THE 20 MODEL CHEMISTRY PRACTICAL SAMPLES [MSCE]

SUMMER LESSONS

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CHEMISTRY PRACTICAL SAMPLES

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ELEMENTS AND CHEMICAL BONDING

1. IDENTIFYING COVALENT AND IONIC SUBSTANCES USING MELTING POINTS

Materials:

- Identical evaporating dishes (2), substances A and B (one is covalent and the other one is ionic but not necessarily in that order), source of heat, spatula.

Procedure:

a. Put a spatulaful of substance A into one evaporating dish and heat it for 1 minute. Note whether it melts or not and record the results in the table of results.
b. Put a spatulaful of substance B into the other evaporating basin and heat for 1 minute. Note whether it melts or not and record your results in the table of results

Table of results

substance	Observation
A	
B	

From the results, the substance which has melted / melted faster has low melting point and the one which takes time to melt / does not melt within the time limit given has high melting point.

Since covalent substances have low melting points and ionic substances have high melting points, it means that the substance which has low melting point in the experiment is covalent and the one which has high melting point is ionic.

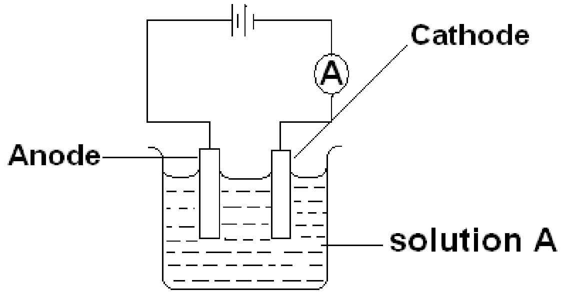
2. IDENTIFYING COVALENT AND IONIC COMPOUNDS USING CONDUCTIVITY

Materials:

- Conducting wires (3), an ammeter, beaker with holed rid, carbon rods (2), power supply, solutions A and B (one is sodium chloride [common salt] solution and the other is sucrose [common sugar] solution but not necessarily in that order).

Procedure:

a. connect the circuit as shown in the figure below



b. read and record the ammeter reading in the appropriate space in the table of results
c. replace solution A with solution B (remember to rinse the electrodes with distilled water followed by solution B)
d. read and record the ammeter reading in the appropriate space in the table of results

Table of results

Solution	Ammeter Reading
A	
B	

The solution which registers a reading is ionic and the one which does not register a reading is covalent. This is so because ionic substances dissociate in water to give out ions which can conduct electric current while covalent substances do not dissociate in water to give out ions which can conduct electric current.

If the solution conducts, it means that it is salt and if it does not conduct it means it is sugar. This is so because salt is ionic and sugar is covalent.

CHEMICAL REACTIONS I & II

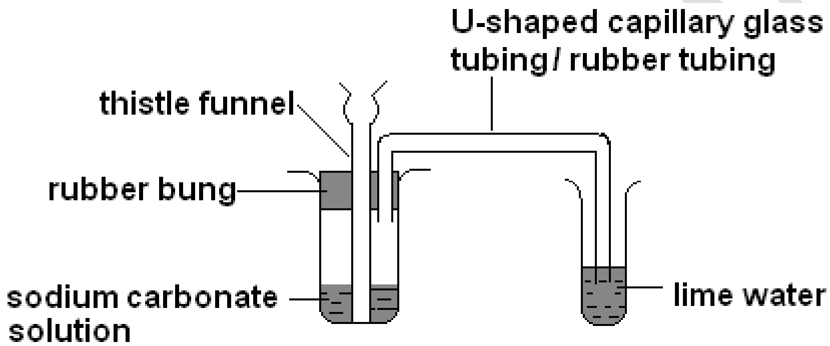
3. INVESTIGATING THE REACTION BETWEEN HYDROCHLORIC ACID AND SODIUM CARBONATE

Materials:

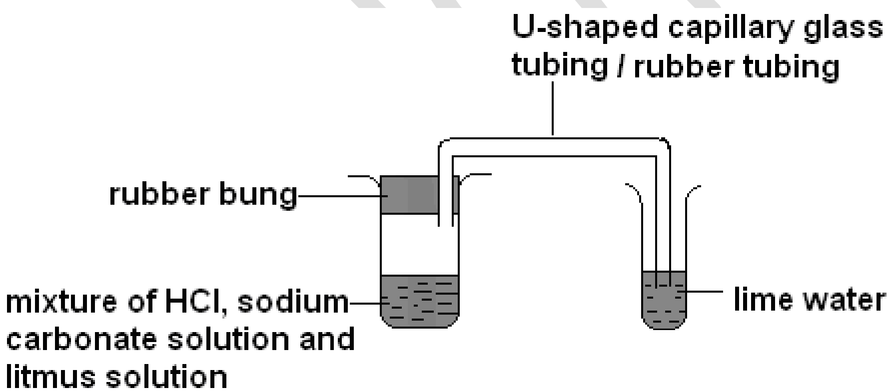
- U-shaped glass tubing / rubber tubing, test tubes (2), thistle funnel, lime water, saturated sodium carbonate solution, hydrochloric acid, rubber bung, litmus solution,

Procedure:

a. put sodium carbonate solution in one test tube and lime water in the other
b. set up the apparatus as shown below



c. Add hydrochloric acid (5ml) and 5 drops of litmus solution to the beaker containing sodium carbonate solution through the thistle funnel and carefully remove the thistle funnel. The set up will look as shown below



d. observe what happens in the test tubes and record in the table of results

TABLE OF RESULTS

TEST TUBE	OBSERVATION
With sodium carbonate solution ,HCl and litmus solution	
With lime water	

It is expected that the mixture of sodium carbonate, hydrochloric acid and litmus solution will turn from red to colourless and the lime water will turn milky.

