ANDERSON SECONDARY SCHOOL
SCIENCE DEPARTMENT
PRELIMINARY EXAMINATION 2014

CANDIDATE NAME					
CLASS	4			INDEX NUMBER	

CHEMISTRY **5073/01**

Paper 1 Multiple Choice **28th August 2014**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name and register number on the Question Paper and Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions.

For each question there are four possible answers **A**, **B**, **C**, and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate **Answer Sheet.**

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark.

A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page **17.**

This document consists of __17__ printed pages including this cover page.

1 Which of the following statements can be used to explain why the volume of a fixed mass of gas is inversely proportional to the pressure at a constant temperature?

A Forces between the particles are overcome at higher pressure.

B Particles collide harder and move farther apart at higher pressure.

C Particles move closer to one another at higher pressure.

D Particles move faster and more randomly at higher pressure.

2 The melting point and boiling point of some gases in air is shown below:

Gas	Melting point / °C	Boiling point / °C
Oxygen	-219	-183
Argon	-189	-186
Nitrogen	-210	-196

To obtain only liquid oxygen, the temperature of a sample of air should be decreased to _____.

A - 180°C

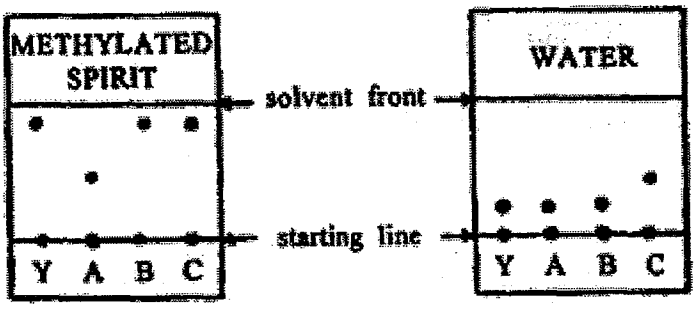
B - 182°C

C - 185°C

D - 195°C

3 It was suspected that an illegal drug **Y** contained one or more of three poisonous compounds, **A**, **B** or **C**.

Spots of each poisonous compound were put on the starting line of two chromatograms. The first chromatogram was developed with methylated spirit, and the second with water. The results were shown below.



From these chromatograms, we can deduce that drug **Y** contains _____.

A compound **A** only

B compound **B** only

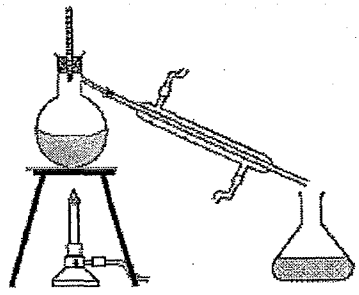
C compound **C** only

D compounds **B** and **C** only

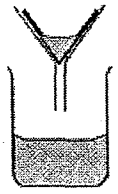
4 In the laboratory experiment, a student prepares an ester, ethyl ethanoate by heating ethanoic acid with ethanol for thirty minutes. It is necessary to separate the ester from the reaction mixture.

Which of the following apparatus is correct for carrying out this separation?

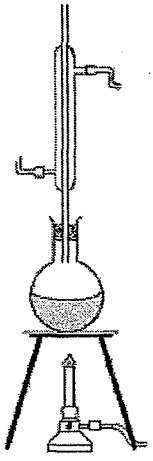
A



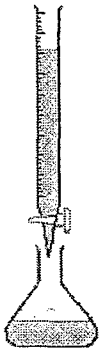
B



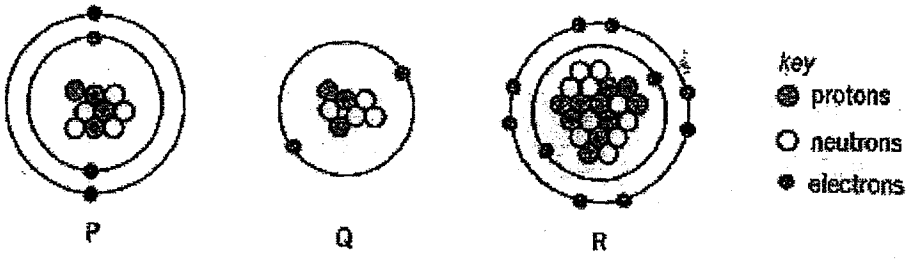
C



D



5 The diagrams below show the structure of three particles, **P**, **Q** and **R**.



Which of the statements about **P**, **Q** and **R** is correct?

A **P** and **Q** are isotopes of the same element.

B The atoms of **P**, **Q** and **R** have the same number of electron shells.

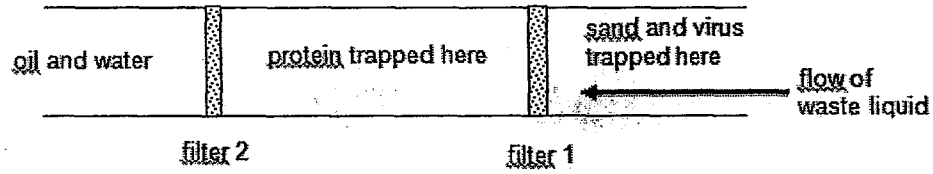
C They all have noble gas electronic configurations.

D They are all electrically neutral.

6 The diameters of some particles are shown in the table below.

Particle	Size in nanometre (nm)
water molecule	0.2
oil molecule	1.0
protein molecule	10.0
virus particle	50.0

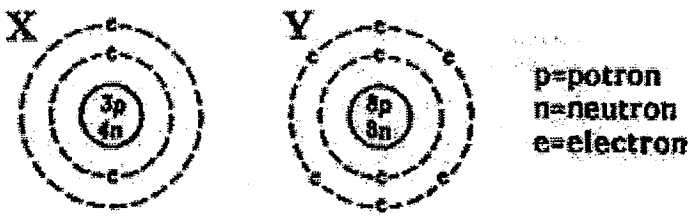
An aqueous waste liquid contains a suspension of visible sand particles mixed with oil, protein and a virus.
By using two filters with holes of different sizes, it is intended to separate the protein and oil as shown in the diagram below.



Filter 1 removes sand and the virus and filter 2 separates the oil from the protein. Which of the following are suitable diameters for the holes in the filters?

	Filter 1	Filter 2
A	0.1 nm	5.0 nm
B	20.0 nm	5.0 nm
C	20.0 nm	0.1 nm
D	100.0 nm	5.0 nm

7 The diagram below illustrates the structure of the atoms of two elements, **X** and **Y**.



When these two elements combine together to form a compound, what will be the mass of one mole of this compound?

A 11 g
B 14 g
C 23 g
D 30 g

8 The properties of four stubstances, **P**, **Q**, **R** and **S** are given below.

Compounds	Properties
P	low melting point; not able to conduct electricity in solid state; made up of two elements
Q	high melting point, not able to conduct electricity in solid state; made up of two elements
R	high melting point; able to conduct electricity in solid state; made up of one element
S	high melting point; not able to conduct electricity in solid state; made up of one element

Which of the following could be **P**, **Q**, **R** and **S**?

	P	Q	R	S
A	ammonia	sodium chloride	graphite	diamond
B	ammonia	sodium chloride	diamond	graphite
C	bromine	magnesium chloride	argon	silicon dioxide
D	bromine	carbon tetrachloride	neon	silicon dioxide

9 Why is graphite a good lubricant for the door lock?

A Graphite has a very high melting point.

B Graphite has very strong covalent bonds.

C The free electrons of graphite can conduct electricity.

D The layers of atoms easily slip over each other.

10 In which reaction is dilute sulfuric acid **not** behaving as an acid?

A $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

B $H_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2HCl$

C $H_2SO_4 + CuO \rightarrow CuSO_4 + H_2O$

D $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$

11 Which of the following substance is **not** appropriate for use in the reaction with dilute sulfuric acid to prepare zinc sulfate?

A zinc

B zinc carbonate

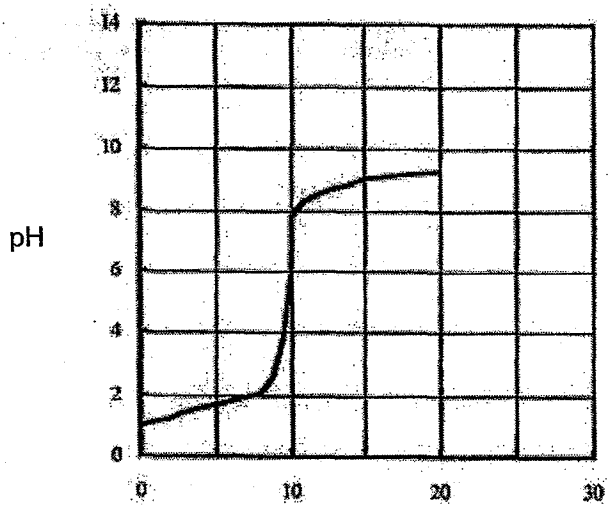
C zinc hydroxide

D zinc nitrate

12 Different indicators change colour over different pH ranges and it is important to choose the correct indicator to obtain an accurate result in a titration.

