Name: ..... Class: .....

ASSUMPTION ENGLISH SCHOOL
MID-YEAR EXAMINATION 2019

SCIENCE (CHEMISTRY)
5076

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LEVEL:	Sec 3 Express / 3 Normal (Academic)	**DATE :**	14 May 2019
CLASS:	Sec 3/1, 3/2, 3/4 (SBB)	**DURATION :**	1 hour 15 minutes

Additional Materials provided: 1 sheet of OAS paper

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page and on the OAS paper. **Shade your index number on the OAS paper.** This paper consists of 3 sections.

SECTION A (20 marks)
MULTIPLE CHOICE QUESTIONS
There are 20 questions in this paper. Answer all questions. For each question, there are four possible answers A, B, C and D. Choose the correct answer and record your choice in soft or 2B pencil on the OAS paper provided. **DO NOT fold or bend the OAS paper.**

SECTION B (30 marks)
SHORT-STRUCTURED QUESTIONS
Answer **all** questions. Write your answers in the spaces provided on the question paper.

SECTION C (20 marks)
LONG-STRUCTURED QUESTIONS
Answer any **two** out of the three questions in the spaces provided on the question paper.

For Examiner's use:	
Section A	/ 20
Section B	/ 30
Section C	/ 20
Total	/ 70

A copy of the Periodic Table is printed on the last page.
At the end of the examination, hand in your OAS paper and Question Papers separately.

This question paper consists of 21 printed pages including this page.

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SECTION A: MULTIPLE CHOICE QUESTIONS [20 MARKS]

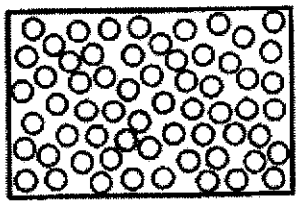
There are 20 questions in this section. Answer **ALL** questions. Choose the correct answer and record your choice on the OAS paper provided.

1. The table below shows the melting points and boiling points of four different substances, **A**, **B**, **C** and **D**.

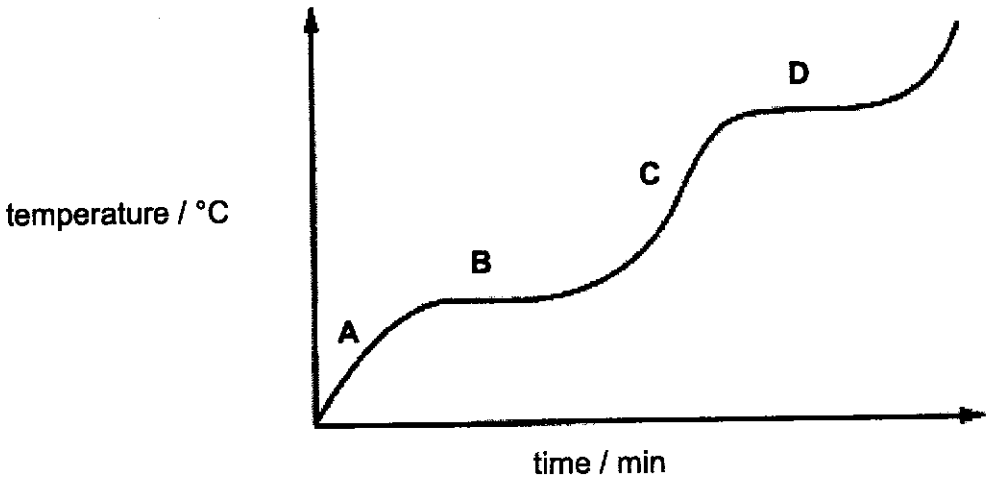
substance	melting point / °C	boiling point / °C
A	-90	15
B	-7	10
C	-10	-6
D	20	250

Which substance exists as a liquid at room temperature?

2. The diagram shows how particles of a substance are arranged at a certain temperature.



In which region of the graph would all the particles be arranged as in the diagram?



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3. Which piece of apparatus is suitable to measure a fixed volume of 25.0 cm^3 of dilute sulfuric acid accurately?

