Register No.	Class

Name ______________________________

BENDEMEER SECONDARY SCHOOL
2018 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (PHYSICS, CHEMISTRY) PAPER 1
5076/01

DATE : 29th August 2018
DURATION : 1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the work you hand in.
Do not use paper clips, glue or correction fluid.

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 2B pencil on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

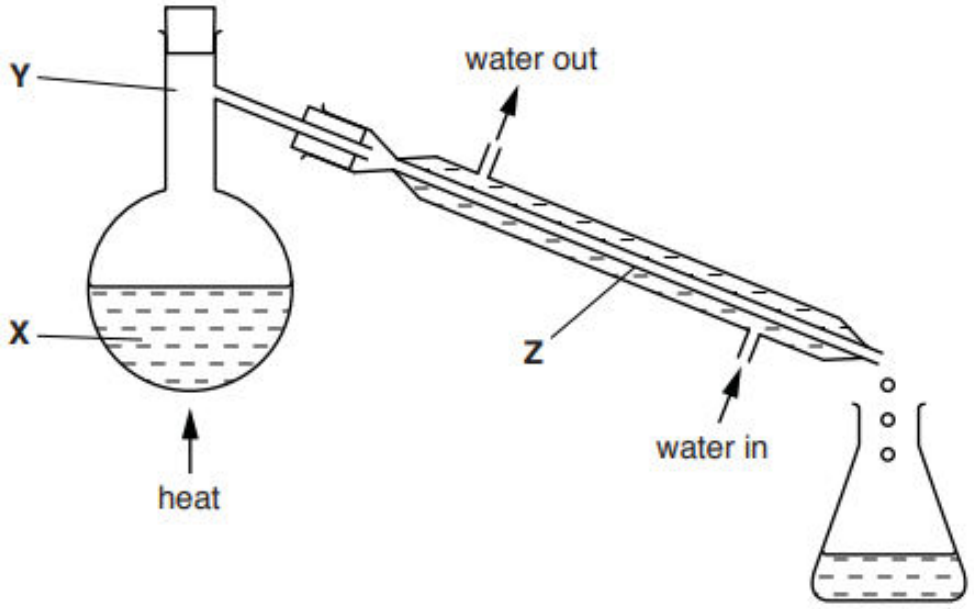
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Data Sheet is printed on page 20.
A copy of the Periodic Table is printed on page 21.
The use of an approved scientific calculator is expected, where appropriate.

/ 40

This document consists of **21** printed pages.

[Turn over

21 The diagram shows the apparatus used to distil seawater.

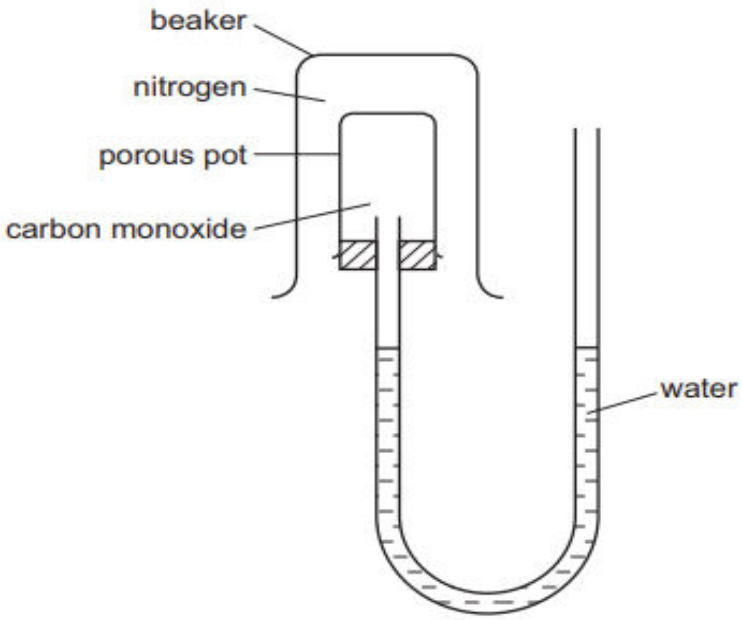


While water is being collected, at which point(s) is the temperature 100°C?

A X **B** Y **C** X and Z **D** X,Y and Z

[Turn over

22 Gases can diffuse through porous pots. The diagram shows a beaker full of nitrogen inverted over a porous pot containing carbon monoxide.



The water level does not move.

Which statement explains this?

A Both gases have two atoms in a molecule.

B Neither gas is soluble in water.

C Nitrogen is almost inert.

D The two gases have equal molecular masses.

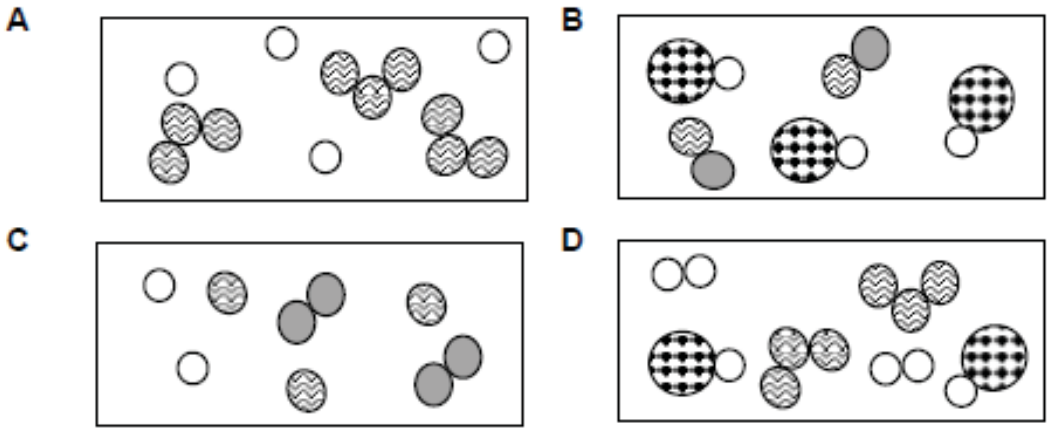
23 Which statement(s) best explain(s) that air is a mixture, not a compound?