If the mixture of sodium carbonate, hydrochloric acid and litmus solution turns from red to colourless, it means that the acid has all reacted (there is no more acid in the reaction vessel). On the other hand, if the lime water turns milky, it means one of the products of the reaction is carbon dioxide. The whole process can be represented in an equation form as follows:

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

4. DETERMINING THE PERCENTAGE COMPOSITION OF CARBON IN SUCROSE (COMMON SUGAR)

Materials:

- Sugar, a tin, tripod stand, wire gauze, a gas or ethanol burner, matches and balance.

Procedure:

a. Weigh the empty tin and record the mass in the table below.
b. With the tin still on the balance, add sugar until the mass increases by approximately 10g.
c. Record the mass of sugar in the table below.
d. Heat the sugar in the tin until a dry, black solid (carbon) is formed.
e. Weigh the tin + the black substance.
f. Heat and reweigh several times until the mass is constant.
g. Record the mass of tin + carbon in the table of results.
h. Calculate the mass of carbon [(mass of tin + carbon) – mass of empty tin].
i. Record mass of carbon in the table.

TABLE OF RESULTS

item	Mass(g)
Empty tin	
Tin + sugar	
Sugar	
Tin + carbon	
Carbon	

To calculate the percentage composition by mass of carbon in the sugar, the formula below is used:

$$\% \text{ composition of carbon} = \frac{\text{mass of carbon from the table}}{\text{mass of sugar (10g)}} \times 100\%$$

The number of moles of the carbon produced can be calculated using the formula below

$$^{n}C = {}^{m}C \ / \ {}^{M}C$$

Where **n** means number of moles, **m** means mass and **M** means molar mass. The mass of the carbon is taken from the table of results and molar of carbon is 12g/mol.

SAMPLE RESULTS

Item	Mass(g)
Empty tin	30
Tin + sugar	40
Sugar	10
Tin + carbon	34.1
Carbon	4.1

$$\% \text{ composition of carbon} = \frac{\text{mass of carbon from the table}}{\text{mass of sugar (10g)}} \times 100\%$$

$$= (4.1g \ / 10g) \times 100\%$$

$$= 42.1 \ \%$$

5. PREPARING A SOLUTION FROM A STANDARD SOLUTION (250ml 2M NaOH solution from a 3M NaOH solution)

Materials:

- Measuring cylinder (100ml), volumetric flask (250ml) with a stopper, distilled water, standard solution (3M NaOH solution), balance.

Procedure:

a. Find the volume of the standard solution to be diluted to give the molarity required. i.e. use the dilution formula,

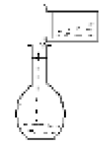
$$C_1 V_1 = C_2V_2$$

$$V_1 = C_2V_2/C_1$$

$$= (2M \text{ X } 250ml) \ / \ 3M$$

$$= 167ml$$

b. Measure the volume of the standard solution found from the calculation (167ml) using the measuring cylinder.

c. Transfer the 167ml solution from the cylinder into the volumetric flask. i.e. 

d. add distilled water up to the mark i.e. 

6. PREPARATION OF 500 CM³ OF 0.2M SODIUM CHLORIDE SOLUTION FROM SODIUM CHLORIDE CRYSTALS

Materials:

- Balance, sodium chloride crystals, beaker (20 cm^3), volumetric flask (250 cm^3), distilled water.

Procedure:

a. calculate the mass of the sodium chloride which is going to be contained in 500 cm^3 of 0.2M sodium chloride solution by following the steps below:

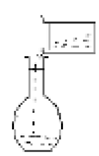
- Finding number of moles

$$n\ NaCl = c\ NaCl \times v\ NaCl$$
$$= 0.2M \times 0.5dm3$$
$$= 0.1mol$$

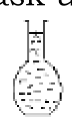
- Finding mass

$$m\ NaCl = n\ NaCl \times M\ NaCl$$
$$= 0.1mol \times 58.5gmol^{-1}$$
$$= 5.85g$$

b. Weigh 5.85 g of NaCl using the balance
c. Dissolve it using a little distilled water in a small beaker
d. Transfer the solution into a 500 cm^3 volumetric flask i.e



e. add distilled water into the volumetric flask up to the mark i.e.



7. PREPARATION OF 250 CM³ OF 1 M COPPER SULPHATE SOLUTION FROM HYDRATED COPPER SULPHATE CRYSTALS

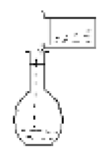
Materials:

- Balance, hydrated copper sulphate crystals, beaker (20 cm^3), volumetric flask (250 cm^3), distilled water.

Procedure:

a. calculate the number of moles which is going to be contained in 250 cm^3 of 1M copper sulphate solution by following the steps below:
   - find the percentage mass of $CuSO_4$ in the compound:
     $160/250 \times 100\% = 64\%$
   - then find the mass of $CuSO_4$ needed to prepare 250 cm^3, 1M solution:
     $n\ CuSO_4 = 1\ mol/l \times 0.25l = 0.25\ mol$
     $mCuSO_4 = Mn = 160g\ /mol \times 0.25\ mol = 40\ g$
   - if 40g is 64% of the mass of the compound, the mass of the whole compound will be found as follows
     $m\ CuSO_4.5H_2O = 100/64 \times 40\ g = 62.5\ g$

b. Weigh 62.5 g of $CuSO_4.5H_2O$ using the balance
c. Dissolve it using a little distilled water in a small beaker
d. Transfer the solution into a 250 cm^3 volumetric flask i.e.



e. add distilled water into the volumetric flask up to the mark i.e.

