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1 Which of the following apparatus is most accurate in measuring volume of solutions?

- A beaker
- B measuring cylinder
- C pipette
- D burette

2 The table below shows the melting and boiling points of four substances, J, K, L and M.

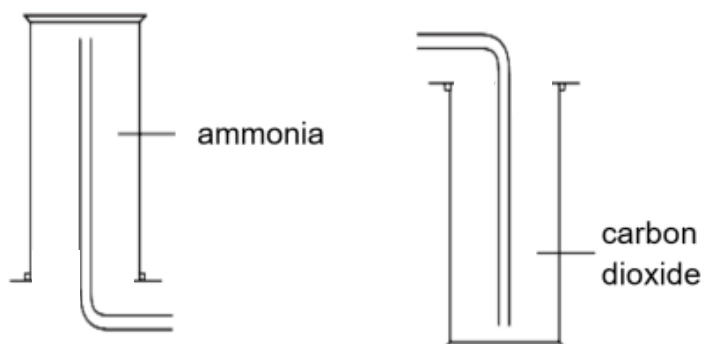
substance	melting point / °C	boiling point / °C
J	−182	−2
K	−23	77
L	−5	65
M	41	182

How many substances are solids at room temperature?

- A 1
- B 2
- C 3
- D 4

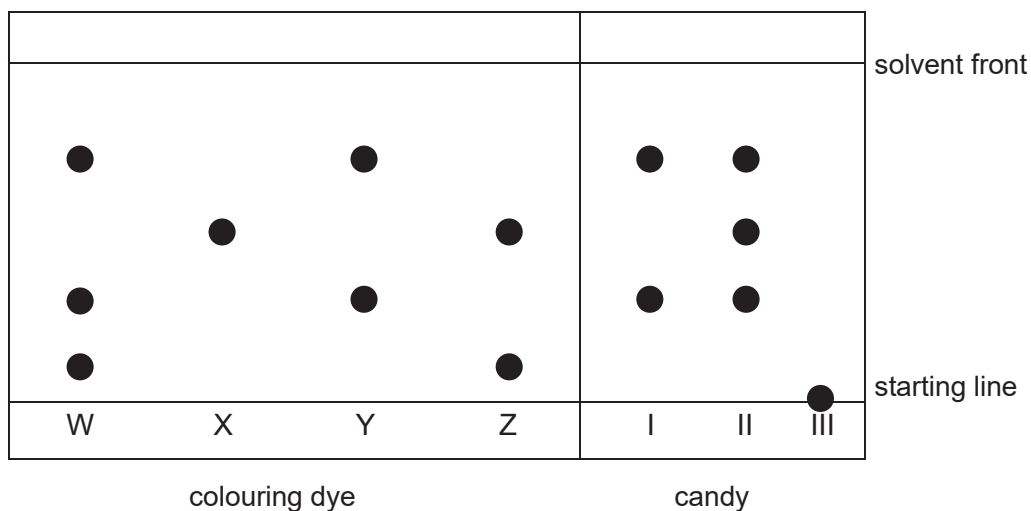
- 3 The three main methods of gas collection are by upward displacement of air, downward displacement of air, and displacement of water.

Ammonia and carbon dioxide are collected by the methods shown below.



What deduction can be made about the properties of the two gases?

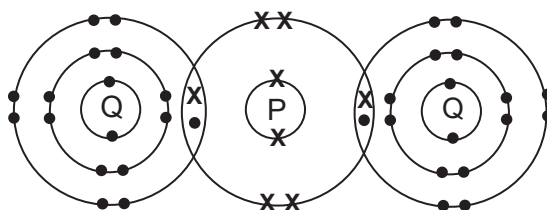
- A Both gases are insoluble in water.
 B Both gases are acidic in nature.
 C Both gases are denser than air.
 D Carbon dioxide is denser than ammonia.
- 4 A chromatography experiment was conducted by a food scientist to find out if banned colouring dyes, W, X, Y and Z, are found in three different candies, I, II and III. The results are as shown below.



