CANBERRA SECONDARY SCHOOL

2017 Semestral Assessment 1

Secondary Two Express

SCIENCE (CHEMISTRY)

5th May 2017
1 hr 45 mins
1015 - 1200h

Name: _____ ( ) Class: _____

READ THESE INSTRUCTIONS FIRST

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

Write your full name, class and index number in the spaces provided on the question paper and on any separate writing papers used.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer ALL the questions in Section A. For each question, there are four possible answers, A, B, C and D. Choose the one you considered to be correct and record your choice in soft pencil on the Optical Test Answer Sheet (OTAS).

Answer ALL the questions in Section B in the spaces provided on the question paper. The intended marks for the question are given in the brackets at the end of the question or part question [ ].

Answer ALL the questions in Section C in the spaces provided on the question paper. The intended marks for the question are given in the brackets at the end of the question or part question [ ].

You may use a calculator for this examination.

A copy of the Periodic Table is printed on page 22.

FOR MARKER'S USE		
Section	Marks Awarded	Max Marks
A		20
B		40
C		20
Total		80

This question paper consists of 22 printed pages including the cover page.

Setter: Ms Kok Han Ni

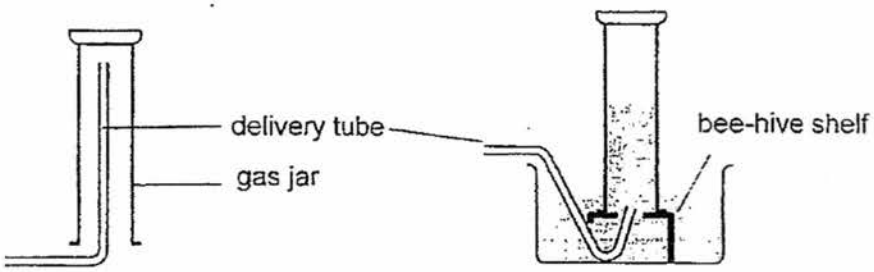
Section A [20 marks]

1 A student wishes to measure approximately 40 cm^3 of ethanol and exactly 20.8 cm^3 of water as part of an experiment.

Which apparatus should the student use to measure these volumes?

	ethanol	water
A	beaker	pipette
B	conical flask	measuring cylinder
C	burette	pipette
D	beaker	burette

2 The diagram below shows two methods for collection of gases.



method 1 to collect gas X

method 2 to collect gas Y

Which of the following properties of gas X and Y makes it possible for both gases to be collected by method 1 and 2 above?

	gas X	gas Y
A	denser than air; slightly soluble in water	less dense than air; insoluble in water
B	less dense than air; slightly soluble in water	less dense than air; soluble in water
C	less dense than air; slightly soluble in water	less dense than air; insoluble in water
D	less dense than air; insoluble in water	less dense than air; soluble in water

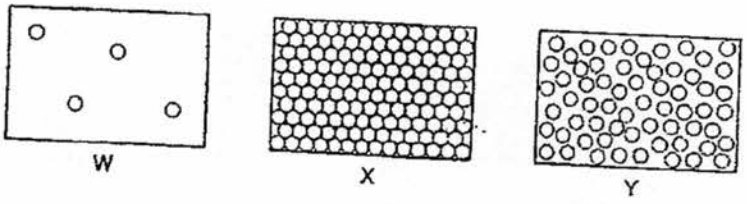
3 Which of the following shows the correct S.I unit for each quantity?

	mass	temperature	time
A	g	K	s
B	g	°C	min
C	kg	°C	s
D	kg	K	s

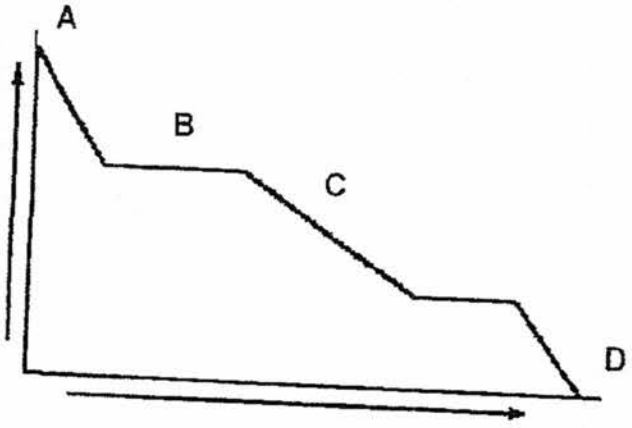
4 Which changes occur when dry ice sublimes?

	separation of particles	energy of particles	attractive force between particles
A	decreases	increases	decreases
B	decreases	decreases	increases
C	increases	increases	decreases
D	increases	decreases	increases

5 Diagrams **W**, **X** and **Y** show how the particles of a substance are arranged at different temperatures.



The graph shows the temperature changes which occur on cooling the substance. In which region of the graph would all the particles be arranged as in **Y**?



6 Sodium chloride is the common salt used in cooking. What is the boiling point of a sample of sodium chloride solution?

A 89°C
B 96°C
C 100°C
D 104°C

7 The table below shows the melting and boiling points of four pure substances. Which substance will undergo a change in physical state when heated from 30°C to 50°C?

	melting point/ °C	boiling point/ °C
A	-9	24
B	20	89
C	45	108
D	367	951

8 Hexane boils at 68°C and ethanol boils at 89°C. Both are completely miscible with each other. Which method is best used to separate a mixture of these two liquids?

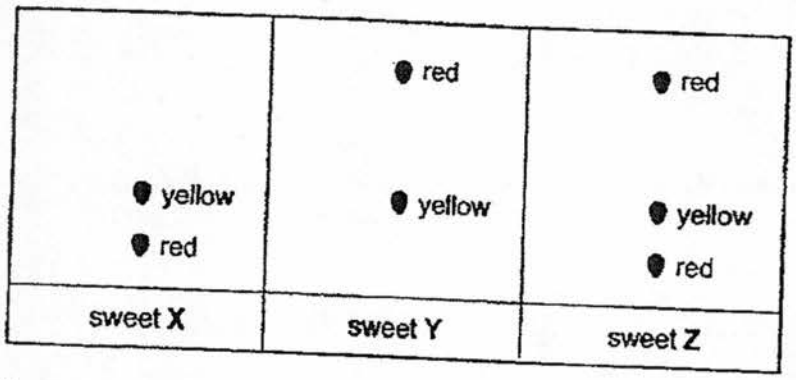
A evaporation
B crystallisation
C simple distillation
D fractional distillation

9 Sugar crystals can be separated from sand by using the processes shown. What is the correct order for the processes?

first ⟶ last

A filter → dissolve → evaporate → crystallise
B dissolve → evaporate → crystallise → filter
C dissolve → evaporate → filter → crystallise
D dissolve → filter→ evaporate → crystallise

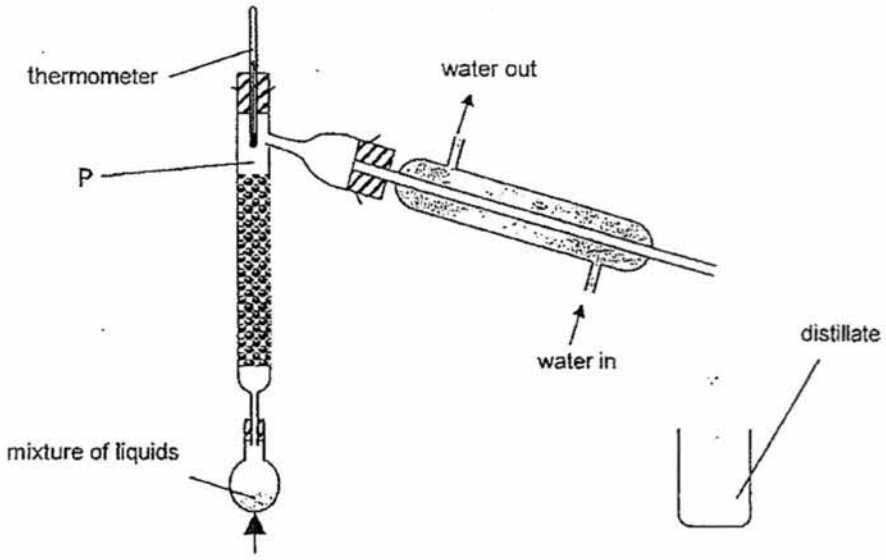
10 The diagram shows a chromatogram obtained from the colouring of three different sweets, X, Y and Z.



How many different colourings are present in the three sweets?

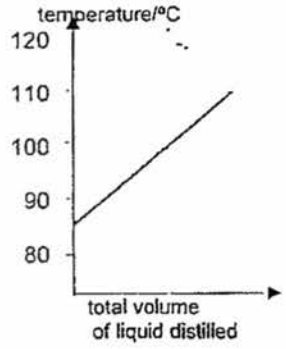
A 2
B 3
C 4
D 5

11 The diagram shows apparatus used to separate a mixture of two liquids with boiling points 85°C and110°C.

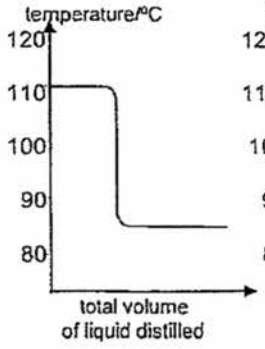


Which graph would be obtained if the temperature at point P was plotted against the total volume of distillate produced?

A



B



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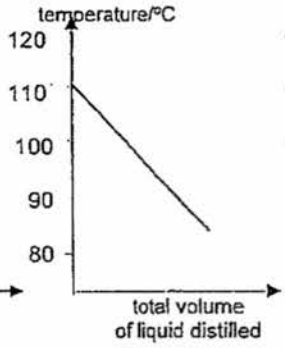
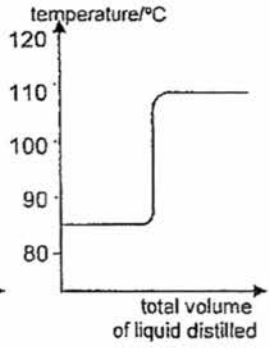
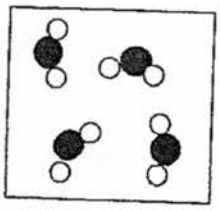
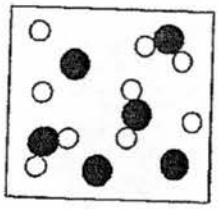


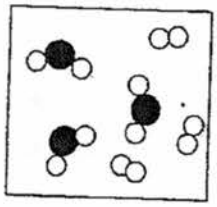
D

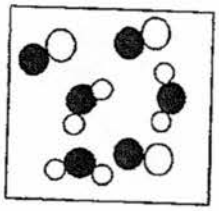


12 Which of the following diagram shows a mixture of a compound and an element?

A 

B 

C 

D 

13 Which compound contains three different non-metallic elements?

A C_2H_5Br
B $NaPH_4$
C H_2O
D NH_3

14 Which pair of substances contain both mixtures?

A air and sea water
B oxygen and orange juice
C water and carbon dioxide
D water and air

15 An ion X^+ has electronic configuration 2, 8. How many electrons does an atom of this element have?

A 1 B 5 C 10 D 11

16 Which of the following pairs of particles contains the same number of electrons?

A H^+ and Be^{2+}
B O^{2-} and K^+
C Al^{3+} and Cl^-
D F^- and Ne

17 An isotope of element X has 20 protons and 20 neutrons in its nucleus. Which symbol is correct for the ion of X?

A $^{20}_{20}X^{2+}$ B $^{40}_{20}X^{2+}$ C $^{20}_{20}X^{2-}$ D $^{39}_{20}X^{2-}$

18 Which of the following atom represents a chemically inert element?

A $^{7}_{3}Y$ B $^{14}_{7}Y$ C $^{20}_{10}Y$ D $^{32}_{16}Y$

19 What is the chemical formula of the compound formed between $^{23}_{11}A$ and $^{31}_{15}B$?

A AB
B A_2B
C A_3B
D A_3B_2

20 Metal X forms a sulfate with a chemical formula of $X_2(SO_4)_3$. What would the chemical formula be if X were to form a nitrate?