I Air does not have a fixed composition.
II It is a colourless and odourless gas.
III It is made up of more than two elements.
IV The gases making up air can be separated by fractional distillation.

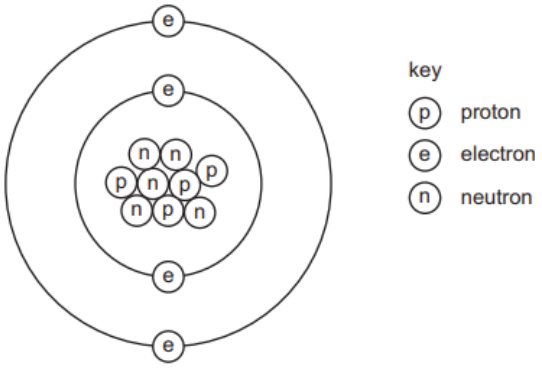
A I only **B** II only **C** I and IV **D** III and IV

[Turn over

24 Which diagram correctly represents a mixture of element(s) and compound(s)?



25 The diagram shows the atomic structure of an element X.



What is X?

A aluminium

B beryllium

C boron

D fluorine

26 What happens when a bond is formed between a green gaseous element and a soft metallic element?

A The gaseous atoms gain an electron.

B The gaseous atoms lose an electron.

C The metal atoms gain an electron.

D The two elements share a pair of electrons.

[Turn over

27 Which salt can be prepared by an acid-alkali titration method?

A aluminium carbonate

B ammonium chloride

C calcium nitrate

D iron(II) sulfate

28 The oxide of element X dissolves in water to form a solution which when tested with Universal Indicator paper gives a pH of 14. The oxide does not react with potassium hydroxide. Where is X mostly likely to be found in the Periodic Table?

A Group I

B Group VI

C Group VII

D Group 0

29 25 cm^3 of 0.1 mol / dm^3 hydrochloric acid exactly neutralise 20 cm^3 of aqueous sodium hydroxide. The equation for this reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

What is the concentration of the sodium hydroxide solution?

A 0.080 mol / dm^3

B 0.125 mol / dm^3

C 0.800 mol / dm^3

D 1.250 mol / dm^3

[Turn over

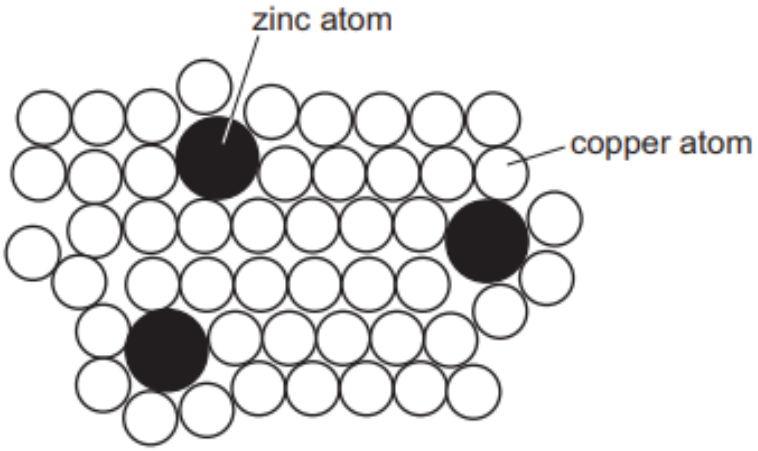
30 W, X and Y are metals, one of which is copper and one of which is iron.

- W has a coloured oxide which can be reduced by carbon.
- X has a black oxide and is also found in nature as a pure metal.
- Y has an oxide which cannot be reduced by carbon.

Which metal is the most reactive and what is the possible identity of W?

	most reactive metal	possible identity of W
A	X	Cu
B	X	Fe
C	Y	Cu
D	Y	Fe

31 The diagram shows the structure of brass.



Why is brass harder than pure copper?

A The zinc atoms form strong covalent bonds with copper atoms.

B The zinc atoms have more electrons than the copper atoms.

C The zinc atoms prevent the 'sea of electrons' from moving freely in the solid.

D The zinc atoms prevent the layers of copper atoms from sliding over each other.

[Turn over

32 The following statements are about elements in the Periodic Table.

I Their atoms have a full outer shell of electrons.
II They are found in Group 0.
III They are present in small quantities in the air.
IV They form basic oxides.

Which statements are correct for the noble gases?

A I, II and III **B** I, II and IV **C** I, III and IV **D** II, III and IV

33 The labels on two bottles fell off. One bottle was known to contain sodium chloride solution and the other bottle contained sodium nitrate solution.

Which test would most likely identify the solutions?

A addition of aqueous ammonia

B addition of aqueous silver nitrate

C addition of blue litmus paper

D addition of dilute sulfuric acid

34 Which reagent when reacted with ammonium sulfate, liberates ammonia?

A acidified potassium dichromate(VI)

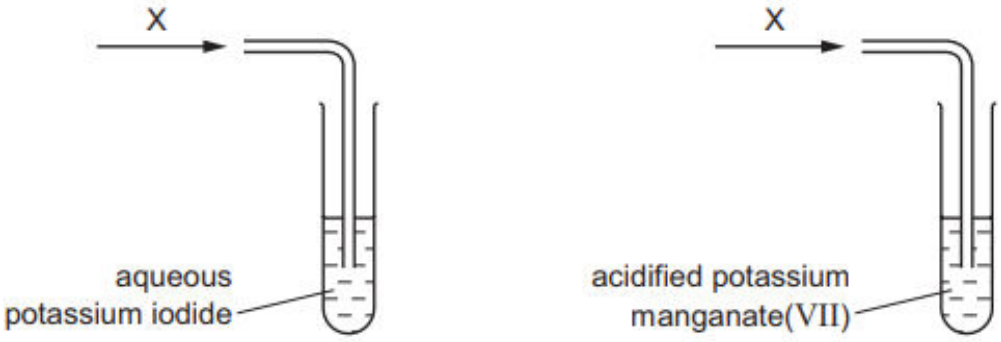
B aqueous bromine

C dilute hydrochloric acid

D limewater

[Turn over

35 Gaseous compound X is an oxidising agent. X is bubbled through separate solutions of aqueous potassium iodide and acidified potassium manganate(VII).



