Class | Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
Preliminary Examination 2019
Secondary 4 Express & 5 Normal (Academic)

SCIENCE CHEMISTRY/BIOLOGY **5078/01**
Paper 1 **19 September 2019**
1 hour

Additional Materials:
Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

Write in soft pencil.

Do not use staples, paper clips, highlighters, 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 **soft pencil** on the separate Answer Sheet.

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 Data Sheet is printed on page 19.
A copy of the Periodic Table is printed on page 20.

1 One of the instructions for an experiment reads as follows:

'Add about 30 cm^3 of hydrochloric acid into a conical flask.'

Which of the following apparatus should be used to measure the stated volume of acid?

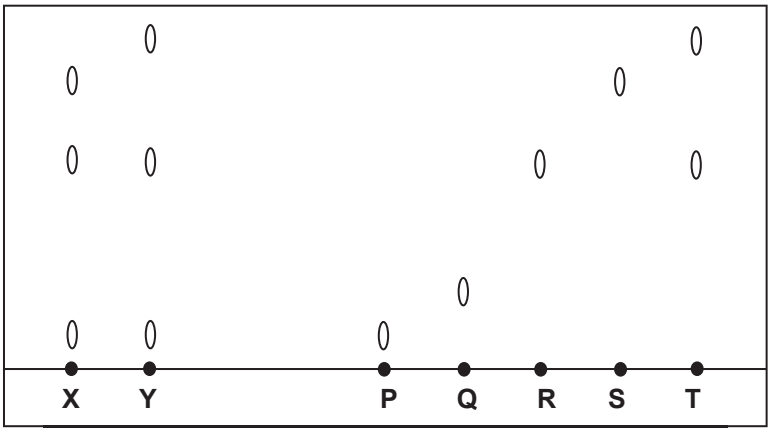
A burette

B beaker

C pipette

D measuring cylinder

2 The following diagram shows the result of a chromatogram obtained from two mixtures, **X** and **Y**.



Which of the substance(s) is/are present in mixture **Y** but not mixture **X**?

A **S** only

B **T** only

C **Q** and **S** only

D **R** and **T** only

3 A chemist discovered four unknown solids **W**, **X**, **Y** and **Z** during a research trip. He conducted a few experiments to identify these solids. Below are the results of these experiments.

Solid **W**	Solid **X**
Solid **W** has a constant composition and decomposes into two elements when heated.	Solid **X** is coloured grey and is attracted to a magnet. It cannot be decomposed into anything simpler.
Solid Y	**Solid Z**
Solid **Y** is coloured white. Only some parts dissolve in an excess of water.	Solid **Z** is black. It can be formed by strongly heating copper in oxygen.

Which of the above solid can be classified as a compound?

A Solid **W** only

B Solid **Y** only

C Solid **X** and **Y**

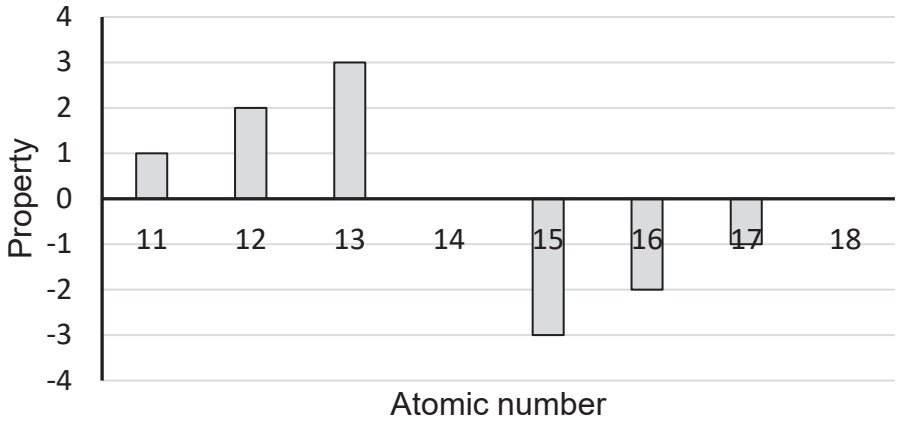
D Solid **W** and **Z**

4 The table gives data about four substances.

In which substance are the particles far apart and moving randomly at high speeds at room temperature?

	melting point / ºC	**boiling point / ºC**
A	62	149
B	-18	82
C	-128	-25
D	1050	1648

5 The graph below shows the trend of a property of the elements in period 3.



What is the property?