A XNO_3
B $X(NO_3)_2$
C X_2NO_3
D $X(NO_3)_3$

~End of section A~

Section B [40 marks]

Answer **ALL** questions in the spaces provided on the question paper.

1 Use the data given in the table below to answer the questions that follow:

element	melting point / °C	boiling point / °C
A	-106	-39
B	-28	0
C	-3	37
D	101	222
E	589	1201

(a) Which substances are solids at room temperature?

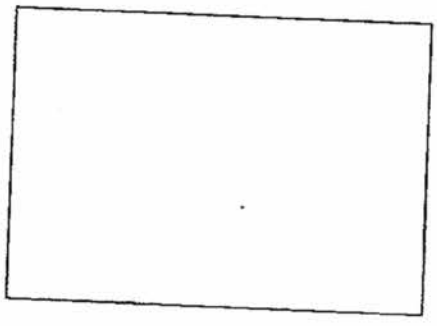
..... [1]

(b) Carbon tetrachloride (CCl_4) exists as a volatile liquid at room temperature. Which substance is likely to be carbon tetrachloride? Explain your answer. [2]

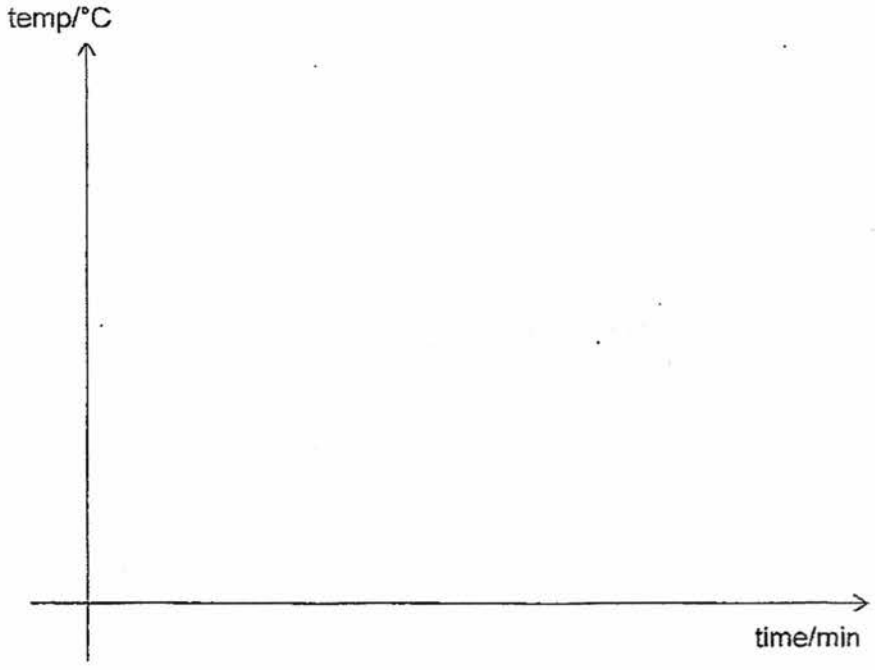
.....

.....

(c) In the box below, draw the arrangement of the particles for element **A** at -107°C. [1]



(d) Using the axis provided, sketch the heating curve for a pure sample of element E when it is heated from 500°C to 1300°C. Indicate the temperature at which changes occur clearly in the graph. [3]



(f) Describe the changes in arrangement of the particles in element E when the temperature increases from 1200°C to 1300°C. [2]

.....

.....

.....

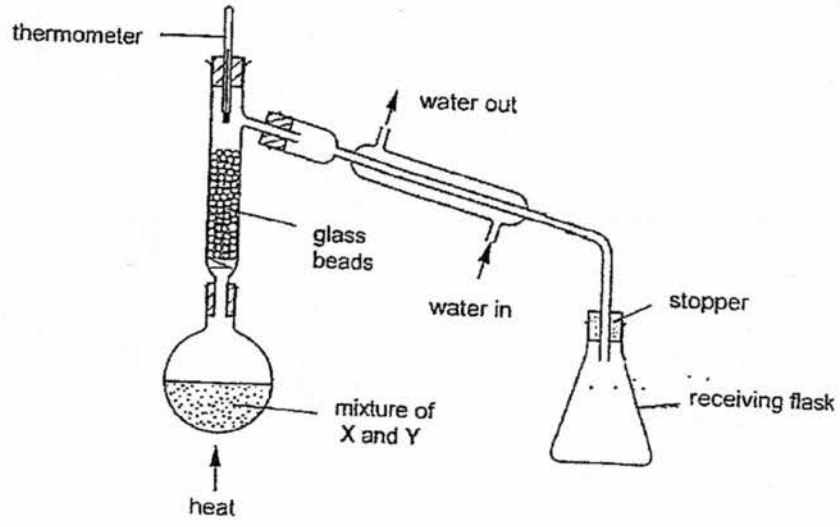
.....

.....

2 The table below shows the melting and boiling points of substances X, Y and Z.

substance	melting point/°C	boiling point/°C
X	-20	80
Y	11	65
Z	2	18

Adam tries to separate a mixture containing X and Y by using the apparatus as shown below.



(a) Suggest the purpose of adding glass beads in the fractionating column. [1]

.....

.....

(b) State one error that Adam has made in his above set-up. [1]

.....

.....

(c) Which substance would be obtained last? Explain your answer. [1]

.....

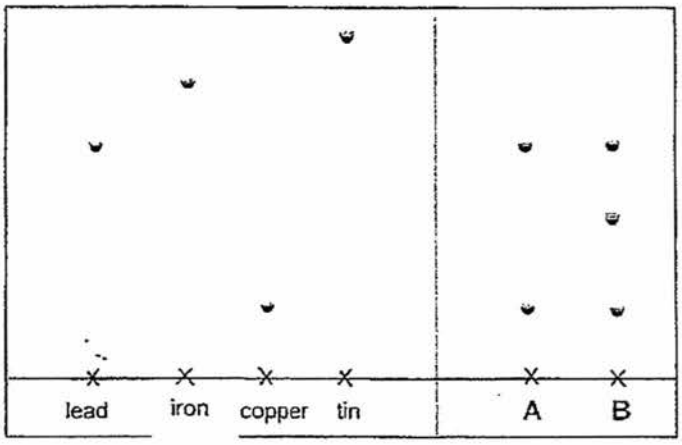
(d) Explain why the technique as shown above cannot be used to separate a mixture of Y and Z at room temperature. [1]

.....

.....

3 Two copper alloys, A and B, were dissolved in acid to produce solutions of metal compounds from the alloys. The solutions were then used in a chromatography experiment to separate and identify the metals present.

The chromatograph below shows the metals present in the two copper alloys, A and B.



(a) Name the metals present in alloy A. [1]

.....

(b) Name one metal absent from alloy B. [1]

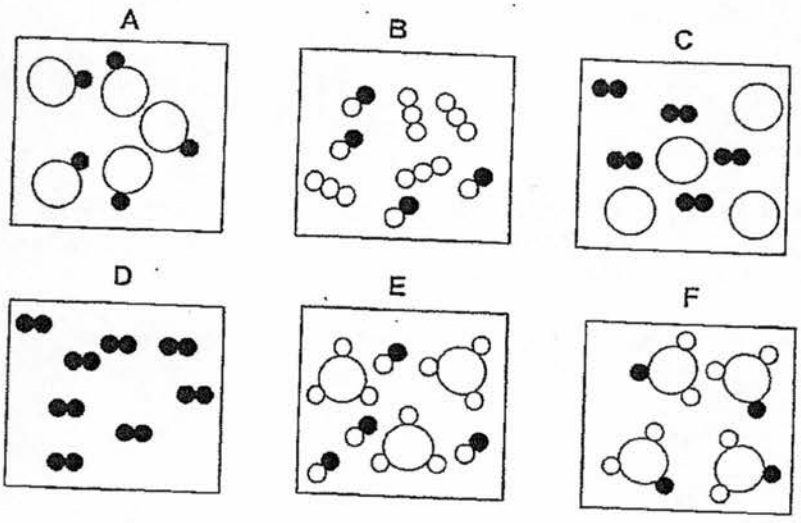
.....

(c) Are the two copper alloys the same? Explain your answer. [2]

.....

.....

4 The following diagrams show the compositions of six different materials (**A** to **F**) in terms of the arrangement of their atoms. There are three kinds of atoms represented by ◯ , ○ and ●.



Which of the diagram(s) **A**, **B**, **C**, **D**, **E** and **F** represent

(a) pure compound ..... [1]

(b) mixture of elements ..... [1]

5 In the table below, state two differences between a compound and mixture. [4]

compound	mixture

6 Use the following information to answer questions below about the particles A, B, C, D, E, F and G.

particle	charge	atomic number	mass number	number of electrons	electronic structure
A	1-	9	19	10	2, 8
B	0	7	14	7	2, 5
C	0	10	20	10	2, 8
D		15	31	18	2, 8, 8
E		3	4	2	2
F	0	20	40	20	
G	0	7	16	7	

(a) Complete the table above. [2]

(b)(i) Which particle is a stable atom? ..... [1]

(ii) Explain why this particle is electrically neutral. [1]

.....

.....

(c) Which particle has the most number of electron shells? ..... [1]

(d) Which particle is an atom containing 9 neutrons? ..... [1]

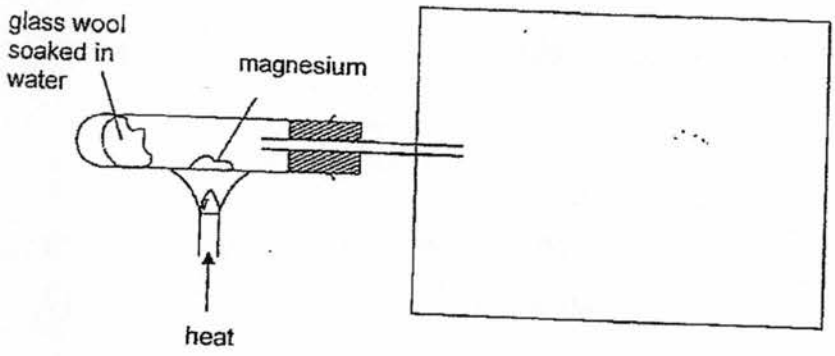
(e) Which two particles are isotopes? Explain your answer. [2]

.....

.....

(f) Draw the electronic structure of **D**. Indicate the charge on the particle if any. You do not have to show the number of protons and neutrons. [2]

7 In the experiment below, magnesium metal reacts with steam to produce hydrogen gas as one of its products.



(a) In the box above, complete the diagram to show how hydrogen gas can be collected and measured. Label the apparatus drawn. [2]

(b) Describe a chemical test to confirm the presence of hydrogen gas. [1]

.....

.....

