



FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

NAME:

CLASS:

INDEX NUMBER:

SCIENCE (CHEMISTRY)
Paper 1

5076/01 and 5078/01
13 September 2017
Papers 1 and 3: 1 hr 45 min
Max mark: 20

Additional material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Paper 1

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

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

A copy of the Periodic Table is printed on page 9.

The use of an approved scientific calculator is expected, where appropriate.

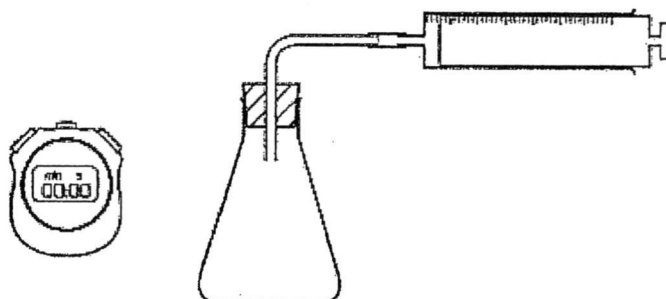
Marks Obtained	
Paper 1	

Name of Setter: Ms Tan Hwee Hwee, Serena

This paper consists of 9 printed pages.

Answer **all** questions.
Shade your answers in the Multiple Choice Answer Sheet provided.

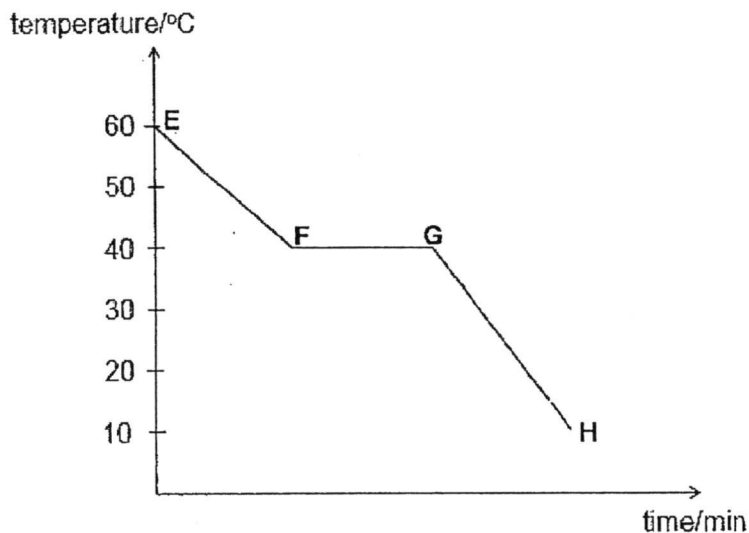
- 1 The apparatus shown can be used to find the rate of some chemical reactions.



Which of the following reactions can be measured using the above set-up?

- A calcium and hydrochloric acid
 - B silver nitrate and sodium chloride
 - C potassium hydroxide and sulfuric acid
 - D sodium hydroxide and iron(III) sulfate
- 2 Which of the following consists of mixtures only?
- A air, milk, steel
 - B bromine, glucose, water
 - C sodium, carbon dioxide, air
 - D argon, magnesium chloride, water
- 3 Propanol has a boiling point of 97 °C and water has a boiling point of 100 °C.
Which method is used to separate a mixture of these two liquids?
- A filtration
 - B evaporation
 - C fractional distillation
 - D paper chromatography

- 4 The graph below shows how temperature changes over time when liquid S was cooled.

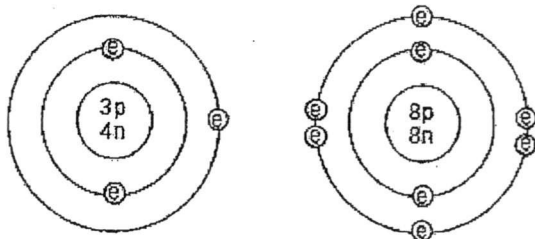


Which of the following statements is correct?

- A There is a mixture of liquid and solid particles at region **FG**.
 - B The particles are moving randomly at high speeds at region **EF**.
 - C The particles are arranged closely in a disorderly manner at region **GH**.
 - D Heat energy is absorbed at region **FG** to strengthen the forces of attraction between particles.
- 5 Nitrogen crystals are obtained by freezing nitrogen at $-210\text{ }^{\circ}\text{C}$.
- What will nitrogen crystals contain?
- A nitrogen atoms only
 - B nitrogen molecules only
 - C nitrogen ions and nitrogen atoms
 - D nitrogen atoms and nitrogen molecules
- 6 Which of the following is likely to have an ionic lattice structure?