Which statement is **not** true?

- A Candy I contains dye Y.
 B Candy II contains both dyes X and Y.
 C All colouring dyes are impure substances.
 D Candy III contains colouring dye(s) that is (are) insoluble in the solvent.

- 5 Which of the following set of substances contain an element, a compound and a mixture?
- A air, copper, steel
- B carbon, carbon monoxide, carbon dioxide
- C hydrogen, sugar solution, magnesium chloride
- D sodium, ammonium nitrate, sodium chloride
- 6 Which of the following properties can be used to determine if a substance is pure?
- A colour
- B density
- C melting point
- D solubility in water
- 7 What do both sulfur atom and sulfide ion have in common?
- A 16 neutrons
- B 16 electrons
- C 32 protons
- D 32 neutrons
- 8 The diagram below shows the bonding between elements P and Q in the molecule, PQ_2 .



Which option represents the electronic structures of atoms P and Q before combining together to form the above molecule?

	P	Q
A	2, 4	2, 8, 6
B	2, 4	2, 8, 7
C	2, 6	2, 8, 7
D	2, 8	2, 8, 8

- 9 Cadmium forms a compound $\text{Cd}(\text{NO}_3)_2$.

What is the charge of cadmium ion?

- A +1
- B +2
- C +3
- D +4

- 10 Ammonium nitrate is added to substance W and heated. A gas is liberated that turns moist red litmus paper blue.

What is substance W likely to be?

- A acid
- B alkali
- C metal
- D indicator

- 11 Samples of three oxides, T, U and V, are added separately to dilute hydrochloric acid and aqueous sodium hydroxide.

T and U react with dilute hydrochloric acid but V does not react.

U and V react with aqueous sodium hydroxide but T does not react.

What is the nature of oxides T, U and V?

	type of oxide		
	acidic	amphoteric	basic
A	T	U	V
B	U	T	V
C	V	T	U
D	V	U	T

- 12 A solid element is easily cut with a knife and floats and darts about when placed in water.

Which Group is this element found in?

- A Group 0
- B Group I
- C Group V
- D Group VII

13 Which pair of reactants is best used to prepare a solution of potassium sulfate?

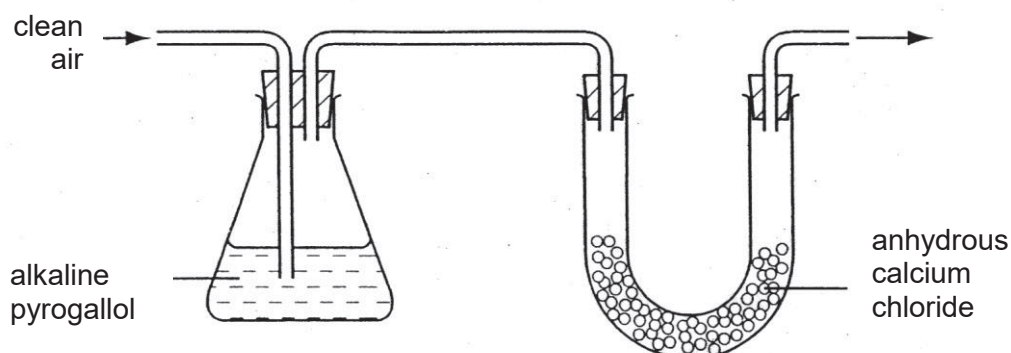
- A potassium and dilute sulfuric acid
- B potassium nitrate and sodium sulfate
- C potassium nitrate and dilute sulfuric acid
- D potassium hydroxide and dilute sulfuric acid

14 Which of the following metal(s) can be obtained by reduction with carbon?

	sodium	aluminium	tin
A	×	✓	✓
B	×	×	✓
C	✓	✓	×
D	✓	×	×

15 Anhydrous calcium chloride is used as a drying agent while the alkaline pyrogallol absorbs oxygen and carbon dioxide gas.