Indicator	pH range for the colour change	Colour	
		Lower pH	Higher pH
Indigo carmine	11.6 to 14.0	Blue	Yellow
Methyl red	4.2 to 6.3	Red	Yellow
Methyl violet	0.3 to 3.0	Yellow	Violet
Phenolphthalein	8.2 to 10.0	Colourless	Pink

If aqueous ammonia is added to hydrochloric acid, the following graph is obtained, which shows the change of pH with the volume of aqueous ammonia added.



Which of the indicators below would be the best choice to use in the titration?

A indigo carmine
B methyl red
C methyl violet
D phenolphthalein

13 Which of the following equations suggests that a metal oxide, RO, behaves as an amphoteric oxide?

A $RO\,(s) + 2H^+\,(aq) \rightarrow R^{2+}\,(aq) + H_2O\,(l)$

B $RO\,(s) + 2OH^-\,(aq) \rightarrow RO_2^{2-}\,(aq) + H_2O\,(l)$

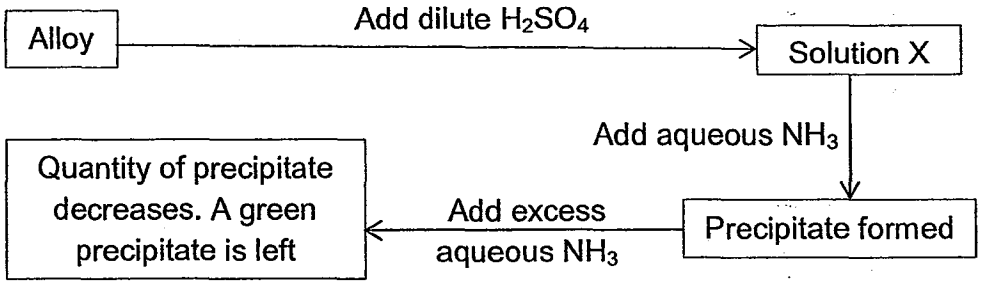
C $RO\,(s) + H_2O\,(l) \rightarrow R^{2+}\,(aq) + 2OH^-\,(aq)$

D $RO\,(s) + NH_4^+\,(aq) \rightarrow R^{2+}\,(aq) + H_2O\,(l) + NH_3\,(g)$

14 Which of the following salts is **not** obtained by crystallization?

A barium nitrate
B iron(II) sulfate
C lead(II) chloride
D calcium chloride

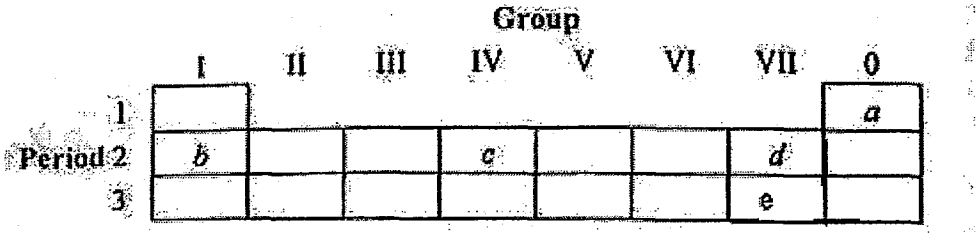
15 A sample of an alloy containing two metals was subjected to the following tests.



What are the two metals present in the alloy?

A aluminium and iron
B calcium and iron
C lead and iron
D zinc and iron

16 A part of the Periodic Table is shown below.



Which of the following statements is correct?

A ***a*** has an octet structure of valence electrons.
B ***c*** forms an ionic compound with ***d***.
C ***e*** is a strong oxidizing agent.
D The metallic character of the elements increases from ***b*** to ***d***.

17 The electronic structures of six elements, **P – U** are listed below.

P: 2,7 **Q**: 2,2 **R**: 2,4

S: 2,8,1 **T**: 2,8 **U**: 2,8,7

Which of the following is a list of non-metals, with the most reactive first and least reactive last?

A **P, R, S, U**

B **P, U, R, T**

C **S, P, Q, T**

D **U, P, S, R**

18 The table below shows the properties of some elements, **W, X, Y** and **Z** in Period 3.

	W	**X**	**Y**	**Z**
Appearance at room temperature	Grey solid	Yellow solid	Grey solid	Yellowish-green gas
Reaction with cold water	Extremely violent reaction	No reaction	Vigorous reaction	Slow reaction
Nature of oxide	Reacts with acids	Reacts with bases	Reacts with acids and bases	Reacts with bases

Which of the following shows the arrangement of these elements in the Periodic Table in **increasing** order of group number, from the smallest to the largest?

A **W, X, Y, Z** **C** **Y, W, X, Z**

B **W, Y, X, Z** **D** **Z, X, Y, W**

19 If 40 g of calcium contains ***x*** number of atoms, how many atoms are there in 71 g of chlorine gas, Cl_2?

A 0.5 ***x*** **C** 1.5 ***x***

B ***x*** **D** 2***x***

20 When an impure sample of calcium carbonate, weighing 12.0 g was added to excess of dilute hydrochloric acid, the volume of carbon dioxide given off, measured at r.t.p. was found to be 2640 cm^3.
What is the percentage purity of the sample?

A 45.8 %
B 51.3 %
C 78.0 %
D 91.7 %

21 60 cm^3 of oxygen was mixed with 10 cm^3 of gaseous hydrocarbon in a closed vessel. After explosion and cooling, the gases occupied 50 cm^3 and after passing the gas through aqueous sodium hydroxide, 30 cm^3 of oxygen remained.
Deduce the molecular formula of the hydrocarbon.

A CH_4
B C_2H_4
C C_2H_6
D C_3H_6

22 In which of the following set-ups will the concentration of copper(II) ions in the electrolyte remain unchanged when electrolysis takes place?

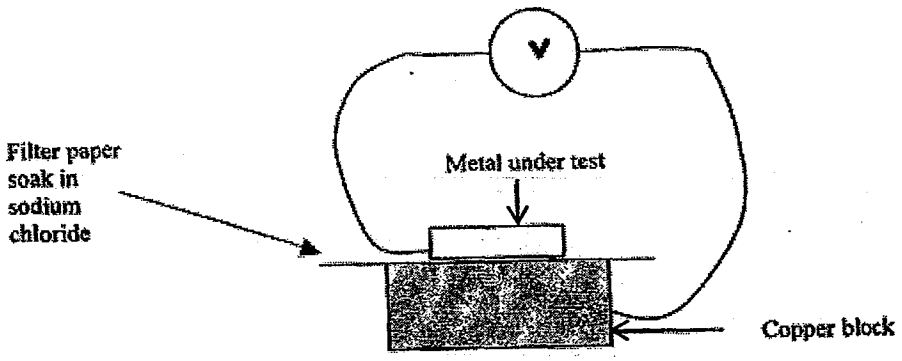
Setup	Electrolyte	Positive Electrode	Negative Electrode
1	$CuSO_4$ (aq)	Copper	Copper
2	$CuSO_4$ (aq)	Copper	Platinum
3	$CuSO_4$ (aq)	Platinum	Copper

A 1 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

23 A pupil tries to electroplate an iron ring with nickel. Which of the following combinations is correct?

	Electrolyte	Anode	Cathode
A	iron(II) sulfate solution	iron ring	nickel rod
B	iron(II) sulfate solution	nickel rod	iron ring
C	nickel(II) sulfate solution	iron ring	nickel rod
D	nickel(II) sulfate solution	nickel rod	iron ring

24 The apparatus shown below was used to compare the reactivity of metals, **P**, **Q**, **R** and **S**.



In each case, the voltmeter reading was recorded in the table shown below.

Metal under test	Direction of electron flow in external circuit	Voltage recorded / V
P	**P** to Cu	+0.87
Q	Cu to **Q**	-1.20
R	**R** to Cu	+1.58
S	**S** to Cu	+0.36

What is the correct order of the metals in **decreasing** reactivity (most reactive to least reactive)?

A **P, Q, R, S**

B **Q, S, P, R**

C **R, P, S, Q**

D **R, S, Q, P**

25 Ammonium chloride dissolves in water according to the equation below.

$$NH_4Cl\ (s) \rightarrow NH_4Cl\ (aq) \qquad \Delta H = +15.0\ kJ/mol$$

When 0.2 moles of ammonium chloride dissolves in 50.0 cm^3 of water,

1. the concentration of the solution is 4.0 mol/dm^3.
2. the energy level of NH_4Cl increases
3. the heat liberated is 3.0 kJ.
4. the temperature of water falls.

Which of the above statements are correct?

A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

26 Flour mills producing rice flour constantly face a greater danger of explosions with naked flame than rice grains. What is the most likely reason for this?

A Flour mills contain methane which combine with the rice flour to form an explosive mixture

B Rice flour has a larger surface area than rice grains.

C Rice flour is more flammable than rice grains.

D Rice in powdered form acts as a catalyst for combustion.

27 When sodium thiosulfate reacts with dilute hydrochloric acid, a fine suspension of sulfur is formed. An experiment was carried out and the time taken for the suspension to appear was recorded at various temperatures in the table below.

Temperature / °C	Time taken / s
30	97
35	52
40	42
50	24

Which one of the following conclusions can be drawn from the results?

A The higher the temperature, the faster is the rate of formation of sulfur.

B The higher the temperature, the slower is the rate of formation of sulfur.

C The longer the time taken, the lower is the temperature rise of the reaction.

D The shorter the time taken, the higher is the temperature rise of the reaction.

