Class	Register Number

Candidate Name _____

PEIRCE SECONDARY SCHOOL
MID-YEAR EXAMINATION 2019
SECONDARY THREE EXPRESS

Chemistry **6092**

07 May 2019
2 hours

Additional Materials: Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name, index number and class on the answer sheet in the spaces provided.

Section A
There are **thirty** questions in this section. 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.

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

Section C
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
Answer only one question from Question 11.

INFORMATION FOR CANDIDATES
A copy of the Periodic Table is printed on page **32.**

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Section C	
Total	

This paper consists of **32** printed pages and **0** blank page.

Name	Index Number	Class

PEIRCE SECONDARY SCHOOL
FIRST SEMESTER EXAMINATION 2019
SECONDARY THREE EXPRESS

CHEMISTRY

6092
2 hours
5 May 2019

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST
Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.

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

Section A (Multiple Choice)

There are thirty questions in this section. For each question there are four possible answers **A, B, C** and **D**. Choose the one you consider correct and record in **soft pencil** on the separate Answer Sheet.

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

Section C
Answer all three questions. The last question is in the form either/or.
Write your answers on the writing papers provided.
At the end of the examination, fasten any separate answer paper used securely to the question paper.
A copy of the Periodic Table is printed on page **31.**

For Examiner's Use	
Section A	
Section B	
Section C	
_ _ _ _ _ _ _	
_ _ _ _ _ _ _	
Total	

Setter: Mr Ashwin

This document consists of **31** printed pages and **1** blank page.

[Turn Over]

Section A (30 marks)

1 Vienna travelled to Venus, the hottest planet, and brought along some items with her. Venus has a minimum surface temperature of −220 °C and maximum surface temperature of 420 °C.

Which of the following items will **not** show a change of state on Venus when the surface temperature changes from minimum to maximum?

	Item	Melting Point/^{o}C	Boiling Point/^{o}C
A	water	0	100
B	sodium chloride	801	1413
C	carbon dioxide	-78	-57
D	oxygen	-219	-183

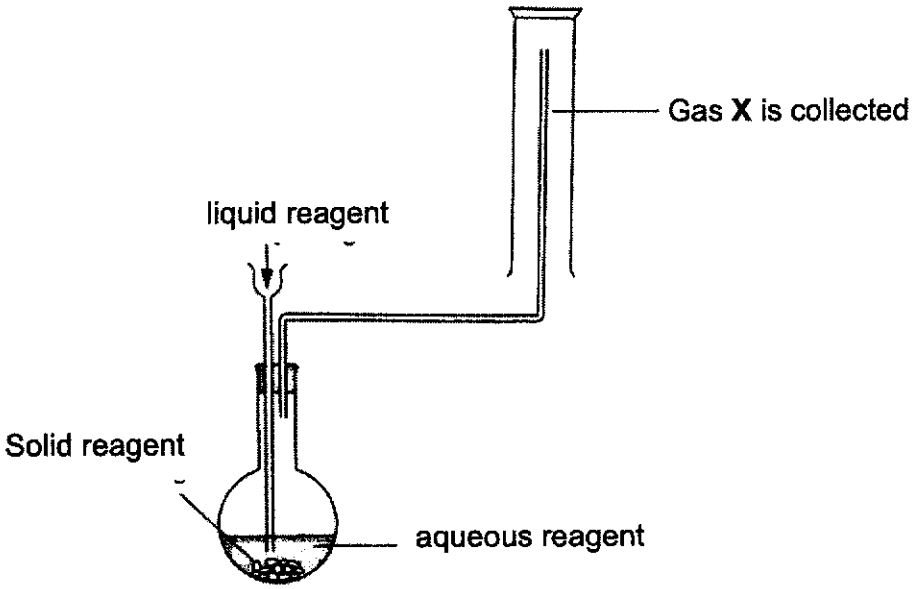
2 Which of the following observations is an exception to the behaviour predicted by our understanding of the kinetic particle theory?

A The smell from a bottle of perfume when opened can be detected from across the room in a short while.
B When liquid water freezes, the ice formed occupies a bigger volume.
C Salt solution can be prepared by adding table salt to water without stirring
D When an inflated balloon is placed in liquid nitrogen, it flattens but regains its shape when returned to room temperature.

3 Which of the following apparatus **cannot** be used to measure volume?

A beaker
B measuring cylinder
C pipette
D test tube

4 Gas **X** can be prepared by the following apparatus.

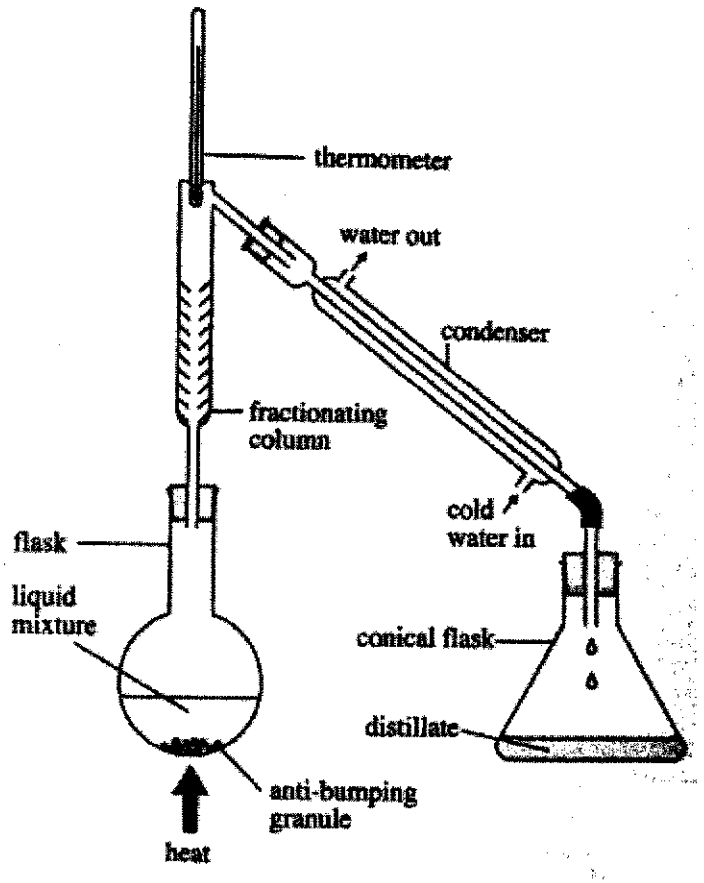


What can you deduce about gas **X**?