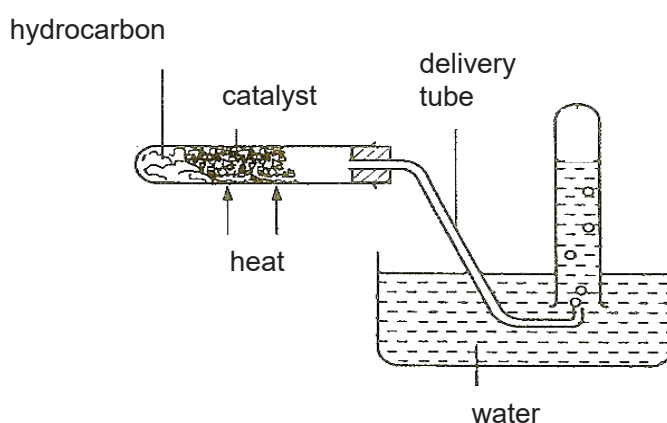
Clean air is passed through the apparatus shown below.



What gases are present in the air leaving the apparatus?

- A nitrogen and argon
- B nitrogen and hydrogen
- C hydrogen and carbon dioxide
- D hydrogen, nitrogen and argon

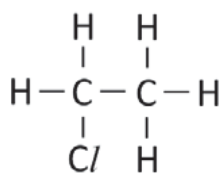
- 16 Which of the following gases lead to respiratory problems and breathing difficulties?
- I. carbon monoxide
 - II. nitrogen dioxide
 - III. sulfur dioxide
- A I only
B II only
C II and III only
D All of the above
- 17 Which of the following air pollutants is **not** found in car exhausts?
- A sulfur dioxide
B nitrogen dioxide
C carbon monoxide
D unburnt hydrocarbons
- 18 What are the colours of the Group VII elements at room temperature and pressure down the Group?
- A light green, pale yellow, reddish brown, black
B light green, pale yellow, black, reddish brown
C pale yellow, light green, reddish brown, black
D pale yellow, light green, black, reddish brown
- 19 The following set-up is used for the cracking of long chain hydrocarbons.



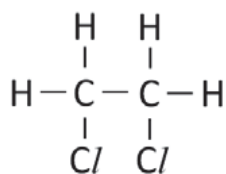
Which of the following is a suitable catalyst?

- A silicon chloride
B aluminium oxide
C aluminium nitrate
D ammonium nitrate

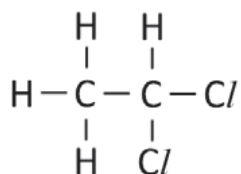
20 The diagrams below show the structures of three compounds.



1



2



3

Which compounds can be the products of the substitution reaction of ethane with chlorine?

- A** 1 and 2
- B** 1 and 3
- C** 2 and 3
- D** 1, 2 and 3

The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		Key															
		proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganesson -	119 Uue unbinilium -	120 Uuh ununilium -

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
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 -

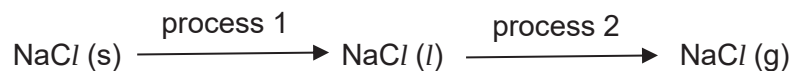
actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Section A

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

- 1 When solid sodium chloride is heated from room temperature to 1500°C, it undergoes the following processes.



- (a) Name processes 1 and 2.

.....

..... [1]

- (b) Describe the arrangement and movement of particles in sodium chloride **after** process 2.

.....

..... [1]

- (c) Draw the dot-and-cross diagram of sodium chloride, showing only the valence electrons.

[1]

- (d) A sample of sodium chloride crystals is mixed with solid sodium carbonate. Jerry adds water to the mixture before filtering.

Explain why Jerry is unable to separate the mixture with his method.