A beaker

B burette

C measuring cylinder

D pipette

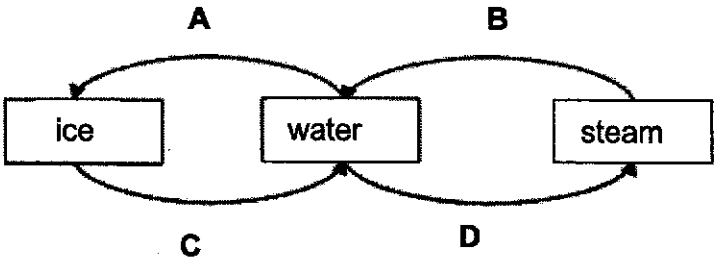
4. The table below lists the properties of nitrogen and ammonia.

name of gas	solubility in water	density
nitrogen	slightly soluble	Slightly denser than air
ammonia	very soluble	less dense than air

Which is the best method to collect each gas?

	nitrogen	ammonia
A	displacement of water	downward delivery
B	displacement of water	upward delivery
C	downward delivery	displacement of water
D	upward delivery	displacement of water

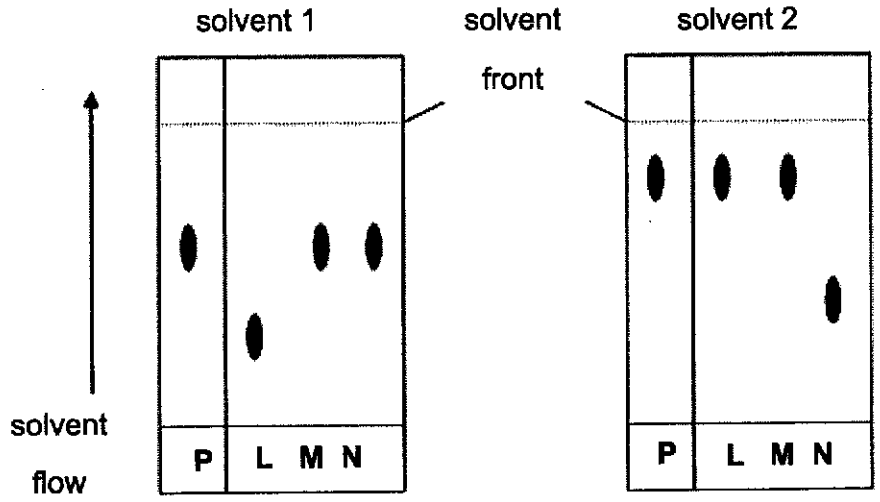
5. Which process best represents water molecules losing kinetic energy to move closer together?



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6. Substance **P** contains one of the three substances, **L**, **M** or **N**.
Two chromatograms of the four substances were obtained using different solvents. The diagram shows the results.



What does **P** contain?

A substance **L** only

B substance **M** only

C either substance **L** or **M**

D either substance **M** or **N**

7. Which list consists of an element, a compound and a mixture?

A air, potassium carbonate, steel

B copper(II) sulfate, francium, magnesium

C mercury, calcium oxide, milk

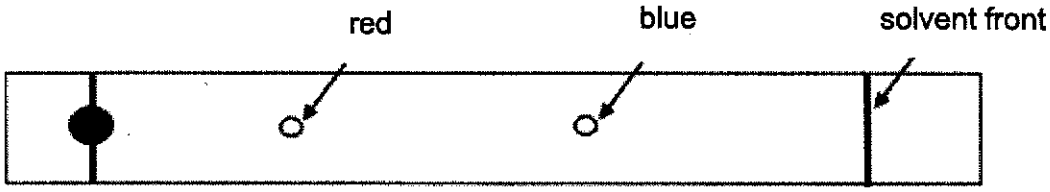
D sodium chloride, nitric acid, zinc fluoride

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8. The chromatogram of the dye used for the colouring of a drink is shown in the diagram below.



What can be deduced from the chromatogram?

A The blue dye is more soluble than the red dye in the solvent used.

B The dye used for the colouring of the drink is pure.

C The molecules of the red dyes are smaller than those of the blue dyes.

D The volume of red dye is less than the volume of blue dye in the drink.

9. The table below shows the information on two different substances.

substance	heat-stable	solubility in water	solubility in alcohol
Y	no	no	yes
Z	yes	no	no

Y and **Z** is mixed. The following steps could be carried out to separate substance **Y** from a mixture of these two substances.

1 filtration

2 dissolving in water

3 dissolving in alcohol

4 heating

5 crystallisation

6 evaporation

What would be the correct order to obtain substance **Y** from the mixture?

A 2, 1, 5

B 3, 1, 5

C 4, 3, 1, 5

D 4, 3, 1,

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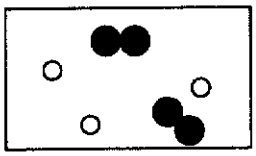
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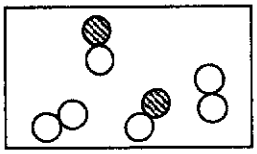
10. Ethyl ethonate is an artificial sweetener with a molecular formula of $CH_3COOC_2H_5$.
What is the number of elements and number of atoms in this molecule?