8. DETERMINING THE CONCENTRATION OF HYDROCHLORIC ACID (HCl(aq)) USING TITRATION

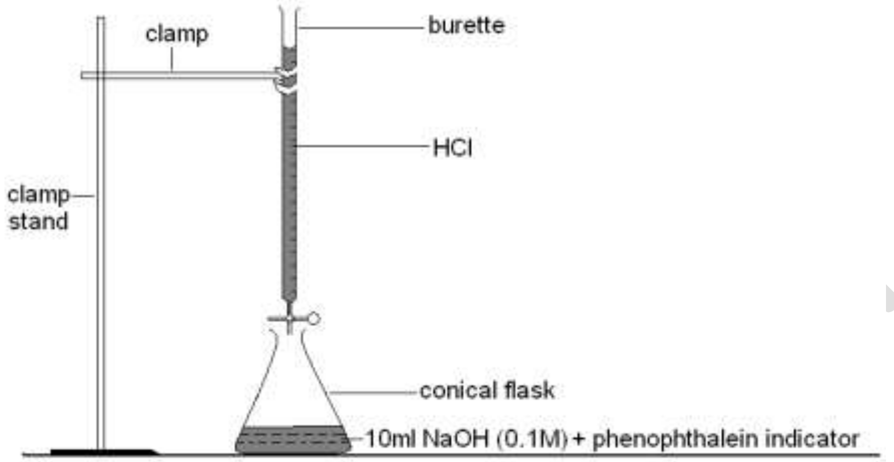
Materials:

- a burette, clamp and clamp stand, measuring cylinder, conical flask, phenolphthalein indicator, 0.1M sodium hydroxide solution (NaOH) and hydrochloric acid (HCl) of unknown concentration.

Procedure:

a. Fill the burette to the mark with the hydrochloric acid (HCl)
b. Record the volume of HCl.

c. Measure 10 ml of the 0.1 M NaOH using the measuring cylinder and transfer it into the conical flask.
d. Add two drops of phenolphthalein indicator into the conical flask and set up the apparatus as shown below



e. Add the HCl gradually, in small amounts, from the burette into the conical flask.
f. Shake the conical flask as the HCl is being added gradually
g. Stop adding the HCl when a colour change is observed in the flask (note that only one drop of the acid is responsible for the colour change).
h. determine the volume of the HCl used (titre) by subtracting the final volume of the HCl from the initial volume and record in the spaces below.

Initial volume of HCl = ________
Final volume of HCl = ________
Volume of HCl used (titre) = ________

The whole process can be represented in form of an equation as shown below:

$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

The concentration of HCl can be found using the formula below:

$$\frac{C_a V_a}{n_a} = \frac{C_b V_b}{n_b}$$

$$\rightarrow \quad C_a = \frac{n_a C_b V_b}{n_b V_a}$$

Where (**a**) means acid and (**b**) means base and Va is the volume of HCl used (titre), Vb is the volume of the base used, which is 10ml, Cb is the concentration of the base, which is 0.1M, and Ca is the concentration of HCl.

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na = 1and nb =1(coeffients of HCl and NaOH in the balanced equation above respectively)

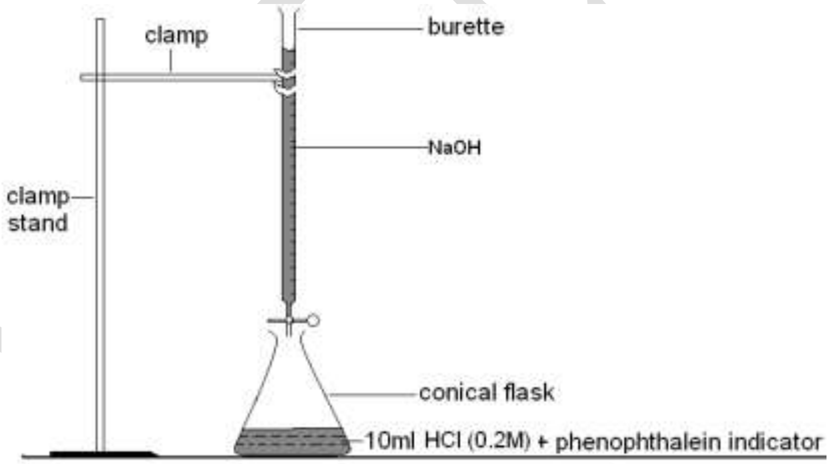
9. DETERMINING THE CONCENTRATION OF SODIUM HYDROXIDE (NaOH(aq)) USING TITRATION

Materials:

- a burette, clamp and clamp stand, measuring cylinder, conical flask, phenolphthalein indicator, sodium hydroxide solution (NaOH) of unknown concentration and 0.2M hydrochloric acid (HCl).

Procedure:

a. Fill the burette to the mark with the sodium hydroxide (NaOH)
b. Record the volume of the NaOH in the table of results.
c. Measure 10 ml of the 0.2 HCl using the measuring cylinder and transfer it into the conical flask.
d. Add two drops of phenolphthalein indicator into the conical flask and set up the apparatus as shown below..



e. Add the NaOH gradually, in small amounts, from the burette into the conical flask.
f. Shake the conical flask as the NaOH is being added gradually
g. Stop adding the NaOH when a colour change is observed in the flask (note that only one drop of the base is responsible for the colour change).
h. Determine the volume of the NaOH used (titre) by subtracting the final volume of the NaOH from the initial volume and record in the spaces below.

Initial volume of NaOH = ________
Final volume of NaOH = ________
Volume of NaOH used (titre) = ________

The whole process can be represented in form of an equation as shown below:

$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

The concentration of NaOH can be found using the formula below

$$\frac{C_b V_b}{n_b} = \frac{C_a V_a}{n_a}$$

$$\rightarrow C_b = \frac{n_b C_a V_a}{n_a V_b}$$

Where (**a**) means acid and (**b**) means base and Va is the volume of HCl = 10ml, Vb is the volume of the base used (titre), Ca is the concentration of HCl and Cb is the concentration of the base.
na = 1 and nb =1(coefficients of HCl and NaOH in the balanced equation above respectively)

10. INVESTIGATING ENDOTHERMIC AND EXOTHERMIC REACTIONS (I)

Materials:

- Test tubes (2) in a rack, a measuring cylinder, stirring rod, thermometer, spatula, tap water and substances A and B.

