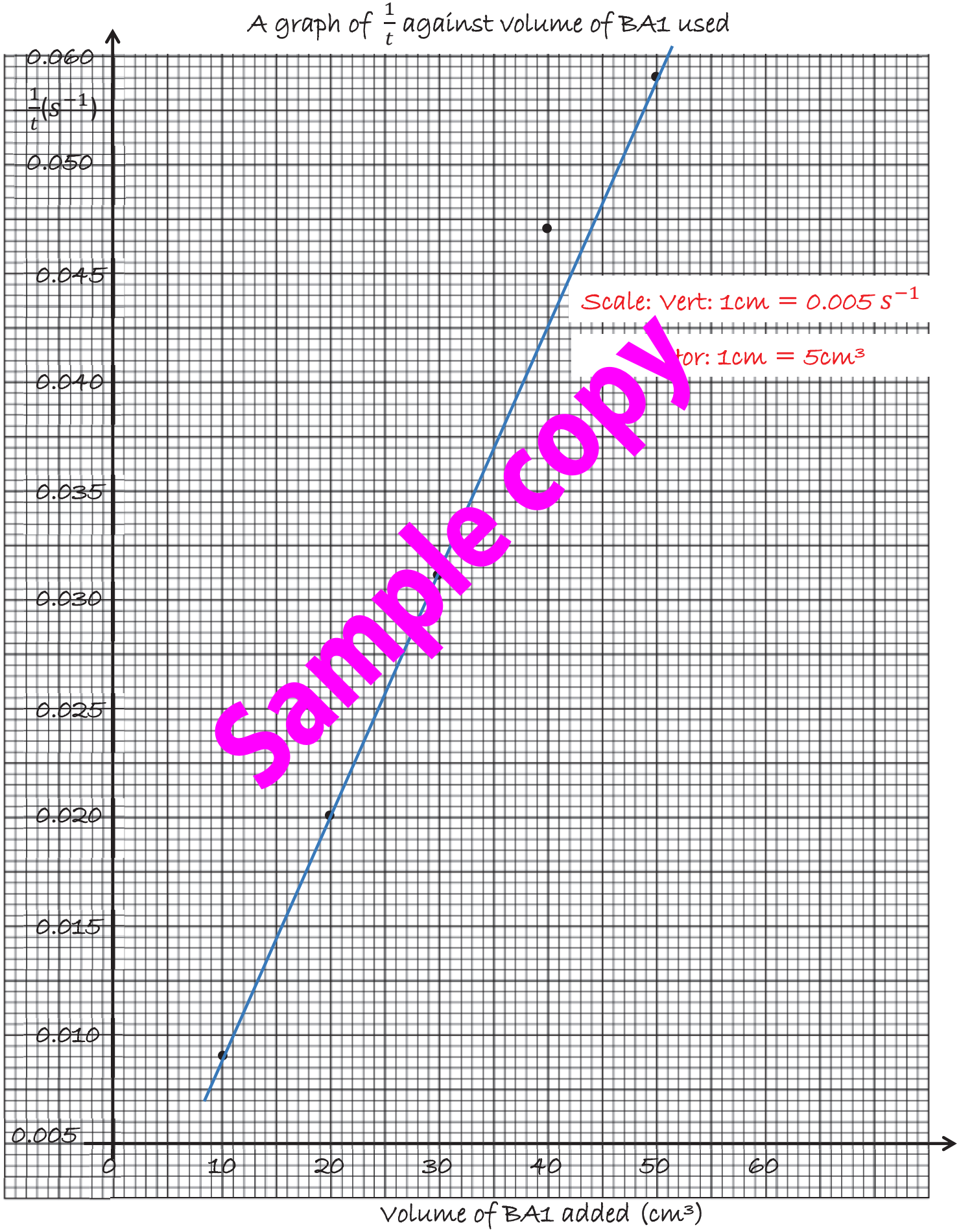
The rate of reaction is directly proportional to initial concentration of the reactant. The higher the concentration, the faster the rate of chemical reaction because increase in concentration increases the frequency of collision (the number of colliding / reacting particles in a given volume as a result the collisions between the particles increases.

(b) Give the name of a more accurate piece of apparatus for measuring volumes than a measuring cylinder.

