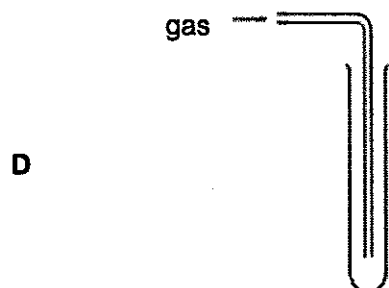
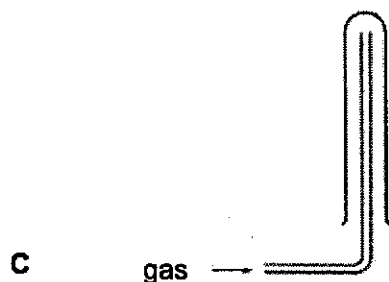
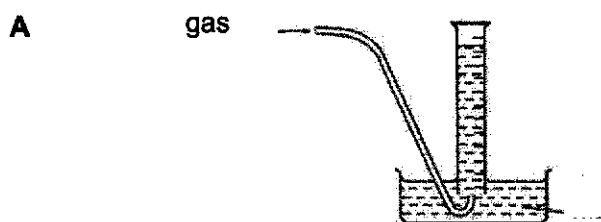


Section A (10 marks)

Answer **all** the questions in this section. Write your answers in the boxes on page 6.

- 1 A student attempts to collect a gas that is less dense than air and is insoluble in water.

Which method **cannot** be used to collect the gas?



3

- 2 The table shows the boiling points of some of the gases present in air.

gas	boiling point/ °C
argon	-186
helium	-269
neon	-246
nitrogen	-196
oxygen	-183

When air is cooled from room temperature to -200°C , which gases remain unchanged in state?

- A argon and helium
B helium and neon
C neon and nitrogen
D nitrogen and oxygen
- 3 An atom of an element X has 12 neutrons and 13 protons.
Which statement is true?
A Element X forms ions with a charge of -1 .
B Element X has a nucleon number of 12.
C Element X is a non-metal.
D Element X is located at Period 3 and Group III of the Periodic Table.
- 4 In the blast furnace, iron is extracted from its ore.
Which substance is **not** used as a raw material in its production?
A air
B haematite
C limestone
D slag

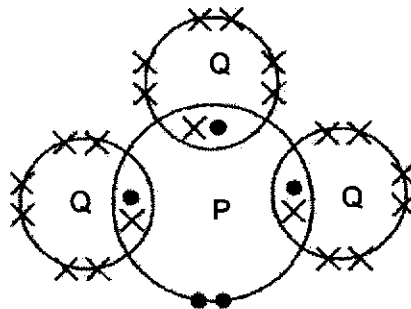
4

- 5 An element is represented by the symbol ${}_{38}^{90}\text{X}$.

How many protons, neutrons and electrons are present in an atom of this element?

	protons	neutrons	electrons
A	38	50	38
B	38	52	38
C	38	52	40
D	40	50	38

- 6 The diagram shows the electron arrangement of the atoms in a molecule of PQ_3 .



Which property does this compound have?

- A** It can be easily separated into its elements by physical methods.
B It dissolves readily in water.
C It has a low melting point.
D It is a good electrical conductor.
- 7 Which equation is balanced?
- A** $\text{Ba}_3\text{N}_2 + 6 \text{H}_2\text{O} \rightarrow 3 \text{Ba}(\text{OH})_2 + 2 \text{NH}_3$
B $\text{CaCl}_2 + 2 \text{Na}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6 \text{NaCl}$
C $\text{HClO}_4 + \text{P}_4\text{O}_{10} \rightarrow 4 \text{H}_3\text{PO}_4 + 6 \text{Cl}_2\text{O}_7$
D $3 \text{PCl}_5 + 4 \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 5 \text{HCl}$
- 8 A detergent contains sodium lauryl sulfate with a chemical formula of $\text{NaC}_{12}\text{H}_{25}\text{SO}_4$.
 Which statement is true about sodium lauryl sulfate?
- A** It is an alloy.
B It is made from six elements.
C It is made of non-metals only.
D There are 43 atoms in one formula unit of the substance.