28 Which of the following colour changes is **not** correct when sulfur dioxide is bubbled in the given test reagents?

	test reagents	colour changes
A	I_2 (aq) + KI (aq)	brown → violet
B	$Fe_2(SO_4)_3$ (aq)	yellow → green
C	$K_2Cr_2O_7$ (aq) + H_2SO_4 (aq)	orange → green
D	$KMnO_4$ (aq) + H_2SO_4 (aq)	purple → colourless

29 A weed-killer can be prepared by heating a bleach solution.

$$\underset{\text{bleach}}{3NaClO} \rightarrow 2NaCl + \underset{\text{weed-killer}}{NaClO_3}$$

What are the oxidation states of chlorine in these three compounds?

A	-1	-1	+5
B	+1	-1	+5
C	+1	-1	+7
D	+2	+1	+7

30 Which method(s) can be used to reduce carbon dioxide emissions into the atmosphere?

I.	Use electric cars
II.	Fit catalytic converters to cars
III.	Use natural gas for generating electricity

A I only
B I and II only
C I and III only
D I, II and III

31 It was found that cars which were parked near a coal-fired power station often corroded more quickly.
Which gas, when present in above average levels in the air is a possible explanation for this?

A carbon dioxide
B oxides of nitrogen
C sulfur dioxide
D water vapour

32 To reduce atmospheric pollution, the following waste gases are passed through powdered calcium carbonate.

- carbon monoxide
- carbon dioxide
- nitrogen monoxide
- nitrogen dioxide
- sulfur dioxide
- phosphorus(V) oxide

How many waste gases will **not** be removed by the powdered calcium carbonate?

A 1
B 2
C 3
D 4

33 In the Haber process, how is ammonia separated from the unreacted nitrogen and hydrogen gases?

A by cooling and compressing

B by diffusion

C by filtration

D by fractional distillation

34 Hydrogen will form water when passed over heated oxides of **P** and **Q**, but not when passed over the oxide of **R**. Furthermore, **Q** reduces the oxide of **P**.

From the given information, it can be deduced that the order of reactivity of the metals (from the most reactive to the least) is _____.

A **P, Q, R**

B **Q, P, R**

C **R, P, Q**

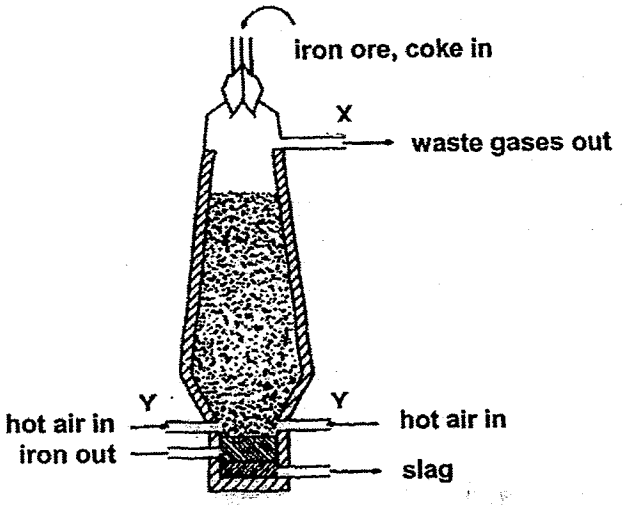
D **R, Q, P**

35 Metal **M** will displace copper from aqueous copper(II) sulfate solution, but will not displace iron from aqueous iron(II) sulfate solution. **M** is extracted from its oxide by heating the oxide with carbon.

Which of the following gives the **descending** order of reactivity of **M**, copper and iron, relative to sodium?

	most reactive ⟶			least reactive
A	sodium	metal **M**	iron	copper
B	sodium	iron	metal **M**	copper
C	copper	iron	metal **M**	sodium
D	copper	metal **M**	iron	sodium

36 The following diagram of a Blast Furnace has been **incorrectly** labelled.

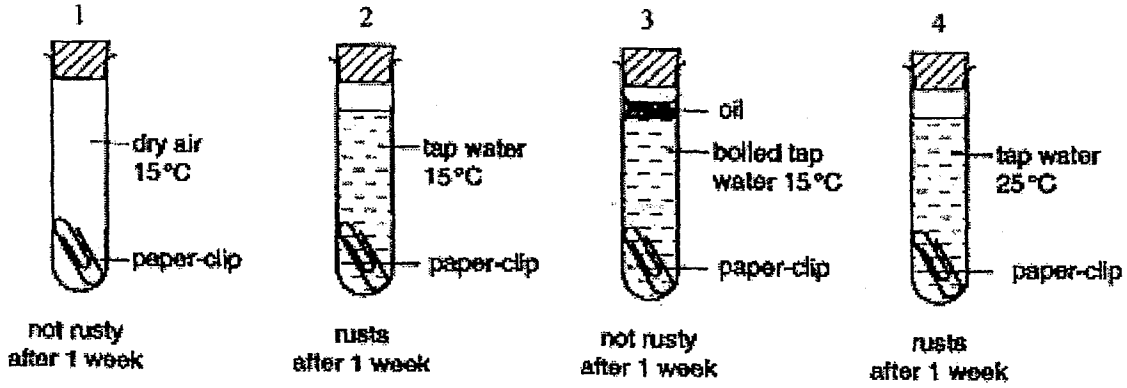


Which of the following modifications in the labelling should be made?

I Hot air should enter at **X** and waste gases should leave at **Y**.
II Iron ore, coke and limestone should be added at the top of the furnace.
III The slag should be above the iron.

A I only
B I and II
C I and III
D II and III

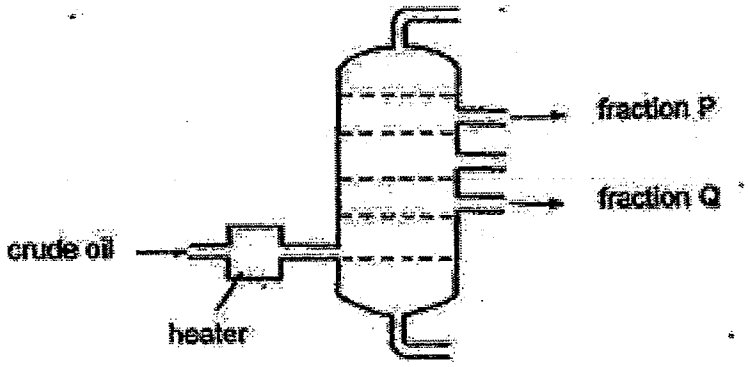
37 Four experiments on rusting are shown.



Which two experiments can be used to show that air is needed for iron to rust?

A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

38 The diagram shows the fractional distillation of crude oil.



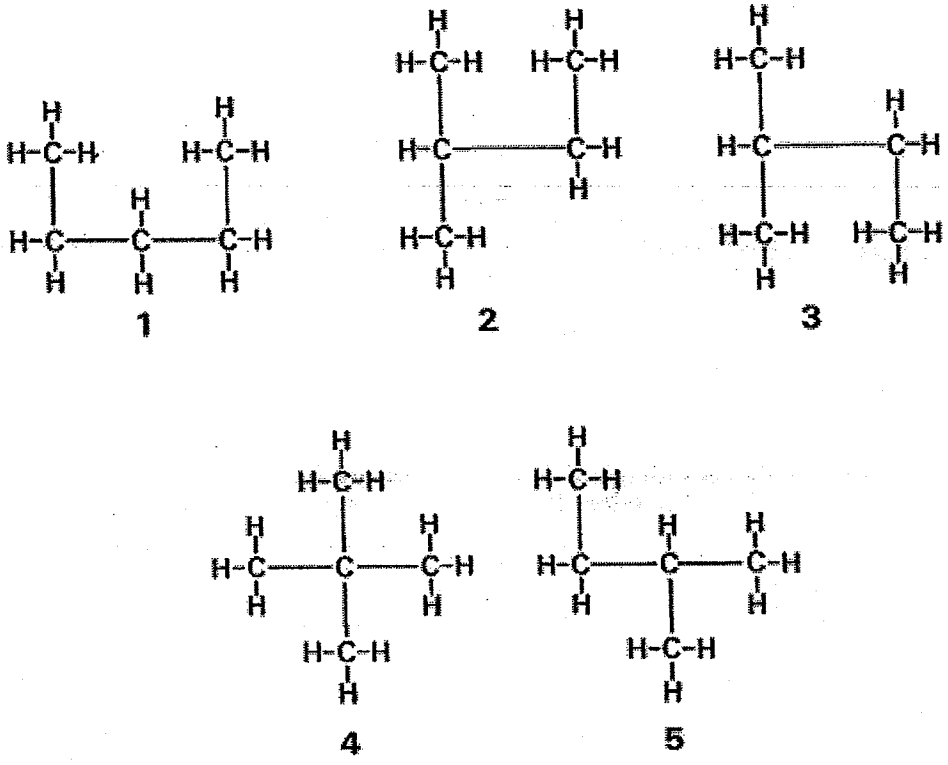
Which statements about the fractions **P** and **Q** are correct?