Burette, Pipette

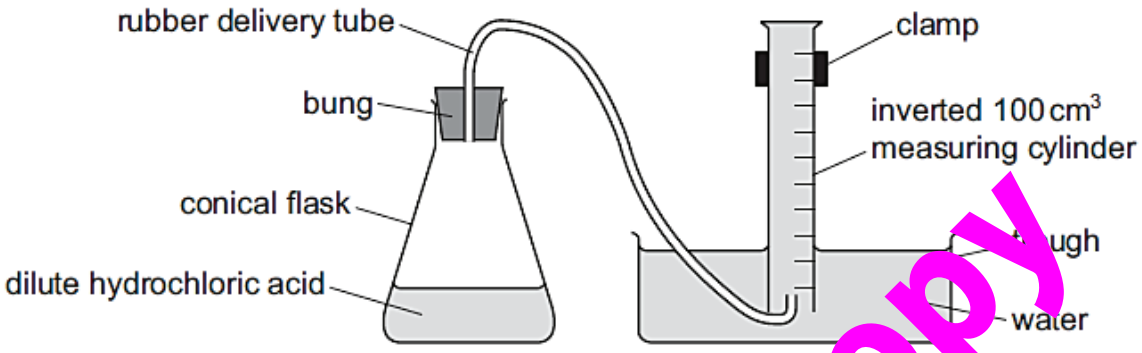
(c) Suggest the effect on the results of using a 100 cm^3 conical flask instead of a 250 cm^3 conical flask. Explain your answer.

No change on the results because the volume of a container , conical flask has no effect on the experimental result.


A graph of $\frac{1}{t}$ against volume of BA1 used
0.060
$\frac{1}{t}(s^{-1})$
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0
10
20
30
40
50
60
Volume of BA1 added (cm^3)
Scale: Vert: 1cm = 0.005 s^{-1}
tor: 1cm = 5cm^3
Sample copy

Experiment 6

A high school science fair showcased various experiments, including one investigating the rate of hydrogen gas production when magnesium reacts with two different solutions of dilute hydrochloric acid, labeled **C** and **D**, each with varying concentrations. Participants were recommended to use the set up below.



Task:

Let C – more concentrated (1.0M)
D – less concentrated (0.7M)

(a) As a participant in the science fair;

(i) design an experiment to investigate the rate at which hydrogen gas is made when magnesium reacts with two different solutions of dilute hydrochloric acid, **C** and **D**, with different concentrations

Aim: To investigate the rate of evolution of Hydrogen gas when Magnesium ribbon reacts with two different acids of different concentration.

Variables: (i) Dependent: Volume of hydrogen gas produced.
(ii) Independent: Time taken during experiment
(iii) Controlled: Mass of magnesium used and volume of acid added.

Hypothesis: The rate of evolution of hydrogen gas depends on the high concentration of the acid solution. (More concentrated acid produces high rate of hydrogen gas).

Risk:	Mitigation
- Acid spilling on skin	- Be careful and clean the table
- Cut from broken glass	- wear gloves
- Choking fumes	- use face masks

Procedure:

- A known mass of magnesium was cut and placed in a test tube / conical flask with a thread.
- 35cm^3 of acid C was measured using a measuring cylinder and added to magnesium ribbon in a conical flask /test tube. At the same time a stop clock was started.
- The conical flask was connected to a gas syringe which is used to measure the volume of gas produced.
- The volume of hydrogen in the syringe is recorded at regular intervals until the reaction is completed. (When the whole mass of the magnesium ribbon has reacted).
- The above procedures were repeated with different acid D of different concentration (Less dilute).
- The results obtained are used to plot graphs of volume of hydrogen gas evolved against time on the same axes.

(ii) Conduct the experiment and record your findings

Length of Ribbon (cm)	1.0	2.0	3.0	4.0	5.0
Volume of H_2 (g) (cm^3) for solution C	3.0	5.4	7.5	9.8	10.8
Volume of H_2 (g) (cm^3) for solution D	2.2	3.6	5.2	9.2	10.8

OR:

Time (s)	0	30	60	120	150	180
Volume of H_2 (g) (cm^3) for solution C	0	3.0	5.4	9.8	10.8	10.8
Volume of H_2 (g) (cm^3) for solution D	0	2.2	3.6	5.2	9.2	10.8