A charge of ions

B ease of gaining electrons

C number of electron shells

D number of valence electrons

6 The nucleon number and proton number of an atom of **U** and an atom of **V** are shown.

	U	**V**
nucleon number	23	24
proton number	11	10

A An atom of **U** has fewer electrons than an atom of **V**.

B An atom of **U** has fewer neutrons than an atom of **V**.

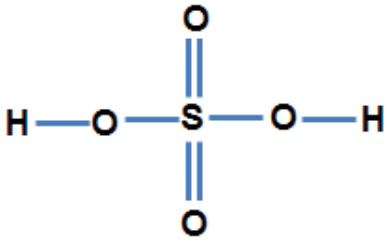
C **U** is above **V** in the same group of the Periodic Table.

D **U** is in the same period in the Periodic Table as **V**.

7 Which of the following could be magnesium oxide?

	melting point / °C	boiling point / °C	electrical conductivity of		
			solid	liquid	solution in water
A	-112	-83.7	poor	poor	good
B	660	2470	good	good	insoluble
C	801	1413	poor	good	good
D	1610	2230	poor	poor	insoluble

8 The bonding in sulfuric acid can be represented by the structure shown.



What is the total number of electrons in the covalent bonds surrounding the sulfur atom?

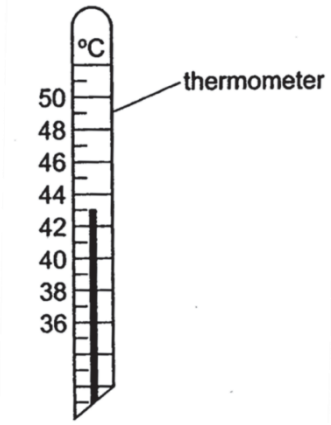
A 6
B 8
C 10
D 12

9 Solution **X** turns aqueous potassium iodide from colourless to brown.

What must solution **X** contain?

A an alkali
B a reducing agent
C an oxidising agent
D an ammonium salt

10 A thermometer is placed in water and the temperature is measured as shown.



An endothermic change takes place as a solid is dissolved in the water. The temperature changes by 5.0 °C.

What is the final temperature shown by the thermometer?

A 37.5 °C

B 38.0 °C

C 47.5 °C

D 48.0 °C

11 Hydrated magnesium sulfate has the molecular formula $MgSO_4.5H_2O$. What is the relative molecular mass, M_r, of hydrated magnesium sulfate?

A 110

B 206

C 210

D 220

12 What is the mass of sodium hydroxide present in 0.5 dm^3 of 2.5 mol/dm^3 sodium hydroxide solution?

A 1.25 g

B 5 g

C 50 g

D 200 g

13 Which of the following compounds has the most number of atoms?

A 1 mol of NH_4NO_3

B 1 mol of $CO(NH_2)_2$

C 1 mol of $(NH_4)_2CO_3$

D 1 mol of NH_4Cl

14 Which of the following is not a reason for recycling metals?

A The supply of metal ores on the earth is limited.

B Extraction of metal from metal ores requires fossil fuels which are finite.

C Recycling of metals causes less pollution than extracting metals from metal ores.

D Recycling metals is more expensive than extracting metals from metal ores.

15 Which pair of substances act as reducing agents in the blast furnace?

A carbon and oxygen

B carbon and carbon monoxide

C carbon dioxide and oxygen

D carbon dioxide and carbon monoxide

16 A salt is prepared by titration by reacting a carbonate and an acid. Which of the following shows the correct solubilities of carbonate, acid and salt?

	carbonate	**acid**	**salt**
A	soluble	soluble	soluble
B	insoluble	soluble	soluble
C	soluble	soluble	insoluble
D	insoluble	soluble	insoluble

17 Carbon monoxide is a pollutant emitted from car exhausts.

Which of its properties makes it harmful to humans?

A It has no colour, taste or smell.
B It has a corrosive action on lung tissue.
C It forms a stable compound with haemoglobin causing lack of oxygen.
D It combines with oxygen in the lungs resulting in breathing difficulty.

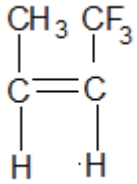
18 Which gas is the main cause of damage to stonework on buildings?