8 Complete the following table below. [4]

name of compound	cations (positive ions)	anions (negative ions)	chemical formula of compound
ammonium nitrate	NH_4^+		
aluminium carbonate	Al^{3+}		
nickel(II) nitride			Ni_3N_2
iron(III) hydroxide	Fe^{3+}		

~End of Section B~

Section C (20 marks)

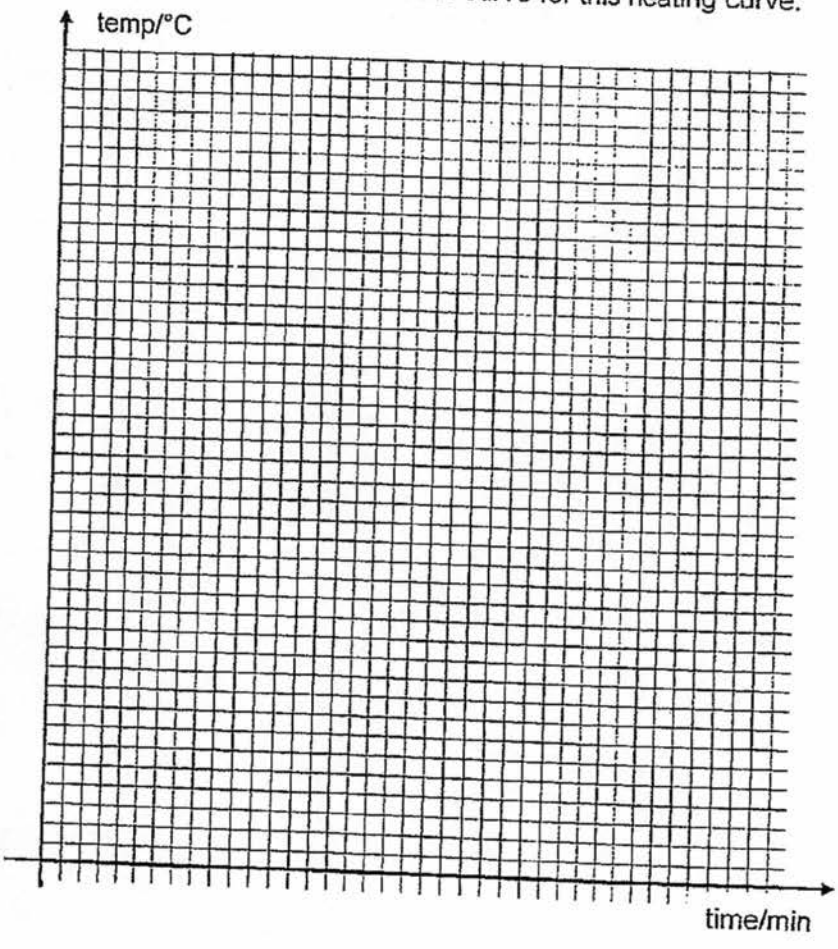
Answer **ALL** questions in the spaces provided below.

1 Sabrina carried out an experiment which involves the heating of solid mercury(II) oxide, HgO at room temperature. After heating, oxygen gas and a silvery liquid is produced. He decided to examine the silvery liquid further by heating it.

The table below shows how the temperature of the silvery liquid changed with time during heating.

time / min	0	1	2	3	4	5	6	7	8	9	10	11
temp / °C	20	40	60	90	130	170	210	260	300	315	320	320

(a) Using the data above, plot a graph of temperature against time on the grid provided below. Draw a smooth curve for this heating curve. [2]



(b) From your graph, deduce the boiling point of the silvery liquid. [1]

.....

(c) Suggest the identity of the silvery liquid formed. [1]

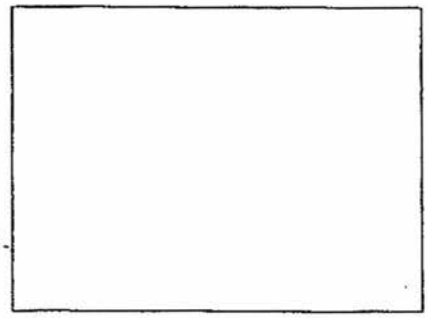
.....

(d) Is mercury(II) oxide a compound? Explain your answer with reference to the experiment above. [2]

.....

.....

(e) Using ◯ to represent an oxygen atom, draw a diagram to show how the diatomic molecules of oxygen gas are arranged at room temperature. [2]



2 The table below shows the solubilities of three solids in two solvents, water and methylbenzene.

solid	solubility in water	solubility in methylbenzene
sand	insoluble	insoluble
sodium chloride	soluble	insoluble
sulfur	insoluble	soluble

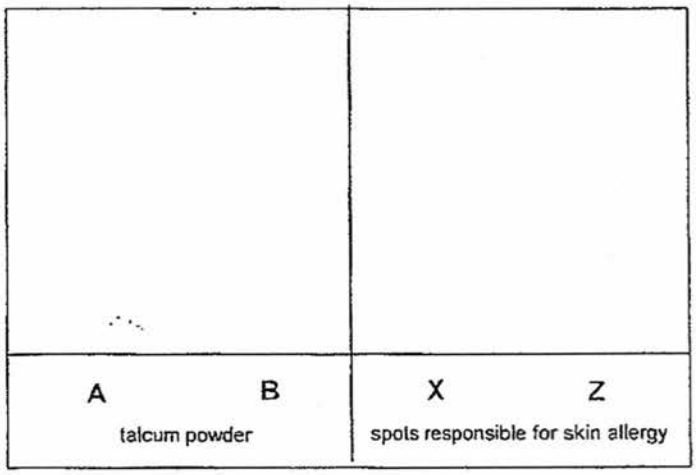
Describe how you would obtain pure, dry samples of both sand and sodium chloride given a mixture of all three solids. [5]

3 In an experiment, solutions from 2 different samples of talcum powder, **A** and **B** were obtained. Spots of **A** and **B** were placed on a chromatography paper, together with spots of substances responsible for skin allergy, **X** and **Z**. The paper was then placed in a large beaker containing a solvent.

The results of the experiment led a student to suggest that:

- **A** contains both **X** and **Z**.
- **B** contains **Z** and an unknown that is more soluble than **X** in the solvent.
- **X** and **Z** are pure substances.
- **X** is less soluble than **Z** in the solvent.

(a) Complete the diagram below to show how the chromatograph should look like based on the above conclusion. [2]



(b) The formula of talcum powder was given in old textbooks as $Mg_3Si_4O_{12}H_2$. This formula is rearranged in modern textbooks as $Mg_3Si_4O_x(OH)_y$.

Given the table below, deduce the values of **x** and **y** in the modern formula. [2]

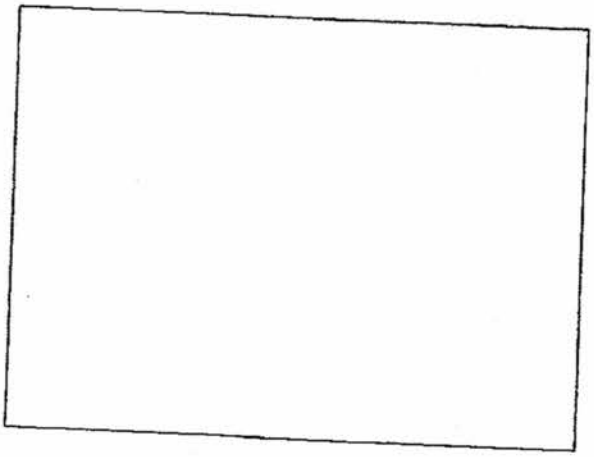
	Mg	Si	O	H
no. of atoms	3	4	12	2

(c) (i) Magnesium is the main element present in talcum powder. Suggest whether it is metallic or non-metallic. Explain your answer. [2]

.....

.....

(ii) In the box below, draw the electronic structure of a magnesium atom. [1]



~End of paper~

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										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 226	89 - 103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bhorium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernecium -		114 Fl flevovium -		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.)

CANBERRA SECONDARY SCHOOL

2017 Semestral Assessment 2

Secondary Two Express

SCIENCE (PHYSICS)

6 Oct 2017
1 hour 45 minutes
0800 - 0945h

Name: _____ ( ) Class: _____

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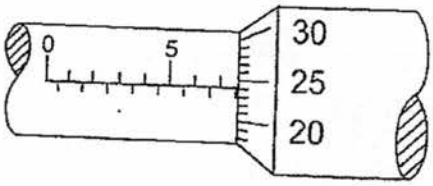
Setter: Mr Ho J E

Section A [20 marks]

1 Which of the following mass is the smallest?

A $2x10^{-5}$ kg
B $2x10^{-1}$ g
C $2x10^{5}$ ng
D $2x10^{2}$ mg

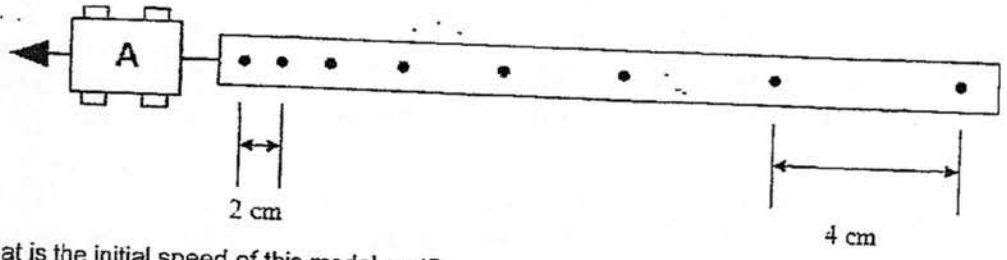
2 A micrometer is used to measure the diameter of a brass rod.



If the zero error of the micrometer is -0.06 mm, what is the length of the rod?

A 5.18 mm
B 5.80 mm
C 7.18 mm
D 7.80 mm

3 A model cart is attached to a ticker tape, which runs through a ticker tape timer working at 50 Hz, as shown below.



What is the initial speed of this model cart?

A 0.04 cm/s
B 0.08 cm/s
C 100 cm/s
D 200 cm/s

4 Earthquakes are caused by seismic waves. In a particular earthquake, the seismic wave has a frequency of 15 Hz. What is the period of oscillation of the ground?

A 0.03 s
B 0.07 s
C 0.12 s
D 0.24 s

5 Which of the following is **not** true about mass and weight?

	mass	weight
A	is a scalar	is a vector
B	can be measured by mass balance	can be measured by newton-meter
C	does not depends on gravity	depends on gravity
D	depends on the density of the object	does not depend on the density of object

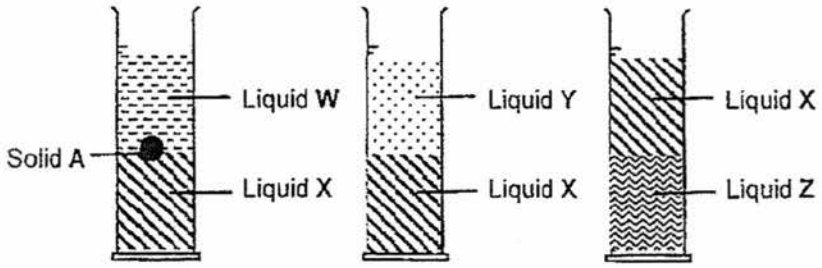
6 Which of the following changes can cause a moving car to have higher inertia?

A when the car is moving faster
B when the car is moving slower
C when more passengers are sitting inside
D when the car is going down a slope

7 A piece of wooden block has a weight of 0.5 N on the Earth. What is the weight of the same block on the Moon? The gravitational field strength of the Earth and the Moon is 10 N/kg and 1.6 N/kg respectively.