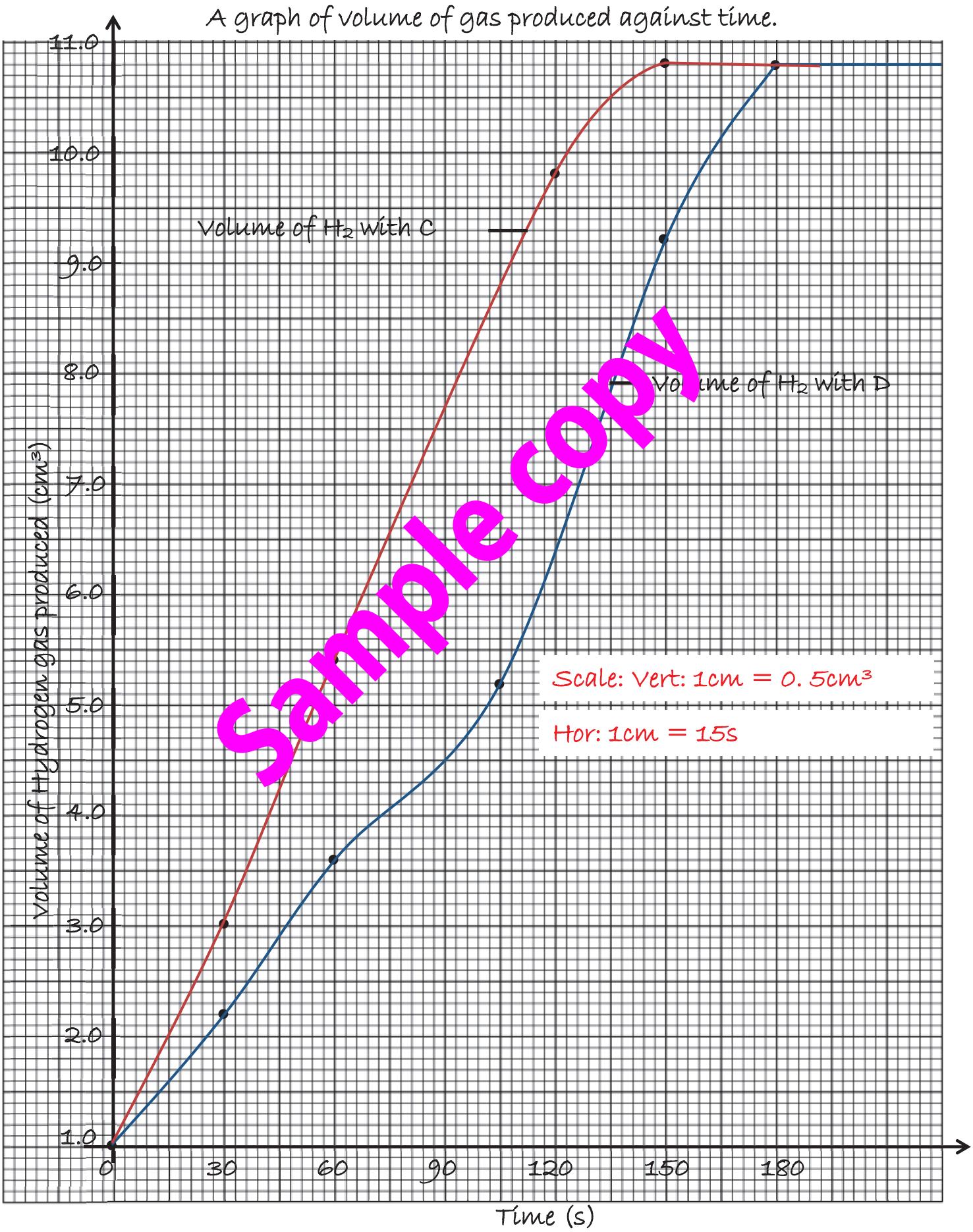
(b) Explain what can be deduced about the concentrations of dilute hydrochloric acid **C** and dilute hydrochloric acid **D**.

The concentration of C is higher than that of D, the rate of reaction (production) of hydrogen gas is more with C than with D.

(c) Suggest why it is important to replace the bung in the conical flask immediately after adding the magnesium ribbon.

To avoid the gas from escaping

It is done to avoid wastage of gas produced.


A graph of volume of gas produced against time.
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
Volume of Hydrogen gas produced (cm³)
Volume of H₂ with C
Volume of H₂ with D
Scale: Vert: 1cm = 0.5cm³
Hor: 1cm = 15s
0
30
60
90
120
150
180
Time (s)

Experiment 35

A local municipality organized a workshop to educate residents on household cleaning products. During the workshop, participants conducted an experiment to observe the heat changes during the neutralization of acidic household waste with a basic solution.

As participants added a solution of acidic household waste to a solution of sodium hydroxide, they observed a temperature increase in the mixture. One participant noticed the temperature change and questioned why the household waste became warmer during the neutralization process.

The acidic solution provided is labeled **BA1** and the base provided is labeled **BA2**.

Task:

(a) As a learner of chemistry:

(i) Design an experiment to measure the temperature change and determine the amount of heat produced during the neutralization of **BA1** with **BA2**.