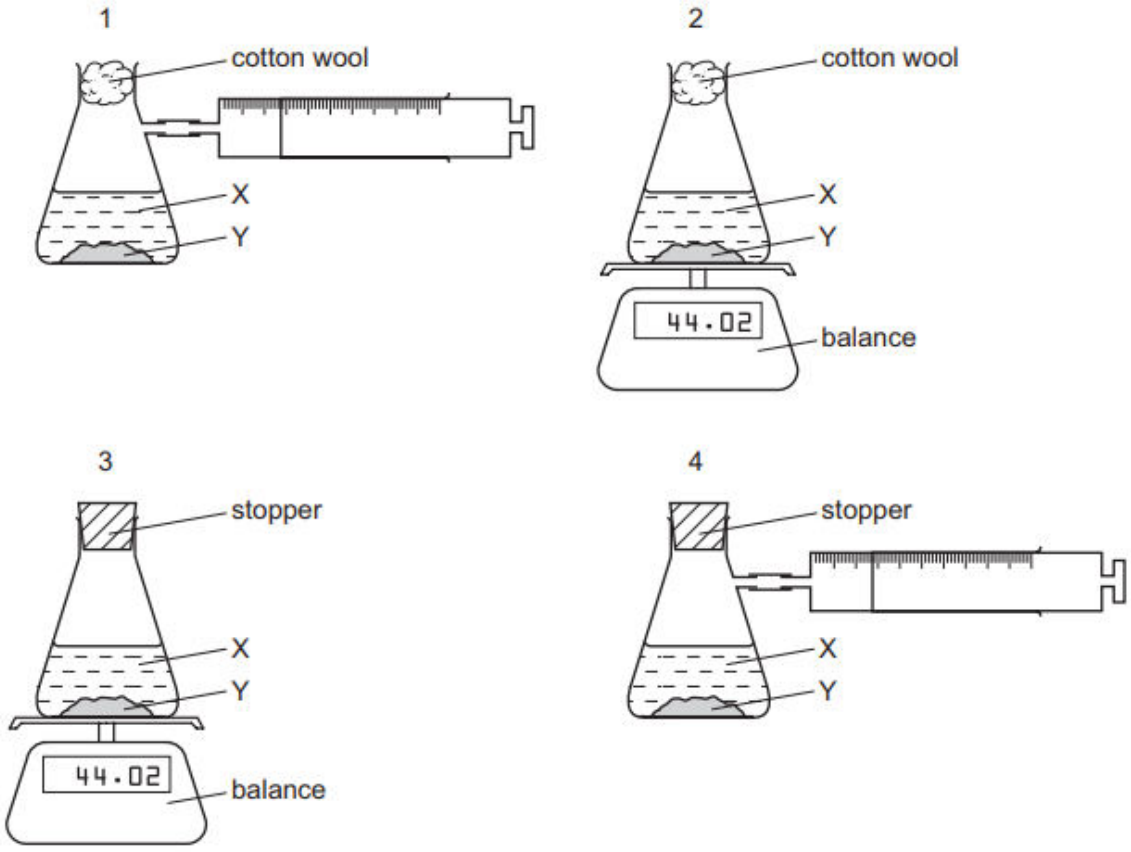
Which row shows the colour changes when X is bubbled through these two solutions?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	brown to colourless	no change
B	brown to colourless	purple to colourless
C	colourless to brown	no change
D	colourless to brown	purple to colourless

[Turn over

36 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the rate (speed) of the reaction?



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

37 A thermometer is placed in water and the temperature is measured to be 43.0 °C. An endothermic change takes place as a solid is dissolved in the water. The temperature changes by 4.5 °C.

What is the thermometer reading now?

A 38 °C **B** 38.5 °C **C** 47 °C **D** 47.5 °C

[Turn over

38 A new planet has been discovered and its atmosphere has been analysed.

The table shows the composition of its atmosphere.

gas	percentage by volume / %
carbon dioxide	4
nitrogen	72
oxygen	24

Which gases present in the atmosphere of the new planet are in a higher percentage than they are in the Earth's atmosphere?

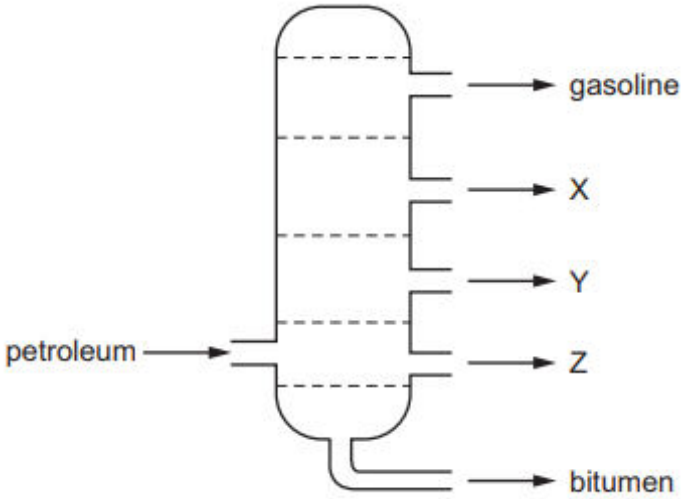
A carbon dioxide and nitrogen

B carbon dioxide and oxygen

C carbon dioxide, nitrogen and oxygen

D nitrogen and oxygen

39 The diagram shows the separation of petroleum into fractions.

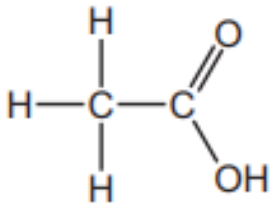


What could X, Y and Z represent?