	Number of elements	Number of atom
A	3	3
B	3	14
C	14	3
D	14	14

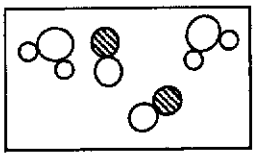
11. Which diagram represents a mixture of an element and a compound?



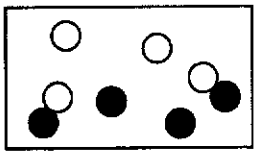
A



B



C



D

12. Which particle contains the largest number of electrons?

A Al^{3+}

B He

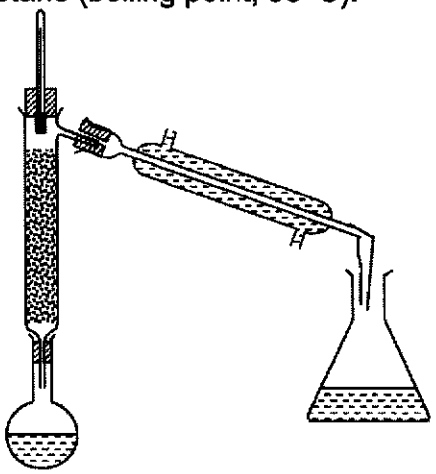
C *Cl*

D P^{3-}

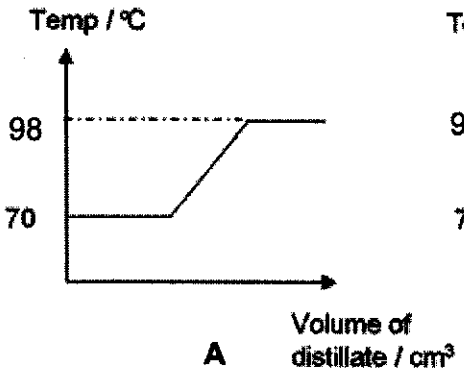
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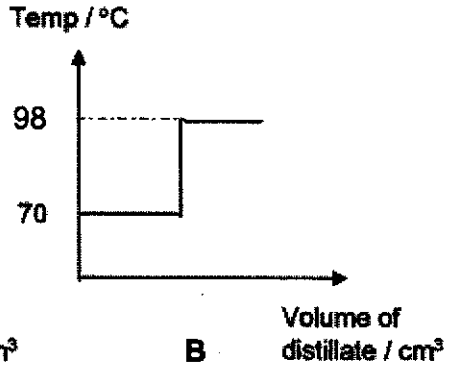
13. The diagram shows the apparatus used to separate hexane (boiling point, 70 °C) and heptane (boiling point, 98 °C).



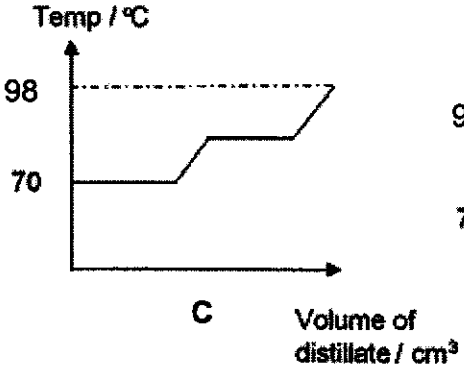
Which graph would be obtained if the temperature recorded by the thermometer was plotted against the total volume of distillate collected?



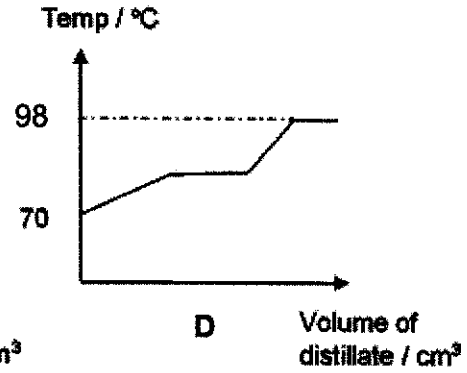
A



B



C



D

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14. Which information about the subatomic particles, proton, neutron and electron is correct?

		proton	neutron	electron
A	position in atom	nucleus	outside nucleus	nucleus
B	relative charge	+1	0	-1
C	relative mass	negligible	1	1
D	symbol	p	e	n

15. The table shows the number of sub-atomic particles in unknown ions **W** and **X**.

ion	proton	neutron	electron
W	16	16	18
X	17	18	18

Which statement is true?