Procedure:

a. Pour 5 cm^3 of tap water into one test tube.
b. Measure the temperature of the water in the test tube and record in the table of results
c. Add half a spatula of substance A into the test tube and stir gently using the stirring rod.
d. Measure the temperature of the solution and record it in the table of results.
e. Remove the thermometer from the test tube and rinse it with water.
f. Repeat steps (a) to (d) with substance B.
g. Rinse the thermometer with distilled water, dry and return it into its case.

TABLE OF RESULTS

SOLUTION	INITIAL TEMPERATURE (^0C)	FINAL TEMPERATURE (^0C)	CHANGE IN TEMPERATURE (^0C) (Final – Initial)
A			
B			

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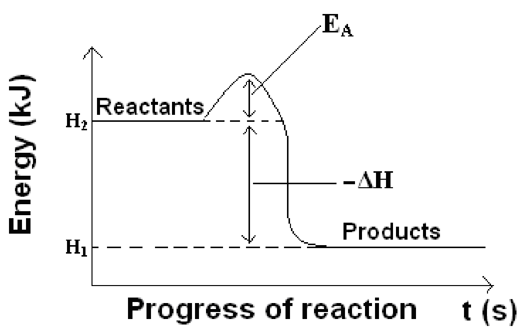
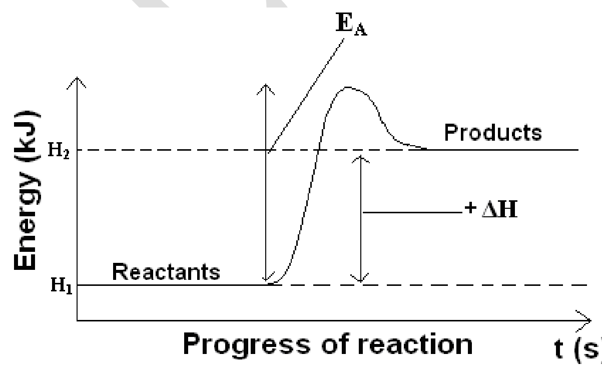
If the final temperature reached exceeds the initial temperature i.e. if the change in temperature is positive, then the reaction is exothermic (this means heat is released into the surroundings). On the other hand, if the final temperature reached is less than the initial temperature i.e. if the change in temperature is negative, then the reaction is endothermic (this means heat is absorbed from the surroundings).

For the exothermic reaction, the change in heat energy is said to be negative because there is loss of heat energy to the surroundings ($-\Delta H$). For the endothermic reaction, the change in heat energy is said to be positive because there is gain of heat energy from the surroundings ($+\Delta H$).

Note: Be careful when interpreting change in temperature and change in heat energy. Positive change in temperature ($+\Delta T$) means negative change in heat energy ($-\Delta H$) and negative change in temperature ($-\Delta T$) means positive change in heat energy ($+\Delta H$).

Energy level diagrams to illustrate the reactions in the solutions of A and B respectively are shown over below;





When using energy profile diagrams like the ones shown above, the energy change is found by the formula: **$\Delta H = H2 - H1$**

11. INVESTIGATING ENDOTHERMIC AND EXOTHERMIC REACTIONS (II)

Materials:

- thermometer, test tubes (2) in a rack, a piece of magnesium ribbon, potassium hydrogen carbonate or sodium hydrogen carbonate, dilute hydrochloric acid solution, spatula or tea spoon and a measuring cylinder.

Procedure:

a. Pour 2 cm^3 (or 2cm column) of hydrochloric acid into a test tube.

b. Measure the temperature of the acid and record it as initial temperature in the table of results.
c. Drop the magnesium ribbon in the acid and record the changes taking place as the reaction occurs.
d. Record the final temperature reached in the table of results.
e. In the second test tube, pour 2 cm3 (or 2cm column) of hydrochloric acid and records temperature as its initial temperature in the table of results.
f. Add ¼ spatulas full of potassium hydrogen carbonate or sodium hydrogen carbonate to the acid and record the changes taking place as the reaction occurs.
g. Record the final temperature reached in the table of results.

TABLE OF RESULTS

Liquid in the tube	Initial temp.	Substance added	Final temp. reached during reaction	Temp. change	Other changes observed during reaction
Hydrochloric acid		Magnesium ribbon			
Hydrochloric acid		Potassium hydrogen carbonate or sodium hydrogen carbonate			

If the final temperature reached exceeds the initial temperature i.e. if the change in temperature is positive, then the reaction is exothermic (this means heat is released into the surroundings). On the other hand, if the final temperature reached is less than the initial temperature i.e. if the change in temperature is negative, then the reaction is endothermic (this means heat is absorbed from the surroundings).

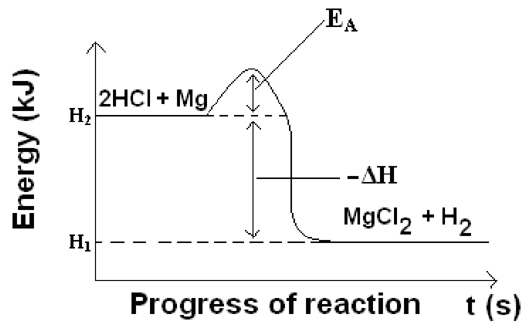
For the exothermic reaction, the change in heat energy is said to be negative because there is loss of heat energy to the surroundings ($-\Delta H$). For the endothermic reaction, the change in heat energy is said to be positive because there is gain of heat energy from the surroundings ($+\Delta H$).

Note: Be careful when interpreting change in temperature and change in heat energy. Positive change in temperature ($+\Delta T$) means negative change in heat energy ($-\Delta H$) and negative change in temperature (ΔT) means positive change in heat energy ($+\Delta H$).