	X	Y	Z
A	diesel oil	lubricating fraction	paraffin
B	lubricating fraction	diesel oil	paraffin
C	paraffin	lubricating fraction	diesel oil
D	paraffin	diesel oil	lubricating fraction

[Turn over

40 The diagram shows a molecule of an organic compound W.



Which statement is not correct?

A A solution of W in water has a pH greater than 7.

B A solution of W in water reacts with sodium hydroxide solution.

C When copper(II) carbonate is added to a solution of W, a gas is produced.

D When magnesium is added to a solution of W, a gas is produced.

[Turn over

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

[Turn over

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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

Register No.	Class

Name _____

BENDEMEER SECONDARY SCHOOL
2018 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY) PAPER 3
5076/03, 5078/03

DATE : 20th August 2018
DURATION : 1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
You may use a 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.

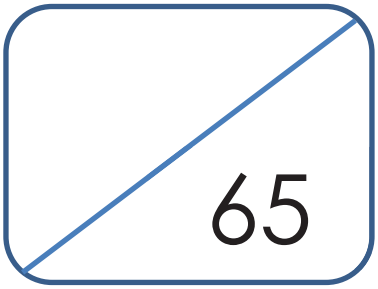
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 14.
A copy of the Periodic Table is printed on page 15.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.



This document consists of **15** printed pages.

[Turn over]

Section A

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

1 The structures of some substances containing chlorine are shown in Fig. 1.1.

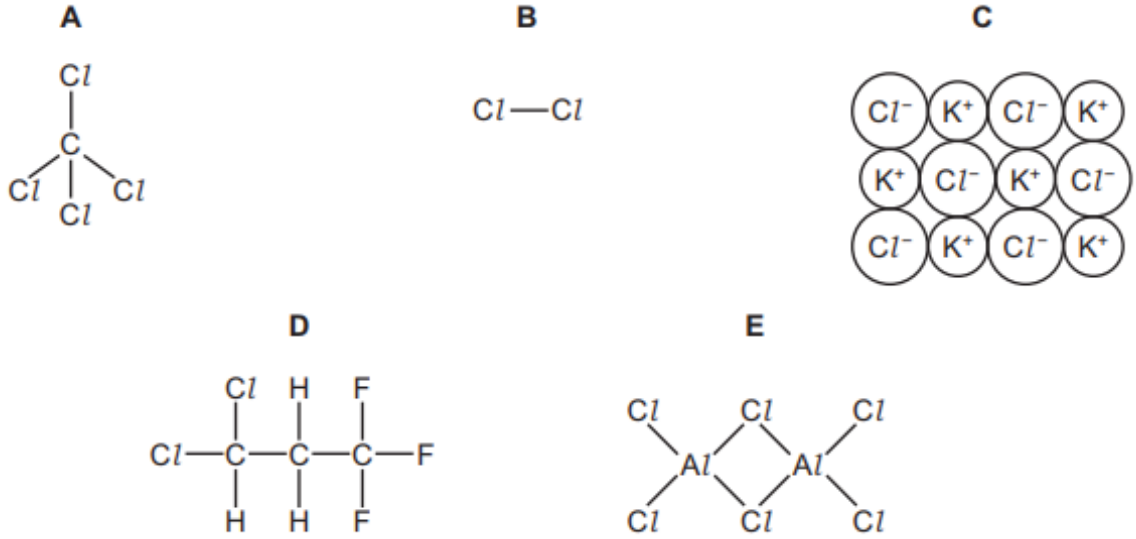


Fig. 1.1

Answer the following questions about these substances. Each of these letters A to E can be used once, more than once or not at all.

(a) Which substance conducts electricity in molten or aqueous state only?

…… [1]

(b) Which substance is a diatomic molecule?

…… [1]

(c) Which substance is an element?

Explain your answer.

……

…… [2]

(d) Which substance is the product of substitution of methane?

…… [1]

[Turn over]

2 Table 2.1 gives the composition of three particles.

Table 2.1

particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

(a) What is the evidence in Table 2.1 for each of the following?

(i) Particle A is an atom.

……..

…….. [1]

(ii) A, B and C are all particles of the same element.

……..

…….. [1]

(iii) Particles A and C are isotopes of the same element.

……..

……..

…….. [2]

(b) **(i)** What is the electronic structure of particle C?

…….. [1]

(ii) Is element C a metal or a non-metal? Give a reason for your choice.

……..

…….. [1]

[Turn over]

3 Coal-burning power stations generate a large amount of heat from the combustion of coal to convert steam which in turn drives turbine generators to produce electricity. Flue gas that is produced contains sulfur dioxide and oxides of nitrogen. These two gases cause acid rain.

(a) Oxides of nitrogen generally consist of a mixture of nitrogen monoxide and nitrogen dioxide. In flue gas, nitrogen monoxide is the main component in the oxides of nitrogen produced.

Explain how nitrogen monoxide causes acid rain even though it is a neutral oxide.

……

……

…… [2]

(b) Acid rain impacts farming greatly as it often causes the soil to be overly acidic and results in leaching of nutrients. In order to alleviate the effects of acid rain, a farmer has been advised to treat the soil to reduce the acidity.

Table 3.1 gives the solubility of some calcium compounds.

Table 3.1

	calcium hydroxide	calcium oxide	calcium carbonate
solubility in water (g per 100 ml of water)	0.173	immediately reacts with water on contact to form an alkaline solution	6.17×10^{-4}

Using the information in Table 3.1, suggest why calcium carbonate is less effective at reducing acidity than calcium hydroxide and calcium oxide.

……..

……..

…….. [2]

(c) Another source of oxides of nitrogen is from car engines.

Explain how the oxides of nitrogen are formed in car engines.

……..

……..

…….. [2]

[Turn over]

(d) Besides acid rain, name two other harmful effects of oxides of nitrogen and sulfur dioxide.