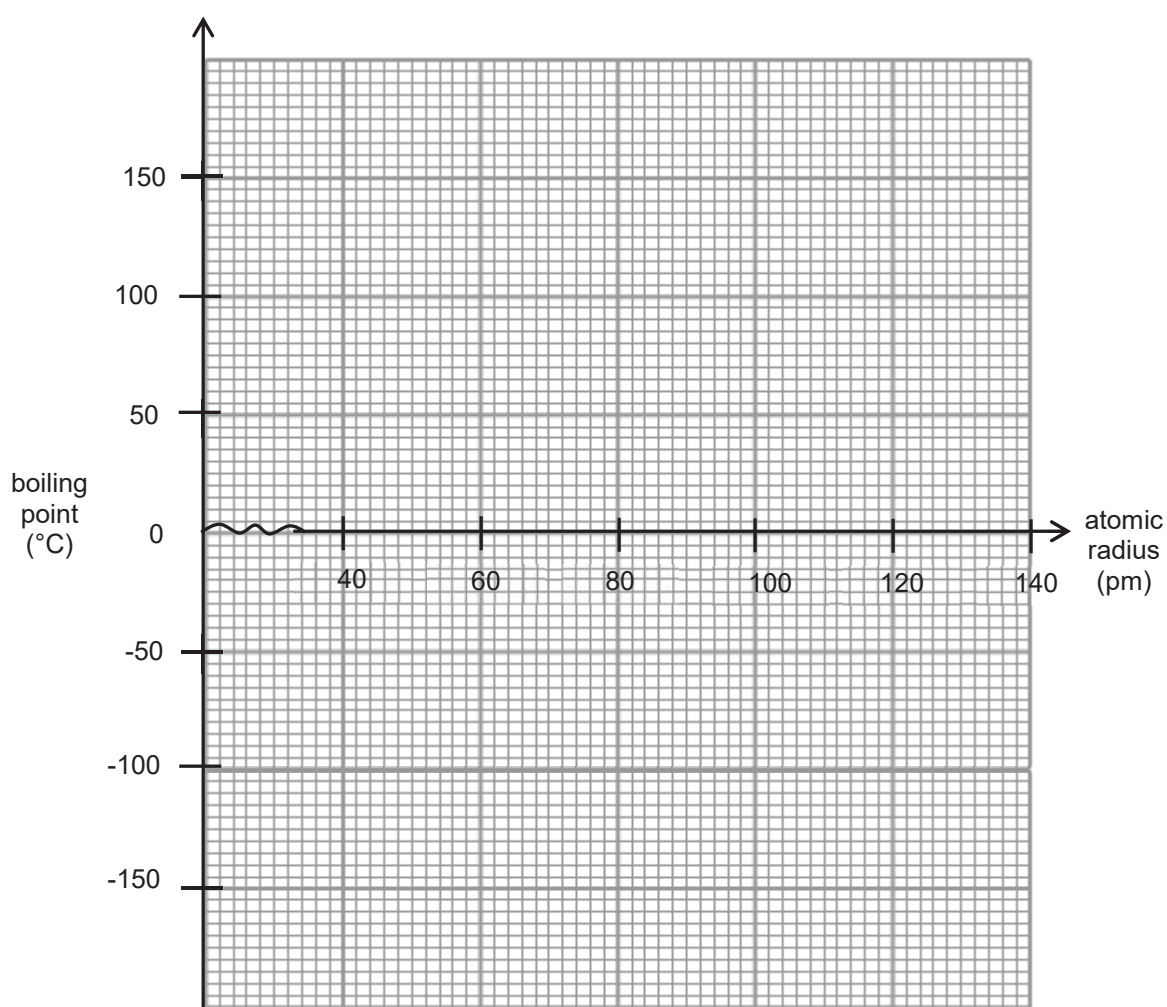
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..... [1]

- 2 The atomic radius (in picometre) of Group VII elements and their boiling points are tabulated below.