I It is less dense than air.
II It is denser than air.
III It is insoluble in water.
IV It is soluble in water.

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

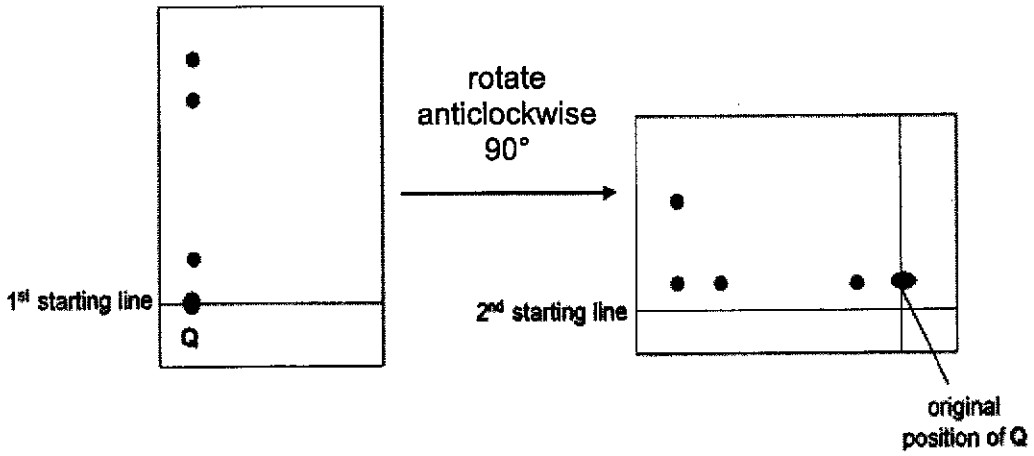
5 The following setup was used by a student to separate a mixture of ethanol and water.



Which of the following is an error in the setup?

A A wrong container was used to collect the distillate.
B The conical flask containing the distillate was enclosed with a cork.
C The direction of flow of the water through the condenser was wrong.
D The thermometer was placed too high in the fractionating column.

6 **Chromatogram 1** below shows the separation of coloured inks in mixture **Q**, using solvent **A**. **Chromatogram 2** shows the separation using the same piece of paper after it has been rotated anti-clockwise 90° in another solvent, **B**.



chromatogram 1 **chromatogram 2**

How many different types of ink are present in mixture **Q**?

A 3
B 4
C 5
D 7

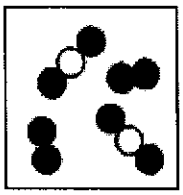
7 When iron filings and powdered sulfur are mixed together, it is still possible to see grains of each substance. However, if these two substances are heated together, a red glow is seen and a grey solid remains at the end of the experiment in which no separated grains of iron or sulfur can be seen.

Which statement is correct about iron and sulfur based on the description above?

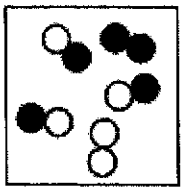
A It is a compound at room temperature and a grey compound when heated.
B It is a compound at room temperature and a grey mixture when heated.
C It is a mixture at room temperature and a grey compound when heated.
D It is a mixture at room temperature and a grey mixture when heated.

8 Which of the following diagrams represents a reaction between two elements which is **not** yet completed?

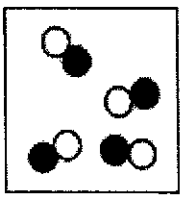
A



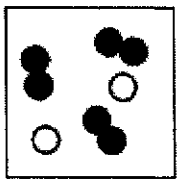
B



C



D



9 Which of the following statement about an atom is correct?

A All elements have only one nucleon (mass) number.
B The nucleon (mass) number can be less than the proton (atomic) number.
C The nucleon (mass) number can be equal to the proton (atomic) number.
D The number of neutrons never equals the number of electrons.

10 A giant molecule is made up of a large amount of carbon, mainly isotopes ^{12}C and ^{13}C. It was found that the average relative atomic mass of carbon in the molecule is 12.2.

What is the ratio by mass of ^{12}C to ^{13}C?

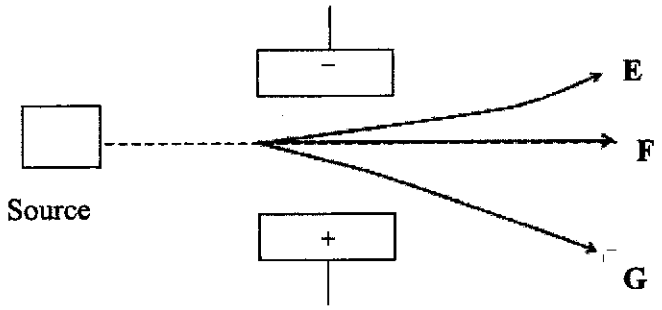
A 4 : 1
B 1 : 4
C 3 : 4
D 3 : 1

11 Which of the following consist of **only** compounds?

(i) air
(ii) oxygen
(iii) steam
(iv) carbon dioxide

A (i) and (ii)
B (ii) and (iii)
C (iii) and (iv)
D (iv) only

12 In an experiment, a sample containing Ba^{2+}, S^{2-} and a neutron were passed through an electric field. Analysis of the deflection of the particles occurring at the electric region revealed the following data for the sample.



What would **E**, **F** and **G** be?