Aim: To measure the amount of heat and heat change produced during the neutralization of acidic household waste and sodium hydroxide.

Variables: (i) Dependent: Temperature change / rise

(ii) Independent: Volume of acid added to NaOH

(iii) Controlled: Volume of NaOH solution measured

Hypothesis: The reaction between BA1 and BA2 produces heat.

Risk:	Mitigation
- Acid spilling on skin	- Be careful and clean the working place
- Bad fumes from the waste	- Wear face masks and other protective gears

Procedures of experiment:

- $30cm^3$ of BA2 is measured into a plastic beaker and its initial temperature noted and recorded as $T_1\,^oC$.
- The thermometer is rinsed and dried, then dipped into BA1 to obtain its initial temperature $T_2\,^oC$.
- Using a measuring cylinder, $30cm^3$ of BA1 is measured and added to BA2 in plastic beaker.
- The solution is stirred with a ther4mometer and its maximum temperature rise is obtained, noted and recorded as $T_3\,^oC$.
- All the results are recorded.

(ii) Conduct the experiment by mixing **BA1** with **BA2** and recording the temperature change over time.

- Initial temperature of BA1 = 25.0°C
- Initial temperature of BA2 = 26.0°C
- Average initial temperature = $\frac{25+26}{2}$

$= 25.5°C$

Volume of BA1 used = 30 cm^3

Volume BA2 used = 30 cm^3

Total volume of mixture = (30+30)cm

$= 60cm^3$

Highest temperature attained by the mixture = 32.0cm^3

(iii) Calculate the maximum heat produced during the neutralization reaction.

Temperature change θ = (Final – Initial) temperature

= (32.0 – 25.5) °C

θ = 6.5°C

Mass of the solution = Density × volume

1g/cm³ × 60cm³

Heat produced = mCθ

=60× 4.2× 6.5

= 16385joules

Heat produced during the reaction = − 63[illegible]J

(b) Based on your findings, explain to the participant how the neutralization reaction between **BA1** and **BA2** generates heat and helps in waste management.

- When BA1 (waste house hold waste) reacts with BA2 (Sodium hydroxide)it produces -1638J of heat implying the reaction is exothermic.
- Therefore during the disposal of waste produces, neutralization has to be done to remove the acidic content in the waste before discharged.
- Used in water treatment in order to reduce the damage of effluent.

Experiment Requirements (Practical Instructions)

Each candidate will require the following materials and apparatus.

Experiment 1

(a) 250 cm^3 of aqueous sodium thiosulfate, $Na_2S_2O_3.5H_2O$, containing 40 g / dm^3 labelled **aqueous sodium thiosulfate**.
The aqueous sodium thiosulphate must be freshly prepared.
(b) 100 cm^3 of hydrochloric acid of concentration 2.0 mol / dm^3 labelled **dilute hydrochloric acid**
(c) access to water and distilled water
(d) 50 cm^3 measuring cylinder
(e) 10 cm^3 measuring cylinder
(f) 250 cm^3 conical flask
(g) teat pipette
(h) stop-clock or timer which can measure to an accuracy of 1 s

Per five candidates
A bucket labelled **quenching bath** must be provided.
The bucket must contain 1 dm^3 of approx[illegible]tely [illegible]% sodium carbonate solution (made up by [illegible]so[illegible]ng 50 g of Na_2CO_3 or 135 g of $Na_2CO_3.1[illegible]H_2O$ [illegible]n 1 dm^3 of water) and Universal Indicator.
The Supervisor must moni[illegible]r the c[illegible]lo[illegible] of the Universal Indicator in each [illegible]ing bath to check that the solution has not become [illegible]idic. If the solution becomes acidic, the Supervisor must add more 5% sodium carbonate solution to the quenching bath.

Experiment 2

- Measuring cylinders (50cm^3 and 10 cm^3)
- conical flask
- filter paper
- stop clock (stop watch).

Experiment 3

- 50 cm^3 of aqueous barium nitrate, $Ba(NO_3)_2$, of concentration 0.33 mol / dm^3 labelled **aqueous barium nitrate**
- 50 cm^3 of aqueous sodium carbonate, Na_2CO_3, of concentration 0.33 mol / dm^3 labelled **aqueous sodium carbonate**
- access to water and distilled water
- 10 cm^3 measuring cylinder
- 50 cm^3 burette with stand and clamp
- funnel for filling burette
- 6 × **identical** test-tubes, capable of holding 15 cm^3
- test-tube rack
- glass stirring rod
- stop-clock or timer which can measure to an accuracy of 1 s
- marker pen to write on glass
- ruler with [illegible]illimetre graduations
- teat pip[illegible]