9 What will be observed if chlorine gas is bubbled slowly into a solution of sodium bromide?

- A Pale yellow-green gas of chlorine becomes dark yellow.
- B Purplish black crystals of iodine is formed.
- C Silvery sodium is seen.
- D Sodium bromide solution turns from colourless to red-brown.

10 The reactions of five unknown metals, P, Q, R, S and T, with water, steam and dilute hydrochloric acid, as well as the reaction of their metal ores with carbon monoxide, are analysed in order to determine the order of their reactivity.

The observations are shown in the table below.

metal	reaction with			carbon monoxide gas passed over metal ore
	cold water	steam	dilute hydrochloric acid	
P	very few bubbles seen	bright white flame seen as a white solid is formed	effervescence seen	no visible change
Q	no visible change	no visible change	no visible change	shiny brown solid
R	sparks seen	not carried out	not carried out	no visible change
S	no visible change	a yellow solid is formed	effervescence seen	shiny silvery solid
T	effervescence	not carried out	not carried out	no visible change

What is the order of the reactivity of the metals from the most reactive to the least reactive?

- A $P \rightarrow Q \rightarrow R \rightarrow T \rightarrow S$
- B $Q \rightarrow R \rightarrow T \rightarrow P \rightarrow S$
- C $R \rightarrow T \rightarrow P \rightarrow S \rightarrow Q$
- D $S \rightarrow Q \rightarrow R \rightarrow T \rightarrow P$

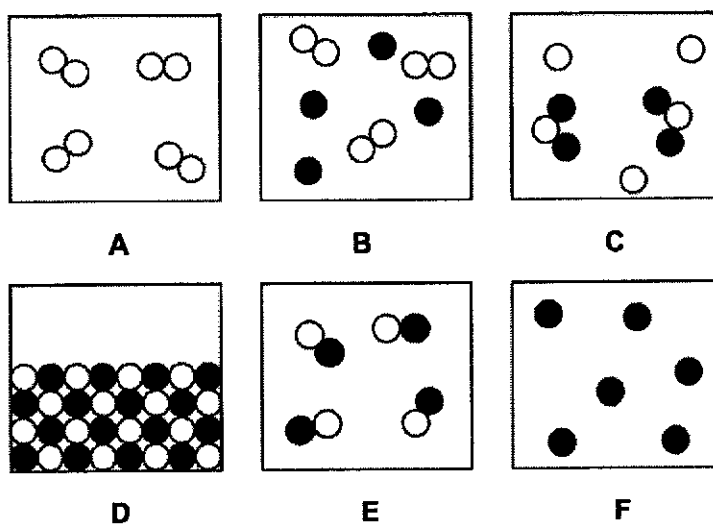
Answers to Section A

1		2		3		4		5	
6		7		8		9		10	

Section B (35 marks)

Answer **all** the questions in this section in the spaces provided.

- 1 The diagrams **A** to **F** below show the arrangement of particles in different substances. Each letter can be used as an answer once, more than once or not at all.