	E	F	G
A	neutron	Ba^{2+}	S^{2-}
B	neutron	S^{2-}	Ba^{2+}
C	S^{2-}	neutron	Ba^{2+}
D	Ba^{2+}	neutron	S^{2-}

13 An element, **R**, has p protons and n neutrons in its nucleus.

Which row gives a possible correct number of protons, neutrons and electrons in a negative ion of an isotope of **R**?

	number of protons	number of neutrons	number of electrons
A	p	n + 1	p + 1
B	p + 1	n	p + 1
C	p	n + 1	p - 1
D	p + 1	n	p - 1

14 Which ion has the most number of electron shells that contain electrons?

A Al^{3+}
B Be^{2+}
C N^{3-}
D S^{2-}

15 In which one of these substances below is there the smallest number of electrons shared?

A F_2
B CH_4
C CO_2
D Cl_2O

16 Which compound has both ionic and covalent bonds?

A ammonium chloride
B carbon dioxide
C silicon dioxide
D sodium chloride

17 The outer shells of three elements **W**, **X** and **Y** contain 2, 6 and 7 electrons respectively. What are the likely formulae of their compounds?

A **XY** and **WY_2**
B **XY_2** and **WX**
C **X_2Y** and **WX**
D **W_2X** and **W_2Y**

18 The melting point of aluminium oxide is much higher than the melting point of calcium oxide.

Which statement explains this?

A A calcium ion has a smaller charge than an aluminium ion.
B A calcium ion has more protons than an aluminium ion.
C A calcium ion has more neutrons than an aluminium ion.
D Calcium is more reactive than aluminium.

19 The table below shows some of the physical properties of four substances **A**, **B**, **C**, **D**.

substance	melting point/ °C	boiling point/ °C	electricity conductivity		solubility in water
			solid state	liquid state	
A	167	445	poor	poor	insoluble
B	585	1860	poor	good	soluble
C	1830	2380	poor	poor	insoluble
D	1553	2989	good	good	insoluble

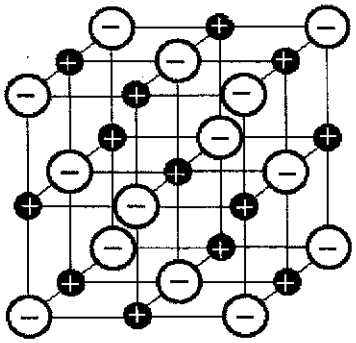
Which of the following statements about the four substances is correct?

A Substance **C** is a giant covalent compound with mobile ions.
B Substance **D** is a giant covalent compound with mobile electrons.
C Substance **B** is an ionic compound with mobile electrons held by strong electrostatic forces.
D Substance **A** is a simple molecular compound containing weak covalent bonds between molecules.

20 Which statement about diamond is correct?

A It conducts electricity.
B It has a giant ionic lattice.
C It has the same structure as copper.
D The carbon atoms are covalently bonded.

21 The diagram below shows the arrangement of ions in an ionic crystal. Which compound **cannot** have this arrangement of ions?



A Barium chloride, $BaCl_2$
B Copper(II) sulfate, $CuSO_4$
C Silver chloride, AgCl
D Sodium chloride, NaCl

22 Which of the following is **true** about the structure of copper metal?

A The flow of atoms in the metal allows copper to conduct electricity.
B The flow of electrons in the metal allows copper to conduct electricity.
C The flow of ions in the metal allows copper to conduct electricity.
D The flow of protons in the metals allows copper to conduct electricity.

23 A compound has the formula $CO(NH_2)_2$. How many elements are present in one molecule of the compound?

A 4
B 5
C 6
D 7

24 The process of respiration occurs to provide the energy required for the daily activities of humans. During this process, glucose from our food reacts with oxygen to produce carbon dioxide and water, as shown in the equation below.

$$\mathbf{t}\ C_6H_{12}O_6 + \mathbf{u}\ O_2 \rightarrow \mathbf{v}\ CO_2 + \mathbf{w}\ H_2O$$

Which of the following shows the correct set of values for **t**, **u**, **v** and **w**?

	t	u	v	w
A	1	6	6	6
B	2	6	9	6
C	1	9	6	12
D	2	12	9	12

25 The percentage composition of an unknown element **X** in C_3H_7X is 45.2%. Which of the following is element **X**?

A O
B Cl
C Br
D S

26 How many atoms are present in 8.8 g of carbon dioxide?

A 1.2×10^{23}
B 2.4×10^{23}
C 3.6×10^{23}
D 30.0×10^{23}

27 Which of the following compounds contains the highest percentage by mass of nitrogen?

A ammonia, NH_3
B urea, $(NH_2)_2CO$
C ammonium carbonate, $(NH_4)_2CO_3$
D ammonium carbamate, $NH_2CO_2NH_4$

28 What is the maximum mass of chromium Cr, that can be extracted from 76g of chromium(III) oxide?

A 48 g
B 52 g
C 104 g
D 152 g

29 10 cm^3 of propane was burnt completely in 100 cm^3 of oxygen, as shown in the equation below.

$$C_3H_8\ (g) + 5O_2\ (g) \rightarrow 4H_2O\ (l) + 3CO_2\ (g)$$

What is the total volume of gases present at the end of the reaction?

A 80 cm^3
B 110 cm^3
C 30 cm^3
D 50 cm^3

30 In polluted air, the white paint pigment in older oil paints form lead (II) sulfide, PbS, which is black in colour. Hydrogen peroxide is used to restore the white colour of the paint, as shown in the equation below.

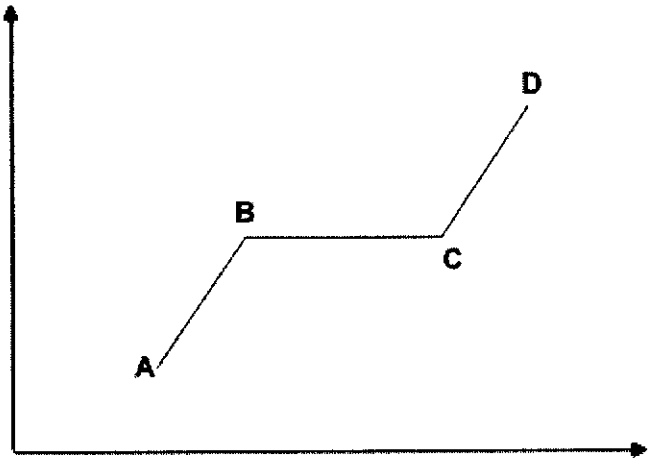
$$PbS\ (s) + 4H_2O_2\ (aq) \rightarrow \underset{\text{white pigment}}{PbSO_4\ (s)} + 4H_2O\ (l)$$

What is the mass of hydrogen peroxide required to react with 0.717g of lead (II) sulfide?