	P is more flammable than Q	**P has a higher boiling point than Q**	**P is more viscous than Q**
A	Yes	No	No
B	Yes	Yes	No
C	No	Yes	Yes
D	No	No	Yes

39 Which set contains the correct process for converting substance **X** to the products?

	substance X	**process**	**products**
A	alkanes	cracking	alkenes and hydrogen
B	carboxylic acid	combustion	carbon dioxide and hydrogen
C	ethanol	hydration	ethene and water
D	glucose	fermentation	ethanol and oxygen

40 Five structural formulae are shown below.



How many of the structures represent isomers of one another?

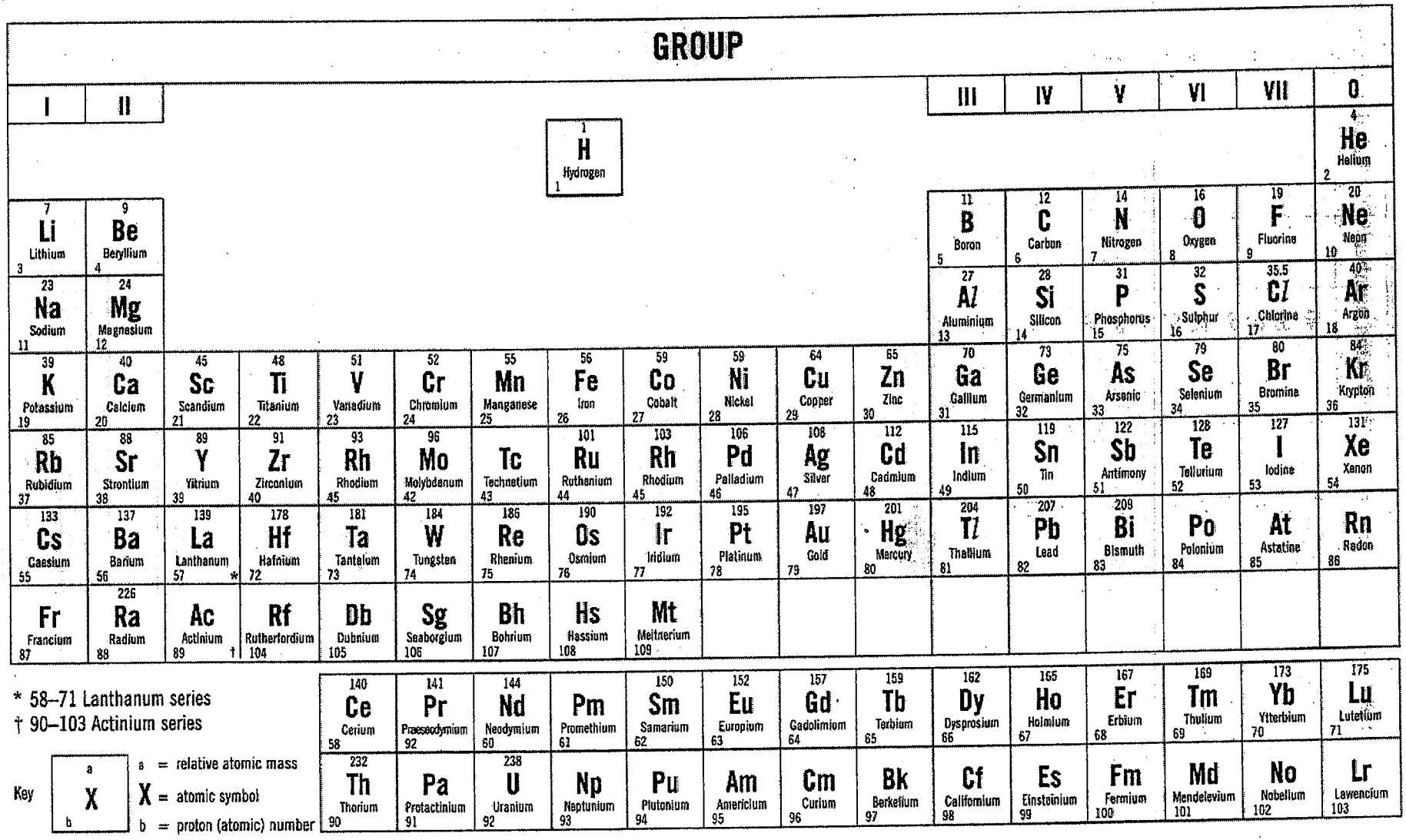
A 2
B 3
C 4
D 5

2014 Anderson Sec Chemistry Preliminary Exam

Paper 1

Answers

1. C	11. D	21. B	31. C
2. C	12. B	22. B	32. B
3. B	13. B	23. D	33. A
4. A	14. C	24. C	34. D
5. B	15. D	25. B	35. B
6. B	16. C	26. B	36. D
7. D	17. B	27. A	37. C
8. A	18. B	28. A	38. A
9. D	19. D	29. B	39. A
10. B	20. D	30. A	40. B



The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

ANDERSON SECONDARY SCHOOL
SCIENCE DEPARTMENT
PRELIMINARY EXAMINATION 2014

CANDIDATE NAME					
CLASS	4			INDEX NUMBER	

CHEMISTRY
Paper 2 Theory

5073/02
29th August 2014
1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **All** questions.

Section B
Answer **THREE** questions, the last question is in the form of EITHER/ OR.
Write your answers on the writing papers provided.

At the end of the examination, fasten the separate Answer papers securely to the question paper.

The number of marks is given in the brackets [ ] at the end of each question or part question.
You may use a calculator.
A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
Section A	
Section B	
Total	

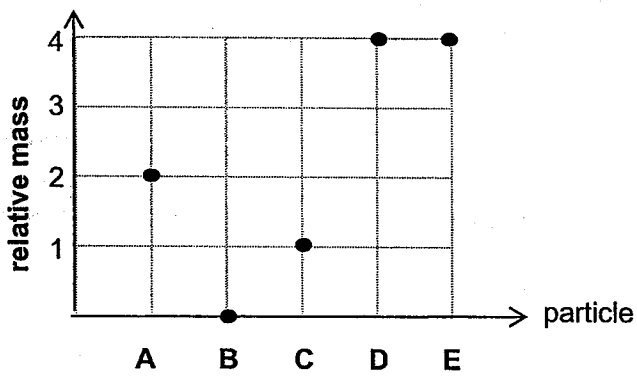
This document consists of ***16*** printed pages including this cover page.

Section A

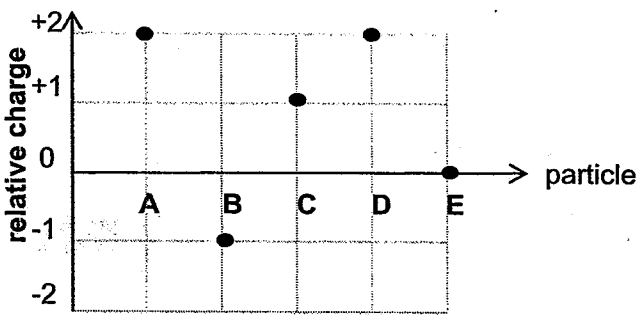
Answer **all** the questions in this section in the spaces provided.
The total mark for this section is 50.

A1 Use Graphs 1 and 2 to answer the following questions about particles **A - E**.

Graph 1



Graph 2



(a) Which particle is an electron? [1]

.....

(b) Which particle could be made up of two protons but no neutrons in the nucleus? [1]

.....

(c) Which particle could represent the nucleus of a helium atom? [1]

.....

(d) Which combination of particles would produce a particle that has the same proton number as lithium? [1]

.....

(e) Which two particles could represent the nuclei of isotopes? Explain how you deduce your answer, stating the number of particles present. [3]

.....

.....

.....

.....

[Total: 7 marks]

A2 The table below shows the effect of heat on some metal oxides.

Metal oxide	Colour of oxide before heating	Effect of heating
Mercury(II) oxide	red	oxygen evolved, silvery liquid remains
Lead(IV) oxide	brown	oxygen evolved, solid turns yellow
Zinc oxide	white	solid turns yellow on heating and becomes white on cooling
Iron(II) oxide	black	solid turns brown

(a) Which of these oxides are chemically unchanged when heated? [1]

.....

(b) Write a balanced chemical equation to show the reaction that occurred when mercury(II) oxide was heated . [1]

.....

(c) State the type(s) of reaction undergone by lead(IV) oxide and iron(II) oxide respectively on heating. [2]

.....

.....

(d) Zinc is found in the block of "transition elements" in the Periodic Table. However, it does not display characteristics that are typical of transition elements.

Using information from the table above, explain how ***two*** characteristics displayed by zinc differ from the typical characteristics of transition elements. [2]

.....

.....

.....

.....

[Total: 6 marks]

A3 There are two proposed methods to prepare CH_2BrCH_2Br.

Method 1: Ethene undergoes addition reaction with bromine.

$$CH_2{=}CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$$

Method 2: Ethane undergoes substitution reaction with bromine.

(a) Give the chemical name of CH_2BrCH_2Br. [1]

.....

(b) Write a balanced chemical equation for **Method 2**, similar to that given for **Method 1** above. [1]

.....

(c) A student commented, "**Method 1** would produce a higher percentage yield of CH_2BrCH_2Br than **Method 2**".

Explain why the student's comment is correct. [2]

.....

.....

.....

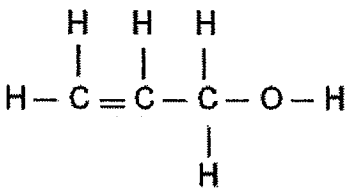
(d) State another advantage of using **Method 1**. [1]

.....