Exp[illegible]en

- 5[illegible] of Sodium hydroxide solution (BA2) - 2M
- 5[illegible] cm^3 of Sulphuric acid solution (BA1) - 1M
- Burette
- Pipette
- Conical flask
- Phenolphthalein indicator
- Distilled water
- Funnel
- Clamp stand
- White tile or paper

Experiment 5

- 200 cm^3 of hydrochloric acid of concentration 0.20mol / dm^3 in a stoppered container
- 100 cm^3 of **solution E**, which is aqueous sodium carbonate of concentration 0.10 mol / dm^3 in a stoppered container
- 50 cm^3 of **solution F**, which aqueous sodium carbonate of concentration 0.15 mol / dm^3 in a stoppered container
- thymolphthalein indicator
- methyl orange indicator
- 50 cm^3 burette with clamp and stand
- white tile
- funnel to fill burette
- 25 cm^3 measuring cylinder
- 250 cm^3 conical flask
- dropping pipettes

- access to water and distilled water

Experiment 6

- 70 cm^3 of dilute hydrochloric acid **C** of concentration 1.0mol / dm^3
- 70 cm^3 of dilute hydrochloric **D** acid of concentration 0.7 mol / dm^3
- Two 5 cm lengths of magnesium ribbon. This should be cleaned with abrasive paper and then coiled into a spiral by wrapping it around a pencil or similar to facilitate dropping it into a flask.

- 50 cm^3 measuring cylinder
- stop-clock or timer which can measure to an
- accuracy of 1s
- stirring thermometer, –10 °C to +110 °C with 1 °C graduations
- access to water and distilled water
- dropping pipette

Experiment 7

- 50 cm^3 of solution A aqueous sodium hydroxide of concentration 0.10 mol / dm^3
- 50 cm^3 of solution B aqueous sodium hydroxide of concentration 0.05 mol / dm^3
- 100 cm^3 of dilute hydrochloric acid of concentration 0.15 mol / dm^3
- thymolphthalein indicator
- access to water and distilled water
- 25 cm^3 measuring cylinder
- 250 cm^3 conical flask
- 150 cm^3 burette stand and clamp for burette
- white tile
- small funnel to fill burette
- dropping pipettes

Experiment 8

- 4 g of anhydrous sodium carbonate, Na_2CO_3, in a dry stoppered test-tube, labelled **solid N**
  The anhydrous sodium carbonate should be newly purchased.
- 6 g of hydrated sodium carbonate, $Na_2CO_3 \cdot H_2O$, in a stoppered test-tube, labelled **solid O**
  Washing soda crystals are NOT suitable.
- access to water and at least 100 cm^3 of distilled water
- 50 cm^3 measuring cylinder
- 250 cm^3 beaker for support
- 2 × polystyrene cups (cardboard cups may be used as an alternative)
- stop-clock or timer which can measure to an accuracy of 1 s
- stirring thermometer, –10 °C to 110 °C at 1 °C graduations
- teat pipette
- spatula

Experiment 9

- burette
- stand and clamp for burette
- white tile
- small funnel to fill burette
- 100 cm^3 of **solution K,** which aqueous sodium carbonate of concentration 0.20 mol / dm^3
- 100 cm^3 of **solution L**, which is aqueous sodium carbonate of concentration 0.10 mol / dm^3
- 100 cm^3 of **acid M**, which is dilute hydrochloric acid of concentration 0.40 mol / dm^3
- 100 cm^3 of **acid N**, which is dilute hydrochloric acid of concentration 0.20 mol / dm^3
- 25 cm^3 measuring cylinder
- 250 cm^3 conical flask
- methyl orange indicator
- access to water and distilled water
- dropping pipettes

Experiment 10

- 150 cm^3 of dilute hydrochloric acid of concentration 1.5 mol / dm^3
- 30 cm^3 of **solution H**, which is aqueous sodium hydroxide of concentration 1.5 mol / dm^3.
- 30 cm^3 **solution H**,which is aqueous sodium hydroxide of concentration 0.8 mol / dm^3
- burette
- stand and clamp for burette
- small funnel to fill burette
- 50 cm^3 measuring cylinder
- stirring thermometer, –10 °C to +110 °C with °C graduations
- 100 cm^3 beaker
- access to water and distilled water
- dropping pipette