A methane
B nitrogen
C carbon monoxide
D sulfur dioxide

19 Which property of the alkanes does **not** increase as the relative molecular mass increases?

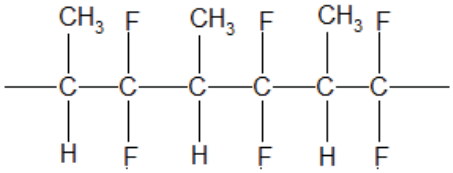
A boiling point
B flammability
C density
D viscosity

20 The following formula represents a monomer.

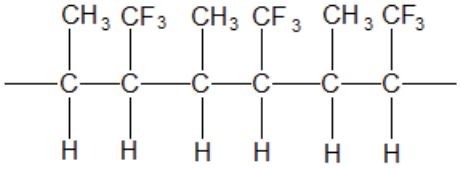


Which formula shows a part of the polymer chain formed from 3 molecules of the monomer?

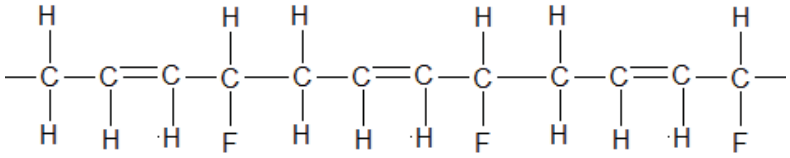
A



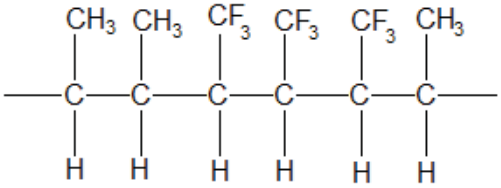
B



C



D



DATA SHEET

Colours of some common metal hydroxides

aluminium hydroxide	white
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.).

Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
Preliminary Examination 2019
Secondary 4 Express & 5 Normal (Academic)

SCIENCE CHEMISTRY **5076&5078/03**
Paper 3 **2 September 2019**
1 hour 15 minutes

Additional Materials:
Nil

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number in the spaces provided at the top of this page.
Write in dark blue or black pen. You may use a soft pencil for any diagrams, graphs or rough working.

Section A [45 marks]
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B [20 marks]
Answer **any two** questions.
Write your answers in the spaces provided on the Question Paper.

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

Setter: Ms Lim Si Ting

Section A

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

A1 Details of the oxides of elements in Period 3 of the Periodic Table are shown in **Table 1.1**.

group number of elements	I	II	III	IV	V	VI	VII	0
formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O	None
approximate melting point of oxide /°C	900	3000	2000	1500	600	20	-20	

Table 1.1

(a) Name the oxide that will react with both acids and alkalis. [1]

……..

(b) Explain why Group 0 elements do not form oxides. [1]

……..

……..

(c) **(i)** Draw the 'dot and cross' diagram of Na_2O and Cl_2O. [4]
Show only valence electrons.

Na_2O:

Cl_2O:

(ii) Na_2O and Cl_2O has boiling points 1950 °C and -123 °C respectively. [3]
Using structure and bonding, explain the difference between the melting point of Na_2O and Cl_2O.

……..

……..

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……..

[Total: 9 marks]

A2 Linoleic acid is an unsaturated carboxylic acid used to make fats. It has the structural formula shown below.

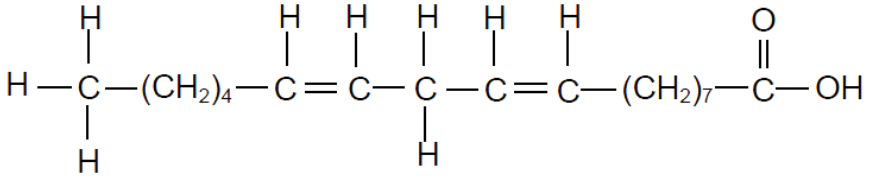


Diagram 2.1

(a) Explain the term *unsaturated*. [1]

……

(b) Name the two functional groups present in Linoleic acid. [2]

Functional group 1: ……

Functional group 2: ……

(c) State the observations if the following reagents were added to Linoleic acid.

(i) aqueous bromine [1]

……

……

(ii) universal indicator [1]

……

……

[Total: 5 marks]

A3 An experimental set-up to determine the speed of reaction between marble chips, $CaCO_3$, and 0.1 mol/dm^3 of excess dilute hydrochloric acid is shown in **Figure 3.1**. The reaction starts when the thread is released and marble chips in the small test-tube is mixed with dilute hydrochloric acid.