A 0.003 g
B 0.204 g
C 0.408 g
D 1.324 g

Section B (40 marks)
Answer **all** questions in the spaces provided.

B1 When nitrogen dioxide, NO_2, is cooled, it forms a yellow liquid and then pale yellow crystals. These crystals are heated and the temperature is measured every minute. The following graph was obtained.



(a) How does the arrangement and movement of the molecules at point **A** differ from that at point **D**? **[2]**

.....

.....

(b) In terms of kinetic particle theory, explain why temperature remains unchanged between point **B** and **C**. **[1]**

.....

.....

(c) Draw the arrangement of gaseous nitrogen dioxide molecules at room temperature and pressure. Use " " to represent a molecule of nitrogen dioxide. **[1]**

[Total: 4 marks]

B2 In the Olympic games, athletes are chosen at random to undergo drug tests. The athlete's urine sample was tested against known drugs that are banned using paper chromatography. In an investigation, an athlete's urine, sample U, is tested against three known drugs X, Y and Z.

The first test is done using water as the solvent. The result is shown in **Fig 2.1**. The second test is carried out using hexane as the solvent. The result is shown in **Fig 2.2**.

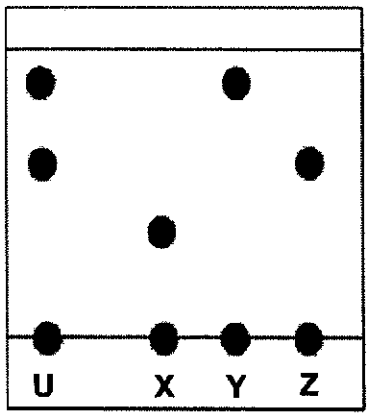


Fig 2.1

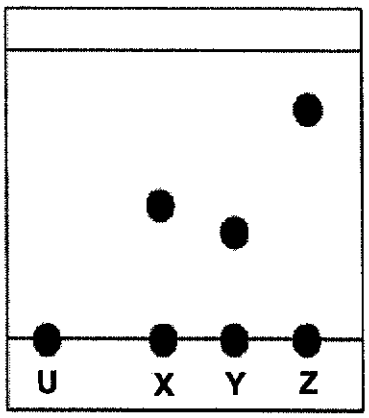


Fig 2.2

(a) With reference to **Fig 2.1** and **Fig 2.2**, state and explain if the athlete consumed the banned drugs. **[1]**

.....

.....

(b) Explain why the spots on the two chromatograms are at different positions even though the urine sample U and the known drugs used are the same. **[1]**

.....

.....

(c) State and explain a precaution that should be taken to ensure proper separation will take place on the paper chromatogram. **[2]**

.....

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.....

(d) The experiment was repeated, using 2-methylphenol as the solvent. Drug X produces a spot which has a R_f value of 0.45. Drug Y produces a spot which is 1 cm further from spot X as measured from the baseline. Drug Y has a R_f value of 0.55. **[2]**

Calculate the distance travelled by drug Y and the distance travelled by the solvent respectively.

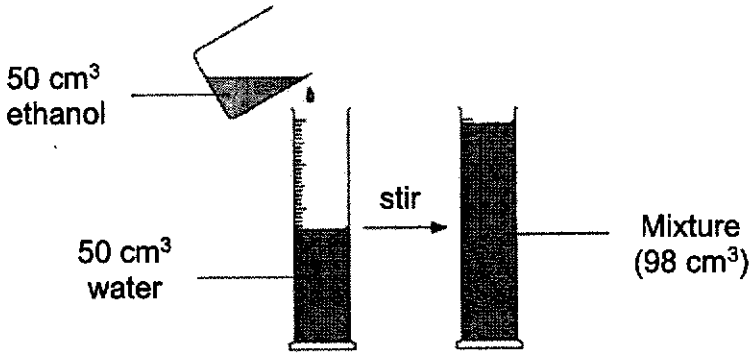
[Total: 6 marks]

B3 The table below gives some information about four substances **P**, **Q**, **R** and **S**. Use the information to decide whether each of these substances is an element, a mixture or a compound.

Substance	Properties	Element / Mixture / Compound
P	**P** is a white solid which dissolves partially in excess water.	
Q	**Q** is a yellow liquid, which undergoes chromatography forming only two spots on the chromatogram.	
R	**R** is a colourless, pungent gas which is very soluble in water.	
S	**S** is a colourless gas with fixed composition and identical atoms.	

[Total: 4 marks]

B4 50 cm^3 of water was poured into a measuring cylinder.
50 cm^3 of ethanol was measured and added to the water.



The mixture was immediately stirred and its final volume was recorded.
The total volume was found to be 98 cm^3, not 100 cm^3 as expected.

No other visible changes were observed.

A few students attempted to explain the observation by providing three reasons.

(a) Reason 1: "Some ethanol molecules escaped as gas into the atmosphere." **[2]**

Do you agree with this explanation? Explain your answer.

.....

.....

(b) Reason 2: "Ethanol and water reacted to form a gas which escaped." **[2]**

Do you agree with this explanation? Explain your answer.

.....

.....

(c) Reason 3: "Ethanol particles moved into the spaces between the water particles" **[2]**

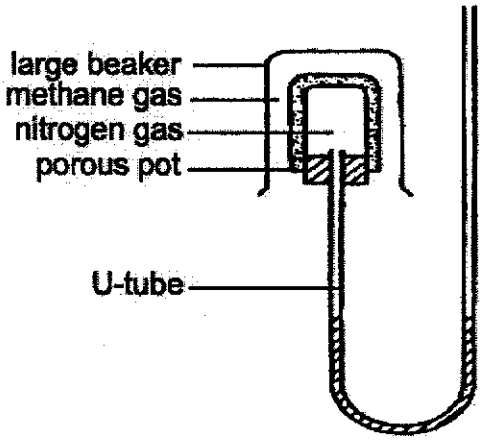
Do you agree with this explanation? Explain your answer.

.....

.....

[Total: 6 marks]

B5 In the diagram below, a large beaker full of methane gas is inverted over a porous pot containing nitrogen gas. The water level in the right-arm of the U-tube rises as a result.