Group VII element	atomic radius (pm)	boiling point (°C)
fluorine	42	-190
chlorine	80	-15
bromine	98	65
iodine	120	165

- (a) Using the grid below, plot a best-fit line graph of boiling point against atomic radius. [2]



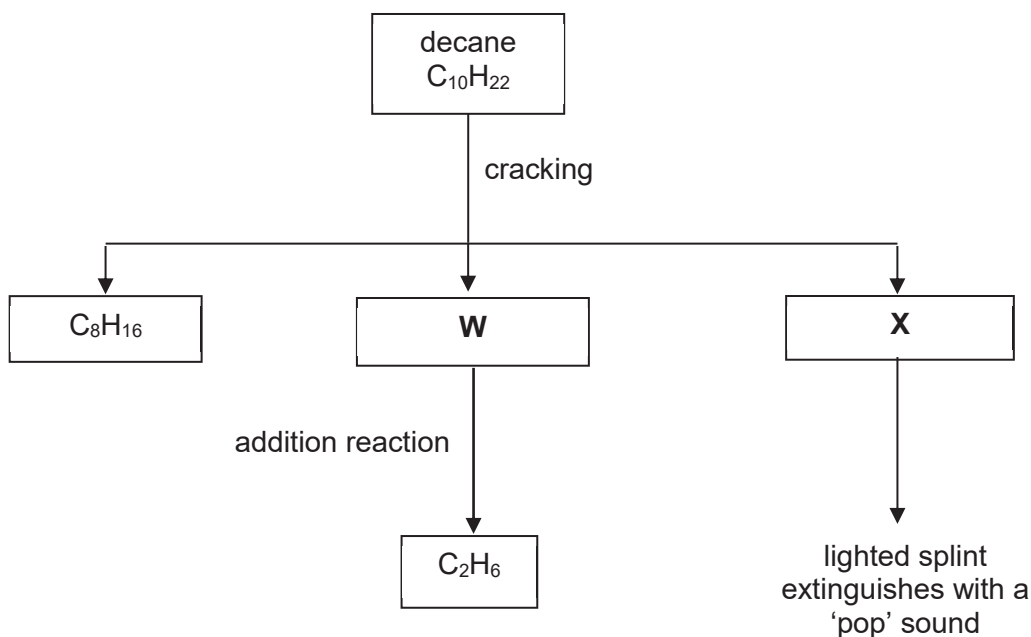
- (b) State the relationship between atomic radius and boiling point of the Group VII elements.

.....
 [1]

- (c) Chlorine gas is bubbled into a solution of potassium bromide. Explain why a reaction takes place.

.....
.....
..... [2]

- 3 Decane is a long chain hydrocarbon that undergoes cracking as shown in the flow chart below.



- (a) Identify **W** and **X**.

W:

X:

[2]

- (b) State the conditions required for the addition reaction.

..... [1]

- (c) Describe a chemical test that will determine if decane ($C_{10}H_{22}$) is a saturated or unsaturated compound and predict the observation.

Test:

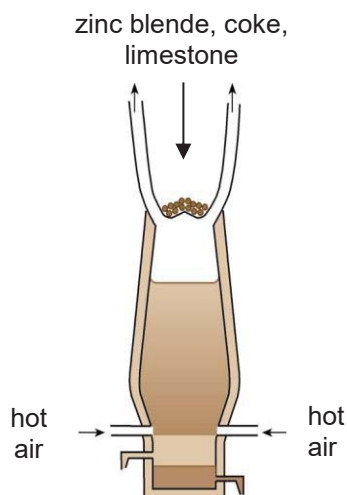
Observation:

..... [2]

Section B

Answer any **two** questions in the spaces provided.

- 4 The ore that zinc is extracted from is called zinc blende (ZnS). The process of zinc extraction is similar to iron extraction and is carried out in a Blast Furnace as shown below.



The main reactions that take place in the extraction of zinc from zinc blende is as shown.

Reaction 1: Zinc blende first reacts with oxygen to form zinc oxide and sulfur dioxide.

Reaction 2: Zinc oxide then reacts with carbon monoxide to obtain zinc metal and carbon dioxide.