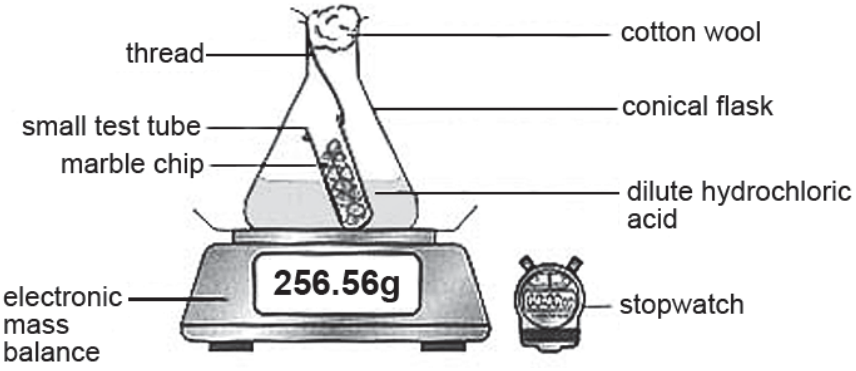
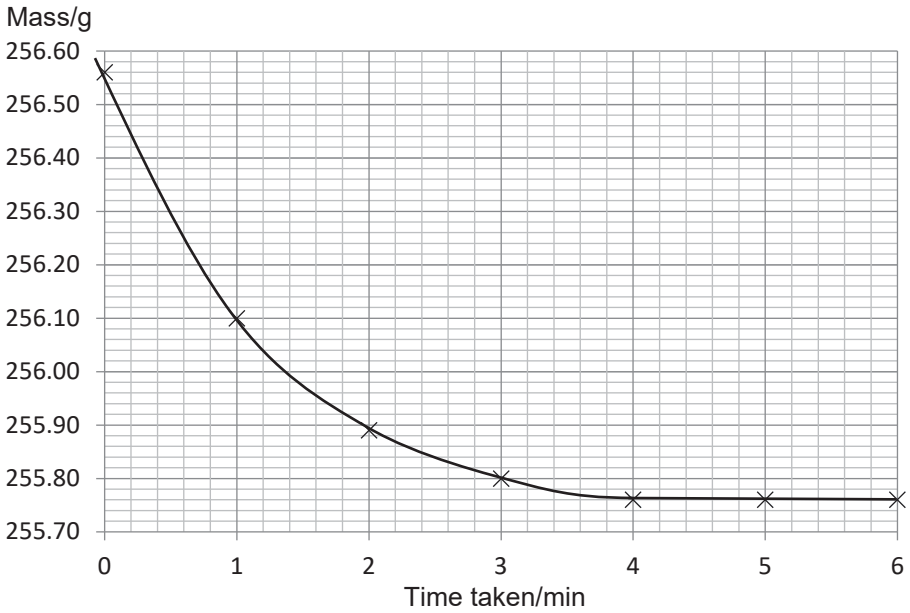


Figure 3.1

A graph of mass against time was plotted to measure the speed of reaction.



(a) Explain why the mass of the reaction mixture decreases as the reaction proceeds. [1]

……..

(b) Using the graph, state what happens to the speed of reaction as time increases. Explain your answer using collision theory. [2]

……..

……..

……..

(c) Sketch on the graph above, the results obtained if

(i) 0.05 mol/dm^3 of hydrochloric acid is used, [1]

(ii) powdered marble is used. [1]

(d) Using collision theory, explain your answer in **(c)(i)**. [2]

……..

……..

……..