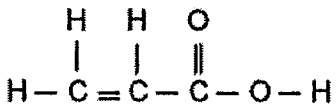
.....

[Total: 5 marks]

A4 Two bottles containing the following chemicals were mixed up in the laboratory.



Compound A



Compound B

(a) To distinguish the chemicals, a laboratory worker added sodium carbonate separately to small portions of the aqueous solution of Compound **A** and Compound **B**.

(i) Explain the results that would be obtained in the test. [2]

.....

.....

.....

.....

(ii) Explain why aqueous solutions of the compounds were used in the test. [1]

.....

.....

(iii) One of the compounds produced a sodium salt in the test. Show the structural formula of this salt in the space below. [1]

(b) Compounds **A** and **B**, under the right conditions, polymerise to form a polymer with the monomer sequence, - A – B – A – B – A – B - , without any loss of material.

Give the full structural formula of the polymer formed. [1]

[Total: 5 marks]

A5 (a) Lithium is a group I element. Statements, 1 to 3, regarding the properties of lithium compounds, are given below.

1 Lithium chloride is soluble in water.
2 Lithium chloride is covalent in character.
3 Lithium oxide dissolves in water to form a solution with a pH of more than 7.

(i) Which one of the statements does not describe the typical properties of compounds of group I elements? Explain your answer. [2]

.....

.....

.....

.....

(ii) Describe a chemical test to show that a solution contains chloride ions. [2]

.....

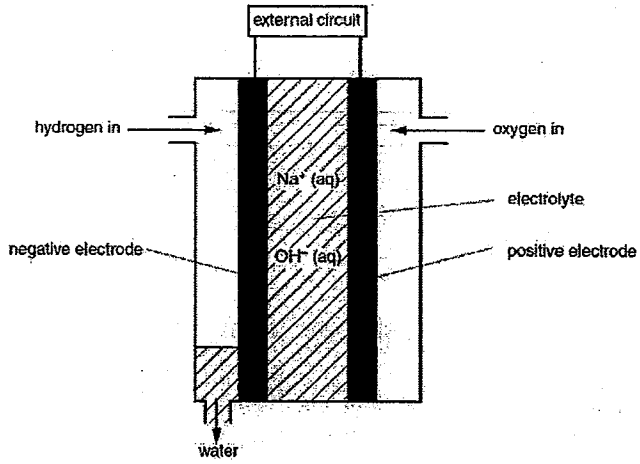
.....

(b) Sodium is also a group I element. Put ticks (√) in the boxes below to show whether the given statements about sodium is/are true or false. [3]

	True	**False**
Sodium is made by reducing sodium oxide with carbon.		
Sodium has an oxidation state of +1 in the compound Na_2O_2.		
Sodium only conducts electricity when molten.		

[Total: 7 marks]

A6 The NASA space shuttle uses fuel cells to generate electricity. The diagram below shows a hydrogen-oxygen fuel cell.



At the positive electrode:

$$O_2\,(g) + 2H_2O\,(l) + 4e^- \rightarrow 4OH^-\,(aq)$$

At the negative electrode:

$$H_2\,(g) + 2OH^-\,(aq) \rightarrow 2H_2O\,(l) + 2e^-$$

(a) Is the positive electrode the cathode or anode? Explain your answer. [2]

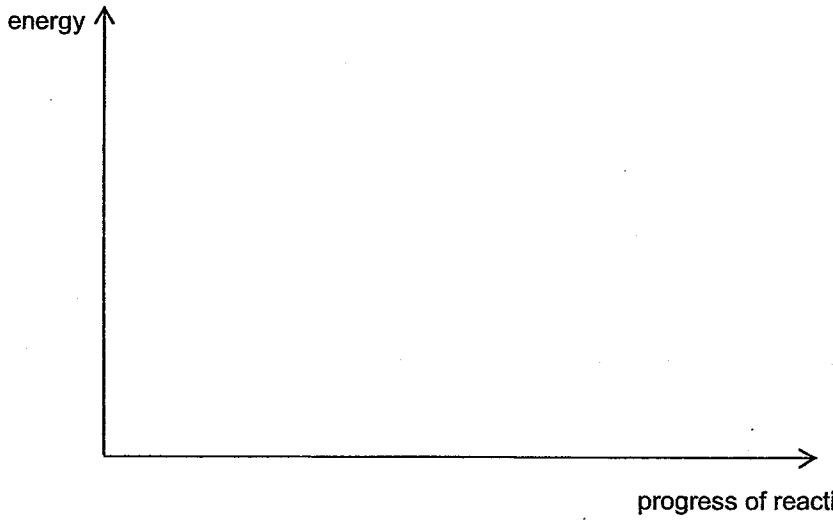
.....

.....

(b) Write a chemical equation for the overall reaction in the fuel cell. [1]

.....

(c) Draw an energy profile diagram for the overall chemical reaction that occurred in the fuel cell. [2]



(d) (i) State an advantage and a disadvantage of using fuel cell over burning of coal to generate electricity. [2]

Advantage: .....

.....

Disadvantage: .....

.....

[Total: 7 marks]

A7 (a) For many years domestic rubbish has been disposed of in landfill sites. These sites produce a mixture of gases called landfill gas, which contains methane and carbon dioxide. Landfill gas is formed in many stages.

In one of the stages, methanoic acid and ethanoic acid are produced.

In the final stage, bacteria convert the organic acids into carbon dioxide and methane.

(i) Construct a balanced chemical equation for the bacterial action on ethanoic acid, forming methane and carbon dioxide. [1]

.....

(ii) Calculate, using the bond energies given in the table below, the enthalpy change (ΔH) of the decomposition of ethanoic acid. [2]

Bond energy	Bond energy (kJ/mol)	Bond energy	Bond energy (kJ/mol)
C – H	413	C – O	358
O = O	495	C = O	799
O – O	146	O – H	463
C – C	348		

(iii) Explain **one** environmental problem that can arise from the emission of methane to the atmosphere. [2]

.....

.....

.....

.....

(b) Dengue fever is a cause of concern for the health authorities of tropical countries due to the high levels of rainfall. Health officers can commonly be seen spraying a layer of kerosene onto the surface of stagnant pools of water to kill mosquito larvae. With time, the layer of kerosene will slowly evaporate from the surface of water. Hence, re-spraying of kerosene is required.

(i) Explain, with reference to **two** physical properties of kerosene, how spraying a layer of kerosene on stagnant water can kill mosquito larvae. [2]

.....

.....

.....

.....

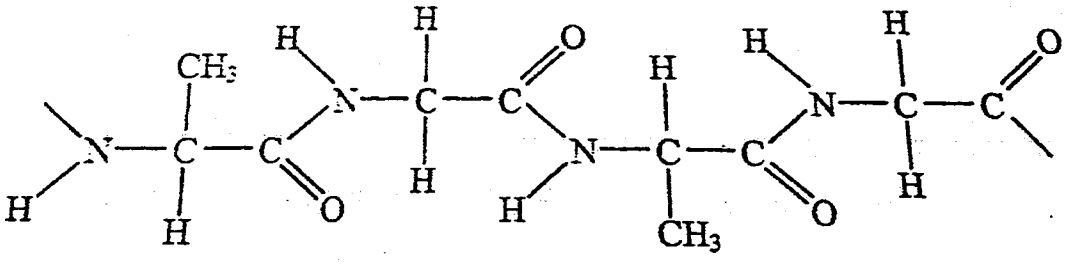
(ii) Suggest why kerosene is more suitable than petrol for spraying onto the water in the prevention of dengue. [1]

.....

.....

[Total: 8 marks]

A8 Hair is made up of long molecules of protein. The diagram below shows part of a protein molecule.



(a) Name the type of linkages that join the repeating units in the protein molecule. [1]

.....

(b) Draw the structures of the monomers used to form this part of the protein molecule. [2]

(c) Name a synthetic polymer that has the same linkage as protein. [1]

.....

(d) Why is this synthetic polymer a condensation polymer? [1]

.....

.....

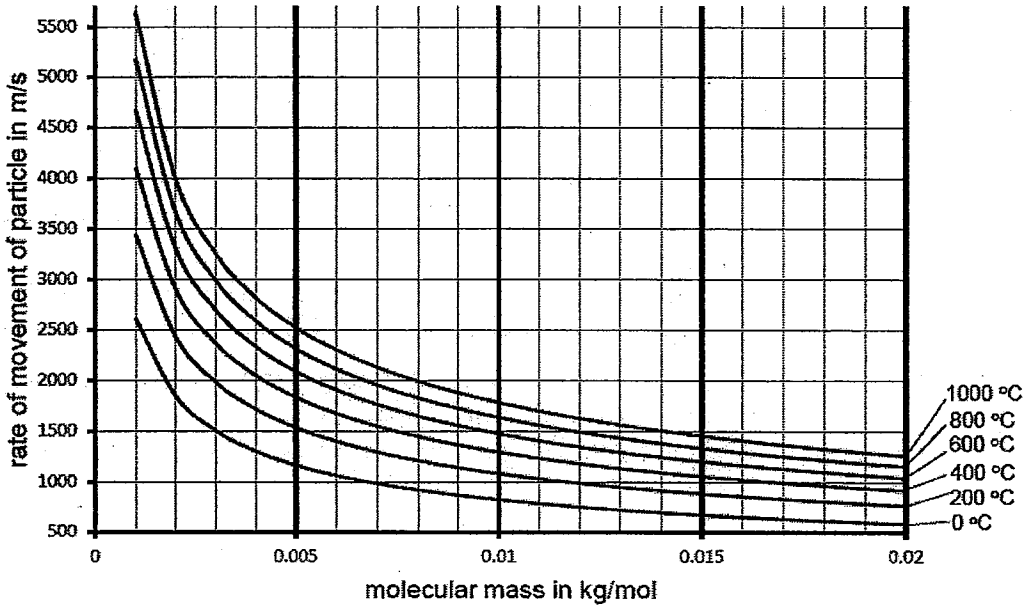
[Total: 5 marks]

Section B

Answer all **three** questions in this section.
The total mark for this section is 30.