A 0.03 N
B 0.08 N
C 3.13 N
D 8.00 N

8 A few experiments are carried out to compare the density of different substances.



Which of the following statement must be true?

A When solid **A** is placed in the liquid **Y**, it will sink.
B When solid **A** is placed in the liquid **Z**, it will float.
C Liquid **X** is the densest liquid.
D Liquid **W** is the least dense liquid.

9 What is the gain of kinetic energy of a 10 g ball when it falls a distance of 5 m. The gravitational field strength is 10 N/kg, and you may ignore air resistance.

A 0.05 J
B 0.50 J
C 50.0 J
D 500 J

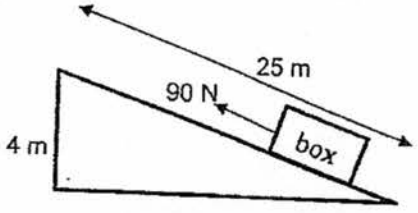
10 Jon carries 5 bricks onto a 2 m high platform in 45 s. The mass of each brick is 150 g. What is the power produced? The gravitational field strength is 10 N/kg.

A 0.33 W
B 1.50 W
C 3.33 W
D 15.0 W

11 A basketball is dropped from a certain height. Just before it hits the ground, it has a speed of 10 m/s. When it rebounds, it reaches only half the previous height. What is the speed of the ball just before it hit the ground the second time? The gravitational field strength is 10 N/kg, and the effect of air resistance is negligible.

A 2.5 m/s
B 5.0 m/s
C 7.07 m/s
D 10.0 m/s

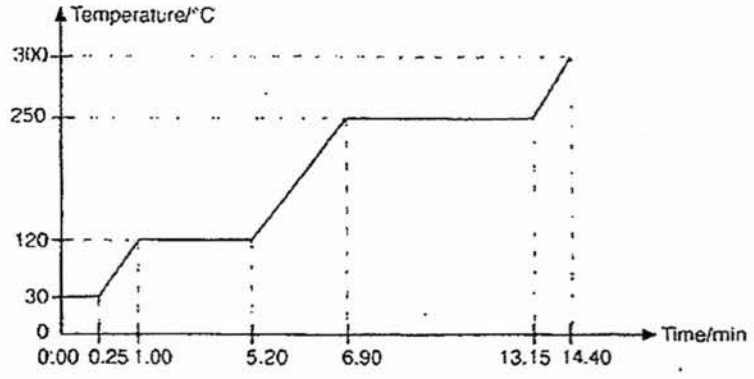
12 A box of 10 kg is being pushed up a slope with a force of 90 N as shown in the diagram below.



The length of the slope is 25 m, the height of the slope is 4 m. What is the work done against gravity?

A 360 J
B 400 J
C 1850 J
D 2250 J

Answer questions **13** to **15** based on the heating curve of substance X shown below. The substance **X** is heated with a 2 kW heater.



13 What is the boiling point of substance X?

A 30°C
B 120°C
C 250°C
D 300°C

14 What is the increase in internal potential energy of substance X during melting?

A 0 J
B 30 kJ
C 504 kJ
D 750 kJ

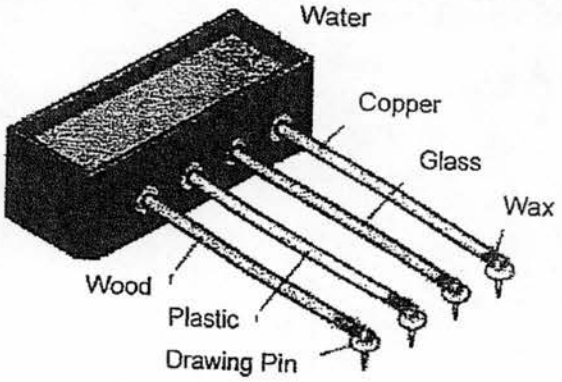
15 Which of the following statement is true for substance X at the end of 14 min?

A Particles in X are vibrating at fixed positions.
B Particles in X are closely packed.
C Forces of attraction between particles in X is very weak.
D Particles in X expands.

16 Which of the following is true when steam condenses to water?

	kinetic energy	potential energy
A	increases	remain the same
B	decreases	Increases
C	increases	Decreases
D	remain the same	Decreases

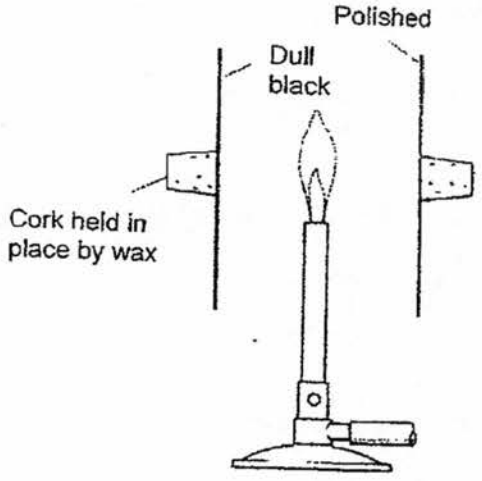
17 In an experiment, boiling water is poured into the apparatus below.



Which rod will heat up faster so that the wax melts and the drawing pin falls?

A Copper
B Glass
C Plastic
D Wood

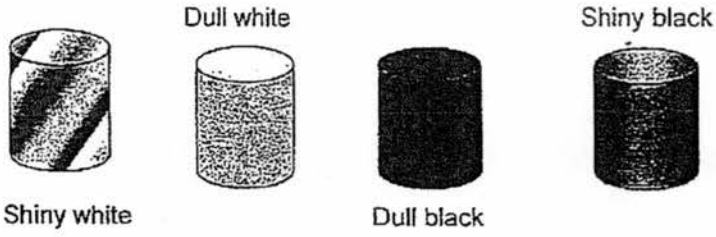
18 In the experiment set up below, the wax melts soon after the flame is turned on.



What is the main process of heat transfer?

A conduction
B convection
C radiation
D all of above

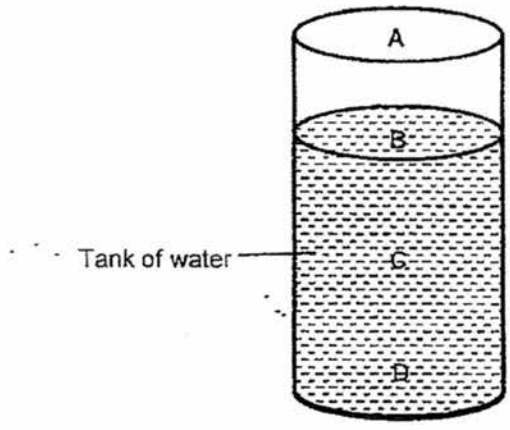
19 Four containers made from the same material are filled with ice as shown below.



Which container will have the most un-melted ice after 5 minutes?

A shiny white
B dull white
C shiny black
D dull black

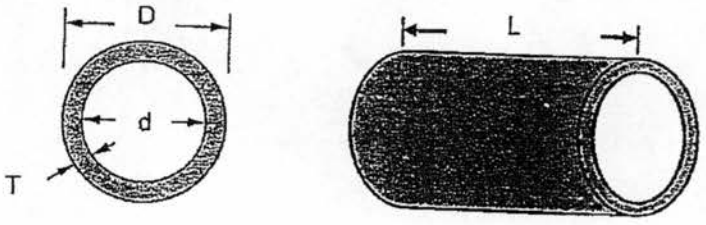
20 In order to cool down a tank of water quickly as shown below, where should the chiller element be placed?



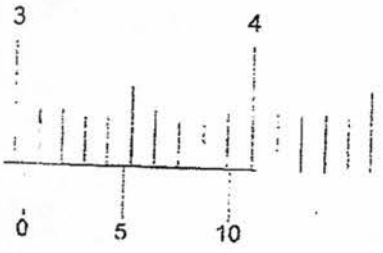
End of Section A

Section B [40 marks]
Answer **ALL** questions in the space provided

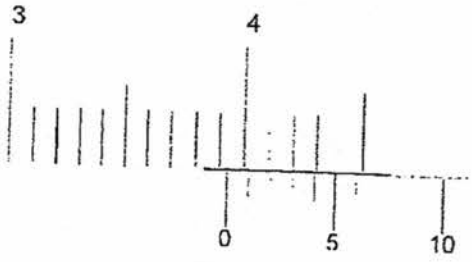
1 The diagram below shows how a length of iron pipe can be measured. The important measurements of a pipe includes the internal diameter (d), the external diameter (D), the wall thickness (T) as well as the length (L).



The internal and external diameters are measured by a vernier caliper, which has no zero error. The results are shown below.



Internal Diameter



External Diameter

(a) What is the

(i) internal diameter of the pipe, ... [1]

(ii) external diameter of the pipe? ..... [1]

(b) Calculate the thickness of the wall.

T = ... cm [1]

(c) Describe a method to increase the accuracy of the measurement. [1]

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(d) Explain why a pipe made of metal is a better conductor of heat compared to styrofoam. [2]

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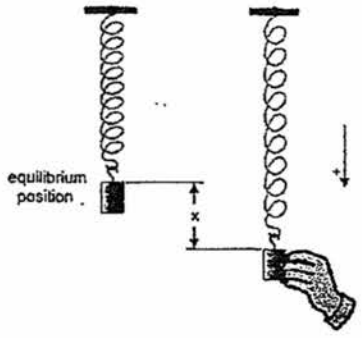
2 A suspended spring with a mass attached is displaced downwards and released. It oscillates up and down with a frequency of 4 Hz.



(a) Explain what it is meant by 'a frequency of 4 Hz'. [1]

.....

(b) Calculate the period of the oscillation.

period = ... s [1]

(c) Suggest two ways to ensure that the period measured is accurate. [2]

.....

.....

.....

(d) Calculate the time it takes for the mass to pass the equilibrium position for the first time.

time = ... s [1]

3 A laboratory is testing the robotic arms of a Lunar Rover. The arms needs to be able to lift 100 g of rock samples on the Moon. The gravitational field strength at the surface of the Moon is 1.6 N/kg.

(a) Explain what is meant by " the gravitational field strength at the surface of the Moon is 1.6 N/kg" . [1]

.....

.....

(b) Calculate the force needed to lift a 100 g rock on the Moon

force = ... N [1]

(c) The test shows that the robotic arm can lift up to 50 g rock on the Earth. Explain if this arm is suitable for the rover. The gravitational field strength on Earth is 10 N/kg. [2]

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4 Bronze is an alloy made up of the following two metals. Copper and tin are not miscible.

metal	% volume	density / (g/cm^3)	boiling point / °C	melting point/ °C
copper	84%	8.96	1084	2562
tin	16%	7.265	231	2602

(a) Calculate the mass of copper and tin in 100 cm^3 of bronze.

mass of copper = ... g

mass of tin = ... g [2]

(b) Calculate the total mass of 100 cm^3 of bronze.

mass = ... g [1]

(c) Hence, calculate the density of bronze in kg/m^3.

density = ... kg/m^3 [2]

(d) If a solid piece of bronze is placed inside mercury, which has a density of 13560 kg/m^3, will it float or sink? Explain your answer. [1]

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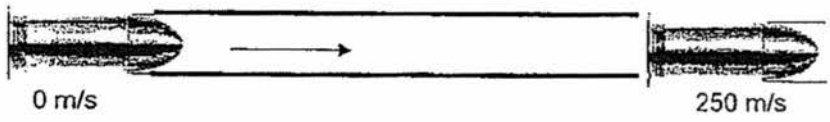
5 A 0.22 revolver bullet has a mass of 1.7 g. When the revolver fires, the gun powder pushes the bullet out of the 30 cm gun barrel with a speed of 250 m/s.