(a) Explain why the water level in the right-arm of the U-tube rises. **[2]**

.....

.....

(b) Suggest a gas to replace nitrogen so that the water level in the right-arm of the U-tube drops instead. **[1]**

.....

(c) A student suggested replacing the nitrogen gas in the porous pot with ammonia gas in another similar experiment. **[2]**

Give a reason why this would not be a good idea.

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[Total: 5 marks]

B6 Magnesium is a mixture of three isotopes. The principal isotope is magnesium - 24 which constitutes about 78.9% of natural magnesium. The other two isotopes are magnesium-25 and magnesium-26. The average mass (relative atomic mass) of one magnesium atom is 24.3.

(a) Define the term 'isotopes'. **[1]**

.....

.....

(b) Calculate the percentage abundance of magnesium-25. **[3]**

[Total: 4 marks]

B7 Bromine is used to produce many useful chemicals. Sodium bromide (NaBr) is used to treat seizures in dogs and cats while tetrabromomethane (CBr_4) is used as a solvent for greases, waxes and oils.

(a) Draw the 'dot and cross' diagram to show the bonding in tetrabromomethane. Show only the valence electrons. **[2]**

(b) Sodium bromide has a melting point of 747 °C while tetrabromomethane has a melting point of 91 °C. Explain, in terms of structure and bonding, why sodium bromide has a much higher melting point than tetrabromomethane. **[3]**

.....

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.....

(c) **(i)** Name a method which may be used to separate the oils which are dissolved in tetrabromomethane. **[1]**

.....

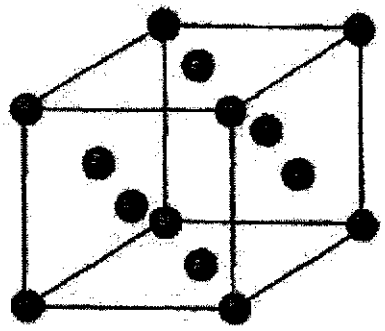
(ii) How are the liquids separated using this separation technique? **[1]**

.....

[Total: 7 marks]

B8 Copper and Iodine are both solids which have different physical and chemical properties. Each element has the same face – centered crystal structure which is shown below.

The particles present in such a crystal may be atoms, molecules, positive ions or negative ions. In the diagram above, the particles present are represented by ●



When separate samples of copper and iodine are heated to 50 ^{0}C, the copper remains as a solid while the iodine turns into a vapour.

(a) Explain, in terms of forces present in the solid structure, why iodine turns into a vapour when heated to 50 ^{0}C. **[2]**

.....

.....

.....

.....

(b) Explain, in terms of forces present in the solid structure, why copper remains a solid at 50 ^{0}C. **[2]**

.....

.....

.....

.....

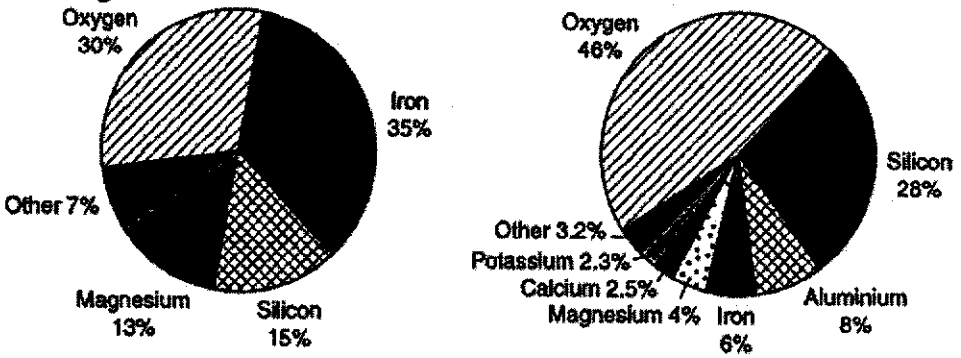
[Total: 4 marks]

Section C (30 marks)
Answer all **three** questions from this section

The last question is in the form **EITHER/OR** and only **one** alternative should be attempted.

C9 Read the information about elements and compounds in the Earth.

The Earth's crust is the thin outer layer of the Earth. The pie charts show a comparison of the percentages of elements in the whole Earth and in the Earth's crust.



Whole Earth **Crust**

In the Earth's crust, silicon and oxygen are the most abundant elements. Rocks such as quartz are made of covalently bonded compounds of silicon and oxygen. Typically, quartz contains 46.7 % silicon and 53.3 % oxygen by mass.

Some rocks such as feldspars contain ionic silicate compounds. These contain metal ions ionically bonded to silicate ions. Examples of naturally occurring silicates are shown in the table below.

name of silicate compound	formula
forsterite	Mg_2SiO_4
phenacite	Be_2SiO_4
anorthite	$CaAl_2Si_2O_8$
microcline	$KAlSi_3O_8$

The formulae of the silicate compounds are not simple. Some silicate compounds contain one type of metal ion, others contain more than one. All silicate ions contain silicon and oxygen, but the numbers of the atoms and the charges on the ions vary. For example,

- **phenacite** (Be_2SiO_4) contains only $\mathbf{Be^{2+}}$ metal ions and the formula of its silicate ion is $\mathbf{SiO_4^{4-}}$,
- **microcline** ($KAlSi_3O_8$) contains $\mathbf{K^+}$ and $\mathbf{Al^{3+}}$ metal ions and the formula of its silicate ion is $\mathbf{Si_3O_8^{4-}}$.

(a) Scientists believe that the centre of the Earth is an inner core made mainly of iron. **[1]**

What evidence from the pie charts supports this idea?

.....

.....

.....

(b) **(i)** Use the information to work out the **empirical formula** and hence the **name** of the main compound in quartz. **[3]**

empirical formula .....

name .....

(ii) There are other compounds of oxygen found in the Earth's crust as well as quartz. **[1]**

Explain how the pie chart information shows this.

.....

.....

(c) Give the formulae of the ions present in anorthite. **[1]**

.....

.....