A **W** and **X** are negative ions of different elements.

B **W** and **X** are negative ions of same elements.

C **W** and **X** are positive ions of different elements.

D **W** and **X** are positive ions of same elements.

16. An atom of element **Z** has the electronic configuration 2, 8, 6.
Which statement about element **Z** is correct?

A It can only react with metals.

B It can react with calcium to form a covalent compound.

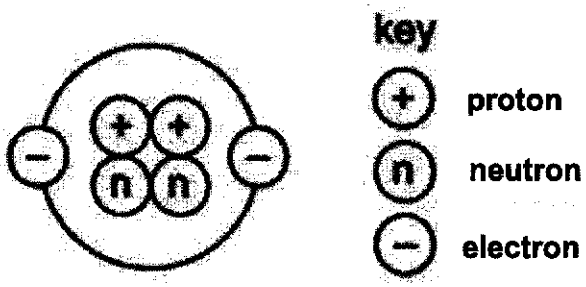
C The formula of a compound between element **Z** and calcium is CaZ_2.

D The formula of a compound between element **Z** and fluorine is ZF_2.

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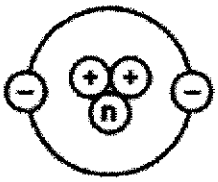
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17. The diagram shows the structure of an atom.

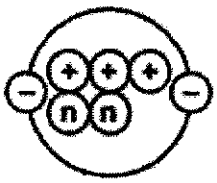


Which diagram shows the structure of an isotope of this atom?

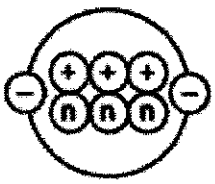
A



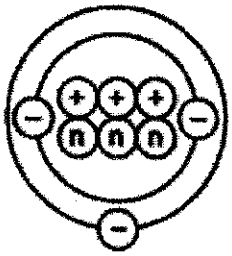
B



C



D



18. Element **P** has an electronic structure 2.8.2.
Element **Q** has an electronic structure 2.8.7
Which option describes the compound formed by elements **P** and **Q**?

A covalent compound of PQ_2

B covalent compound of P_2Q

C ionic compound of PQ_2

D ionic compound of P_2Q

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19. The table below shows the ability of four substances **A**, **B**, **C** and **D** to conduct electricity. Which substance is likely to be an ionic compound?

substance	electrical conductivity		
	in solid state	in liquid state	in aqueous state
A	good	good	insoluble in water
B	good	poor	good
C	poor	poor	poor
D	poor	good	good

20. Hydrogen can form both ionic and covalent compounds. With which element will hydrogen form a covalent compound?

A carbon

B sodium

C magnesium

D iron

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SECTION B: SHORT-STRUCTURED QUESTIONS [30 MARKS]

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

1. Sulfur can be obtained from volcanoes.

(a) A sample of sulfur from a volcano contained two different types of sulfur isotopes: sulfur-32 and sulfur-34.

(i) Complete the table below to show the atomic structure of each isotope of sulfur.

isotope	number of		
	proton	neutron	electron
sulfur-32			
sulfur-34			

[2]

(ii) The relative atomic mass of sulfur is 32.2. Explain why the relative atomic mass of sulfur does is not a whole number.

.....

.....[1]

(iii) Write the electronic configuration of sulfur-34.

.....[1]

(b) One of the gases produced during volcanic eruptions is hydrogen sulfide, H_2S. Hydrogen sulfide is a poisonous, colourless gas which smells of rotten eggs. It is noted that sulfur reacts in the same way as oxygen with hydrogen.

(i) Draw a dot-and-cross diagram to represent the bonding in a hydrogen sulfide molecule. Show valence electrons only.

[2]

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(ii) Explain, in terms of bonding and structure, why hydrogen sulfide gas does not conduct electricity.

.....

.....

.....[2]

2. **Fig. 2.1** shows the arrangement of particles in six substances.