……..

…….. [2]

4 Soluble salts can be made by using a base and an acid.

(a) Complete this method of preparing dry crystals of the soluble salt cobalt(II) chloride from the insoluble base cobalt(II) carbonate.

step 1
Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

step 2

……

step 3

……

step 4

……

step 5

…… [3]

(b) 5.95 g of solid cobalt(II) carbonate is added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3.

(i) Write a balanced chemical equation, including state symbols, for the above reaction.

…… [2]

(ii) Show that the cobalt(II) carbonate is added in excess.

[3]

5 The reactivity of different metal oxides was compared by heating them with metals in a crucible. This is shown in Fig. 5.1.

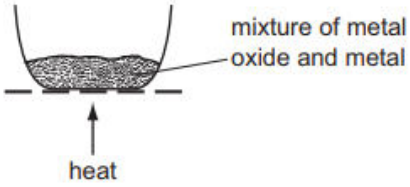


Fig. 5.1

The results are shown in Table 5.2.

Table 5.2

mixture	observations
iron(III) oxide + metal X	reacts
lead(II) oxide + iron	reacts
magnesium oxide + metal X	no reaction

(a) Use the results in Table 5.2 to suggest the order of reactivity of the metals iron, lead, magnesium and X, starting with the most reactive metal.

……... [1]

(b) Predict whether iron will react with zinc oxide.

Explain your answer.

……... [1]

(c) Write down two observations when lead(II) oxide reacts with iron.

……...

……... [2]

(d) In the mixture, iron(III) oxide reacts with metal X.

Which element is reduced in the reaction? Use ideas about oxidation state to explain your answer.

……...

……... [2]

[Turn over]

6 Fig. 6.1 shows how the ions present in solution A are separated.

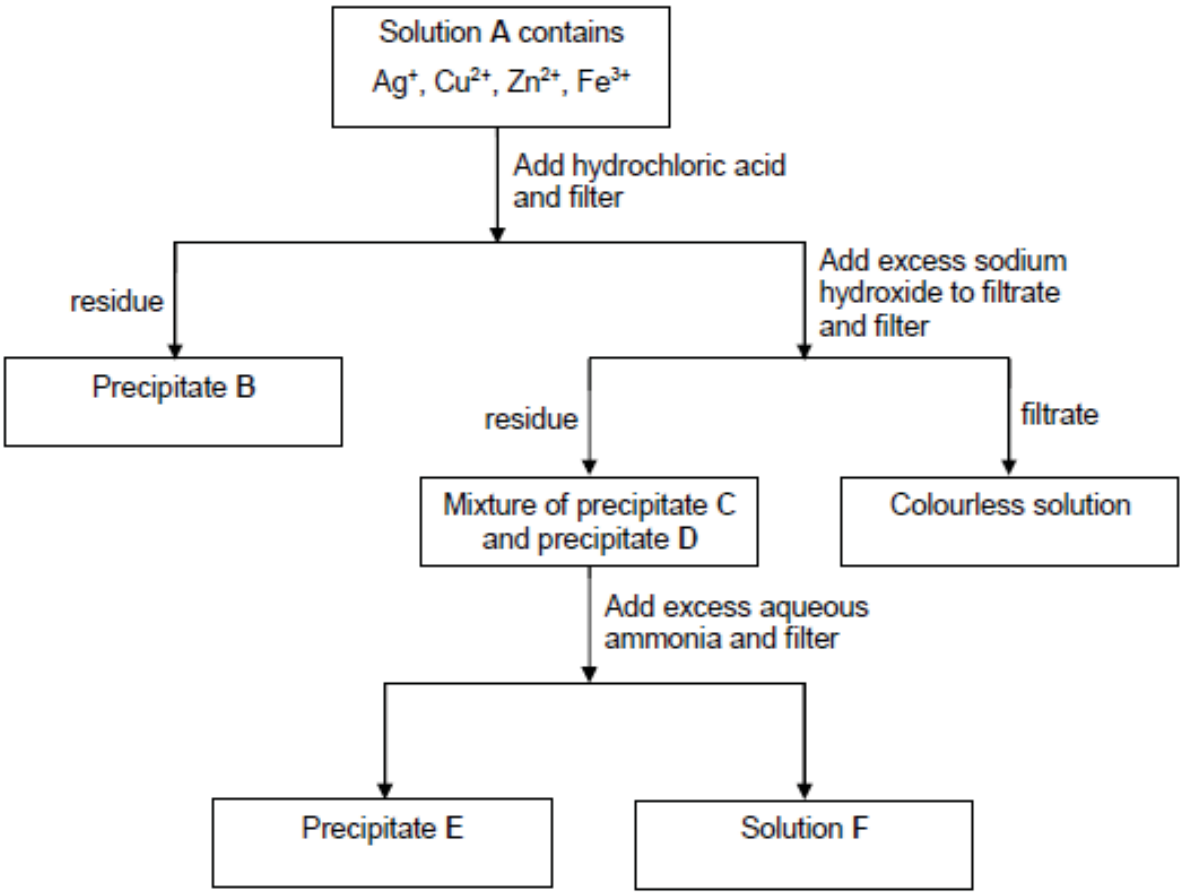


Fig. 6.1

(a) **(i)** It is known that solution A contains one anion. Suggest the identity of this anion. Give a reason for your answer.

……

……

…… [2]

(ii) Describe a test to confirm the anion named in **(a)(i).**

……

…… [1]

(b) Suggest the identity of substances B and C.

B ……..

C …….. [2]

[Turn over]

(c) Describe the movement and arrangement of particles in precipitate E which has been dried.

……

……

…… [2]

7 Fig. 7.1 shows a molecule of cyclohexane, C_6H_{12}, which is a cycloalkane and a saturated hydrocarbon. Cycloalkanes react in a similar way to alkanes.