(a) Calculate the kinetic energy of the bullet as it leaves the gun barrel.

kinetic energy = ... J [2]

(b) Calculate the size of the force pushing the bullet out of the barrel.

force = ... N [2]

(c) Calculate the power produced by the gun powder if the bullet remains in the barrel for 0.2 s.

power = ... W [1]

(d) If such a bullet is fired upwards, calculate the maximum height it can reach.

height = ... m [2]

6 (a) State the kinetic theory of matter. [1]

.....

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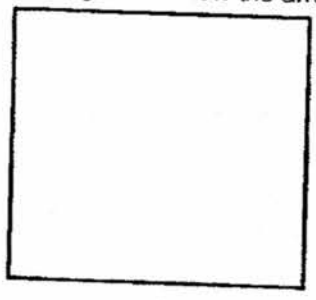
(b) In the space below, draw a diagram to show the arrangement of particles in a solid. [1]



(c) By referring to the particles in the matter, explain

(i) why the density of a gas is very low; [1]

.....

.....

(ii) why liquid takes the shape of the container it is in. [1]

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7 Homeostasis is the ability of living organisms to cope with temperature changes. When the weather is hot, human beings perspire to keep themselves cool.

(a) Explain, in terms of particles, how evaporation of perspiration cools down the body. [2]

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(b) State two differences between boiling and evaporation. [2]

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(c) Describe the changes in the arrangement of water particles when it turns from liquid to gas. [2]

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(d) State what happens to the kinetic and potential energy of the water as it boils? [2]

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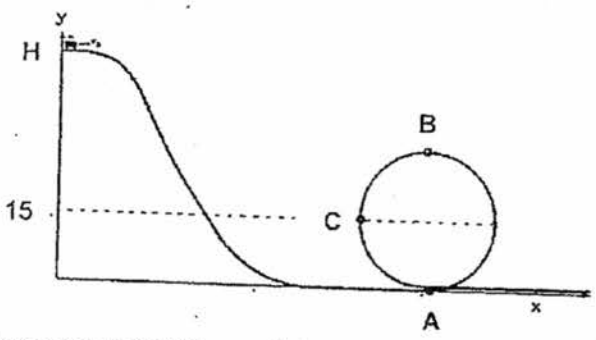
End of Section B

Section C [20 marks]

Answer **ALL** questions in the space provided

1 A Roller coaster moves through a vertical loop of 15 m radius as shown in the diagram below.



The mass of the roller coaster is 1500 kg and it has a speed of 3 m/s at position H. In order for the roller coaster to pass through the loop safely, the minimum speed of the rollercoaster must be more than 12.2 m/s.

(a) At which position of the loop (**A**, **B** or **C**) does the rollercoaster have the lowest speed? Explain your answer. [2]

.....

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.....

(b) Calculate the kinetic energy of the roller coaster at when it passes the loop safely with a speed of 12.2 m/s.

kinetic energy = ... [2]

(c) Calculate the gravitational potential energy of the rollercoaster at position **B**.

gravitational potential energy = ... [2]

(d) Calculate the minimum height H so that the rollercoaster can pass through the loop safely.

height = ... [3]

(e) The actual height needed is higher than the answer calculated in (d). Explain why this is so. [1]

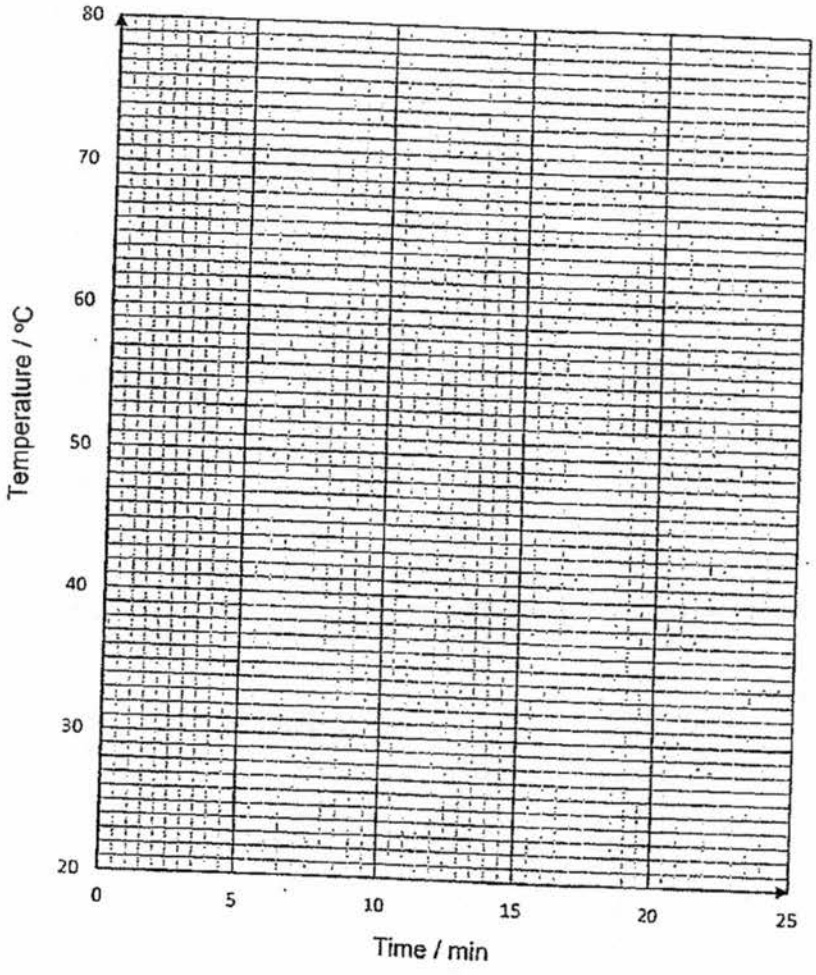
.....

.....

2 A clay pot and a iron pot are filled with equal volume of water and placed on the stove of the same heating power. The temperature of the water is measured every 2 minutes and is recorded in the table below.

Time / min	Temperature / °C	
	Clay pot	Iron pot
0	25	25
2	28	30
4	31	35
6	34	40
8	37	45
10	40	50
12	43	55
14	46	60
16	49	65
18	52	70
20	55	75

(a) Plot a graph of temperature against time for the two different pots on the next page. Label your graphs clearly. [2]



(b) Based on the graph, which pot conducts heat faster to the water? Explain your answer. [2]

.....

.....

(c) Calculate the gradient of the graph for the iron pot. Show your working clearly.

gradient = ... [2]

(d) By referring to the particles in the clay pot, explain how heat is transferred through it. [2]

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(e) Explain how all the water in the clay pot become heated. [2]

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End of Paper

CANBERRA SECONDARY SCHOOL

2017 Semestral Assessment 1

Secondary Two Express

SCIENCE (CHEMISTRY)

5th May 2016
1 hr 45 mins
1015 - 1200h

Name: _____ ( ) Class: _____

READ THESE INSTRUCTIONS FIRST

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

Write your full name, class and index number in the spaces provided on the question paper and on any separate writing papers used.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer ALL the questions in Section A. For each question there are four possible answers, A, B, C and D. Choose the one you considered to be correct and record your choice in soft pencil on the Optical Test Answer Sheet (OTAS).

Answer ALL the questions in Section B in the spaces provided on the question paper. The intended marks for the question are given in the brackets at the end of the question or part question [ ].

Answer ALL the questions in Section C in the spaces provided on the question paper. The intended marks for the question are given in the brackets at the end of the question or part question [ ]

You may use a calculator for this examination.

A copy of the Periodic Table is printed on page 21.

FOR MARKER'S USE		
Section	Marks Awarded	Max Marks
A		20
B		40
C		20
Total		80

This question paper consists of 21 printed pages including the cover page.

Setter: Ms Kok Han Ni

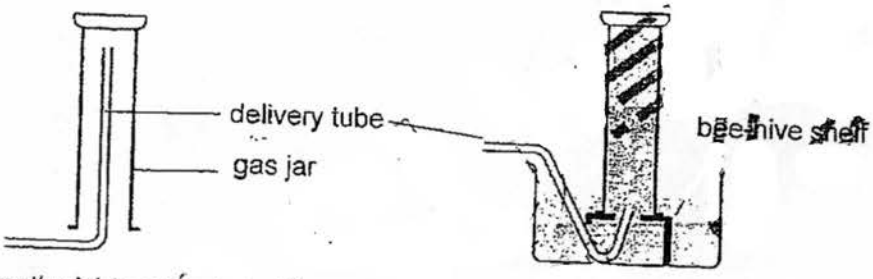
Section A [20 marks]

1 A student wishes to measure approximately 40 cm^3 of ethanol and exactly 20.8 cm^3 of water as part of an experiment.

Which apparatus should the student use to measure these volumes?

	ethanol	water
A	beaker	pipette
B	conical flask	measuring cylinder
C	burette	pipette
D	beaker	burette

2 The diagram below shows two methods for collection of gases



method 1 to collect gas X

method 2 to collect gas Y

Which of the following properties of gas X and Y makes it possible for both gases to be collected by method 1 and 2 above?

	gas X	gas Y
A	denser than air; slightly soluble in water	less dense than air; insoluble in water
B	less dense than air; slightly soluble in water	less dense than air; soluble in water
C	less dense than air; slightly soluble in water	less dense than air; insoluble in water
D	less dense than air; insoluble in water	less dense than air; soluble in water

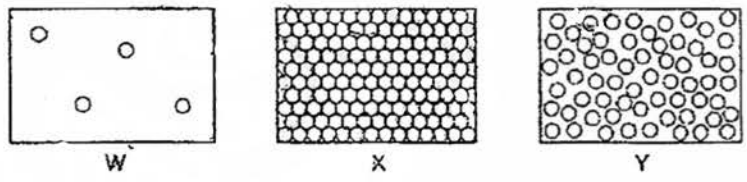
3 Which of the following shows the correct S.I unit for each quantity?

	mass	temperature	time
A	g	K	s
B	g	°C	min
C	kg	°C	s
D	kg	K	s

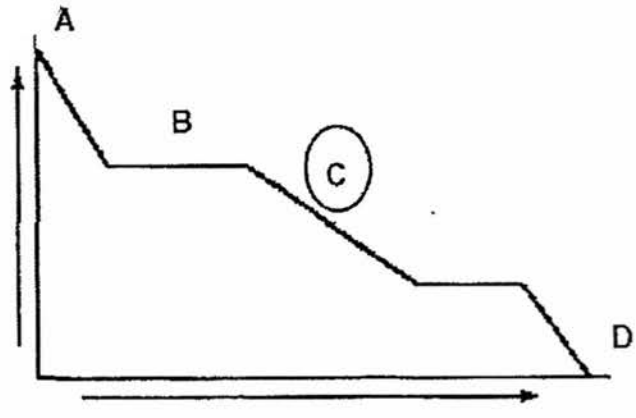
4 Which changes occur when dry ice sublimes?

	separation of particles	energy of particles	attractive force between particles
A	decreases	increases	decreases
B	decreases	decreases	increases
C	increases	increases	decreases
D	increases	decreases	increases

5 Diagrams **W**, **X** and **Y** show how the particles of a substance are arranged at different temperatures.



The graph shows the temperature changes which occur on cooling the substance. In which region of the graph would all the particles be arranged as in Y?