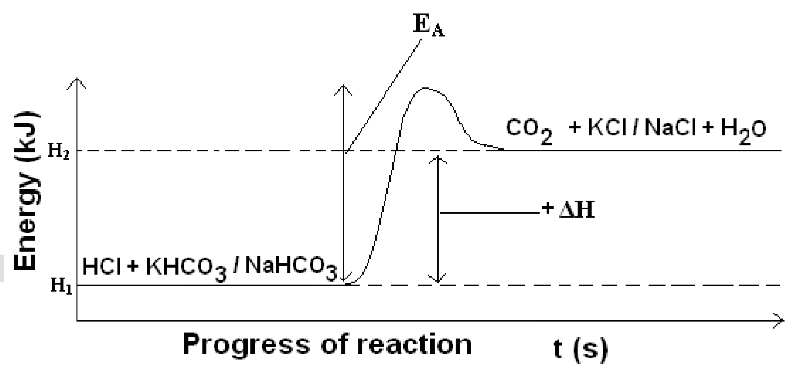
Expectedly, the reaction between hydrochloric acid and magnesium will be exothermic; and the reaction between hydrochloric acid and potassium hydrogen carbonate / sodium hydrogen carbonate will be endothermic.

Energy level diagrams to illustrate the two reactions are shown below

Reaction between hydrochloric acid and magnesium



Reaction between hydrochloric acid and potassium hydrogen carbonate / sodium hydrogen carbonate



Note: ΔH = H2 – H1

12. INVESTIGATING EXOTHERMIC AND ENDOTHERMIC REACTIONS (III)

Materials:

- test tubes in a rack (2), measuring cylinder (5cm3), thermometer, spatula/ tea spoon, sodium hydroxide pellets (NaOH(s)), hydrochloric acid (HCl(aq), 1M), Ammonium nitrate crystals (NH_4NO_3(s)), distilled water.

Procedure:

a. Pour 5 cm^3 of distilled water into one test tube.

b. Measure the temperature of the water in the test tube and record in the table of results
c. Add half spatula full/quarter teaspoon (about 1g) of ammonium nitrate, NH_4NO_3, crystals and stir gently using the thermometer.
d. Measure the temperature of the solution and record in the table of results
e. Remove the thermometer from the test tube and rinse it with distilled water.
f. Pour $5cm^3$ of the hydrochloric acid into the second test tube.
g. Measure the temperature of the hydrochloric acid in the test tube and record in the table of results.
h. Add one sodium hydroxide pellet into the test tube with HCl and stir gently with the thermometer.
i. Measure and record the temperature of the solution and record it in the table of results.

TABLE OF RESULTS

SOLUTION	INITIAL TEMP.	FINAL TEMP.	CHANGE IN TEMP. (Final – Initial)
Ammonium nitrate + water			
Sodium Hydroxide + hydrochloric acid			

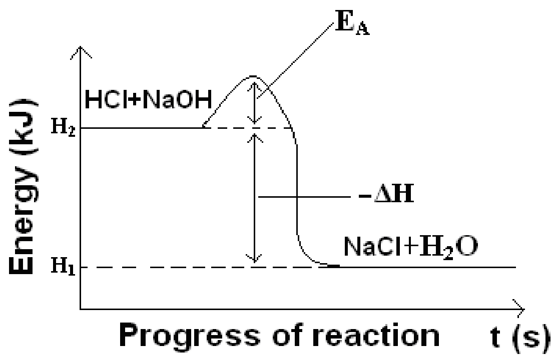
If the final temperature reached exceeds the initial temperature i.e. if the change in temperature is positive, then the reaction is exothermic (this means heat is released into the surroundings). On the other hand, if the final temperature reached is less than the initial temperature i.e. if the change in temperature is negative, then the reaction is endothermic (this means heat is absorbed from the surroundings).

For the exothermic reaction, the change in heat energy is said to be negative because there is loss of heat energy to the surroundings ($-\Delta H$). For the endothermic reaction, the change in heat energy is said to be positive because there is gain of heat energy from the surroundings ($+\Delta H$).

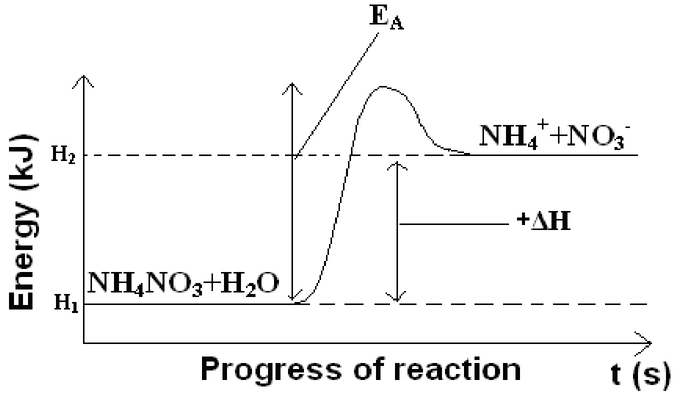
Note: Be careful when interpreting change in temperature and change in heat energy. Positive change in temperature ($+\Delta T$) means negative change in heat energy ($-\Delta H$) and negative change in temperature (ΔT) means positive change in heat energy ($+\Delta H$).

The process that takes place when ammonium nitrate and water are mixed is ionization i.e. $NH4NO3 + H2O \rightarrow NH4^+(aq) + NO3^-(aq)$ and it is an endothermic process. On the other hand, the reaction between hydrochloric acid and sodium hydroxide will be exothermic. Energy level diagrams to illustrate the two reactions are shown below;

Reaction Between HCl and NaOH



Ionisation of NH_4NO_3 in Water



13. DETERMINING THE REACTIVITY SERIES OF METALS USING DISPACEMENT REACTIONS

Materials:

- beakers (4), distilled water , a measuring cylinder, sand paper, solutions of copper sulphate, zinc sulphate, iron sulphate and magnesium sulphate, pieces of copper, zinc, iron and magnesium metal.

Procedure:

a. Pour about 2 cm^3 of copper sulphate solution into each of the four beakers.
b. Clean the copper, zinc, iron and magnesium metals using sand paper.
c. Put a piece of each metal into each of the four beakers containing copper sulphate solution.
d. Observe the contents of the beakers for 2 to 3 minutes.
e. Record the results in the table below by indicating "Reaction" or "No reaction".
f. Rinse the beakers with distilled water.
g. Repeat steps (a) to (f) using solutions of zinc sulphate, iron sulphate and magnesium sulphate, respectively.