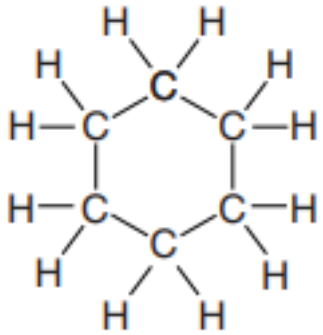


Fig. 7.1

(a) **(i)** Define the term saturated.

…… [1]

(ii) Define the term hydrocarbon.

……

…… [1]

(b) Construct the equation for the complete combustion of cyclohexane.

…… [1]

(c) Cyclohexane reacts with chlorine in the presence of ultraviolet light. This is a substitution reaction. Write the molecular formulae of two products of this reaction.

…… [2]

[Turn over]

Section B

Answer **any two** questions in this section.
Write your answer in the spaces provided.

8 Metals undergo different chemical reactions to produce different products.

(a) The rate of reaction between a metal and an acid is investigated.

A piece of zinc foil is added to 50 cm^3 of hydrochloric acid, of concentration 2.0 mol / dm^3. The acid is in excess. The hydrogen evolved is collected in the gas syringe and its volume measured every minute. The results are plotted and labelled as graph 1. This is shown in Fig. 8.1.

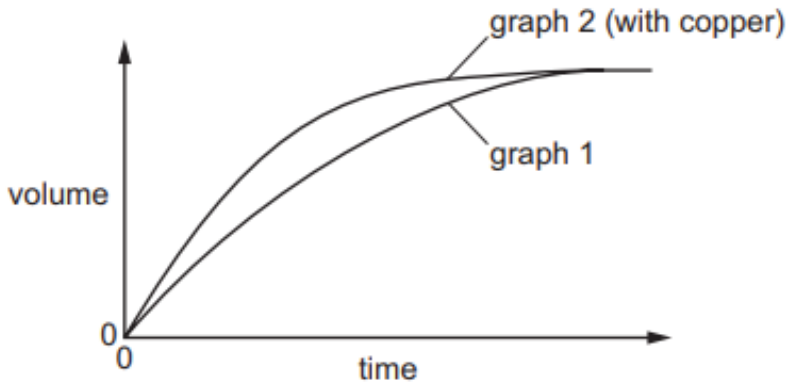


Fig. 8.1

The experiment is repeated to show that the reaction between zinc metal and hydrochloric acid is catalysed by copper. A small volume of aqueous copper(II) chloride is added to the acid before the zinc is added. The results of this experiment are plotted on the same grid and labelled as graph 2 in Fig. 8.1.

(a) **(i)** Explain why the reaction mixture in the second experiment contains copper metal. Include an equation in your explanation.

……

……

…… [2]

[Turn over]

(ii) If the first experiment is repeated using ethanoic acid, CH_3COOH, instead of hydrochloric acid, explain how and why the graph would be different from graph 1. Indicate the speed of this reaction on Fig. 8.1 and label it as graph 3.

……

……

…… [3]

(b) When lithium reacts with water, it moves about on the surface of the water. Bubbles are seen and the lithium disappears slowly.

Predict how the reaction of potassium with water compares with the reaction of lithium with water.

In your answer, include

- any three differences in observations,
- the names of the products formed when lithium and potassium react with water.

……

……

……

……

……

…… [5]

9 In the laboratory, scientists are always doing research and conducting experiments to make useful products for mankind.

(a) One such useful product is phosphine, PH_3, which is used as a fumigant. It has the smell of garlic and is effective in pest control.

(i) Predict two physical properties of phosphine at room conditions.

Explain your answer.

……..

……..

……..

……..

……..

…….. [5]

(ii) Draw the electronic structure of phosphine. Show outer electrons only.

[2]

(b) Scientists also make margarine from vegetable oils. List the conditions and explain how vegetable oils are used to make margarine for use in foods.

……

……

……

……

…… [3]

[Turn over]

10 Thermal decomposition of compounds breaks them down into smaller substances when sufficient heat is applied.

(a) Air bags are used to protect passengers in a car during an accident. When the crash sensor detects an impact, it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag. This is shown in Fig. 10.1.

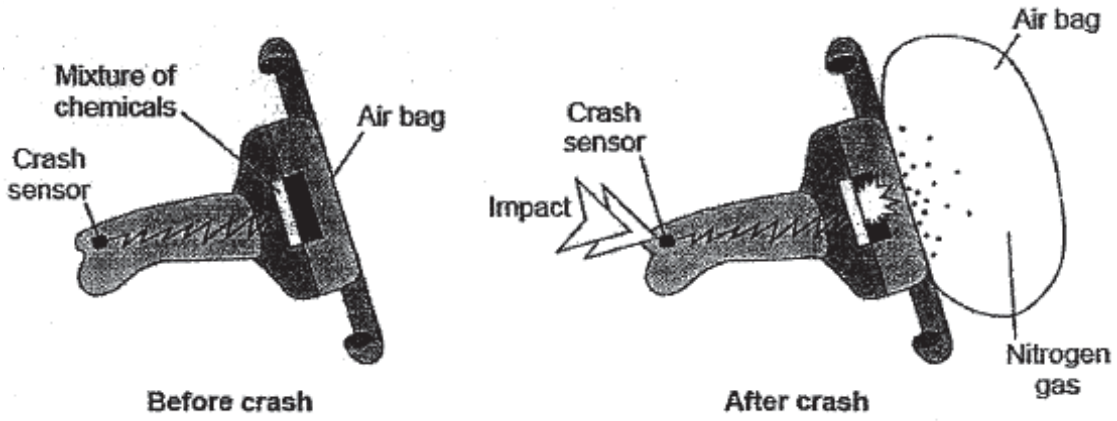


Fig. 10.1

The mixture of chemicals contains solid sodium azide, NaN_3 which decomposes to form sodium and nitrogen as follows.

…… NaN_3 (…….) → ……Na (…….) + …..N_2 (…….)

(i) Balance the chemical equation and complete the state symbols in the chemical equation above. [2]

(ii) Draw the electronic structure of nitrogen gas. Show outer electrons only.