6 Sodium chloride is the common salt used in cooking. What is the boiling point of a sample of sodium chloride solution?

A 89°C
B 96°C
C 100°C
D 104°C

7 The table below shows the melting and boiling points of four pure substances. Which substance will undergo a change in physical state when heated from 30°C to 50°C?

	melting point/ °C	boiling point/ °C
A	-9	24
B	20	[illegible]
C	45	[illegible]
D	367	951

8 Hexane boils at 68°C and ethanol boils at 89°C. Both are completely miscible with each other. Which method is best used to separate a mixture of these two liquids?

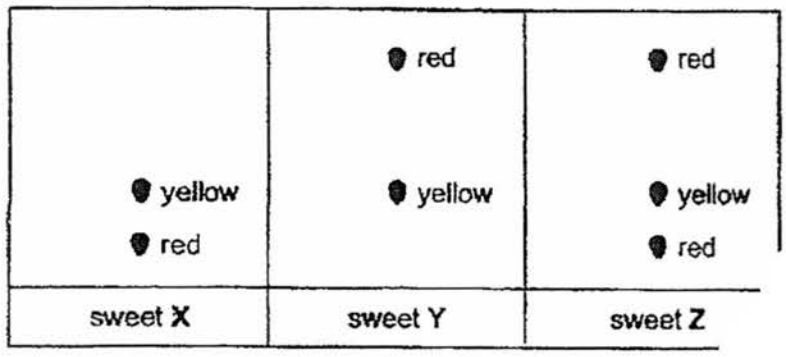
A evaporation
B crystallisation
C simple distillation
D fractional distillation

9 Sugar crystals can be separated from sand by using the processes shown. What is the correct order for the processes?

first ⟶ last

A filter → dissolve → evaporate → crystallise
B dissolve → evaporate → crystallise → filter
C dissolve → evaporate → filter → crystallise
D dissolve → filter → evaporate → crystallise

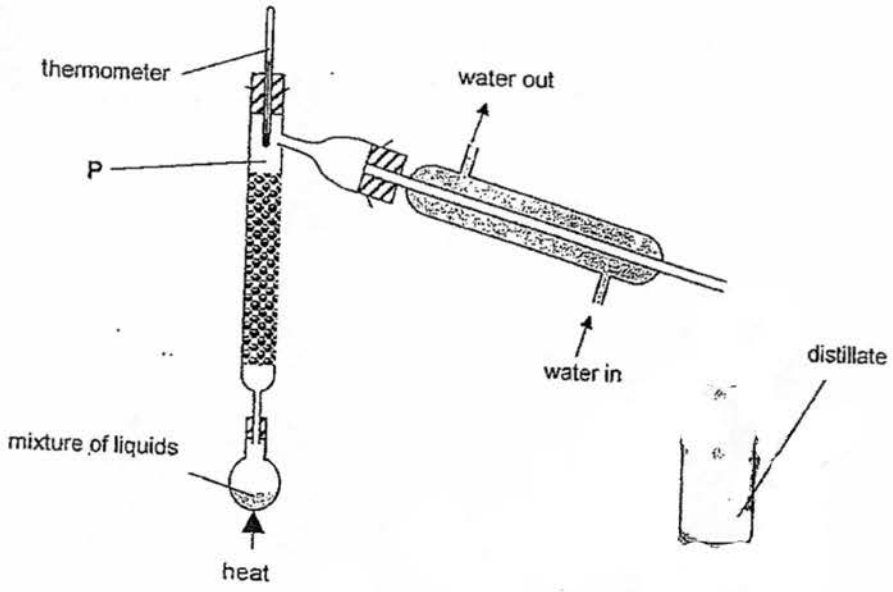
10 The diagram shows a chromatogram obtained from the colouring of three different sweets, X, Y and Z.



How many different colourings are present in the three sweets?

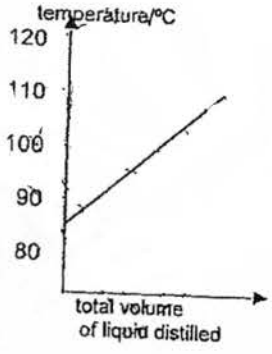
A 2
B 3
C 4
D 5

11 The diagram shows apparatus used to separate a mixture of two liquids with boiling points 85°C and110°C.

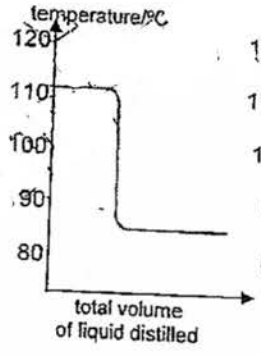


Which graph would be obtained if the temperature at point P was plotted against the total volume of distillate produced?

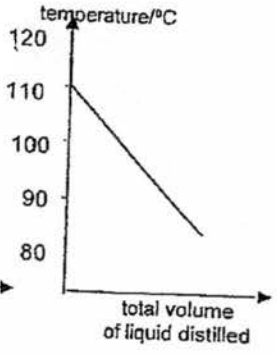
A



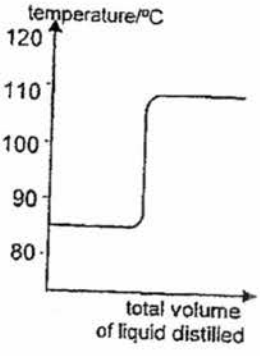
B



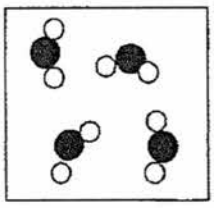
C

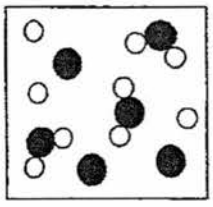


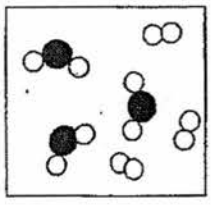
D

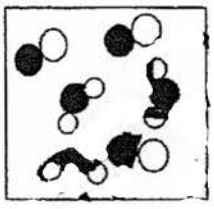


12 Which of the following diagram shows a mixture of a compound and an element?

A 

B 

C 

D 

13 Which compound contains three different non-metallic elements?

A C_2H_5Br
B $NaPH_4$
C H_2O
D NH_3

14 Which pair of substances contain both mixtures?

A air and sea water
B oxygen and orange juice
C water and carbon dioxide
D water and air

15 An ion X^+ has electronic configuration 2, 8. How many electrons does an atom of this element have?

A 1 B 5 C 10 D 11

16 Which of the following pairs of particles contains the same number of electrons?

A H^+ and Be^{2+}
B O^{2-} and K^+
C Al^{3+} and Cl^-
D F^- and Ne

17 An isotope of element X has 20 protons and 20 neutrons in its nucleus. Which symbol is correct for the ion of X?

A $^{20}_{20}X^{2+}$ B $^{40}_{20}X^{2+}$ C $^{20}_{20}X^{2-}$ D $^{39}_{20}X^{2-}$

18 Which of the following atom represents a chemically inert element?

A $^{7}_{3}Y$ B $^{14}_{7}Y$ C $^{20}_{10}Y$ D $^{32}_{16}Y$

19 What is the chemical formula of the compound formed between $^{23}_{11}A$ and $^{31}_{15}B$?

A AB
B A_2B
C A_3B
D A_3B_2

20 Metal X forms a sulfate with a chemical formula of $X_2(SO_4)_3$. What would the chemical formula be if X were to form a nitrate?

A XNO_3
B $X(NO_3)_2$
C X_2NO_3
D $X(NO_3)_3$

~End of section A~

Section B [40 marks]

Answer **ALL** questions in the spaces provided on the question paper.

1 Use the data given in the table below to answer the questions that follow:

element	melting point / °C	boiling point / °C
A	-106	-39
B	-28	0
C	-3	37
D	101	122
E	589	[illegible]

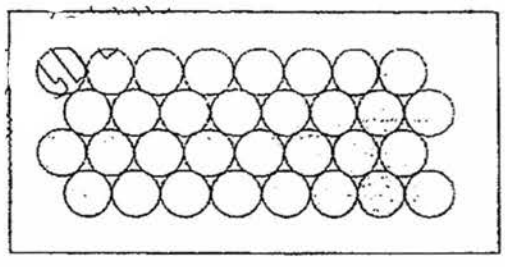
(a) Which substances are solids at room temperature?

D and E (Both correct -1m) [1]

(b) Carbon tetrachloride (CCl_4) exists as a volatile liquid at room temperature. Which substance is likely to be carbon tetrachloride? Explain your answer [2]

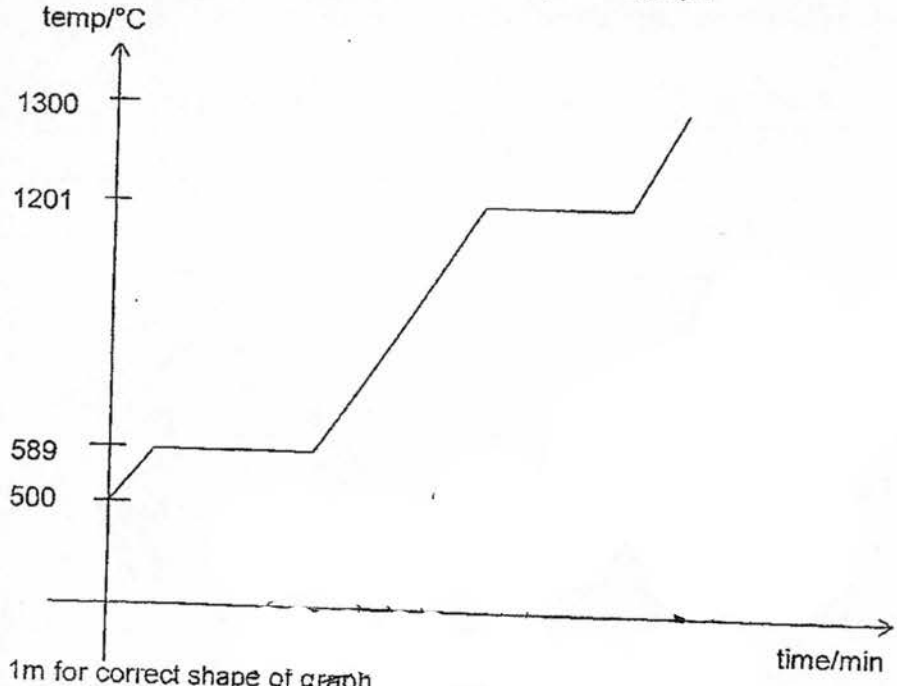
Element C.(1m) It has a small difference between the melting and boiling point Only C exist has a quid at room temperature. (1m)

(c) In the box below draw the arrangement of the particles for element A at -107°C [1]



-particles are closely packed & in orderly manner

(d) Using the axis provided, sketch the heating curve for a pure sample of element E when it is heated from 500°C to 1300°C. Indicate the temperature at which changes occur clearly in the graph. [3]



1m for correct shape of graph
1m for correct labelling of temperatures

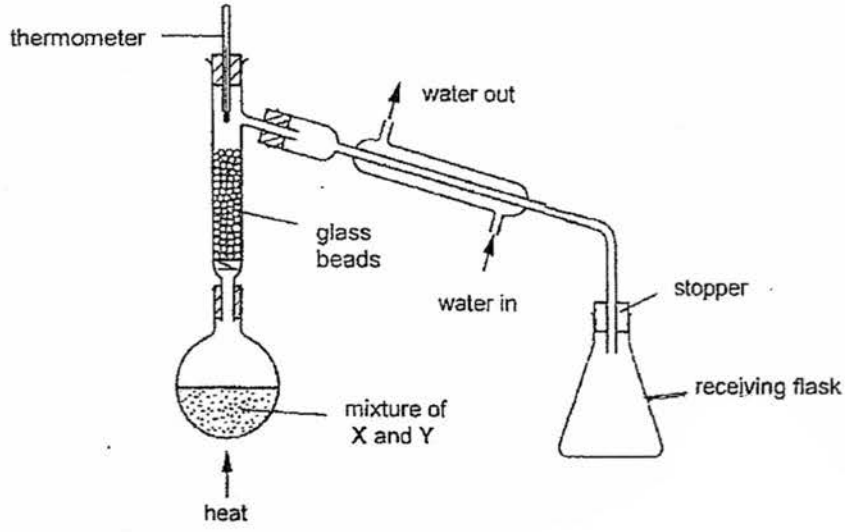
(f) Desoribe the changes in arrangement of the particles in element E when the temperature increases from 1200°C to 1300°C. [2]

At 1200°C, the particles are closely packed in a disorderly manner. (1m) At 1201- 1209°C, particles are further apart. At 1300°C, particles are far apart in a random manner.(1m)

2 The table below shows the melting and boiling points of substances X, Y and Z.

substance	melting point/°C	boiling point/°C
X	-20	80
Y	11	65
Z	2	18

Adam tries to separate a mixture containing X and Y by using the apparatus as shown below.