TABLE OF RESULTS

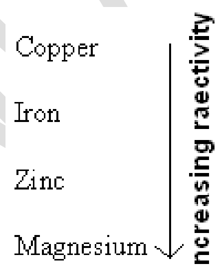
metal / solutions	copper	zinc	iron	magnesium
copper sulphate				
zinc sulphate				
iron sulphate				
magnesium sulphate				

Expectedly, the results will be as follows

solutions \ metal	copper	zinc	iron	magnessium
copper sulphate		reaction	reaction	reaction
zinc sulphate	no reaction		no reaction	reaction
iron sulphate	no reaction	reaction		reaction
magnessium sulphate	no reaction	no reaction	no reaction	

Where it is marked reaction, it means the metal has been displaced from solution and is less reactive than the metal which has displaced it. In this case, copper has been displaced by 3 metals, iron has been displaced by 2 metals, zinc has been displaced by 1 metal only and magnesium has not been displaced by any of the metals. It follows, therefore, that copper is the least reactive and magnesium is the most reactive. The metals can be arranged in the order of increasing reactivity as shown over leaf.

Copper, Iron, Zinc, Magnesium i.e.



14. INVESTIGATING THE EFFECT OF ACIDITY ON PERCENTAGE CORROSION OF IRON

Materials:

- Test tubes (7), HCl (aq) of pH from 1 to 7, Iron nails (7).

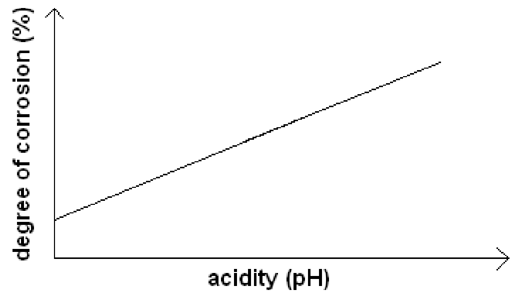
Procedure:

a. label the test tubes 1 to 7
b. Put the HCl (aq) of different pHs in respective test tubes.
c. Put the iron nails in all the test tubes

d. Leave the test tubes at a safe place for a week.
e. Observe the degree of corrosion / rusting of the iron nails and arrange the test tubes in order of decreasing corrosion of the iron nail.

Expectedly, the degree of corrosion will decrease as the pH increases from 1 to 7. But the increase in pH is a decrease in acidity; hence the degree of corrosion is directly proportional to acidity i.e. the iron nail will corrode/ rust more if the solution in which it is put is more acidic.

The relationship can be clearly illustrated if a graph as shown below is used



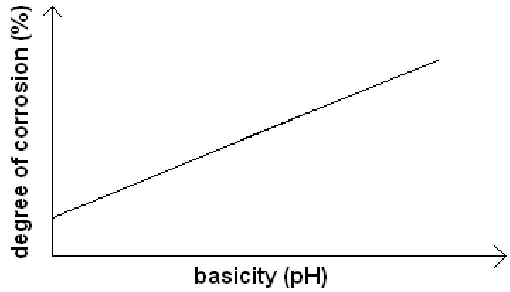
15. INVESTIGATING THE EFFECT OF BASICITY ON PERCENTAGE CORROSION OF IRON

Materials:
- Test tubes (7), NaOH (aq) of pH from 8 to 14, Iron nails (7).

Procedure:
a. label the test tubes 8 to 14
b. Put the NaOH (aq) of different pHs in respective test tubes.
c. Put the iron nails in all the test tubes
d. Leave the test tubes at a safe place for a week.
e. Observe the degree of corrosion / rusting of the iron nails and arrange the test tubes in order of decreasing corrosion of the iron nail.

Expectedly, the degree of corrosion will increase as the pH increases from 8 to 14. But the increase in pH is also an increase in basicity; hence the degree of corrosion is directly proportional to basicity i.e. the iron nail will corrode / rust more if the solution in which it is put is more basic.

The relationship can be clearly illustrated if a graph as shown below is used



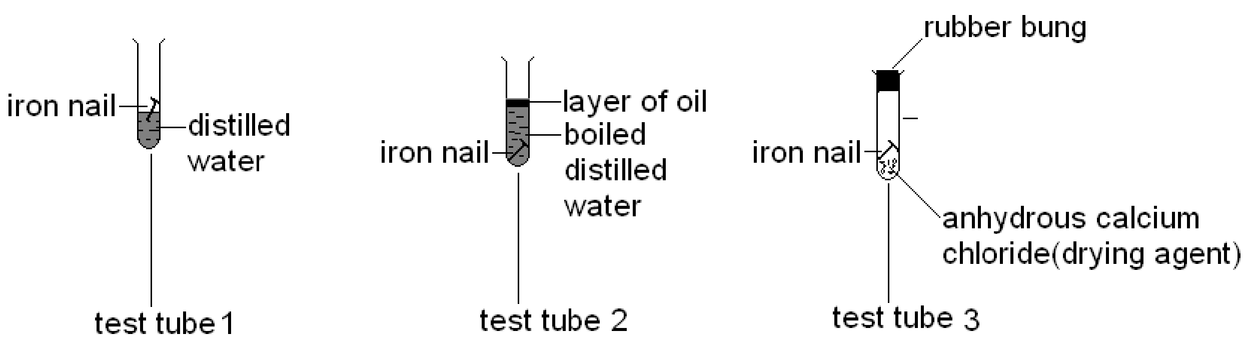
16. INVESTIGATING THE CONDITIONS OF RUSTING

Materials:

- Iron nails (3), test tubes (3), distilled water, boiled but cooled water, distilled water, Anhydrous calcium chloride, cotton wool, oil, glass wool, rubber bung

Procedure:

a. Set up the apparatus as shown below



b. Leave the set up for 2 weeks
c. Observe what happens to the iron nail after the 2 weeks
d. Record your observations by writing 'rusting' or 'no rusting' in the appropriate space in the table of results

TABLE OF RESULTS

Test tube	Observation
1	
2	
3	

The test tube in which there is rusting consists of the necessary conditions of rusting.