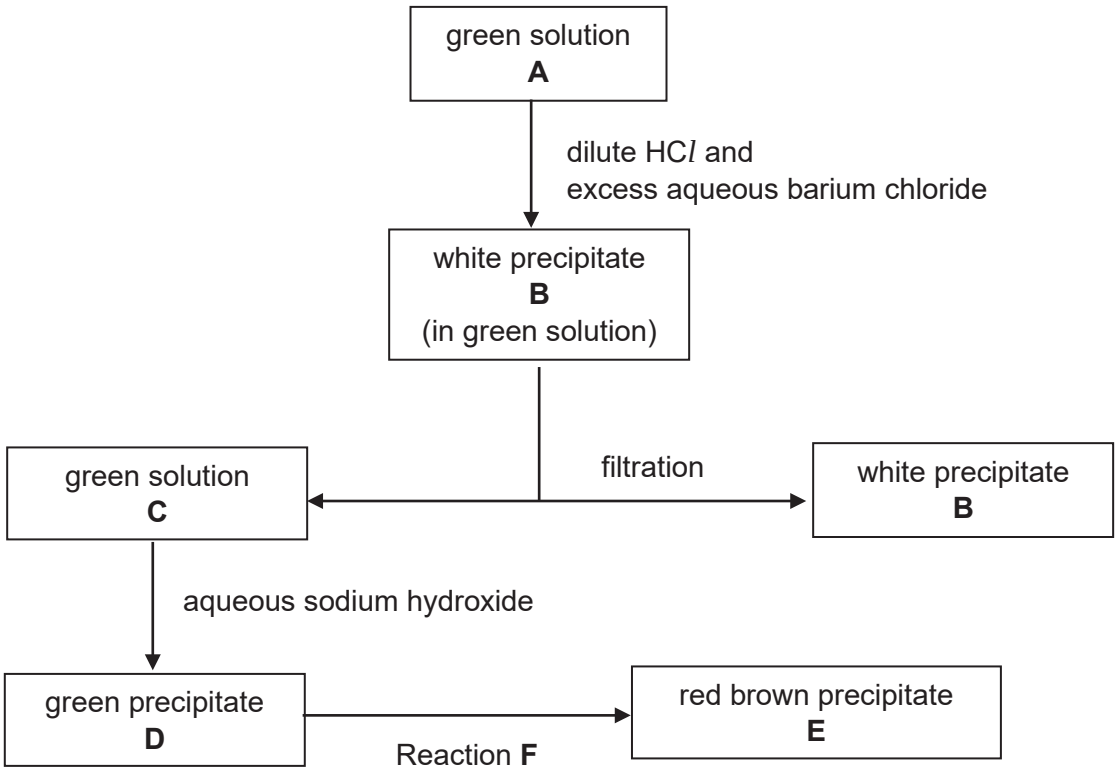
……..

……..

(e) Calculate the number of moles of carbon dioxide produced in the reaction. [1]

[Total: 8 marks]

A4 The flow chart below describes some of the properties and reactions of several substances.



(a) Suggest the identity of the following substances: [5]

A ……

B ……

C ……

D ……

E ……

(b) Write an ionic equation for the formation of white precipitate B. [1]

……

(c) State the name of reaction **F**. Explain your answer using the gain or loss of electrons. [2]

……

……

[Total: 8 marks]

A5 To separate the components of clean air industrially, the air must be cooled to -200 °C before entering a cryogenic (low temperature) air separation unit as shown in **Figure 5.1**.

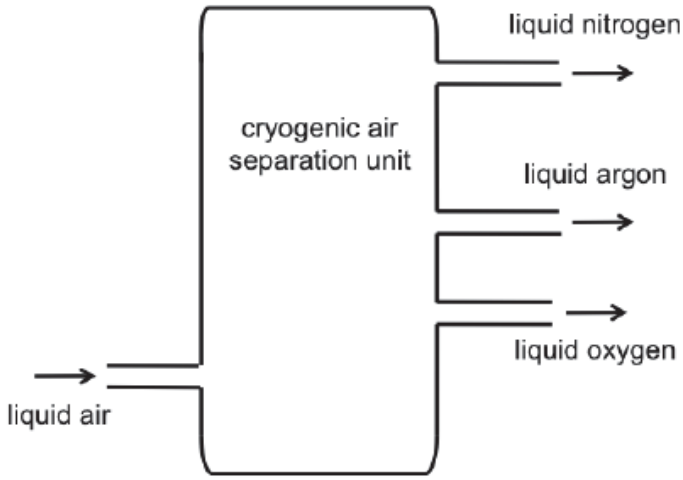


Figure 5.1

(a) Deduce the separation method used in **Figure 5.1**. [1]

……

(b) Describe what happens to the movement and arrangement of air particles as it is cooled to -200 °C. [2]

……

……

……

(c) After separation of the components of air, the gases are stored in gas tanks. The technician accidently mixed up the gas tank labels between oxygen gas and nitrogen gas. [2]

Suggest a chemical test that can be used to distinguish between the gas tank with oxygen gas and the gas tank with nitrogen gas.

……

……

……

[Total: 5 marks]

A6 Solid Rocket Boosters (SRBs) are the main source of thrust for the Space Shuttle during the first two minutes of flight. The main components in SRBs are aluminium and ammonium perchlorate that reacts to produce a lot of heat and energy for the space shuttle to take off.