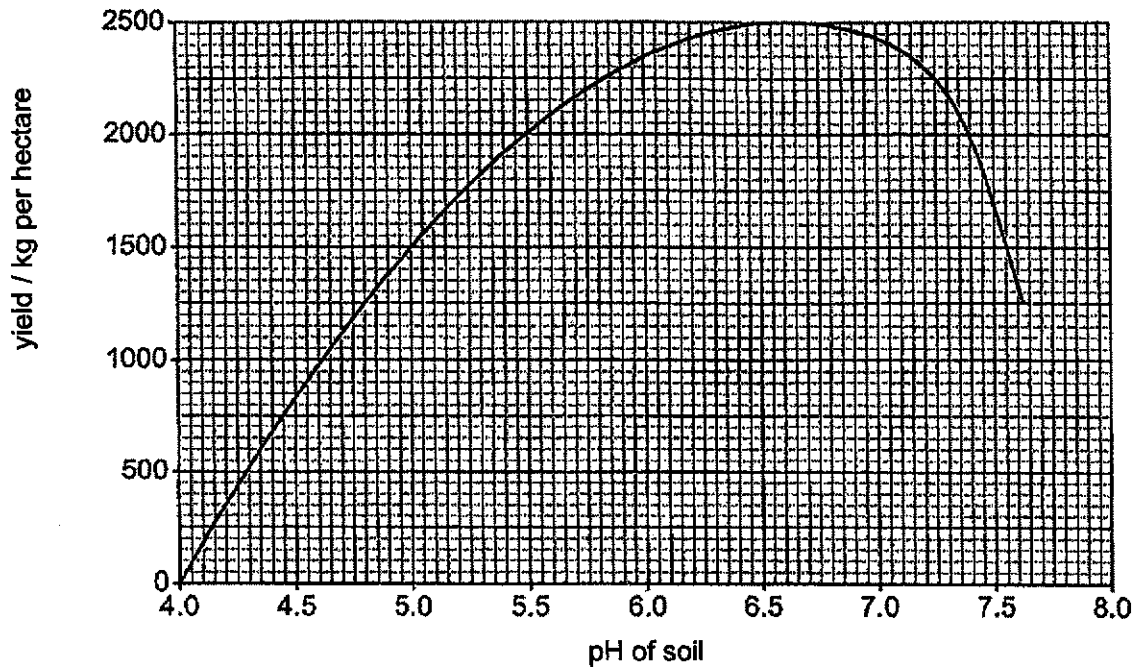


Which diagram best represents

- (a) a mixture of two elements, _____
- (b) a noble gas, _____
- (c) a substance that boils over a range of temperatures, _____
- (d) negative and positive ions in sodium chloride. _____

[4]

- 2 Soy bean is an important crop grown by farmers in many countries. The graph below shows how the yield of soy beans is affected by the pH of the soil in which they are grown.



- (a) What must the pH of the soil be if the farmer wants the best yield?
_____ [1]
- (b) What is the yield in kg per hectare if the soil is neutral?
_____ [1]
- (c) (i) If a farmer obtains a yield of 1200 kg per hectare of land used, was the soil acidic, neutral or alkaline when he first planted the soy beans? Explain your answer.
_____ [1]
- (ii) What could he have added to the soil in (i) before he planted the soy bean in order to change the pH to one that gives the best yield?
_____ [1]

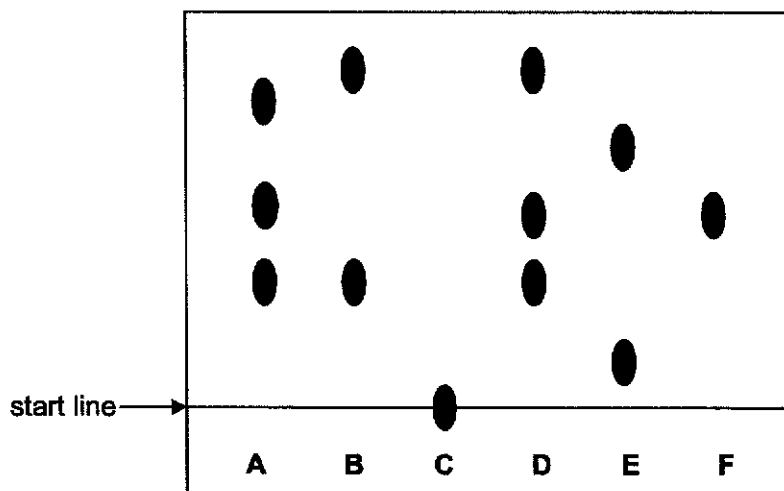
- 3 The names of some salts with their ions and use are shown in the table below.

name of substance	ions	use of substance
barium sulfate	Ba^{2+} and SO_4^{2-}	emphasize organs in x-rays
copper(II) chloride	Cu^{2+} and Cl^-	control fungal diseases of crops
silver chloride	Ag^+ and Cl^-	antidote for mercury poisoning
calcium nitrate		chemical fertiliser

- (a) State the chemical formulae for copper(II) chloride and barium sulfate.
 copper(II) chloride: _____ barium sulfate: _____ [1]
- (b) State the chemical symbols of the ions present in calcium nitrate.
 _____ [1]
- (c) How can a sample of silver chloride be determined to be pure?
 _____ [1]
- (d) If water is added to a mixture of all four salts and stirred until no more salt can dissolve, which salt(s) will remain as the residue after filtration?
 _____ [1]
- (e) Name a base and an acid that can be used to prepare copper(II) chloride.
 base _____ acid _____ [2]

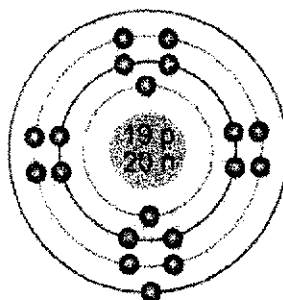
- 4 Paper chromatography was used to investigate a series of inks, A, B, C, D, E and F, using water as a solvent.