[2]

[Turn over]

(iii) An air bag consists of 130 g of sodium azide. When the sodium azide decomposed, 60 dm^3 of nitrogen was obtained at room temperature and pressure.

Show, using calculations, if the thermal decomposition of sodium azide has been efficient in producing nitrogen to fill up the air bag.

[3]

(b) A student used the apparatus in Fig. 10.2 to investigate what happens when liquid paraffin is heated to a high temperature.

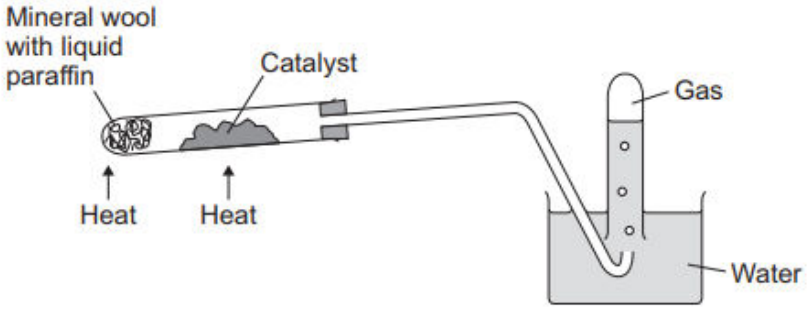


Fig. 10.2

Liquid paraffin contains alkanes. The most abundant alkane has a chemical formula of $C_{20}H_{42}$.

Name the reaction shown in Fig. 10.2. Describe, with the aid of a chemical equation, what happens to the alkane molecules in the reaction.

……

……

……

…… [3]

END OF PAPER

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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

Prelim Exam 2018
4E/5N Sc(Chem)
Marking Scheme

Section A [1 mark each; 20 marks total]

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

11	12	13	14	15	16	17	18	19	20
D	A	B	D	C	D	B	B	D	A

Section B [45 marks total]

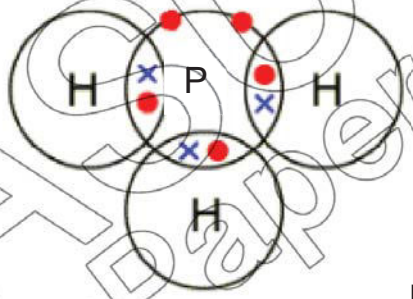
1	**(a)**	C	[1]
	(b)	B	[1]
	(c)	B [1] It has only one type of atom. [1]	[2]
	(d)	A	[1]
2	**(a)**	**(i)** It has the same number of protons and electrons; 15 each.	[1]
		(ii) All have the same number of protons (15) / same proton number / same atomic number	[1]
		(iii) same number of protons (15) / same proton number / same atomic number [1]; Different number of neutrons / different nucleon number / different mass number [1]	[2]
	(b)	**(i)** 2.8.5 / 2,8,5 [1] **(ii)** non-metal because it accepts electrons / needs 3 electrons to complete valence electron shell / because it is in Group V or 5 electrons in valence shell [1] Note: need both non-metal and reason for one mark	[2]

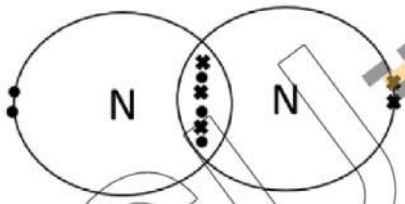
3	**(a)**	NO will be oxidised by oxygen in air to form nitrogen dioxide. [1] Nitrogen dioxide will then dissolve in rainwater to form nitric acid which caused acid rain. [1]	[2]
	(b)	Calcium carbonate is very much less soluble than calcium hydroxide and calcium oxide. [1] Thus, $CaCO_3$ reacts slowly with acid / effective only in reducing acidity of soil / surface in contact / cannot penetrate soil to neutralize acid deeper down. [1]	[2]
	(c)	The high temperatures of the car engines causes[1] nitrogen in the air to react with oxygen in the air producing oxides of nitrogen. [1]	[2]
	(d)	➢ irritates the eyes and lungs and cause breathing difficulties [1] ➢ high levels lead to inflammation of the lungs (bronchitis) [1]	[2]
4	**(a)**	Step 2 Filter to remove excess cobalt(II) carbonate; [1] Step 3 Heat the filtrate till saturation; [1] Step 4 Cool to allow crystals to form; [0.5] Step 5 Rinse crystals with a little distilled water to remove impurities and dry between sheets of filter paper; [0.5]	[3]
	(b)	**(i)** $CoCO_3$ (s) + 2HCl (aq) → $CoCl_2$ (aq) + CO_2 (g) + H_2O (l) State symbols [1]; balanced chemical equation [1]	[2]
		(ii) no of moles of HCl = cv = 2 * (40/1000) = 0.08 mol [1] Mole ratio $CoCO_3$: HCl Fm eqn 1 : 2 Fm data 0.04 : 0.08 [1] Mass of $CoCO_3$ = mol * molar mass = 0.04 * (59+12+48) = 0.04 * 119 = 4.76 g [1] 4.76 g of $CoCO_3$ needed but 5.95 g was used. Hence, $CoCO_3$ was in excess.	[3]