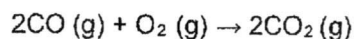
substance	melting point / $^{\circ}\text{C}$	electrical conductivity	
		in solid state	in molten state
A	-78	poor	good
B	651	poor	good
C	900	good	good
D	1710	poor	poor

- 7 The diagrams below show the structures of the atoms of two elements.



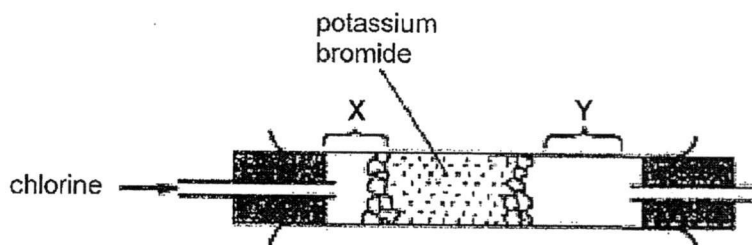
What is the relative molecular mass of the compound formed by these two elements?

- A 11 B 14 C 23 D 30
- 8 40 cm³ of carbon monoxide reacts with 20 cm³ of oxygen. The equation for the reaction is shown below.



What volume of carbon dioxide will be produced?
(all volumes are measured at r.t.p.)

- A 20 cm³ B 40 cm³ C 60 cm³ D 80 cm³
- 9 In the diagram below, chlorine was passed through a tube. After a short time, coloured substances were seen at X and Y.



What would be observed at X and Y?

	X	Y
A	greenish yellow gas	greenish yellow gas
B	greenish yellow gas	reddish brown vapour
C	reddish brown vapour	greenish yellow gas
D	reddish brown vapour	reddish brown vapour

10 Rubidium is an alkali metal.

Which statement about rubidium is **not** correct?

- A Rubidium is more reactive than potassium
- B Rubidium forms an ion with a positive charge.
- C Rubidium is a silvery solid at room temperature.
- D Rubidium has a higher melting point than potassium.

11 Experiments were carried out to construct a reactivity series for metals W, X and Y.

The table shows the results.

experiment	W	X	Y
Does the metal liberate hydrogen from dilute hydrochloric acid?	yes	no	yes
Is the metal oxide reduced by heating with carbon?	no	yes	yes

What is the order of reactivity of the metals?

	most reactive	→	least reactive
A	W	Y	X
B	Y	W	X
C	X	W	Y
D	Y	X	W

12 G is a solid that conducts electricity and has a high melting point.

On warming, G partly dissolves in excess dilute hydrochloric acid, leaving behind a residue.

What is G?

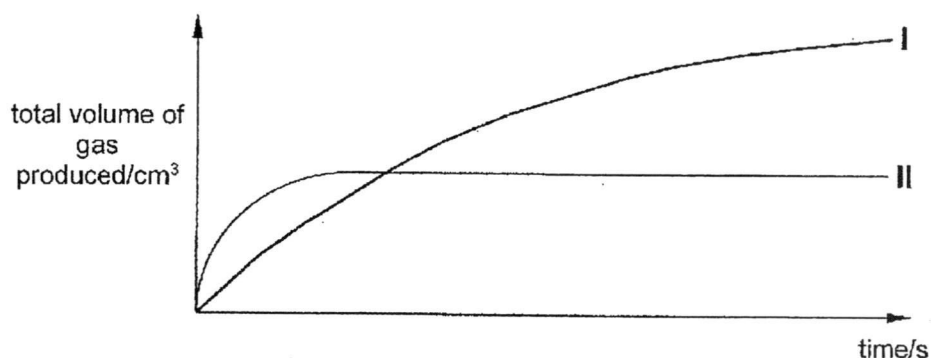
- A zinc
- B brass
- C copper
- D magnesium chloride

- 13 Scrap iron is often recycled.

Which reason for recycling is **not** correct?

- A It saves natural resources.
- B It reduces the need to collect the scrap iron.
- C It reduces the amount of waste taken to landfill sites.
- D It reduces the amount of pollution at the site of the ore extraction.

- 14 In the graph, curve I represents the results of the reaction between 1.0 g of granulated magnesium and an excess sulfuric acid at 30 °C.



Which change could have produced curve II?

- A 0.5 g of granulated magnesium at 20 °C
 - B 0.5 g of granulated magnesium at 40 °C
 - C 1.0 g of granulated magnesium at 20 °C
 - D 1.0 g of powdered magnesium at 40 °C
- 15 An aqueous solution of compound P reacts with aqueous ammonia to form a red-brown precipitate. Aluminium powder was then added and the mixture was heated. A gas that turns damp red litmus paper blue was evolved.

What is P?