The last question is in the form of an **either/or** and **only one** of the alternatives should be attempted.

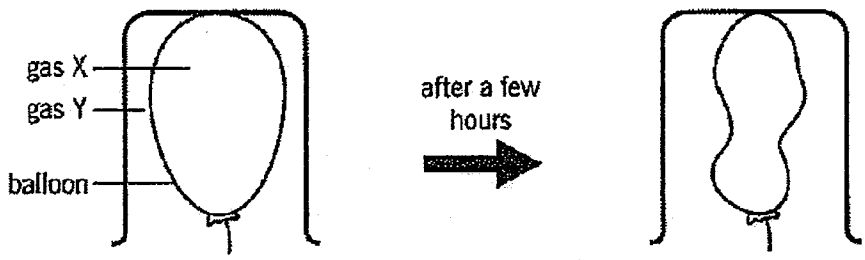
B9 (a) The graphs below show the relationship between the molecular mass of gases and the rate at which the gas particles move through air at different temperatures.



(i) Using information from the graph, describe the trends for the rate of movement of gas particles. [2]

(ii) What is the rate of movement of particle in a gas with molecular mass of 12 g/mol at 800°C? [1]

(b) A balloon filled with gas **X** is placed inside a beaker. The beaker is filled with gas **Y** as shown. After a few hours, the balloon shrinks in size.



Explain why the balloon shrinks in size. [2]

(c) The table below shows the solubility of four gases in water for a range of temperatures.

temperature/ °C	solubility in μmol/dm³			
	hydrogen	oxygen	methane	carbon dioxide
15	15.1	27.6	31.1	821
20	14.6	25.0	28.1	707
25	14.1	22.9	25.2	615
30	13.8	21.2	23.5	541
35	13.5	19.8	21.8	480

where $\mu = 1 \times 10^{-6}$

Nuclear reactions produce a lot of heat and some nuclear reactors make use of water as a coolant.

Using the information from the table, explain how warm water that is pumped out from nuclear reactors will affect the marine life in a river. [2]

(d) Silicon and carbon are Group IV elements. Both silicon and carbon form oxides that have similar chemical formula.

Unlike carbon dioxide, silicon(IV) oxide is not soluble in water.

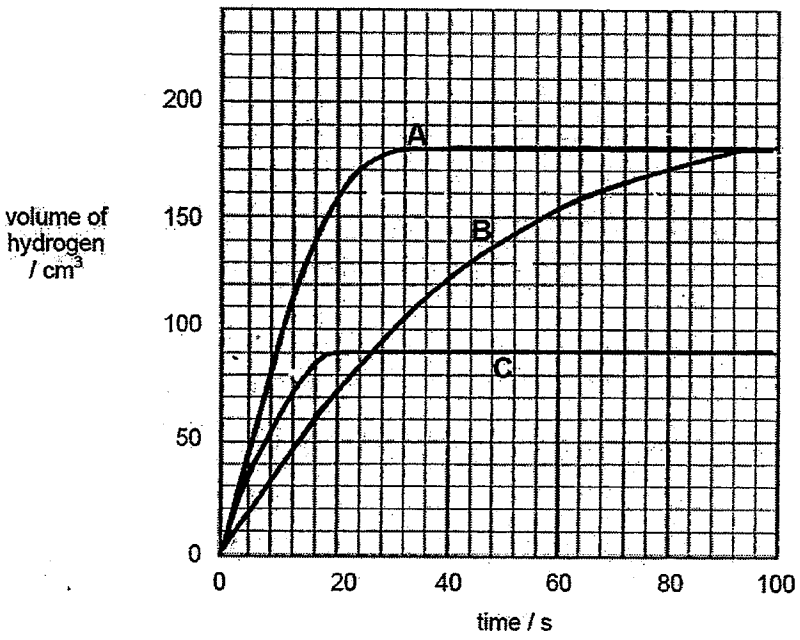
(i) Using the structure of silicon(IV) oxide, explain why it is not soluble in water. [2]

(ii) State a chemical property of silicon(IV) oxide that is similar to that of carbon dioxide. [1]

[Total: 10 marks]

B10 A student carried out two separate reactions between 0.488 g of zinc and two acids, hydrochloric acid and sulfuric acid. The volume and concentration of the acids used were both 20.0 cm^3 and 2.00 mol/dm^3 respectively. The curves **A** and **B** shown in the graph below show the results of the reactions.

He carried out a third reaction **C** with 20.0 cm^3 of a 2.00 mol/dm^3 acid, but forgot to weigh the mass of zinc as well as take note of which acid, hydrochloric acid or sulfuric acid, was used.



(a) With relevant calculations, explain why the same volume of gas was produced for both curve **A** and curve **B**. [3]

(b) Between curve **A** and **B**, identify the curve for the reaction that used sulfuric acid. Explain your choice. [2]

(c) In experiment **C**, identify the acid used and calculate the mass of zinc the student had used. [2]

(d) The student repeated experiment **C** using the same mass of zinc and the same volume and concentration of the acid, but this time, he added in a small amount of copper(II) sulfate crystals to the reaction mixture.

He noted that the effervescence was more vigorous and a brown deposit was formed. The volume of hydrogen collected was slightly less than in experiment **C**.

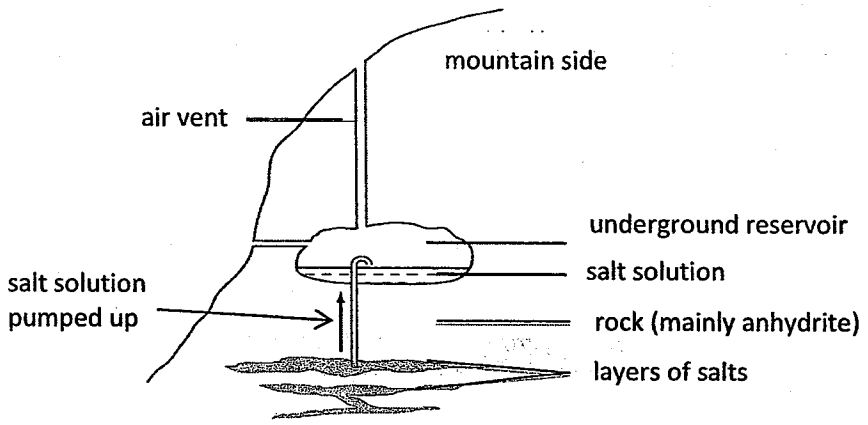
(i) Explain why less hydrogen was collected. [2]

(ii) The student concluded that copper(II) sulfate acted as a catalyst. Comment with a reason whether the student's conclusion is right or wrong. [1]

[Total: 10 marks]

B11 Either

The diagram below shows a salt mine in a mountain. It was found that the layers of salt consist of magnesium chloride and sodium chloride. These salts are dissolved in water from underground springs and then pumped up to a reservoir where it is stored as a solution.



(a) Suggest how the salts are recovered from the salt solution obtained. [1]

(b) Draw a dot and cross diagram to show the bonding in magnesium chloride. Show only the valence electrons. [2]

(c) Magnesium can be extracted from the molten magnesium chloride obtained from the mountain by electrolysis using graphite electrodes. Magnesium formed is tapped off.

(i) Why is the aqueous form of magnesium chloride **not** used for the electrolysis? [1]

(ii) Explain why there is no need to remove the sodium chloride impurity from magnesium chloride before the electrolysis. [1]

(iii) Suggest an advantage of not removing the sodium chloride impurity for the electrolysis of magnesium chloride. [1]

(iv) Write the half equations for the reactions that will occur at the electrodes. [2]

(d) The rock that surrounds the layers of salts is made up mainly of anhydrite. Pure anhydrite has the chemical formula, $CaSO_4$.

(i) Pure anhydrite can be made by reacting calcium hydroxide with sulfuric acid. Write a balanced chemical equation for this reaction. [1]

(ii) The spring water running through the rocks changes anhydrite into gysum ($CaSO_4.2H_2O$). This reaction is exothermic.

Use this information to explain why the temperature of the mine never falls below 17°C even in cold winters. [1]

[Total: 10 marks]

B11 OR

(a) Fertilisers are added to the soil to improve crop yields.

A farmer has the choice of three nitrogenous fertilisers: ammonium nitrate, NH_4NO_3, diammonium hydrogenphosphate, $(NH_4)_2HPO_4$, or urea, $CO(NH_2)_2$.