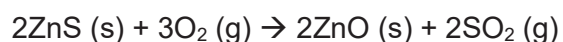
- (a) Write the balanced chemical equation for Reaction 2.

..... [1]

- (b) State the main purpose of adding limestone.

..... [1]

- (c) The chemical equation for Reaction 1 is shown below.



Calculate the mass of oxygen required for complete reaction of 50 kg of zinc blende.

- (d) Scrap zinc is often recycled in order to save finite zinc which will otherwise be depleted eventually.

Give one **other** reason for recycling scrap zinc.

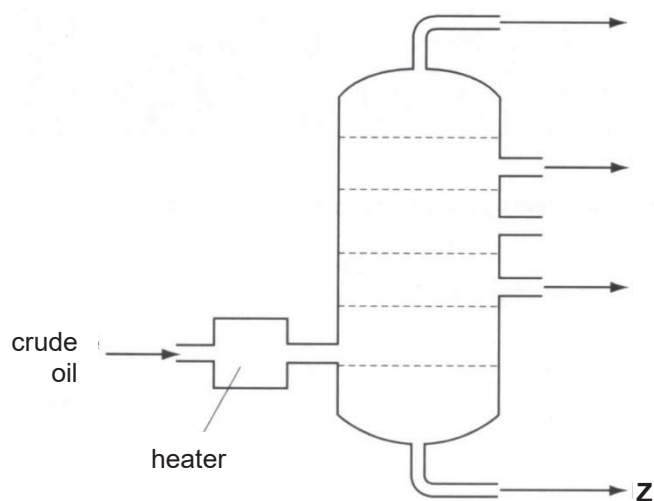
.....
..... [1]

- (e) Zinc forms a number of useful salts. An example would be zinc carbonate, which is used as a pigment in cosmetics and lotions.

Describe how a pure and dry sample of zinc carbonate can be prepared using **two** suitable reagents.

.....
.....
.....
.....
..... [2]

- 5 Crude oil is separated into different fractions as shown in the diagram below.



- (a) Describe how the different fractions of crude oil are separated and collected from the set-up above.

.....

.....

.....

.....

.....

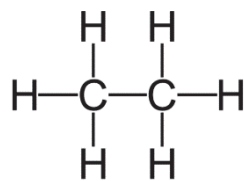
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..... [3]

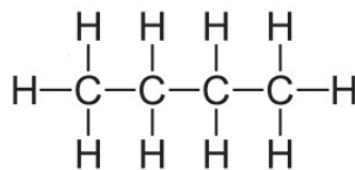
- (b) Name fraction **Z** and state its use.

..... [1]

- (c) The structural formulae of two different molecules found in the fraction collected at the top of the column (petroleum gas) are shown below.



molecule **J**



molecule **K**

- (i) Explain why molecules of **K** have a higher boiling point compared to molecules of **J**.

.....
.....
.....
.....[2]

- (ii) Comment on the electrical conductivity of both molecules **J** and **K**.

.....
.....
.....[2]

- 6** Alcohols are a family of organic compounds with the functional group –O–H. The table below shows some information of the first 4 members.

number of carbon atoms	name	molecular formula	boiling point (°C)
1	methanol	CH ₃ OH	65
2	ethanol	C ₂ H ₅ OH	79
3		C ₃ H ₇ OH	97
4	butanol	C ₄ H ₉ OH	117

- (a)** Using the information provided, give two reasons why the members belong to the same homologous series.

.....
.....
..... [2]

- (b)** Name the third member alcohol, C₃H₇OH.

..... [1]

- (c)** Suggest the full structural formula of methanol.

[1]

- (d)** A student makes the following claim:

“An example of a hydrocarbon is alcohol.”

State if the claim is correct and explain your answer.

.....
.....
..... [2]

- (e) Aside from melting and boiling point, predict one **other** trend in physical property of alcohols as the number of carbon atoms increases.

.....