(d) Beryllium and silicon can both be extracted from the mineral phenacite. **[4]**

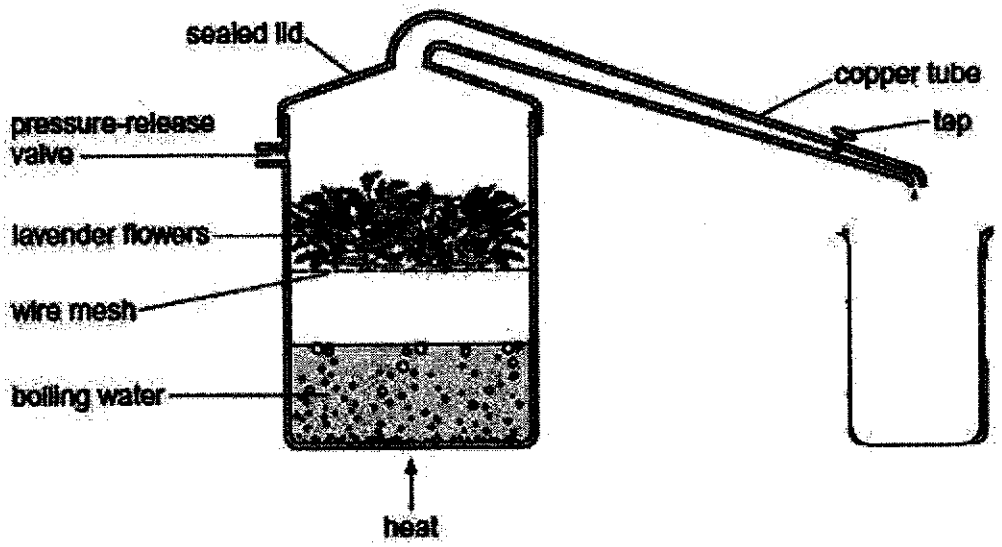
Show by calculation that 1 kg of phenacite contains a larger mass of silicon than beryllium but a larger number of moles of beryllium atoms than silicon atoms.

[Total: 10 marks]

C10 To obtain the fragrant oils used in perfumes, a method called steam distillation is often used.

Lavender oil is a perfume obtained from lavender flowers. Steam at 100°C is passed through the flower petals in the apparatus below.

Water vapour and lavender oil vapour pass down a copper tube towards a beaker.



(a) Suggest how you could heat the water to produce steam from the boiling water. **[1]**

.....

(b) Why are the lavender flowers being heated over a water bath, instead of direct heating? **[1]**

.....

.....

(c) Suggest what happens as the steam passes through the lavender petals. **[1]**

.....

(d) **(i)** The lavender flowers are heated in a container with a sealed lid. Why must the lid be sealed? **[1]**

.....

(ii) What would happen if the container did **not** have a pressure-release valve? **[1]**

.....

(e) Lavender oil vapour and water vapour cool as they pass down the copper tube. **[1]**

Suggest what is the purpose of the copper tube.

.....

(f) A mixture of two immiscible liquids collects in the beaker. **[2]**
Name the two liquids and describe, with reasons how they would appear when collected in the beaker.

.....

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.....

(g) Suggest how you would separate the mixture in part **(f)**. **[1]**

.....

(h) Suggest **one** change that you could propose to the setup of this method to improve its efficiency. **[1]**

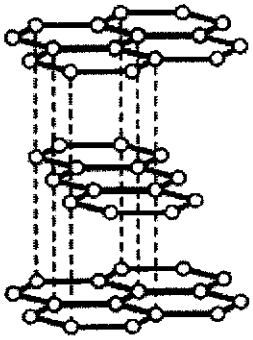
.....

.....

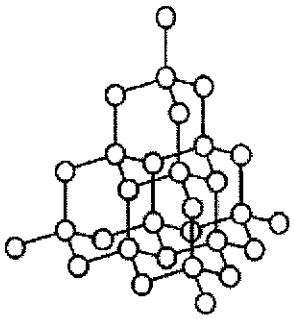
[Total: 10 marks]

EITHER

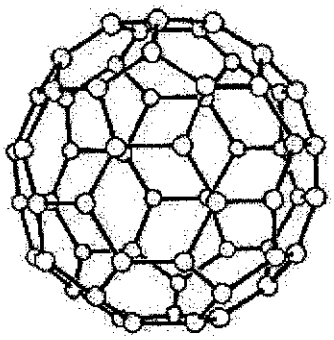
C11 (a) Graphite, diamond and fullerene are all allotropes of carbon.



Graphite



Diamond



Fullerene

(i) Explain, in terms of its structure and bonding, why graphite (m.p.= 4200 °C) has a lower melting point as compared to diamond (m.p.= 4500 °C). **[3]**

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(ii) Does fullerene conduct electricity? Explain your answer in terms of the structure and bonding of fullerene. **[2]**

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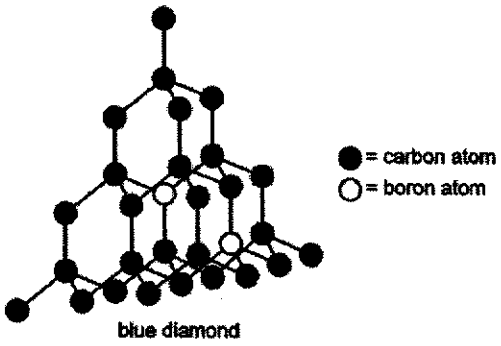
(b) Blue diamonds are an impure form of carbon. **[1]**
Part of the structure of a blue diamond is shown below.



Suggest why blue diamonds can conduct electricity.

.....

(c) Graphite, an allotrope of carbon, is used as a lubricant in industrial machineries, which are operated at very high temperatures. The carbon atoms are bonded in the way that is shown in **diagram I**.

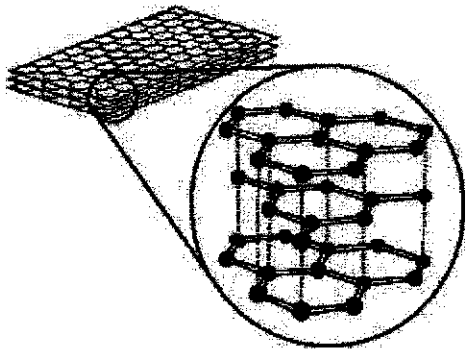


Diagram I

(i) Describe **two** characteristics of this structure of graphite that allows it to be suitable to be used as a lubricant in industrial machineries. **[2]**

Characteristic 1:.....