Experiment 11

(a) three 10 cm^3 measuring cylinders
(b) one 50 cm^3 burette
(c) two boiling tubes
(d) 100 cm^3 of aqueous potassium peroxodisuphate, $K_2 S_2 O_8$, of concentration 0.02 mol / dm^3 , (5.4 g /dm^3), labelled solution L
(e) 50cm^3 of aqueous potassium iodide, KI, of concentration 0.5mol/dm^3, (83g/dm^3), labelled aqueous potassium iodide. This solution should be freshly prepared.
(f) 50 cm^3 of aqueous sodium thiosulfate, $Na_2 S_2 O_3 .5H_2 O$, of concentration 0.01 mol / dm^3 , (2.5 g /dm^3), labelled aqueous sodium thiosulphate
(g) 20cm^3 of 0.2% starch indicator solution, labelled starch indicator
(h) access to water and distilled water
(i) stop clock or timer
(j) a Bunsen burner and matches
(k) holder for heating the boiling tube
(l) one stirring thermometer, 0–110 °C

Note: Mixing 10 cm^3 of solution L with 5 cm^3 of aqueous potassium iodide, 3 cm^3 of aqueous sodium thiosulfate and 2 cm^3 of starch solution should produce a blue colour within five minutes.

Experiment 12

(a) one 25 cm^3 or 50 cm^3 measuring cylinder
(b) one 50 cm^3 burette with stand and clamp
(c) one 250 cm^3 conical flask
(d) 100 cm^3 of aqueous hydrochloric acid of concentration 0.2 mol /dm^3, labelled hydrochloric acid
(e) 50 cm^3 of an aqueous solution which is a mixture of sodium hydroxide, NaOH, of concentration 0.05mol /dm^3, and sodium carbonate, Na_2CO_3, of concentration 0.05 mol /dm^3 labelled solution R

Solution R can be made up by dissolving 2 g of sodium hydroxide and 5.3 g of anhydrous sodium carbonate in distilled water and making the solution up to 1 dm^3

(f) access to water and distilled water
(g) phenolphthalein indicator
(h) methyl orange indicator
(i) one white tile
(j) one test-tube
(k) teat pipette
(l) one funnel for filling burette

Experiment 13

(a) 50 cm^3 measuring cylinder
(b) stirring thermometer, 0–110 °C
(c) polystyrene cup and 250 cm^3 beaker
(d) 150 cm^3 of aqueous sodium hydroxide, NaOH, of concentration 1.0 mol / dm^3
(e) 100 cm^3 of aqueous hydrochloric acid, HCl, of concentration 2.0 mol / dm^3 , labelled **acid A**
(f) 100 cm^3 of aqueous sulfuric acid, H_2SO_4, of concentration 2.0 mol / dm^3 , labelled **acid B**
(g) access to water and distilled water
(h) 50 cm^3 burette with stand and clamp
(i) teat pipette
(j) funnel for filling burette

Experiment 14

(a) one 25cm^3 measuring cylinder
(b) one 50cm^3 burette with stand and clamp
(c) one 250cm^3 conical flask
(d) 100cm^3 of an aqueous solution of sodium carbonate, Na_2CO_3, of concentration 0.05mol/dm^3, labelled aqueous sodium carbonate (This can be made by adding 5.3g of anhydrous sodium carbonate to 500cm^3 of distilled water. Dissolve the solid and then make the volume up to 1dm^3 with distilled water.)
(e) 100cm^3 of hydrochloric acid of concentration 0.10mol/dm^3, labelled **solution A**
(f) 100cm^3 of hydrochloric acid of concentration 0.20mol/dm^3, labelled **solution B**
(g) access to water and distilled water
(h) thymolphthalein indicator
(i) methyl orange indicator
(j) a white tile
(k) funnel for filling burette
(l) teat pipette

Experiment 15

(a) $2 \times 25cm^3$ measuring cylinders
(b) $1 \times 10cm^3$ measuring cylinder
(c) $1 \times 50cm^3$ burette with stand and clamp
(d) $1 \times 250cm^3$ conical flask
(e) $100cm^3$ of an aqueous solution of hydrated sodium thiosulfate, $Na_2S_2O_3.5H_2O$, of concentration $0.1mol/dm^3$ containing 25g per dm^3, labelled aqueous sodium thiosulfate. $3cm^3$ of $1mol/dm^3$ aqueous sodium hydroxide should be added to the above solution to ensure that it is not acidic.
(f) $50cm^3$ of an aqueous solution of potassium iodate, KIO_3, containing 6g per dm^3, labelled **solution C**
(g) $50cm^3$ of an aqueous solution of potassium iodate, KIO_3, containing 3g per dm^3, labelled **solution D**
(h) $50cm^3$ of sulfuric acid of concentration $1mol/dm^3$, labelled dilute sulfuric acid
(i) access to water and distilled water
(j) two samples in stoppered test-tubes of 1g solid potassium iodide, each labelled 1g of potassium iodide
(k) $10cm^3$ of starch solution
(l) white tile
(m) funnel for filling burette