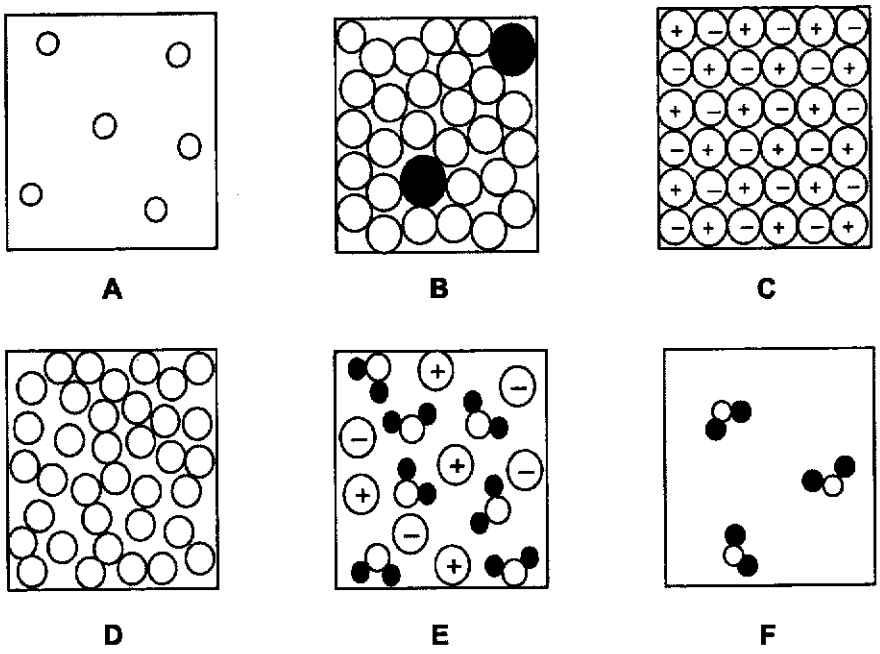


Fig 2.1

Which diagram best represents

(a) steam, ...

(b) molten copper, ...

(c) solid sodium chloride, ...

(d) neon, ...

(e) bronze. ..... [5]

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3. Chromatography is often used to solve crimes involving forgery. In an investigation of a case which involves a bank cheque issued with a forged signature, the sample of ink from the forged signature was tested together with inks from the pens of five suspects **V**, **W**, **X**, **Y** and **Z**. **Fig. 3.1** shows the chromatogram that was obtained with the use of an organic solvent.

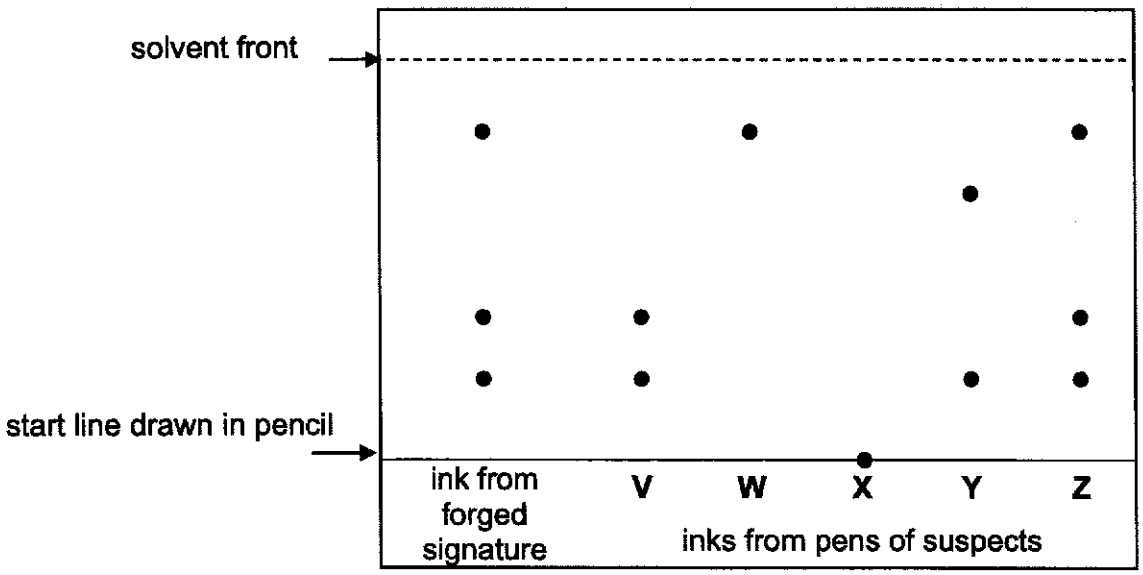


Fig. 3.1

(a) Which suspect is most likely to have forged the signature in the bank cheque?

.....[1]

(b) Suggest why the ink from the pen of suspect **W** gives only one spot on the chromatogram.

.....[1]

(c) Explain why the start line is drawn in pencil but not in pen.

.....

.....[1]

(d) Suggest a reason why water would probably not be a suitable solvent to use for this chromatography.