(a) Suggest the purpose of adding glass beads in the fractionating column. [1]

To provide a large surface area for evaporation and condensation of the liquid mixture./ To increase efficiency of separation

(b) State one error that Adam has made in his above set-up. [1]

He placed a stopper at the neck of the receiving flask.

(c) Which substance would be obtained last? Explain your answer. [1]

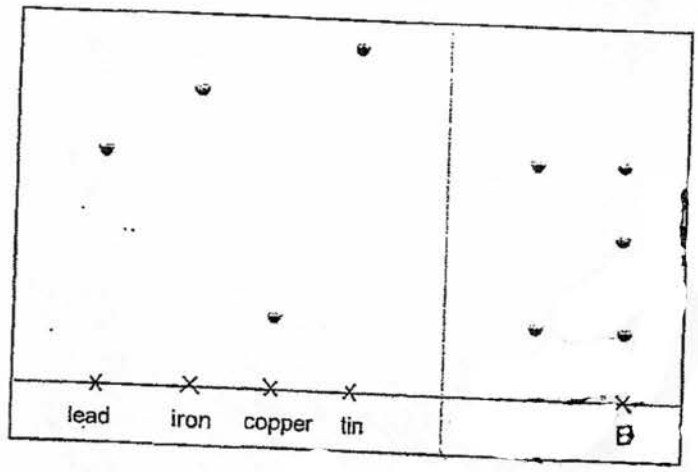
X. It has the higher boiling point.

(d) Explain why the technique as shown above cannot be used to separate a mixture of **Y** and **Z** at room temperature. [1]

Z is a gas at room temperature (1m). Distillation can only be used to separate a mixture of miscible liquids.

3 Two copper alloys, A and B, were dissolved in acid to produce solutions of metal compounds from the alloys. The solutions were then used in a chromatography experiment to separate and identify the metals present.

The chromatograph below shows the metals present in the two copper alloys, A and B.



(a) Name the metals present in alloy A. [1]

copper, lead both answers for 1m)

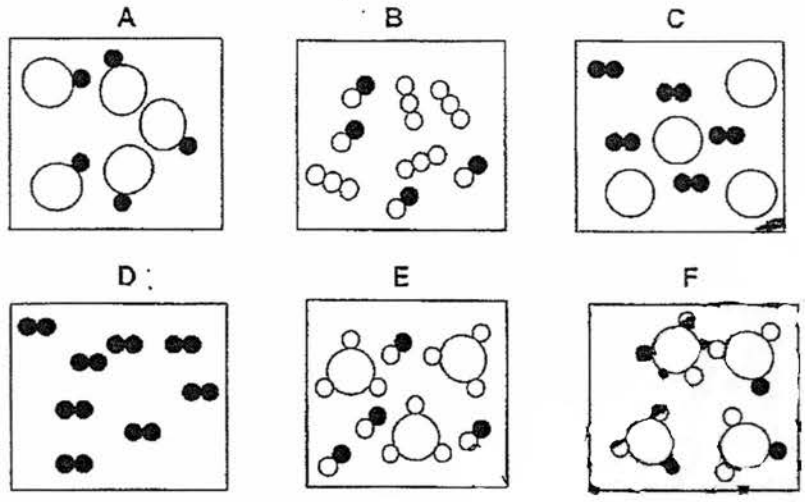
(b) Name one metal absent from alloy B [1]

iron or tin

(c) Are the two copper alloys the same? Explain your answer. [2]

No. (1m) B contains one spot of unknown substance. /The spots after separation are different. (1m)

4 The following diagrams show the compositions of six different materials (A to F) in terms of the arrangement of their atoms. There are three kinds of atoms represented by ◯ , ● and ○.



Which of the diagram(s) A, B, C, D, E and F represent

(a) pure compound A or F [1]

(b) mixture of elements [1]

5 In the table below state two differences between a compound and mixture. [4]

compound	mixture
has a fixed composition by mass	does not have a fixed composition by mass
has fixed melting and boiling point	does not have fixed melting and boiling point
has its own properties which are different from those of its constituent elements	has the same properties as its components
can be broken down into its elements or simpler compounds by chemical process (e.g. electrolysis, thermal decomposition)	can be separated into its components easily by physical processes (e.g. filtration, distillation)
form with an energy change	form with little or no energy change

Any 2 differences

6 Use the following information to answer questions below about the particles A, B, C, D, E, F and G.

particle	charge	atomic number	mass number	number of electrons	electronic structure
A	1-	9	19	10	2, 8
B	0	7	14	7	2, 5
C	0	10	20	10	2, 8
D	3-	15	31	18	8, 8
E	1-	3	4	2	2
F	0	20	40	20	2, 8, 8, 2
G	0	7	16		2, 5

(a) Complete the table above. (1/2m for each blank) [2]

(b)(i) Which particle is a stable atom? C [1]

(ii) Explain why this particle is electrically neutral. [1]

The total number of positively charged protons is neutralised by an equal number of negatively charged electrons.

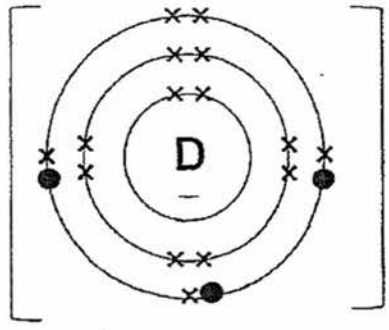
(c) Which particle has the most number of electron shells? F [1]

(d) Which particle is an atom containing 9 neutrons? G [1]

(e) Which two particles are isotopes? Explain your answer. [2]

B and C. (1m) Both contain same number of protons but different number of neutrons. (1m)

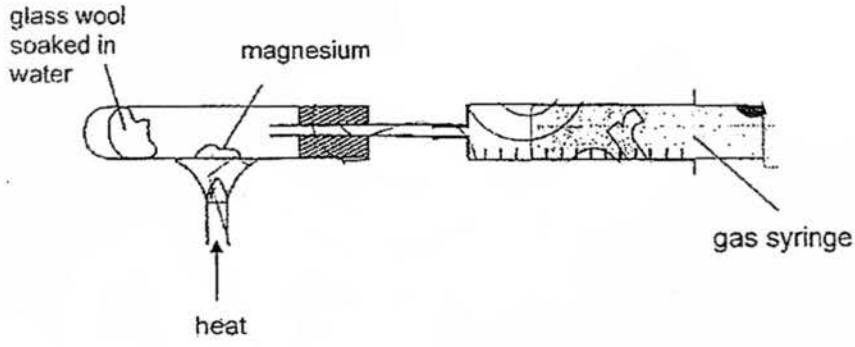
(f) Draw the electronic structure of **D**. Indicate the charge on the particle if any. You do not have to show the number of protons and neutrons. [2]



3-

1m for correct number of electrons; 1m for correct charge.

7 In the experiment below, magnesium metal reacts to produce hydrogen gas as one of its products.



(a) In the box above complete the diagram to show how hydrogen gas can be collected and measured. Label the apparatus drawn. [2]
1m for correct drawing; 1m for correct label

(b) Describe a chemical test to confirm the presence of hydrogen gas. [1]

Insert a lighted splint near the mouth of test tube. If it extinguishes with a 'pop' sound, hydrogen gas is present.

8 Complete the following table below. [4]

name of compound	cations (positive ions)	anions (negative ions)	chemical formula of compound
ammonium nitrate	NH_4^+	NO_3^-	NH_4NO_3
aluminium carbonate	Al^{3+}	CO_3^{2-}	$Al_2(CO_3)_3$
nickel(II) nitride	Ni^{2+}	N^{3-}	Ni_3N_2
iron(III) hydroxide	Fe^{3+}	OH^-	$Fe(OH)_3$

1/2m for each blank

Section C (20 marks)

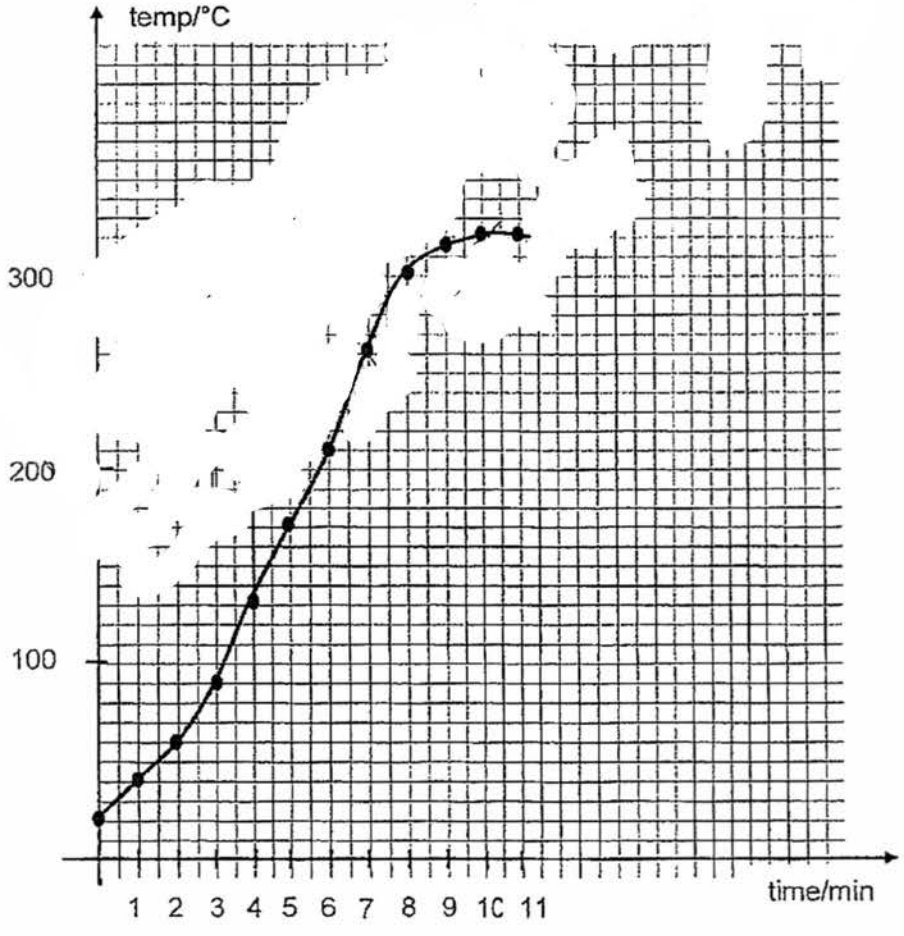
Answer **ALL** questions in the spaces provided below.