Show by calculations, which fertilisers provides the most nitrogen nutrient to the crops. [2]

(b) Ammonia, an important chemical in the fertilizer industry, is manufactured by the Haber process. State the optimum conditions for the manufacture of ammonia by the Haber process. [1]

(c) Diammonium hydrogenphosphate, $(NH_4)_2HPO_4$, can be prepared in the laboratory by the reaction between aqueous ammonia and phosphoric acid.

(i) Name the method used to prepare this salt from aqueous ammonia and phosphoric acid and explain why this method is used. [2]

(ii) Give the formulae of **two** other possible salts formed in the reaction between aqueous ammonia and phosphoric acid. [1]

(d) The farmer mixed up two bags of unlabelled fertilisers, one of which contains ammonium nitrate. He decided to test the fertilisers for nitrate ions.

Describe the chemical test for nitrate ions. [2]

(e) (i) Certain bacteria in the soil convert nitrogen gas into ammonium salts. The ionic equation for the conversion is as follows.

$$N_2 + 8H^+ + 6e^- \rightarrow 2NH_4^+$$

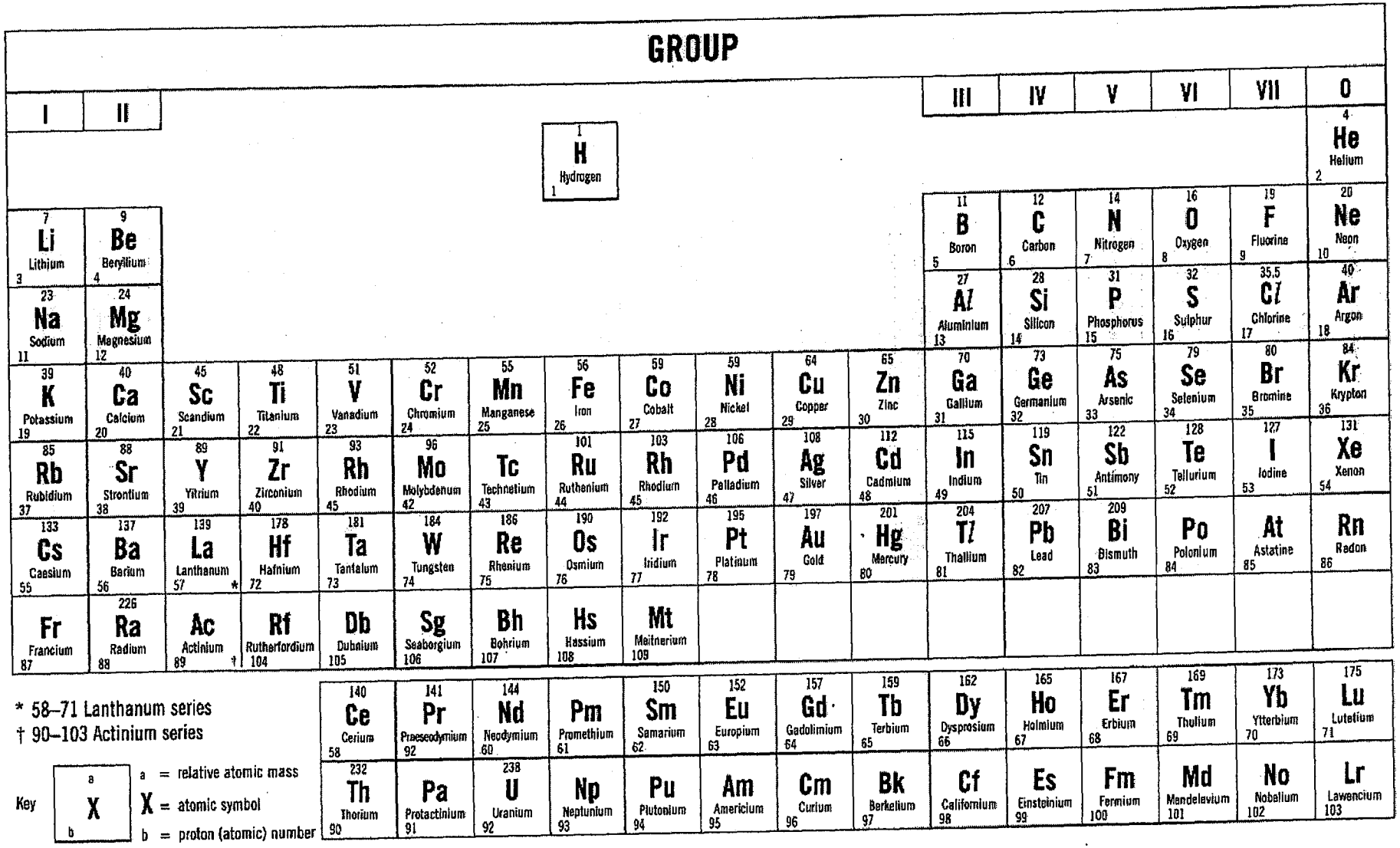
Explain in terms of oxidation states whether the conversion involves oxidation or reduction. [1]

(ii) In a similar reaction, a different type of bacterium converts nitrate ions in the presence of hydrogen ions into nitrogen gas and water.

Write a balanced ionic equation for this reaction. (State symbols are not required) [1]

[Total: 10 marks]

END OF PAPER



The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Anderson Secondary School Chemistry Preliminary Exam 2014

Paper 2 (Marking Scheme)

Section A (50 marks)

A1(a)B [1]

(b) A [1]

(c) D [1]

(d) A and C / D and C [1]

(e) A and D [1]
Both have same number of protons which is two as they have the same relative charge (of 2+). [1]
Both have (different number of neutrons. A has no neutrons while D has 2 neutrons), as shown by their different relative masses. [1]

A2(a)zinc oxide [1]

(b) $2HgO \rightarrow 2Hg + O_2$ [1]

(c) Lead(IV) has undergone thermal decomposition [1]
iron(II) oxide has undergone oxidation [1]

(d) Zinc forms white oxide unlike of iron / mercury / transition elements form coloured oxides/compounds. [1]

Zinc exhibits a fixed oxidation state of +2 / fixed charge of 2+ or +2 in the oxide, instead of variable oxidation states displayed by transition elements / mercury /iron in the oxides/compounds. [1]

A3(a)1,2-dibromoethane [1]

(b) $CH_3CH_3 + 2Br_2 \rightarrow CH_2BrCH_2Br + 2HBr$ [1]

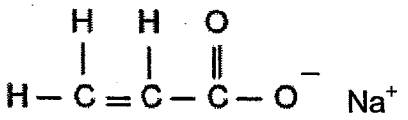
(c) **Method 1** produces only one product . [1]
Method 2 produces a mixture of substituted / organic products. [1]

(d) **Method 1** as it occurs at room conditions / temperature and pressure or does not require uv while **Method 2** requires presence of ultraviolet radiation / uv.
So, **Method 1** is less costly / more energy saving / safer to carry out. [1]

A4(a)(i) Effervescence would be observed only in compound **B.**
Compound **A** is an *alcohol/contains hydroxyl group while **B** is a carboxylic acid/contains (carboxyl group, giving rise to acidic properties).
Hence, only **B** can react with sodium carbonate to liberate carbon dioxide [2]

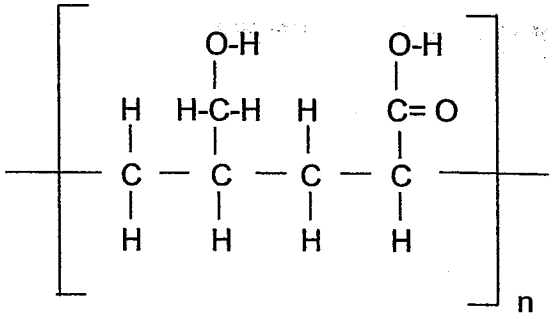
(ii) Water is needed for the dissociation / ionization of **B** or carboxylic acid to produce hydrogen ions / H^+, responsible for acidic properties. [1]

(iii)



[1]

(b)



[1]

(OR – the functional groups can be at adjacent carbon atoms or at the 1st and 4th carbon atoms in the chain)

A5(a)(i) Statement 2
Group I elements have one valence electron which is lost (readily) to form stable ions / to achieve stable noble gas electronic configuration.
Hence, lithium chloride should be ionic in character /contain ions. [2]

(ii) Add acidified silver nitrate /(nitric acid and aqueous silver nitrate) to the solution. [1]
Chloride is present if a white precipitate is formed. (Reject ppt) [1]

(b) [3X1]

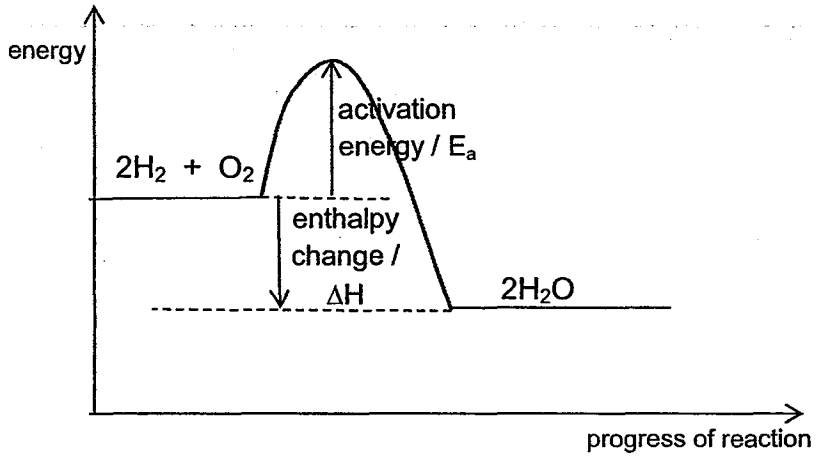
	True	False
Sodium is made by reducing sodium oxide with carbon.		√
Sodium has an oxidation state of +1 in the compound Na_2O_2.	√	
Sodium only conducts electricity when molten.		√

A6(a)Cathode as reduction occurred. [1]

The reaction involves a gain of electrons / oxygen gaining electrons / oxidation state or number of oxygen decreases from 0 (in O_2) to -2 (in OH^-). [1]

(b) $2H_2 + O_2 \rightarrow 2H_2O$ [1]

(c)



[2]

(d) Advantage: Water, the sole product of fuel cell, is harmless to the environment while pollutants (such as soot/carbon monoxide may be produced when coal is incompletely burnt) / (sulphur dioxide emitted as coal contains sulphur as impurities). [1]

Disadvantage: Hydrogen being a gas requires special storage arrangement as it has to be stored under high pressure unlike coal, a solid at room temperature.