Expectedly, there will be rusting in test tube 1 and no rusting in test tubes 2 and 3. In test tube 1, there is both oxygen (from the air) and water but in test tube 2, there is no oxygen and in test tube 3, there is no water.

Hence the necessary conditions for rusting are oxygen and water.

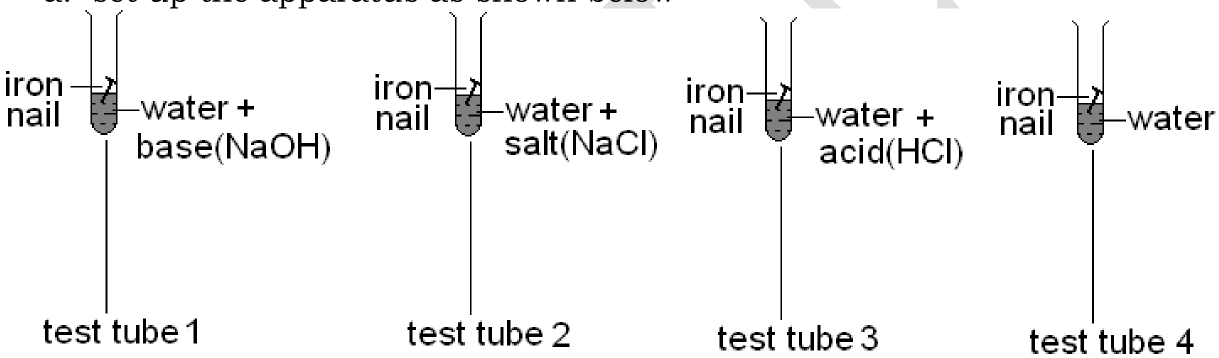
17. INVESTIGATING THE FACTORS THAT AFFECT RUSTING

Materials:

- Test tubes (4), Iron nails (4), dilute sodium hydroxide, dilute hydrochloric acid, dilute sodium chloride solution and water.

Procedure:

a. set up the apparatus as shown below



b. Leave the set ups for 2 weeks
c. Observe what happens to the iron nails
d. Record your observations in the table of results by writing ‘more rusting’ if the degree of rusting exceeds that of test tube 4 and ‘less rusting’ if the degree of rusting is less than that of test tube 4.

TABLE OF RESULTS

Test tube	Content	Observation
1	Water + air + base (sodium hydroxide)	
2	Water + air + salt (sodium chloride)	
3	Water + air + acid (hydrochloric acid)	

In test tube 1, there will be normal rusting. If there is more or less rusting in the other test tubes, it means the additional substances in the test tubes i.e. acid, base and salt affect rusting.

Expectedly, there will be more rusting in the other test tubes; hence acids, bases and salts affect rusting

18. IDENTIFYING ACIDS AND BASES USING UNIVERSAL INDICATOR

Materials:

- Universal indicator, test tubes (3), solutions A, B and C

Procedure:

a. Put 2ml of liquid X in one test tube
b. Add 4 drops of universal indicator in the test tube in which liquid X has been put
c. Obverse the colour change and record in the table of results
d. Repeat steps (a) to (c) for the solutions Y and Z

TABLE OF RESULTS

SOLUTION	OBSERVATION (COLOUR)	ACID/BASE
X		
Y		
Z		

The solution is acidic if the colour changes to either red, orange or yellow; the solution is basic if the colour changes to either blue, violet or purple and the solution is neutral if the colour changes to green.

To determine the strength of the acid or base, a pH scale is used. The colour of the solution is matched against the colour on the scale. The scale is shown below

Colour of universal indicator	Red	orange	Light orange	yellow	green	Green blue	Light blue	Dark blue	Violet	Purple
Ph	0 - 2	3 - 4	5	6	7	8	9	10	11 - 12	13 - 14

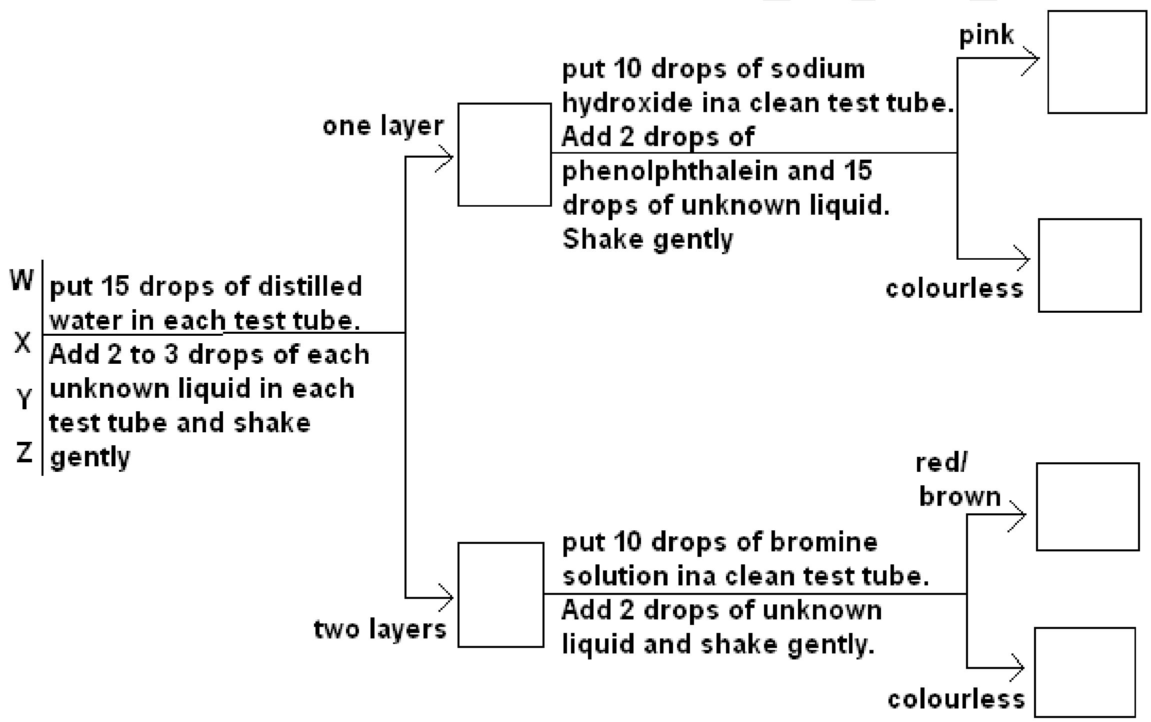
19. IDENTIFYING ORGANIC SUBSTANCES USING FLOW DIAGRAM

Materials:

- Test tubes (4), distilled water, bromine solution, sodium hydroxide solution and phenolphthalein indicator, unknown liquids labeled W, X, Y and Z which are hexane, ethanol, cyclohexene and ethanoic acid but not necessarily in that order.

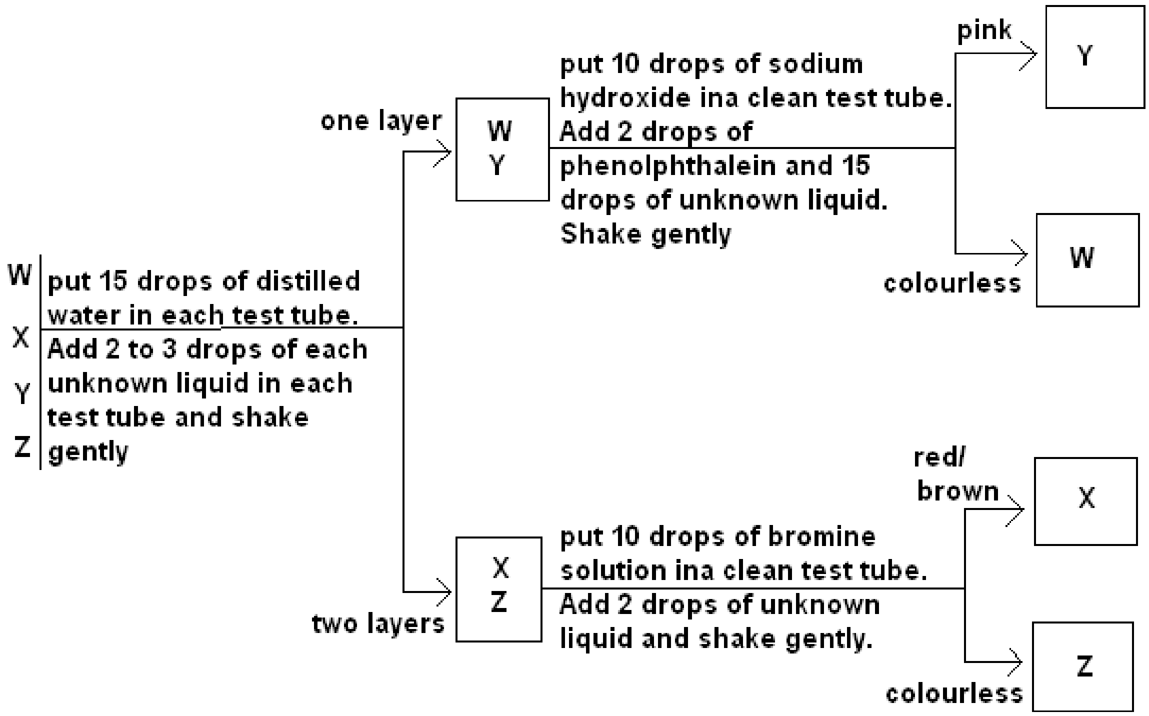
Procedure:

a. Perform the tests given in the flow diagram in the figure below and complete the diagram by filling in the letters W, X, Y and Z in the appropriate boxes.



b. identify liquids W, X, Y and Z

Assuming the results are as shown below



Then

W is ethanoic acid
X is hexane
Y is ethanol
Z is cyclohexene

20. IDENTIFYING FAMILIES OF ORGANIC COMPOUNDS

Materials:

- Dilute sodium hydroxide, phenolphthalein indicator and bromine solution in dropper bottles, four test tubes (in a rack) containing substances P, Q, R and S and distilled water in a wash bottle.

Procedure:

a. On each substance, perform the tests shown in the table below and record the observations in the appropriate space. Wash the test tubes after use.

Substance \ Test	add 1-2 drops of substance to 15 drops of distilled water	add 1drop of phenolphthalein to 15 drops NaOH then add 1 drop of substance	add 1-2 drops of substance to 15 drops bromine
	RESULTS	RESULTS	RESULTS
P			
Q			
R			
S			

Identify the families to which the compounds belong.

P__________________________

Q__________________________

R__________________________

S__________________________

The substance belongs to alkene family if

- It is insoluble in water i.e. two layers form when water is added to it
- It does not decolourise the solution of NaOH + phenolphthalein
- It makes the brown colour of bromine disappear i.e. if it reacts with bromine

The substance belongs to alkane family if

- It is insoluble in water i.e. two layers form when water is added to it
- It does not decolourise the solution of NaOH + phenolphthalein
- It does not make the brown colour of bromine disappear i.e. if it does not react with bromine

The substance belongs to alkanol family if

- It is soluble in water i.e. one layer forms when water is added to it
- It does not decolourise the solution of NaOH + phenolphthalein
- It does not make the brown colour of bromine disappear i.e. if it does not react with bromine

The substance belongs to carboxylic family if

- It is soluble in water i.e. one layer forms when water is added to it
- It decolourises the solution of NaOH + phenolphthalein
- It does not make the brown colour of bromine disappear i.e. if it does not react with bromine

END OF CHEMISTRY SAMPLE MSCE
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