1 Sabrina carried out an experiment which involves the heating of solid mercury(II) oxide, HgO at room temperature. After heating, oxygen gas and a silvery liquid is produced. He decided to examine the silvery liquid further by heating it.

The table below shows how the temperature of the silvery liquid changed with time during heating.

time / min	0	1	2	3	4	5	6	7	8	9	10	11
temp / °C	20	40	60	90	130	170	210	260	300	315	320	320

(a) Using the data above, plot a graph of temperature against time on the grid provided below. Draw a smooth curve for this heating curve. [2]



1m for correct points; 1m for smooth curve

(b) From your graph, deduce the boiling point of the silvery liquid. [1]

320°C

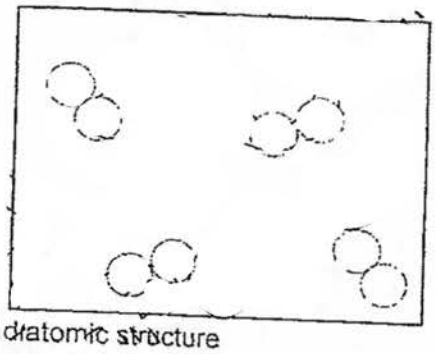
(c) Suggest the identity of the silvery liquid formed. [1]

Mercury.

(d) Is mercury(II) oxide a compound? Explain your answer with reference to the experiment above. [2]

Yes. (1m) Upon heating, mercury(II) oxide breaks down into its 2 constituent elements, oxygen and mercury. (1m)

(e) Using ◯ to represent an oxygen atom, draw a diagram to show how the diatomic molecules of oxygen gas are arranged at room temperature. [2]



1m for drawing diatomic structure
1m for widely spaced apart

2 The table below shows the solubilities of three solids in two solvents, water and methylbenzene.

solid	solubility in water	solubility in methylbenzene
sand	insoluble	insoluble
sodium chloride	soluble	insoluble
sulfur	insoluble	soluble

Describe how you would obtain pure, dry samples of both sand and sodium chloride given a mixture of all three solids. [5]

Add methylbenzene to the mixture and stir to dissolve sulfur. (1m) Filter the mixture and collect the residue. (1m) Add water to the residue and stir to dissolve sodium chloride. (1m). Filter the mixture to obtain sand as residue. (1m) Dry sand by pressing between sheets of filter papers. (1m)

OR

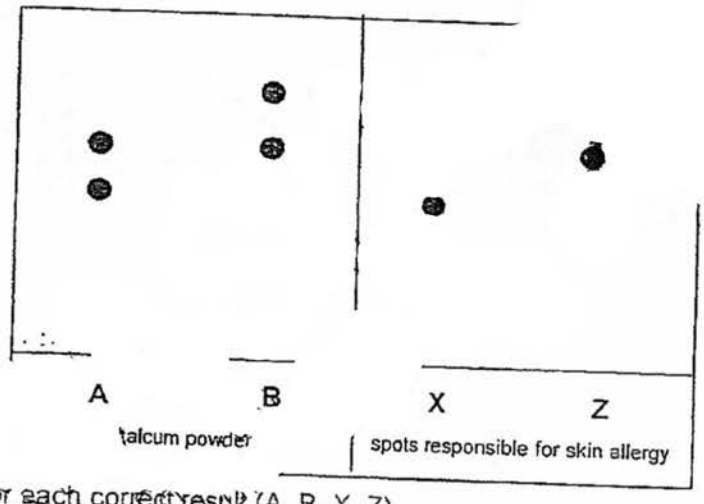
Add water to the mixture and stir to dissolve sodium chloride. (1m) Filter the mixture and collect the residue. (1m) Add methylbenzene to the residue and stir to dissolve sulfur. (1m). Filter the mixture to obtain sand as residue. (1m) Dry sand by pressing between sheets of filter papers. (1m)

3 In an experiment, solutions from 2 different samples of talcum powder, A and B were obtained. Spots of A and B were placed on a chromatography paper, together with spots of substances responsible for skin allergy, X and Z. The paper was then placed in a large beaker containing a solvent.

The results of the experiment led a student to suggest that:

- A contains both X and Z.
- B contains Z and an unknown that is more soluble than X in the solvent.
- X and Z are pure substances.
- X is less soluble than Z in the solvent.

(a) Complete the diagram below to show how the chromatograph should look like based on the above conclusion. [2]



1/2m for each correct result (A, B, X, Z)

(b) The formula of talcum powder was given in old textbooks as $Mg_3Si_4O_{12}H_2$. This formula is rearranged in modern textbooks as $Mg_3Si_4O_x(OH)_y$.

Given the table below, deduce the values of x and y in the modern formula. [2]

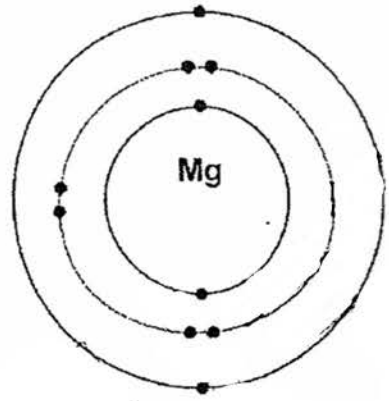
	Mg	Si	O	H
no. of atoms	3	4	12	2

x+y = 12
y= 2 (1m)
x= 10 (1m)

(c) (i) Magnesium is the main element present in talcum powder. Suggest whether it is metallic or non-metallic. Explain your answer. [2]

Metallic. (1m) It loses 2 valence electrons to form a positive ion. (1m)

(ii) In the box below, draw the electronic structure of a magnesium atom. [1]



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										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 226	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 -

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

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

2E Science Physics SA 2

Marking Scheme

Section A

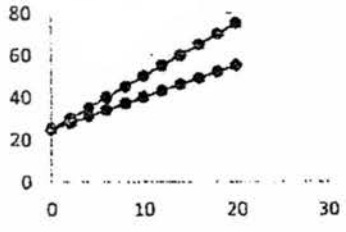
1	2	3	4	5.	6	7	8	9	10
C	D	C	B	D	C	B	B	B	A
11	12	13	14	15	16	17	18	19	20
C	B	C	C	C	D	A	C	A	B

Section B

1(a)	(i) 3.03 cm (ii) 3.93 cm	1 1
1(b)	Thickness = (3.93-3.03) / 2 = 0.45 cm	1
1(c)	Measure the thickness of the tube at different positions, then take average of the reading. Accept other reasonable suggestion	1
1(d)	Metals has free moving electrons / Styrofoam has pockets of air When they are heated, they gain kinetic energy and move rapidly to collide with other particles in the solid to transfer kinetic energy.	1 1
2(a)	There are 4 complete oscillation in 1 second	1
2(b)	T = 1/f = 0.25 s	1 1
2(c)	Take 20 oscillations, then divide the reading by 20 to obtain the period of one oscillation Repeat the experiment and take average	1 1
2(d)	t = ¼ T = 0.0625 s	1
3(a)	For every 1 kg of mass on the Moon, the gravitational force acting on it is 1.6 N	1
3(b)	F = W = 0.1x1.6 = 0.16 N	1
3(c)	The arm is suitable F = W = 0.05 x 10 = 0.5 N which is more than the 0.16 N required	1 1
4(a)	Copper: V = 100 x84% = 84 cm3 m = 84 x 8.96 = 752.64 g (753 g) tin: V = 100 x 16% = 16 cm3 m = 16 x 7.265 = 116 g	1 1
4(b)	M = 752.64 + 116.24 = 868.88 g (869 g)	1
4(c)	D = 868.88 / 100 = 8.6888g/cm3 =8690 kg/m3	1 1
4(d)	The bronze will float because it is less dense than mercury	1
5(a)	KE = ½ x 0.0017 x 250^2 =53.1 J	1 1
5(b)	Work = F x D 53.1 = F x 0.30 F = 177 N	1 1
5(c)	P = E/ t = 53.125 / 0.2=266 W	1
5(d)	GPE = KE = 53.125 J 53.125 = 0.0017 x 10 x h h = 3125 m (3130 m)	1 1

6(a)	All matters are made of **tiny numerous** particles in **continuous (random)** motion	1
6(b)	All particles of the same size and touching neighbouring particles	1
6(c)	(i) The particles of gas are far apart with lots of space between them/ weak forces of attraction (ii) Particles in liquid can slide over each other and move freely throughout the liquid, thus it has no fixed shape so it can take the shape of the container	1 1
7(a)	High energy liquid particles at the surface can leave the liquid and left behind lower energy ones. This cause the average kinetic energy of the liquid to drop thus the sweat becomes cooler.	1 1
7(b)	Evaporation takes place at the surface while boiling take place throughout the liquid Evaporation take place at any temperature while boiling take place at Boiling point. Evaporation is slow while boiling is fast Bubbles form during boiling but not evaporation	2 max
7(c)	The particles changes from closely packed in an disorderly manner To far apart and random arrangement.	1 1
7(d)	The internal kinetic energy remains the same while the internal potential energy increases	1 1

Section C

1(a)	At point B B is the highest point, the rollercoaster has higher GPE and thus least KE	1 1
1(b)	KE = ½ x 1500 x 12.2^2 = 111630 J (112 kJ).	1 1
1(c)	GPE = 1500 x 10 x 30 =450000 J (450 kJ)	1 1
1(d)	KE at H = ½ x 1500 x 12.2^2 = 6750 J GPE at H = 111630 + 450000 – 6750 = 554880 J 554880 = 1500 x 10 x h H = 36.992 m (37.0 m)	1 1 1
1(e)	Work done is needed to overcome friction / air resistance	1
2(a)		1 for each line and label
2(b)	the iron pot heats up faster. Iron is a better conductor of heat. Based on the graph, the rate of increase in temperature is faster than clay pot.	1 1
2(c)	Gradient = (57-37)/(15-5)=2.50 [1 mark for working]	2
2(d)	The particles in clay pot vibrates more vigorously when heated, They collide with the neighbouring particles and transfer kinetic energy	1 1

2(e)	The water at the bottom is heated, expands become less dense and rise Cooler water on top is denser and sinks, this forms a convection current.	1 1

TOS

Topic	Section A				Section B				Section C			
	KU	Marks	HISP	Marks	KU	Marks	HISP	Marks	KU	Marks	HISP	Marks
unit and measurement	1,4	2	2,3	2	1(a,c),2(a,c)	5	1(b), 2(b,d)	4	2(a)	2	2(b,c)	4
mass weight density	5,6	2	7,8	2	3(a),4(b)	2	3(b,c), 4(a,b,d)	8				
work energy power	10	1	9,11,12	3	5(c)	1	5(a,b,d)	6	1(b)	2	1(a,c,d)	8
kinetic particle theory			15,	1	6(a,b,c)	4						
transfer of thermal energy	17,18,20	3	19	1	1(d)	2			2(d,e)	4		
thermal property of matter	13,16	2	14,	1	7(b,c,d)	6	7(a)	2				
total	10		10		20		20		8		12	