[1]

A7(a)(i) $CH_3COOH \rightarrow CO_2 + CH_4$ [1]

(ii) Bonds broken: 3 C-H, 1 C-C, 1 C=O, 1 C-O and 1 O-H
Bonds formed: 2 C=O and 4 C-H

Energy absorbed to break bonds = [(3X413) + 348 + 799 + 358 + 463] kJ
= 3207 KJ

OR $\Delta H_{bond\text{-}breaking}$ = + 3207 kJ

Energy liberated to form bonds = [(2X799) + (4X413)] kJ
= 3250 kJ

OR $\Delta H_{bond\text{-}froming}$ = - 3250 kJ

ΔH = + 3207- 3250 kJ
= - 43 kJ

[2]

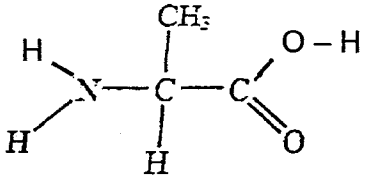
(iii) Methane is a greenhouse gas which traps heat/infrared radiation and will cause global warming / enhanced average global temperature. [1]
This will cause melting of polar ice-caps, leading to rising sea levels and *flooding of low-lying lands. (or other effects)
OR extreme weather such as droughts or typhoons, leading to destruction of crops or habitats/properties. [1]

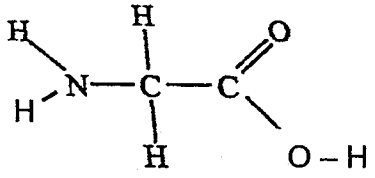
(b) (i) Kerosene is immiscible with water and being less dense than water, oxygen is insoluble in kerosene / it forms a impermeable/non-porous layer **over/on** the water surface, thus preventing the entry of air/oxygen required for the respiration/survival of the larvae. [2]

(ii) Kerosene has a higher boiling point / less volatile than petrol and evaporate more slowly, thus remaining longer on the water surface / less frequent re-spraying is needed. [1]

A8(a)Amide linkage [1]

(b)





[2X1]

(c) Nylon [1]

(d) When the monomers join, simple/small molecules, such as water, are removed. [1]

Section B (30 marks)

B9(a)(i) As the molecular mass of the gas increases, the rate of movement of the particle decreases at a fixed temperature. [1]
As the temperature of the gas increases, the rate of movement of the particles increases for a fixed molecular mass. [1]

(ii) 1500 m/s [1]

(b) Gas **X** is less dense / has lower molecular mass than gas **Y**.
Gas **X** diffuses **faster** out of the balloon than **Y** diffuses into the balloon.
This results in the gas pressure within the balloon to *decrease / lower than atmospheric pressure outside, causing the shrinkage to occur. [2]

(c) From the table, the higher the temperature, the lower the solubility of gases [1]
[OR the lower the solubility of oxygen and carbon dioxide]
Warm water from the nuclear plant pumped into the river would contain less oxygen for the respiration of marine organisms and less carbon dioxide for photosynthesis in plants, thus, destroying marine life. [1]

(d) (i) Silicon(IV) oxide is a macromolecule, consisting of atoms joined by strong covalent bonds in a three dimensional network. [1]
A large amount of energy is required to break the strong covalent bonds.
There is no/little attraction between water molecules and the atoms of silicon(IV) oxide / water molecules cannot surround the atoms . [1]

(ii) Silicon(IV) oxide is an acidic oxide / reacts with alkali to form salt and water only. [1]

B10(a) Solution 1

No. of moles of Zn = 0.488 / 65 = 0.00751

No. of moles of acid = 2.00 X (20/1000) = 0.04

Mole ratio of Zn to HCl = 1 : 1

Mole ratio of Zn to H_2SO_4 = 1 : 2

Hence, Zn is the limiting reactant.

For both reactions, 1 mol of Zn produces 1 mol of H_2, thus same volume of gas were produced in the experiments.

Solution 2

No. of moles of Zn = 0.488 / 65 = 0.00751

No. of moles of acid = 2.00 X (20/1000) = 0.04

From the graph, volume of H_2 produced is 180 cm^3

No. of moles of H_2 produced is (180 / 24000) = 0.0075

No. of mole of H_2 produced = No. of mole of Zn reacted,

Zn is the limiting reactant, producing the same volume of gas in both experiments.

[3]

(b) Curve **A** used sulfuric acid.
Sulfuric acid contains twice the / higher H^+ concentration than hydrochloric acid. Thus, sulfuric acid reacted faster with the zinc, as shown by the steeper gradient of curve **A**. [2]

(c) Acid used in **C** is sulfuric acid.

Volume of hydrogen gas (from graph) = 90 cm^3

No. of moles of hydrogen gas = 90/24000 = 3.75 X 10^{-3}
Mass of zinc = 3.75 X 10^{-3} X 65 g = 0.244 g (to 3 s.f.)

OR Since 0.488 g zinc produced 180 cm^3 of hydrogen gas (from graph),
(0.488 ÷ 2) = 0.244 g of zinc was used.

[2]

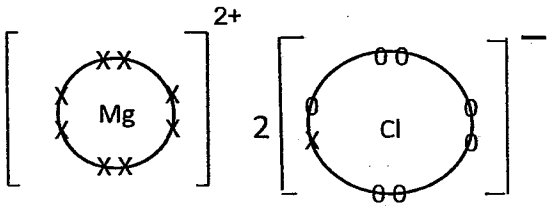
(d) (i) Zinc is more reactive than copper. Some of the zinc is used up to displace copper from the copper(II) sulfate / reacts with copper(II) sulfate to form copper and zinc sulfate.
Hence, less zinc is available to react with the acid to produce hydrogen. [2]

(ii) Wrong
Catalyst is recovered chemically unchanged at the end of the reaction.
Copper(II) sulfate had reacted to form copper. (Allow ECF frong wrong reaction stated in part (i) [1]

B11 Either

(a) Heat / Evaporation to dryness [1]

(b)



Key
X : electron of Mg
0 : electron of Cl

[2]

(c) (i) Aqueous salt contains hydrogen ions / H^+ which will be discharged/reduced preferably to Mg^{2+}, forming hydrogen gas instead of magnesium. [1]

(ii) Mg^{2+} is preferentially discharged/reduced over Na^+ during electrolysis. [1]

(iii) Sodium chloride impurity lowers the melting point of magnesium chloride so less energy will be needed to obtain / maintain the molten salt. [1]

(iv) Cathode: $Mg^{2+}(l) + 2e^- \rightarrow Mg(l)$ [1]

Anode: $2Cl^-(l) \rightarrow Cl_2(g) + 2e^-$ [1]
(Award max of 1 m if electrodes are not specified)

(d) (i) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$ [1]

(ii) The heat liberated by the reaction to the surroundings leads to temperature rise and this prevents the temperature from falling further. [1]

B11 OR

(a)

	NH_4NO_3	$(NH_4)_2HPO_4$	$CO(NH_2)_2$
% N by mass	(28/80) X100 % = 35.0 %	(28/132) X 100 % = 21,2 %	(28/60) X 100 % = 46.7 %

(Working must be shown. Deduct max of ½ m for no 3 s.f.)
Urea / $CO(NH_2)_2$ provides the most nitrogen. [2]

(b) Conditions: 450°C, 250 atm and iron as catalyst [1]

(c) (i) Titration because the salt and the starting materials are soluble (in water). Using indicator, the exact volumes of acid and alkali needed for complete neutralization can be determined. Hence a pure salt can be obtained. [2]

(ii) $NH_4H_2PO_4$ and $(NH_4)_3PO_4$ [1]

(d) Add aqueous sodium hydroxide and aluminium to the fertilizer. [1]

On warming, ammonia gas which turns damp red litmus paper blue will be liberated if nitrate ion is present. [1]

(e) (i) Reduction occurs because oxidation state of nitrogen decreases from 0 (in N_2) to -3 (in NH_4^+). (Award ½ m if oxidation states are stated without the substances) [1]

(ii) $2NO_3^- + 12H^+ + 10e^- \rightarrow N_2 + 6H_2O$ [1]