.....[1]

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(e) Why did the ink from suspect **V** travelled a shorter distance compared to ink from suspect **W**?

.....[1]

4. **Table 4.1** gives some information on the component gases of clean air in the atmosphere.

gas	melting point / °C	boiling point / °C
nitrogen	–210	–196
oxygen	–218	–183
argon	–189	–186
other noble gases		
carbon dioxide	sublimes at –78 °C	
water vapour	0	100

Table 4.1

Separating air into its component gases is an important process in the industries. Air is first cooled to liquid at –200 °C before it is gradually warmed up and separated into its component gases, as illustrated in **Fig. 4.1**.

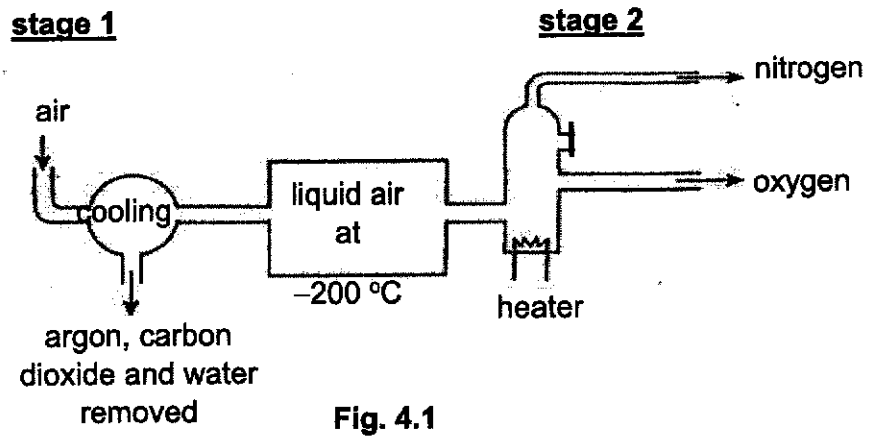


Fig. 4.1

(a) Describe the arrangement and movement of the particles in the liquid air.

.....

.....[2]

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(b) Explain why argon, carbon dioxide and water can be removed as the air is being cooled to –200 °C in **stage 1.**

.....[1]

(c) Name the method used to separate the components of liquid air in **stage 2.**

.....[1]

(d) Which component will be collected last in **stage 2**? Explain your answer.

.....

.....[2]

5. Sir James Jeans, who was a great populariser of Science, once described an atom of nitrogen as being like seven bees buzzing around a space the size of a football stadium.

(a) Suggest what were represented by the seven bees in this description.

.....[1]

(b) What is missing from Jeans' description when applied to an atom of nitrogen?

.....[1]

(c) (i) Write the electronic structure of nitrogen atom.

.....[1]

(ii) State and explain which group and period does nitrogen belong to?

.....

.....[2]

(iii) Describe why and how would a nitrogen atom forms a nitride ion?

.....

.....[1]

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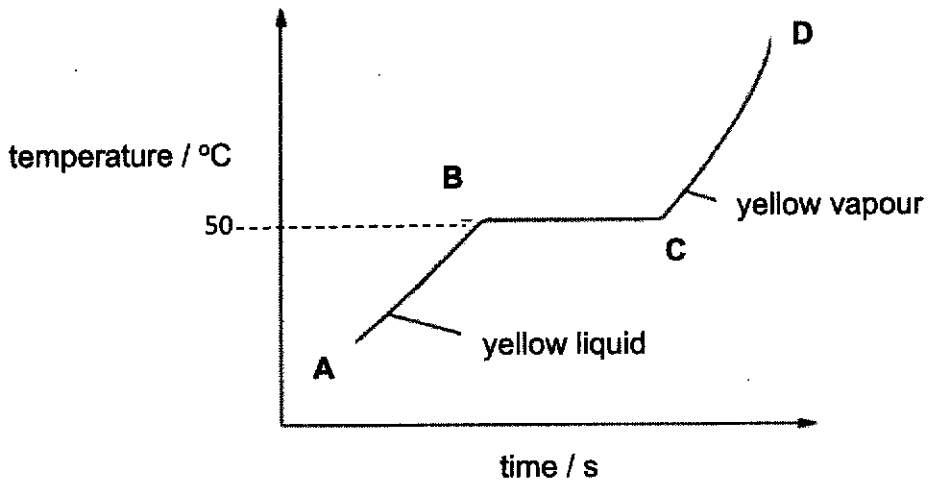
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SECTION C: LONG-STRUCTURED QUESTIONS [20 MARKS]

Answer **two** out of the three questions in the spaces provided.