..... [1]

- (f) Write the balanced chemical equation for the incomplete combustion of methanol to give carbon monoxide and water.

..... [1]

End of Paper

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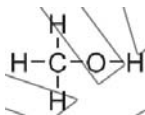
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Section A: MCQs (10 marks)

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

Section B: Structured Questions (30 marks)

1	(a)	Process 1: melting Process 2: boiling	1 m
	(b)	The particles are <u>spread far apart in a disorderly arrangement</u> , and <u>move rapidly and randomly in all directions</u> .	1 m
	(c)		1 m
	(d)	Both sodium chloride and sodium carbonate are <u>soluble</u> and their solutions will <u>pass through the filter paper</u> .	1 m
2	(a)	1 m – plot points correctly 1 m – draw straight line passing through all points	2 m
	(b)	As the atomic radius increases, the boiling point increases.	1 m
	(c)	Chlorine, <u>being more reactive than bromine</u> , gains electrons more readily and is able to <u>displace bromine</u> from potassium bromide to form potassium chloride and bromine.	1 m 1 m
3	(a)	Nickel catalyst, 200°C	1 m
	(b)	W: C ₂ H ₄ / ethene X: H ₂ / hydrogen	1 m 1 m
	(c)	Test: Add aqueous bromine into decane. Observation: Reddish brown aqueous bromine will remain reddish brown.	1 m 1 m
4	(a)	ZnO + CO → Zn + CO ₂	1 m
	(b)	To remove acidic impurities.	1 m
	(c)	Mass of ZnS = 50 x 1000 = 50000 g No. of moles of ZnS = 50000/(65+32) = 515.46 moles (5 s.f.)	1 m

		Comparing mole ratio ZnS : O ₂ 2 : 3 No. of moles of O ₂ = 515.46/2 x 3 = 773.20 moles Mass of O ₂ = 773.20 x (16x2) = 24742 g = 24800 g (3 s.f.)	1 m allow ecf 1 m
	(d)	To prevent land pollution as landfills are required to bury scrap zinc. / To save finite fossil fuels which is otherwise used in the extraction of zinc.	1 m
	(e)	Mix <u>aqueous zinc nitrate</u> and <u>aqueous sodium carbonate</u> . <u>Filter</u> mixture to obtain the <u>residue</u> . <u>Wash</u> and <u>dry</u> between pieces of filter paper.	1 m 1 m
5	(a)	Crude oil is <u>heated</u> and <u>vapourised</u> . Then, the <u>vapours</u> rise up the column and are separated based on different <u>boiling points</u> . The fraction with the <u>lowest boiling point</u> is cooled, condensed and collected at the <u>top</u> of the column, while the fraction with the <u>highest boiling point</u> is cooled, condensed and collected at the <u>bottom</u> of the column.	1 m 1 m 1 m
	(b)	Bitumen, to make road surfaces	1 m
	(c)(i)	K molecules are bigger and have <u>stronger intermolecular forces of attraction</u> . <u>More energy</u> is required to overcome the forces of attraction. Therefore, it will have a higher boiling point.	1 m 1 m
	(c)(ii)	Both molecules cannot conduct electricity in any state due to the <u>absence of free mobile electrons or ions to carry charges</u> .	1 m 1 m
6	(a)	Alcohols are a family of organic compounds with the same functional group (-OH), the same general formula (C _n H _{2n+1} OH), show a gradual change in physical properties (such as boiling point).	2 m (any 2)
	(b)	propanol	1 m
	(c)		1 m
	(d)	The claim is <u>not correct</u> . A <u>hydrocarbon</u> is an organic compound containing <u>only hydrogen and carbon</u> , but alcohol has an <u>oxygen atom</u> in its molecule.	1 m 1 m
	(e)	As the number of carbon atoms increases, Flammability decreases Viscosity increases, Density increases	1 m (any)
	(f)	CH ₃ OH + O ₂ → CO + 2H ₂ O	1 m