The following diagram shows the chromatogram obtained.



- (a) Suggest a reason why ink C remains at the start line.
 _____ [1]
- (b) Which water-soluble ink is a pure substance?
 _____ [1]
- (c) Which inks could be mixed to form ink D?
 _____ [1]
- (d) Describe an advantage chromatography has over other physical methods of separation such as fractional distillation.
 _____ [1]

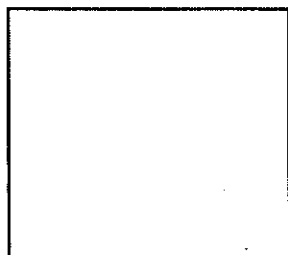
- 5 The diagram shows the atomic structure of a pure element Z.



- (a) Name element Z.
 _____ [1]
- (b) State the chemical symbol of the ion formed from an atom of element Z.
 _____ [1]
- (c) Describe how element Z should be stored.
 _____ [1]
- (d) Describe a physical property and a chemical property of element Z.
- physical property
 _____ [1]
- chemical property
 _____ [1]

12

- (e) (i) Draw the structure of the pure element Z when it is completely melted.



[1]

- (ii) Describe the movement of the particles in liquid Z.

[1]

- 6 The symbols of two hydrogen isotopes are shown below.

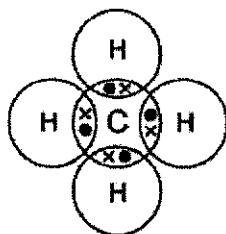


- (a) What do the atoms have in common and what is their difference?

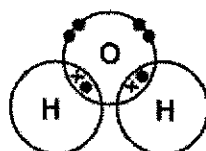
_____ [1]

- (b) Methane, CH_4 , and water, H_2O , are compounds of hydrogen.

The 'dot and cross' diagrams of these compounds are shown below.



methane



water

- (i) What bonds are formed within these molecules?

[1]

13

(ii) How many such bonds as named in (i) are found within each molecule?

methane : _____ water : _____ [1]

(c) Hydrogen atoms can combine with nitrogen atoms to form an alkaline gas.

(i) Name the alkaline gas.

_____ [1]

(ii) Describe the test for the alkaline gas named in (i).

_____ [1]

7 Brass is an alloy of copper and zinc.

The table shows how the composition of brass influences its strength.

composition of brass		relative strength of alloy
% copper	% zinc	
90	10	2.6
80	20	3.0
70	30	3.3
60	40	3.6

(a) Using the information provided in the table above, describe how the composition of brass affect its strength.

_____ [1]

- (b) Using your knowledge of the structure of metals, explain why brass is stronger than pure copper.

[2]

- (c) Describe the differences in observations if brass, copper and zinc are added to dilute sulfuric acid separately.

brass : _____

copper : _____

zinc : _____ [2]

Section C (20 marks)

Answer all the questions in this section in the spaces provided.

1 Fluorine is a non-metal in Group VII of the Periodic Table. It reacts vigorously with sodium, a Group I metal, to form a solid at room temperature.

(a) (i) Draw a diagram to show the electronic structure of a fluorine atom.

[1]

(ii) Why is the fluorine atom considered to be unstable?

[1]

(b) Why is fluorine placed in Group VII of the Periodic Table of elements?

[1]

(c) (i) State the name and chemical formula of the solid that is formed when fluorine reacts with sodium.

name _____ chemical formula _____ [2]

(ii) Explain why the product formed between sodium and fluorine has a high melting point.

[1]

(iii) Draw a 'dot and cross' diagram to show the arrangement of electrons in the product formed from the reaction between sodium and fluorine.

[2]

16

- (d) (i) Name another element in Group I that can also react with fluorine but at a slower rate than reaction of sodium with fluorine.

_____ [1]

- (ii) Describe how this element named in (d)(i) differs from sodium in its melting point.