Experiment 16

- $200cm^3$ of dilute hydrochloric acid of concentration $2.0mol/dm^3$ labelled as **dilute hydrochloric acid**
- a tube or weighing boat containing 1g of sodium hydrogencarbonate labelled as **1g of sodium hydrogencarbonate**
- a tube or weighing boat containing 2g of sodium hydrogencarbonate labelled as **2g of sodium hydrogencarbonate**
- a tube or weighing boat containing 3g of sodium hydrogencarbonate labelled as **3g of sodium hydrogencarbonate**
- a tube or weighing boat containing 5g of sodium hydrogencarbonate labelled as **5g of sodium hydrogencarbonate**
- a tube or weighing boat containing 6g of sodium hydrogencarbonate labelled as **6g of sodium hydrogencarbonate**
- a tube or weighing boat containing 7g of sodium hydrogencarbonate labelled as **7g of sodium hydrogencarbonate**
- $250cm^3$ conical flask
- $25cm^3$ measuring cylinder
- stop-clock or timer which can measure to an accuracy of 1s 1 stirring thermometer, –10°C to +110°C at 1°C graduations
- dropping pipettes
- access to water and distilled water

Experiment 17

(a) 3g of anhydrous sodium carbonate in a stoppered test-tube labelled **A**;
(b) 4g of potassium hydrogen carbonate in a stoppered test-tube labelled **B**;
(c) two plastic drinking cups;
(d) 200cm[illegible] hydrochloric acid of concentration $2m[illegible]^3$;
(e) stirring thermometer, covering the range 0° C to [illegible]° C graduated in degrees and clamped securely in such a way as to allow a plastic cup of fluid to be swirled underneath;
(f) a timer, e.g. a stop clock, stop watch or wall clock with seconds hand;
(g) one measuring cylinder, $0cm^3$ to $50cm^3$.

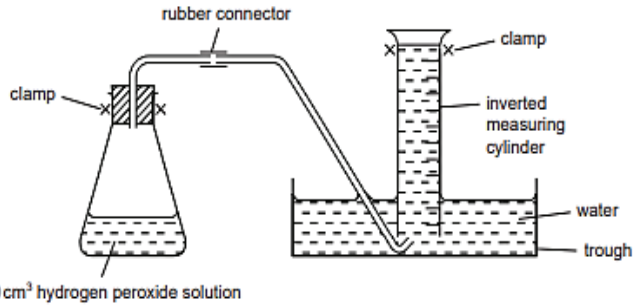
When solid **A** is added to $30cm^3$ of hydrochloric acid there should be a measurable temperature rise.

When solid **B** is added to $30cm^3$ of hydrochloric acid there should be a measurable temperature decrease

Experiment 18

(a) about $100cm^3$ of aqueous hydrogen peroxide of concentration 5 volume (1.5% w/v), labelled solution **A**.
(b) about 5g of manganese (IV) oxide powder,
(c) distilled water,
(d) (i) two measuring cylinders, one to measure $20cm^3$ of liquid and one to collect $50cm^3$ of gas
(ii) one conical flask, $100cm^3$, with bung; rubber connector and delivery tube;
(iii) two clamps, one to support the conical flask and one to support the inverted measuring cylinder;
(iv) trough, or other suitable container, of water,

The students will need to set this apparatus as below.



(e) a stop clock or access to a timer with a second hand;
(f) one spatula;
1 spatula measure of manganese (IV) oxide added to 20cm^3 of 5 volume hydrogen peroxide should produce atleast 20cm^3 and not more than 40cm^3 of gas in 20 seconds;
(g) splints;
(h) Bunsen burner;
(i) test tube.

Experiment 19

(a) one 50cm^3 measuring cylinder;
(b) one 50cm^3 burette;
(c) one or more 250cm^3 conical flasks;

(d) 50cm^3 of aqueous sulphuric acid of concentration 2.0 mol/dm^3, labelled acid **C**;
(e) 50cm^3 of aqueous nitric acid of concentration 2.0 mol/dm^3, labelled acid **D**;
(f) 50cm^3 of aqueous sodium hydroxide of concentration 2.0mol/dm^3, labelled aqueous sodium hydroxide;
(g) access to water and distilled water;
(h) one stirring thermometer, 0°C–110°C;
(i) a white tile;
(j) phenolphthalein indicator, labelled phenolphthalein indicator .