5	**(a)**	magnesium → X → iron → lead / Mg > X > Fe > Pb	[1]
	(b)	no / it will not react **and** zinc is more reactive / iron is less reactive; [1] ignore: zinc is reactive / iron is unreactive	[1]
	(c)	A greenish ppt/solid [1] and a grey/silver solid are formed. [1]	[2]
	(d)	Iron is reduced.[1] The oxidation state of iron decreases from +3 in iron(III) oxide to 0 in iron. [1]	[2]
6	**(a)**	**(i)** Nitrate [1] All nitrates are soluble. [1] or Sulfate [1] All Ag^+, Cu^{2+}, Zn^{2+} and Fe^{3+} sulfates are soluble. [1]	[2]
		(ii) Add sodium hydroxide, aluminium foil and warm. [0.5] Gas produced turns moist red litmus paper blue. [0.5] or Add barium nitrate / barium chloride. [0.5] A white precipitate is seen. [0.5]	[1]
	(b)	B: silver chloride / AgCl [1] C: copper(II) hydroxide / $Cu(OH)_2$ / iron(II) hydroxide / $Fe(OH)_2$ [1]	[2]
	(c)	The particles are in solid state. They vibrate at their fixed positions. [1] They are closely packed in a orderly manner. [1]	[2]
7	**(a)**	**(i)** Contains only carbon-carbon single bonds	[1]
		(ii) Contains only carbon and hydrogen atoms	[1]
	(b)	$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$	[1]
	(c)	HCl (1) $C_6H_{11}Cl$ (1)	[2]

Section C (20 marks)

8	**(a)**	**(i)** zinc displaces copper / zinc more reactive than copper; [1] $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$ / $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$; [1] **(ii)** less steep (line) or lower gradient / (because of) decreased rate; [1] ethanoic is a weak(er) acid / only partially ionised / dissociated / lower concentration of hydrogen ions; [1]; graph 3 is below graph 1 and ends at the same volume as graph 1 [1]	[5]
	(b)	3 marks from any 3 differences in observations e.g. • more bubbles with K; • it /K moves faster (on water surface); • Li does not catch fire/K catches fire/K bursts into flame; • it /K fizzes more than Li; • it /K disappears rapidly; • K explodes / lithium does not explode; • K melts / ball with K/ lithium does not melt/ does not go into ball [3] Products: lithium hydroxide [0.5] potassium hydroxide; [0.5] hydrogen/H_2 [1]	[5]

9	(a)	**(i)** Phosphine is a liquid / gas at room condition [1] It is made up of 2 non-metals [1] which will form a covalent compound which is a liquid / gas at room conditions. [1] / Phosphine has low melting and boiling points [1] It is a simple covalent molecule [1] with weak intermolecular forces of attraction. Hence little energy is needed to overcome them. [1] / Phosphine does not conduct electricity in any state [1] It has no mobile ions [1]or mobile electrons to carry the current to conduct electricity. [1] Any 2 points with explanations maximum [5]	[5]
		(ii)  [1] for P, [1] for H	[2]
	(b)	react with hydrogen or hydrogenation [1] in the presence of a nickel catalyst at 60 °C (allow 50-200 °C) [1] because vegetable oils are unsaturated or have carbon-carbon double bonds (vegetable oils are hardened) to make them solid at room temperature or to make them useful as spreads/spreadable [1]	[3]

10	**(a)**	**(i)** 2, 2, 3 [1] (s), (s), (g) [1]	[2]
		(ii)  [1] for 3 pairs of bonds, [1] for 2 unshared electrons per N atom	[2]
		(iii) Mole of NaN_3 = mass / molar mass = 130 / (23+ (14*3)) = 2 [1] Mole ratio NaN_3 : N_2 Fm eqn 2 : 3 Fm data 2 : 3 [0.5] Vol of N_2 = mol x 24 = 3 * 24 = 72 dm^3 [1] It was not efficient as only 60 dm^3 of N_2 was produced. [0.5]	[3]
	(b)	Cracking [1] Big alkane → smaller alkanes + smaller alkene (+ hydrogen) $C_{20}H_{42}$ → $C_{12}H_{26}$ + C_8H_{16} (any appropriate balanced equation) [1] It undergoes cracking to produce small(er) molecules / alkanes hydrocarbons and alkenes or a named alkene [1]	[3]

Prelim Exam 2018
4E/5N Sc(Chem)
Marking Scheme

Section B [45 marks total]

				Marker's Comments
1	**(a)**	C	[1]	
	(b)	B	[1]	
	(c)	B [1] It has only one type of atom. [1]	[2]	
	(d)	A	[1]	
2	**(a)**	**(i)** It has the same number of protons and electrons; 15 each.	[1]	
		(ii) All have the same number of protons (15) / same proton number / same atomic number	[1]	
		(iii) same number of protons (15) / same proton number / same atomic number [1]; Different number of neutrons / different nucleon number / different mass number [1]	[2]	
	(b)	**(i)** 2.8.5 / 2,8,5 [1] **(ii)** non-metal because it accepts electrons / needs 3 electrons to complete valence electron shell / because it is in Group V or 5 electrons in valence shell [1] Note: need both non-metal and reason for one mark	[2]	

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	(c)	The high temperatures of the car engines causes[1] nitrogen in the air to react with oxygen in the air producing oxides of nitrogen. [1]	[2]	
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5	**(a)**	magnesium → X → iron → lead / Mg > X > Fe > Pb	[1]	
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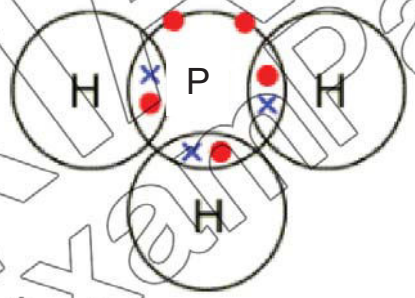
		(ii)  [1] for P, [1] for H	[2]	

	(b)	react with hydrogen or hydrogenation [1] in the presence of a nickel catalyst at 60 ^{o}C (allow 50-200 ^{o}C) [1] because vegetable oils are unsaturated or have carbon-carbon double bonds (vegetable oils are hardened) to make them solid at room temperature or to make them useful as spreads/spreadable [1]	[3]	
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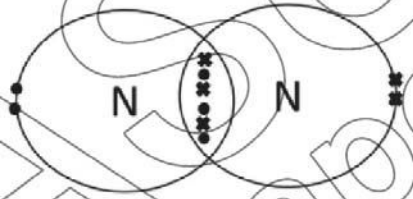
		(ii)  [1] for 3 pairs of bonds, [1] for 2 unshared electrons per N atom	[2]	
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