_____ [1]

2 Jim wanted to prepare a dry sample of magnesium sulfate crystals in a laboratory. He measured about 50 cm^3 of dilute sulfuric acid and poured it into a beaker. He then added magnesium carbonate powder to the acid slowly, taking care to stir the mixture constantly. He stopped adding magnesium carbonate after observing the reaction had stopped. The mixture was then filtered and the filtrate was further treated to obtain dry magnesium sulfate crystals.

- (a) Write a balanced chemical equation to represent the reaction that had taken place, including the state symbols.

_____ [2]

- (b) Name a suitable apparatus that was used to measure the required volume of sulfuric acid needed in the experiment.

_____ [1]

- (c) What did Jim observe that enabled him to conclude that the reaction had stopped?

_____ [1]

- (d) Why was there a need for Jim to add magnesium carbonate powder till the reaction had stopped?

_____ [1]

- (e) What was the purpose of filtering the mixture after the reaction had stopped?

_____ [1]

- (f) Describe how Jim would have treated the filtrate in order to obtain a dry sample of magnesium sulfate from its filtrate.

[3]

- (g) Suggest an alternative substance that could be used to replace the magnesium carbonate powder used in the experiment to produce the same magnesium sulfate salt.

[1]

The Periodic Table of Elements

I		II										III										IV										V										VI										VII										0																																																																																																																																																																																																																																																																																																																																																			
		Group																																																																																																																																																																																																																																																																																																																																																																																																															
		1																				2																				3																				4																				5																				6																				7																				8																				9																				10																																																																																																																																																																																																																											
		H																				He																				Li																				Be																				B																				C																				N																				O																				F																				Ne																																																																																																																																																																																																																											
		hydrogen																				helium																				lithium																				beryllium																				boron																				carbon																				nitrogen																				oxygen																				fluorine																				neon																																																																																																																																																																																																																											
		1																				4																				11																				12																				13																				14																				15																				16																				17																				18																																																																																																																																																																																																																											
		1																				4																				Al																				Si																				P																				S																				Cl																				Ar																																																																																																																																																																																																																																																																			
		1																				9																				19																				20																				21																				22																				23																				24																				25																				26																				27																				28																				29																				30																																																																																																																																											
		1																				9																				K																				Ca																				Sc																				Ti																				V																				Cr																				Mn																				Fe																				Co																				Ni																				Cu																				Zn																																																																																																																																											
		1																				9																				potassium																				calcium																				yttrium																				titanium																				vanadium																				chromium																				manganese																				iron																				cobalt																				nickel																				copper																				zinc																																																																																																																																											
		1																				9																				39																				40																				39																				40																				41																				42																				43																				44																				45																				46																				47																				48																																																																																																																																											
		1																				9																				rubidium																				strontium																				yttrium																				zirconium																				niobium																				molybdenum																				technetium																				ruthenium																				rhodium																				palladium																				silver																				cadmium																																																																																																																																											
		1																				9																				85																				86																				87																				88																				89																				90																				91																				92																				93																				94																				95																				96																				97																				98																																																																																																			
		1																				9																				cesium																				barium																				lanthanoids																				hafnium																				tantalum																				tungsten																				rhenium																				osmium																				iridium																				platinum																				gold																				mercury																				thallium																				lead																																																																																																			
		1																				9																				133																				137																				57-71																				72																				73																				74																				75																				76																				77																				78																				79																				80																				81																				82																				83																				84																																																											
		1																				9																				francium																				radium																				actinoids																				rutherfordium																				dubnium																				seaborgium																				bohrium																				hassium																				meitnerium																				darmstadtium																				roentgenium																				copernicium																																																																																																																																											
		1																				9																				87																				88																				89-103																				104																				105																				106																				107																				108																				109																				110																				111																				112																				114																				116																																																																																																			
		1																				9																				francium																				radium																				actinoids																				rutherfordium																				dubnium																				seaborgium																				bohrium																				hassium																				meitnerium																				darmstadtium																				roentgenium																				copernicium																																																																																																																																											
		1																				9																				57																				58																				59																				60																				61																				62																				63																				64																				65																				66																				67																				68																				69																				70																				71																																																																															
		1																				9																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																				lanthanoids																																																																																																			
		1																				9																				89																				90																				91																				92																				93																				94																				95																				96																				97																				98																				99																				100																				101																				102																				103																																																																															
		1																				9																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																				actinoids																																																																																																																							
		1																				9																				lanthanum																				cerium																				praseodymium																				neodymium																				promethium																				samarium																				europium																				gadolinium																				terbium																				dysprosium																				holmium																				erbium																				thulium																				ytterbium																				lutetium																																																																															
		1																				9																				139																				140																				141																				144																				144																				145																				146																				147																				150																				151																				152																				157																				159																				163																				167																				169																				173																				175																			
		1																				9																				actinium																				thorium																				protactinium																				uranium																				neptunium																				plutonium																				americium																				curium																				berkelium																				californium																				einsteinium																				fermium																				mendeleevium																				nobelium																				lawrencium																																																																															
		1																				9																				232																				231																				231																				238																				238																				238																				238																				238																				238																				238																				238																				238																				238																				238																																																																																																			