1. **Z** is a liquid at room temperature. When heated, **Z** forms a yellow vapour. The following graph is obtained.



Pale yellow liquid and vapour are observed at regions **AB** and **CD** respectively.

(a) (i) State the process represented by region **BC** of the graph.

.....[1]

(ii) Explain why the temperature remains constant at region **BC** of the graph.

.....

.....[1]

(b) Using kinetic particle theory, describe what happens to the yellow vapour when it is **cooled** from 60 °C to room temperature.

.....

.....

.....

.....[3]

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(c) In the experiment, 22.4 cm^3 of yellow liquid is used and the volume of vapour is also measured. Name the most apparatus that can be used to measure

(i) 22.4 cm^3 of yellow liquid .....[1]

(ii) the volume of vapour produced .....[1]

(d) Vapour **Z** is a soluble acidic gas that is denser than air. Name the method that is used to collect vapour **Z**. Explain your choice.

.....

.....[2]

(e) Describe one method to show that liquid **Z** is pure.

.....

.....[1]

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2. Oxygen gas will react with sodium to form sodium oxide. It can also burn with carbon to form carbon dioxide.

(a) Name the type of bond formed in sodium oxide and carbon dioxide respectively

Sodium oxide: .....

Carbon dioxide ..... [2]

(b) Draw the "dot and cross" diagrams of sodium oxide and carbon dioxide. Show all the electrons clearly.

[Proton (atomic) numbers: C:6 ;O:8 ; Na:11]

Sodium oxide

Carbon dioxide

[4]

(c) Use these structures to explain why, at room temperature and pressure, sodium oxide is a solid and carbon dioxide is a gas.

.....

.....

.....

.....

.....[4]

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3. The table below lists the properties of substances **L**, **M**, **N**, **P**, **Q** and **R**.

substance	melting point (°C)	electrical conductivity		effect with oxygen	Effect on heating
		solid	molten		
L	–249	poor	poor	no reaction	remains the same
M	900	poor	good	burns when heated	decomposes
N	98	good	good	burns when heated	remains the same
P	44	poor	poor	ignites, even at room temperature	decomposes
Q	–112	poor	poor	burns readily on slight warming	decomposes
R	1230-1400	good	good	burns when strongly heated	some part remains the same, some part decompose

(a) (i) Which substance is a noble gas?

.....[1]

(ii) Which substance is a pure metal?

.....[1]

(iii) Which substance can be a covalent compound?

.....[1]

(b) Which substance can be separated physically? Explain your choice.

.....

.....[2]

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(c) Damein suggested that substance **M** could be an element.

(i) State, with an explanation, if you agree with Damein.

.....

.....[2]

(ii) In terms of composition, state the difference between element and compound.

.....

.....[1]

(d) Which substance could be ionic compound? Provide evidence from the table in your answer.

.....

.....[2]

-End of Paper-

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The Periodic Table of Elements

Group I	II	III	IV	V	VI	VII	0
							2 He helium 4
3 Li lithium 7	4 Be beryllium 9						
11 Na sodium 23	12 Mg magnesium 24						
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
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
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
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf Rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 He hassium -

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

1 H hydrogen 1

			5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
			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
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
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
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 -
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.).

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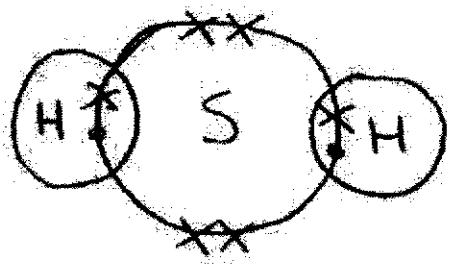
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3 Express Science Chemistry 5076 Mid Year Exam 2019 Marking Scheme

Section A Multiple-Choice Questions [20m]

1	2	3	4	5	6	7	8	9	10
D	**C**	**D**	**B**	**A**	**B**	**C**	**A**	**B**	**B**
11	12	13	14	15	16	17	18	19	20
B	**D**	**B**	**B**	**A**	**D**	**A**	**C**	**D**	**A**

Section B Short-Structured Questions [30m]