20cm^3 of sodium hydroxide solution + 10 cm^3 of acid C should give a temperature rise of about 10°C.

Experiment 20

(a) Bunsen burner and matches;
(b) 12g of potassium nitrate crystals in a stoppered boiling tube, labelled **salt A**;
(c) one 50cm^3 burette;
(d) one 250cm^3 beaker,
(e) distilled water;
(f) one stirring thermometer, covering the range 0°C to 100°C.

12g of potassium nitrate dissolved in 10cm^3 of hot distilled water should form crystals on cooling at about 70°C.

Experiment 21

- Potassium chloride

(a) Bunsen burner and matches;
(b) 12g of potassium chloride crystals in a stoppered boiling tube, labelled **potassium chloride crystals**;
(c) one 50cm^3 burette;
(d) one 250cm^3 beaker,
(e) distilled water;
(f) one stirring thermometer, covering the range 0°C to 100°C.

Experiment 22

(a) 50g of Potassium chloride (KCl)
(b) Distilled water
(c) Thermometer
(d) Stirring rod
(e) Weighing balance
(f) Beakers
(g) Graduated cylinder
(h) Hot plate or water bath
(i) Stopwatch or timer

Experiment 23

- 50cm^3 of **BA1**
- 50cm^3 of **BA2**
- Thermometer 100cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 250m1 plastic beakers

- **BA2** is a 1M sodium hydroxide

- **BA1** is a 1M sulphuric acid

Experiment 24

- $50cm^3$ of **BA1**
- $50cm^3$ of **K**
- Thermometer
- $100cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250ml plastic beaker

- **BA1** is a 0.1M sodium hydroxide
- **K** is a 1M hydrochloric acid

Experiment 25

- $50cm^3$ of **BA1**
  $50cm^3$ of **BA2**
- Thermometer
- $100cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250m1 plastic beakers

- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 1M sulphuric acid

Experiment 26

- $50cm^3$ of **BA1**
  $50cm^3$ of **BA2**
- $100cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators

- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 0.5M Hydrochloric acid

Experiment 27

- $50cm^3$ of **BA1**
  $50cm^3$ of **BA2**
- $100cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 1M sulphuric acid

Experiment 28

- 50cm³ of **BA1**
  50cm³ of **BA2**
- 100cm³ measuring cylinder
- 250cm³ conical flask / titration flask
- 50cm³ burette
- 20.cm³ or 25.0cm³ pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 0.2M acetic acid

Experiment 29

- $50cm^3$ of **BA1**
  $50cm^3$ of **BA2**
- $100cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators

- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 0.3M citric acid

Experiment 30

- 50cm^3 of **HCl**
  50cm^3 of **R**
- 100cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators
- **HCl** is a 0.1M Hydrochloric acid
- **R** is river water

Experiment 31

- 50cm^3 of **KOH**
  50cm^3 of **J**
- 100cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Phenolphthalein and methyl orange indicators
- **KOH** is a 0.1M Potasium hydroxide
- **J** is orange Juice sample

Experiment 32

- 50cm^3 of **BA1**
  50cm^3 of **BA2**
- 50cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is a 0.1M Hydrochloric acid

Experiment 33

- 50cm^3 of **BA1**
  50cm^3 of **BA2**
- 50cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Calorimeter
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is Acidic water solution (Contaminated water sample)

Experiment 34

- 50cm^3 of **BA1**
  50cm^3 of **BA2**
- 50cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Calorimeter
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is fatty acid solution (Mixture of fatty acids from vegetable oils)

Experiment 35

- 50cm^3 of **BA1**
  50cm^3 of **BA2**
- 50cm^3 measuring cylinder
- 250cm^3 conical flask / titration flask
- 50cm^3 burette
- 20.cm^3 or 25.0cm^3 pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Calorimeter
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide

- **BA1** is Acidic household waste solution
  (Diluted household acidic waste)

Experiment 36

- $50cm^3$ of **BA1**
  $50cm^3$ of **BA2**
- $50cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ or $25.0cm^3$ pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Calorimeter
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is Acidic skincare ingredients solution
  (Mixture of acidic components from skincare products)

Experiment 37

- $50cm^3$ of **BA1**
  $200cm^3$ of **BA2**
- $50cm^3$ measuring cylinder
- $250cm^3$ conical flask / titration flask
- $50cm^3$ burette
- $20.cm^3$ pipette
- A stand
- 2 250m1 plastic beakers
- Thermometer
- Phenolphthalein and methyl orange indicators
- **BA2** is a 0.1M sodium hydroxide
- **BA1** is 0.1M hydrochloric acid

END