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Answers for BSS/ 2019 EOY/3E Sc Chem**Section A**

1. D
2. B
3. D
4. D
5. B
6. C
7. A
8. D
9. D
10. C

Section B

- 1
 - (a) B
 - (b) F
 - (c) B and C
 - (d) D

- 2
 - (a) Accept any value from pH from 6.45 to 6.7
 - (b) 2450 kg per hectare
 - (c) (i) acidic, pH less than 7 [both ans required]
(ii) add calcium hydroxide

- 3
 - (a) CuCl_2 and BaSO_4 [both correct]
 - (b) Ca^{2+} and NO_3^- [both correct]
 - (c) Find either mp or bp; must be constant or fixed [both required]
 - (d) barium sulfate and silver chloride [both correct]
 - (e) copper(II) oxide/ hydroxide[1]
hydrochloric acid [1]

- 4
 - (a) Ink C is not soluble in water
 - (b) ink F
 - (c) inks B and F
 - (d) In chromatography, only a small amount is required, unlike fractional distillation

- 5 (a) potassium
 (b) Z^+ or K^+
 (c) in oil
 (d) physical property [1m for any one]
 silvery and shiny/ good heat conductor or good electrical conductor/ malleable and ductile/ sonorous/ low mp and bp/ low density/ soft and easily cut with a blade/ less dense than water
- chemical property [1m for any one]
 -reacts explosively with water to form an alkali/ potassium hydroxide/ hydrogen gas [accept reactions with steam and acid if products are correct]
- (e) (i) (3 layers of atoms in liquid state)
 (ii) slide past each other slowly and freely
- 6 (a) same number of protons, different number of neutrons [both correct]
 (b) (i) covalent bonds
 (ii) methane: 4 ; water: 2 [both correct]
 (c) (i) ammonia
 (ii) Put a damp red/ pink litmus into gas. It turns blue.
- 7 (a) As % of copper decreases [or % of zinc increases], the strength of alloy increases
 (b) brass has different types of atoms with different sizes;
 orderly arrangement in pure metal is disrupted; structure becomes disorderly;
layers of atoms cannot slide over each other easily
 [2m for 3 pts; 1m for 1 to 2 pts only]
 (c) effervescence observed with brass in acid;
no effervescence (or bubbles) observed with copper in acid;
lots of effervescence observed with zinc in acid;
 [2m for 3 pts; 1m for 1 to 2 pts only]

Section C

- 1 (a) (i) correct atomic structure of a fluorine atom
- (ii) fluorine atom does not have the full, stable structure of a noble gas.
- (b) it has 7 valence electrons
- (c) (i) sodium fluoride [1], NaF [1]
- (ii) It has strong ionic bonds ; lots of energy required to break them
- (iii) correct charge on each ion [1]
 correct electronic configuration on each ion [1]
 [or 1m for each correct ion]
- (d) (i) lithium
- (ii) mp is higher than sodium
- 2 (a) $\text{MgCO}_3 (\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$
 [equation 1m; state 1m]
- (b) measuring cylinder
- (c) effervescence stopped; no more solid could react and dissolve
- (d) to remove all the acid as acid cannot be easily removed by filtration
- (e) to remove excess magnesium carbonate
- (f) Heat the filtrate to point of saturation/ crystallisation;
Cool
Decant/ filter to obtain crystals
Dry in between filter papers
- Any 3 points [3]
- (g) magnesium or magnesium oxide or magnesium hydroxide