.....

Characteristic 2:.....

.....

(ii) In **diagram II**, a piece of pure graphite is connected to an open circuit. **[2]**

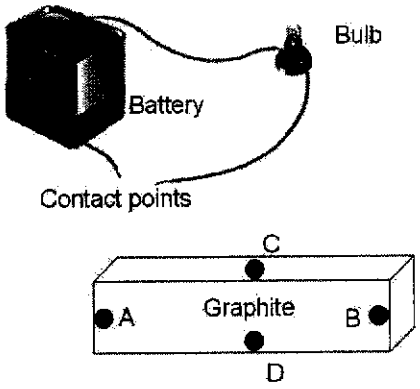


Diagram II

When the circuit is connected across points A and B, the bulb lit up very brightly. However, when the circuit is connected across points C and D, the bulb does **not** light up.

Account for this observation, with reference to the structure and bonding of graphite.

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[Total: 10 marks]

OR

C11 Read the following passage carefully.

What do a glittering diamond and a lead pencil have in common? Diamond and graphite have high melting point of 3700 ^{0}C and 3300 ^{0}C respectively and both contain a wonderful proof of creation called *carbon*.

It is very interesting that the soft, breakable graphite in a pencil tip is made up of the same atoms as a diamond. While one is soft, the other is extremely hard. Hardness is the resistance of a mineral to scratches from outside forces; it is easy to recognize minerals by this trait. The hardness of a crystal is measured on a scale devised by Friederich Mohs. By scratching one mineral with another, their relative hardness can be determined. Scientists rate diamonds with the highest ratio of *ten over ten on the Mohs scale*. Unlike diamond, *the hardness of graphite is less than one*.

Graphite is also known to be a *good conductor of electricity while diamond is an insulator*. While graphite is as black as a lump of charcoal and is commonly found in nature, diamond may be sparkling bright and is rare. For all these reasons, diamonds are much more valuable than graphite.

Adapted from: http://www.scientificamerican.com/article.cfm?id=how-can-graphite-and-diam&topicID=4

(a) Name the type of bond present in both diamond and graphite. **[1]**

.....

(b) With close reference to the bonding and structures, explain the following statements:

(i) Graphite is a good conductor of electricity while diamond is an insulator. **[3]**

.....

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(ii) Diamond can be rated "ten over ten on the Mohs scale while the hardness of graphite is less than one". [4]

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(c) Explain why carbon can combine chemically with other elements to form compounds with structures that are different from diamond and graphite. [2]

.....

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[Total: 10 marks]

– The End –

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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

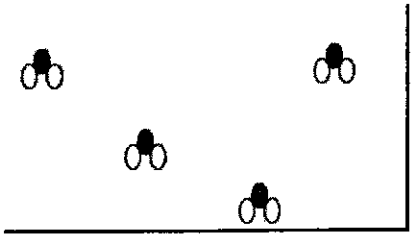
PSS 2019 Sec 3 Express Chemistry 6092 Mid – Year Exam

Marking Scheme

Section A (MCQ)

Qn	1	2	3	4	5	6	7	8	9	10
Ans	B	B	D	B	B	B	C	B	C	A
Qn	11	12	13	14	15	16	17	18	19	20
Ans	C	D	A	D	A	A	B	A	B	D
Qn	21	22	23	24	25	26	27	28	29	30
Ans	A	B	A	A	B	C	A	B	A	C

PSS 2019 Sec 3 Express Chemistry 6092 SA 1 **Marking Scheme**

	Section B		Marks	Marker's comments
B1	(a)	Arrangement: A – closely packed and regularly/orderly arranged D – slightly further away but remain close together, disorderly arranged Movement: A – vibrating at fixed position D – slide over each other	1 mark 1 mark	
	(b)	Energy is absorbed to **<u>overcome the intermolecular forces of attraction between the particles</u>** to increase the distance between them and change the arrangement of particles.	1 mark	
	(c)		1 mark	
B2	(a)	No, sample U did not produce the two spots at the same position as drugs Y and Z; Accept: same distance/ R_f values	1 mark	

	(b)	The substances have different solubility in different solvent;	1 mark	
	(c)	Starting line should be drawn in pencil; Pencil lead is insoluble in water and will not undergo separation/pen ink is soluble in water and will undergo separation; Water/solvent level should be below the starting line; To prevent sample spots from dissolving into solvent pool/sample spots will dissolve into solvent and no separation would be carried out;	1 mark 1 mark	
	(d)	distance travelled by Y = 5.5 cm; distance travelled by solvent = 10 cm;	1 mark 1 mark	
B3	P : mixture Q : mixture R : compound S : element		1 mark 1 mark 1 mark 1 mark	
B4	(a)	No. Evaporation is a slow process. Molecules need to absorb enough energy to overcome the intermolecular forces of attraction before they can escape from the surface of the liquid.	 1 mark 1 mark	No marks for just saying 'No'
	(b)	No. If a gas is formed in the mixture, effervescence will be observed	1 mark 1 mark	
	(c)	Yes.	1 mark	

		Both liquids are made up of particles and these particles can fit into the gaps between the particles.	1 mark	
B5	(a)	Methane has a **smaller relative molecular mass** than nitrogen gas. Hence, methane will **diffuse faster** into the porous pot than nitrogen gas diffusing out. The increase in pressure in pot then forces the water level to rise in the right arm.	1 mark 1 mark	
	(b)	Helium or hydrogen	1 mark	
	(c)	Ammonia gas is **very soluble** in water. Hence, it will **dissolve in water** instead of diffusing out of the porous pot/forcing the water level in the U-tube to change due to diffusion.	1 mark 1 mark	
B6	(a)	Isotopes are **atoms of the same element** with the **same no of protons** but **different no of neutrons**.	1 mark 1 mark	
	(b)	$\frac{24(78.9) + 25x + 26(21.1-x)}{100} = 24.3$ $X = 12.2\ \%$	1 mark 1 mark 1 mark	
B7	(a)		1 mark 1 mark	