The chemical equation for the reaction can be represented as:

$$10\ Al + 6\ NH_4ClO_4 \longrightarrow 4\ Al_2O_3 + 2\ AlCl_3 + 12\ H_2O + 3\ N_2$$

(a) Suggest whether the reaction between aluminium and ammonium perchlorate is an exothermic or endothermic reaction. Explain your answer. [2]

……

……

(b) **(i)** Calculate the oxidation state of chlorine in ammonium perchlorate, NH_4ClO_4. [1]

(ii) In terms of change in oxidation state, explain whether chlorine is oxidised or reduced in the reaction. [2]

……

……

……

[Total: 5 marks]

A7 **Table 7.1** shows the proportions of some of the exhaust gases released by a car.

gas	% in exhaust gas
carbon dioxide	6.0
carbon monoxide	4.0
oxygen	8.0
unburnt hydrocarbon	1.5
nitrogen oxides	0.2
sulfur dioxide	trace

Table 7.1

(a) Explain how this data shows that complete combustion is not taking place in the car exhaust. [1]

……

……

(b) **(i)** Explain how nitrogen oxides are formed in the car exhaust. [2]

……

……

(ii) State and explain the environmental effects of nitrogen oxides. [2]

……

……

……

[Total: 5 marks]

Section B

Answer any **two** questions.
Write your answers in the spaces provided.

B8 **Table 8.1** shows the properties of some compounds.

substance	chemical formula	solubility in water	pH
potassium sulfate		soluble	
	HNO_3	soluble	1.0
silver chloride			
barium hydroxide		soluble	
	$CaCO_3$	insoluble	

Table 8.1

(a) Fill in the blanks in **Table 8.1**. [4]

(b) **(i)** State the method used to prepare potassium sulfate. [1]

……

(ii) Describe, with named reagents, the method used to prepare potassium sulfate solution. [3]

……

……

……

……

……

……

……

(c) Write chemical equation, with state symbols, for the reaction between nitric acid and calcium carbonate. [2]

……

[Total: 10 marks]

B9 Four different metals, **A**, **B**, **C** and **D** are tested in a laboratory. Their results are shown in **Table 9.1**.

metal	observations
A	Has to be hot before it reacts with steam.
B	Does not react with steam. Reacts slowly with hydrochloric acid.
C	Only metal to react with cold water. The reaction with water is steady but not explosive.
D	Does not react with dilute sulfuric acid.

Table 9.1

(a) Place the metals, **A, B, C** and **D** in increasing order of reactivity. [1]

……..

(b) One of the metals in **Table 9.1** is magnesium.

(i) Which metal, **A**, **B**, **C** or **D** could be magnesium? [1]

……

(ii) Write a balanced equation for the reaction of magnesium described in **Table 9.1**. [1]

……

(iii) Calculate the volume of gas evolved from reacting 2.4 g of magnesium. [2]

(c) One of the metals in **Table 9.1** is an alkali metal.

(i) Which metal, **A**, **B**, **C** or **D** could be an alkali metal? [1]

……

(ii) State two physical properties of alkali metals that differs from other metals. [2]

……

(iii) State and explain the chemical reactivity of alkali metals down the Group. [2]

……

……

……

……

[Total: 10 marks]

B10 Petroleum is a complex mixture of hydrocarbons. **Table 10.1** shows the fractions obtained and the amounts produced by fractional distillation compared with the amount required.

fraction	percentage produced (supply)	percentage required (demand)
petroleum gas	3	4
petrol	14	45
naphtha	9	3
kerosene	15	7
diesel	10	22
heavy oil and bitumen	49	19

Table 10.1

(a) State one industrial use for naphtha. [1]

……

(b) **(i)** From **Table 10.1**, state the fraction which has demand exceeding the supply by the greatest amount. [1]

……

(ii) Name a chemical process that is used to meet the demands of the fraction stated in **(b)(i)**. [1]

……

(c) Hydrogen is produced as one of the products from the chemical process in **(b)(ii)**. Hydrogen undergoes addition reaction with alkenes.

(i) State the conditions for addition of hydrogen to alkenes. [1]

……

(ii) Draw the chemical equation, with full structural formula, for addition of hydrogen to propene. [2]

(d) Ethanol can be produced by fermentation of glucose. [4]
Describe, with the use of a chemical equation, how fermentation is carried out to produce **pure** ethanol.

……..

……..

……..

……..

……..

……..

……..

……..

[Total: 10 marks]

End of Paper

DATA SHEET

Colours of some common metal hydroxides

aluminium hydroxide	white
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											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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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.).