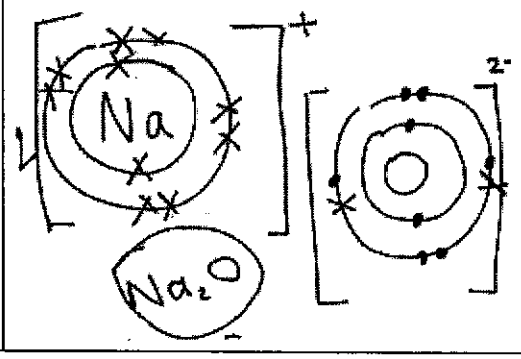
<table>
<tr><td>1ai</td><td>
<table>
<tr><th rowspan="2">Isotope</th><th colspan="3">Number of</th></tr>
<tr><th>Proton</th><th>Neutron</th><th>Electron</th></tr>
<tr><td>Sulfur-32</td><td>16</td><td>16</td><td>16</td></tr>
<tr><td>Sulfur-34</td><td>16</td><td>18</td><td>16</td></tr>
</table>
</td><td>2m
6 correct
-2m
3/4/5 –
1m</td></tr>
<tr><td>1aii</td><td>It is the average mass of the all the isotopes of sulfur.</td><td>1</td></tr>
<tr><td>1aiii</td><td>2,8,6</td><td>1</td></tr>
<tr><td>1bi</td><td>

1m: Correct illustration of bonding electrons
1m: correct illustration for non bonding electrons</td><td>2</td></tr>
<tr><td>1bii</td><td>It exists in simple molecular structure.
There are no mobile electrons to act as charge carriers to conduct electricity as all electrons are involved in bonding</td><td>1
1</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>2a</td><td>F, D, C, A, B (1m each)</td><td>5</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>3a</td><td>Z</td><td>1</td></tr>
<tr><td>3b</td><td>The ink is pure</td><td>1</td></tr>
<tr><td>3c</td><td>Pen is soluble and will move with the solvent
This will affect the result</td><td>1</td></tr>
<tr><td>3d</td><td>Ink is insoluble in water/ not compatible with the solvent used</td><td>1</td></tr>
</table>

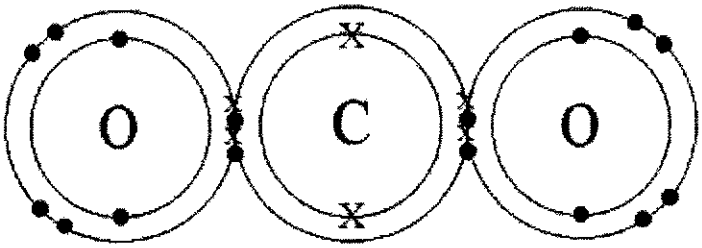
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3e	It is less soluble than the rest	
4a	Arrangement: Closely packed in disorderly manner Movement: Slide over one another	1 1
4b	To prevent blockage by solid carbon dioxide and ice	1
4c	Fractional distillation	1
4d	Oxygen It has the highest boiling point	1 1
5a	electrons	1
5b	Protons and neutrons	1
5ci ii iii	2,5 Gp V because have 5 valence electrons Period 2 because have 2 electron shells It will gain 3 electron to achieve stable electronic configuration	1 1 1 1

Section C Long-Structured Questions [20m]

1ai	Boiling	1
1aii	Energy is taken in to overcome the forces of attraction instead of raising temperature	1
1b	At 60, Particles are far apart and move freely and rapidly As it cools down, the particles lose energy and move slower and come closer At room temperature, the particles are closely packed in disorderly manner and slide over one another	1 1 1
1ci	burette	1
1cii	Gas syringe	1
1d	Downward delivery The gas is more dense than air and will sink	2
1e	Pure Z will boil at one temperature	1
2a	Sodium oxide: ionic Carbon dioxide: covalent	2
2b		2

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	1m: correct cation 1m: correct anion	
2b	 **1m: Correct illustration of bonding electrons** **1m: correct illustration for non bonding electrons**	2
2c	Sodium oxide exist as giant lattice structure and there are strong forces of attraction between the oppositely charged ion A lot of energy needed to overcome strong electrostatic force of attraction. Hence it has high boiling point and exist as solid Carbon dioxide exist simple covalent. There weak intermolecular forces of attraction Little energy is needed to overcome the forces of attraction. Hence it has low boiling point and exist as gas	1 1 1 1
3ai	L	1
3aii	N	1
3aiii	Q or P	
3b	R It is a mixture and it melts over a range of temp	1 1
3ci	I do not agree with Damein. M decomposes. Element will not be able to decompose as it is the simplest	1 1
3cii	Element is only made up of only one type of atom but compound is made up of 2 or more types of atoms chemically combined together	1
3d	M It can conduct electricity in molten state	1 1

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