	(b)	Sodium bromide has **strong electrostatic forces of attraction between oppositely-charged**, **sodium and bromide ions** which **requires a large amount of energy to overcome**. As compared to tetrabromomethane which has **weak intermolecular forces of attraction between the molecules**. These weaker attractive forces require lesser amount of energy to overcome them. Thus, sodium bromide has a higher melting point.	1 mark 1 mark 1 mark	
	(c)(i)	Fractional distillation.	1 mark	
	(c)(ii)	Different boiling points	1 mark	
B8	(a)(i)	At 50^0C, the molecules gain sufficient energy to **overcome the weak intermolecular forces of attraction**, in the solid so that the **molecules can move randomly and rapidly in all directions.**	1 mark 1 mark	
	(a)(ii)	At 50^0C, the energy gained by the Cu atoms are **not enough to overcome** the strong metallic bonds. The atoms **remain held together in fixed positions**.	1 mark 1 mark	
	Section C			
C9	(a)	From the pie chart, the whole earth contains 35% iron, while the crust only contains 6% iron. The rest of the iron must be present in the core.	1 mark	

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>(b)(i)</td><td>
<table>
<tr><td></td><td>Si</td><td>O</td></tr>
<tr><td>percentage by mass</td><td>46.7</td><td>53.5</td></tr>
<tr><td>$\div A_r$</td><td>$\frac{46.7}{28} = 1.67$</td><td>$\frac{53.5}{16} = 3.34$</td></tr>
<tr><td>$\div 1.67$</td><td>1</td><td>2</td></tr>
</table>
So, empirical formula is SiO_2.
The chemical name is silicon(IV) oxide / silicon dioxide.</td><td>1 mark

1 mark
1 mark</td><td></td></tr>
<tr><td></td><td>(b)(ii)</td><td>Silicon only makes up 28% of Earth's crust. This means only $\frac{53.3}{46.7} \times 28 = 32\%$ of oxygen from Earth's crust is found in quartz. The remaining 14% of oxygen can be found in other compounds.</td><td>1 mark</td><td></td></tr>
<tr><td></td><td>(c)</td><td>Cations: Ca^{2+} and Al^{3+}
Anion: $Si_2O_8^{8-}$</td><td>1 mark</td><td></td></tr>
<tr><td></td><td>(d)</td><td>Number of moles of phenacite in 1 kg = $\frac{1000}{110} = 9.091$ mol
So, number of moles of Be = 2×9.091 = 18.18 mol
and number of moles of Si = 9.091 mol
Mass of Be present = 18.18 x 9 = 164 g
Mass of Si present = 9.091×28 = 255 g</td><td>1 mark

1 mark

1 mark
1 mark</td><td></td></tr>
</table>

C10	(a)	From Bunsen burner	1 mark	
	(b)	The lavender oil is flammable	1 mark	
	(c)	The heat from the steam vapourises the oil into vapour.	1 mark	
	(d)(i)	It is prevents the oil vapour from escaping.	1 mark	
	(d)(ii)	Too much pressure will be built up and may break the apparatus.	1 mark	
	(e)	Acts as a condenser	1 mark	
	(f)	Water and lavender oil Collected as two separate layer with oil floating on top of water, as oil is less dense	1 mark 1 mark	
	(g)	Separating funnel	1 mark	
	(h)	Change the copper tube to a water condenser	1 mark	

C11 Either	**(a)(i)**	In graphite, within each carbon layer, **each carbon is bonded to three carbon atoms** while in diamond, each C atom is bonded to 4 other carbon atoms held together by **strong covalent bonds** and **between the layers** are **weak intermolecular forces of attraction.** In graphite, the carbon layers are held together by **weak intermolecular forces** as compared to diamond which is **held together by numerous strong covalent bonds throughout** the macromolecule. **Each carbon atom is bonded to 4 other carbon atoms.** In graphite, **less energy is needed to overcome weak intermolecular forces of attraction** as compared to the numerous strong covalent bongs in diamond.	1 mark 1 mark 1 mark	
	(a)(ii)	Yes. Like graphite, each carbon atom in fullerene is covalently bonded to three other carbon atoms. The non-bonding electron in each carbon atom are mobile to conduct electricity.	1 mark 1 mark	No marks for saying "Yes" only
	(b)	Each C atom has 4 valence electrons while each B atom has 3 valence electrons. Some C atoms have 1 unbonded electron which can conduct electricity.	1 mark	
	(c)(i)	Characteristic 1: Weak forces of attraction between layers of carbon atoms. Characteristic 2: Many strong covalent bonding between carbon atoms within each layer results in high melting point.	1 mark 1 mark	
	(c)(ii)	Conduct of electricity across points A and B occurs along the layers where the non-bonding electron of each carbon atom is mobile/ 4th valence electron not involved in bonding is free to move across the layers. Between points C and D, since no electrons are mobile across layers, electrical conductivity is not possible.	1 mark 1 mark	[Reject: "free electrons" as it is used for describing electrical conduction in metals"]

Section C				Marker's comments
C11 OR	(a)	covalent	1 mark	
	(b)(i)	3 out of 4 outer/<u>valence</u> electrons of carbon atom in graphite are used for bonding; with the 4th electron delocalised/free-moving/mobile. Hence, conducts electricity. All 4 outer electrons of carbon atom in diamond are used for bonding. No delocalised electrons for electrical conductivity.	1 mark 1 mark 1 mark	*(1st point must be correct to be awarded 2nd point mark)*
	(b)(ii)	Strong covalent bonds exists between all carbon atoms in diamond. Numerous strong covalent bonds throughout the macromolecule which gives rise to the rigid structure, making it hard. Large amount of energy required to overcome these bonds, hence, diamond is hard. Weak attraction forces exist between layers of carbon atoms in graphite. Small amount of energy required to slide layers of carbon atoms past each other, hence, graphite is soft and slippery.	1 mark 1 mark 1 mark 1 mark	
	(c)	Carbon has <u>4 electrons at the outermost shell</u>, hence it can share electrons with other non-metals; to form covalent compounds with <u>simple molecular structures</u> with weak intermolecular forces between molecules.	1 mark 1 mark	