- | | |
|----------------------|---------------------|
| A iron(II) chloride | B iron(III) nitrate |
| C copper(II) nitrate | D ammonium chloride |

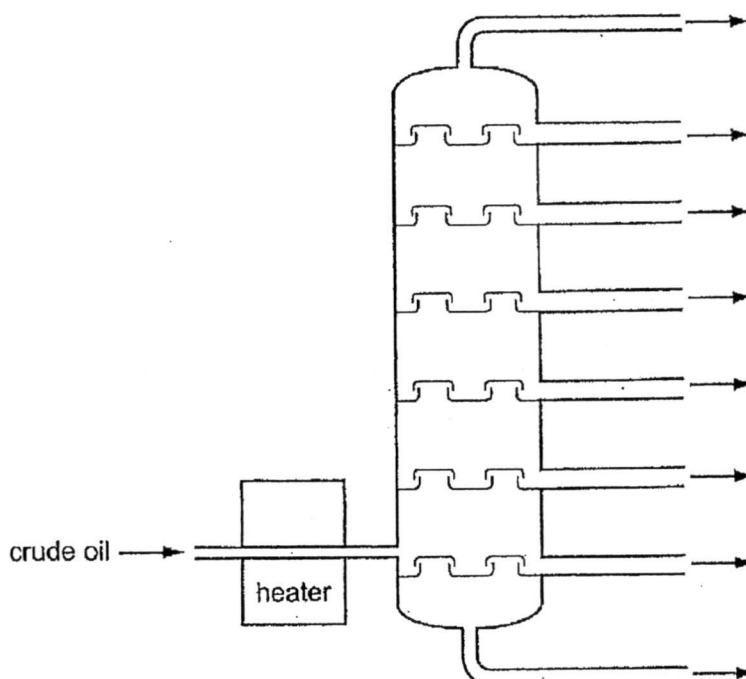
- 16 Which of the following is an endothermic process?

- A combustion of methane
- B adding potassium to water
- C thermal decomposition of calcium nitrate
- D reaction between sodium hydroxide and sulfuric acid

17 Which air pollutant is **not** correctly matched to its source?

	air pollutant	source
A	carbon monoxide	complete combustion of fossil fuels
B	nitrogen oxides	lightning activity
C	sulfur dioxide	volcanoes
D	unburnt hydrocarbon	incomplete combustion of fossil fuels

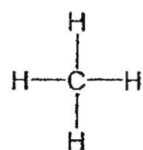
18 The diagram shows the apparatus used in fractional distillation of crude oil.



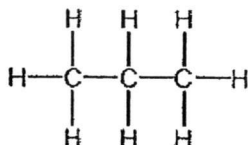
Which statement about the fractional distillation of crude oil is correct?

- A The molecules collected at the bottom of the column are the most flammable.
- B The molecules collected at the bottom of the column have the lowest boiling point.
- C The molecules collected at the top of the column are used as fuel for buses and lorries.
- D The molecules reaching the top of the column have the smallest relative molecular masses.

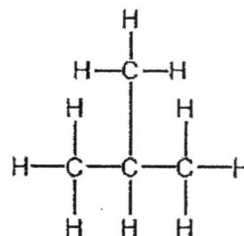
- 19 The structure of three hydrocarbons from the same homologous series are shown.



W



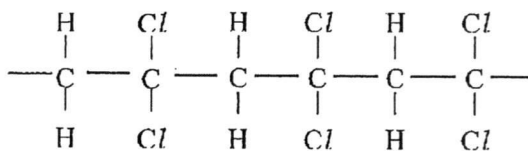
X



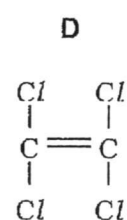
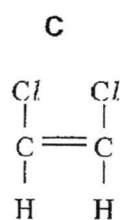
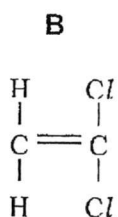
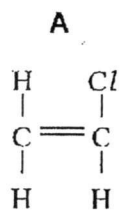
Y

Which statement is correct?

- A W has the lowest boiling point.
 B X and Y have the same molecular formula.
 C All three molecules are unsaturated hydrocarbons.
 D All three molecules have different chemical properties.
- 20 The diagram shows part of the structure of a polymer.



Which monomer is used to manufacture the polymer?



End of Paper



FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
SECONDARY 4 EXPRESS/ 5 NORMAL ACADEMIC

NAME:

CLASS:

INDEX NUMBER:

SCIENCE (CHEMISTRY)
Paper 3

5076/03 and 5078/03
13 September 2017
Papers 1 and 3: 1 hr 45 min
Max mark: 65

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

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

Section B

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

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

Marks Obtained	
Paper 3 Sect A	
Paper 3 Sect B ____	
B ____	
Total	

Name of Setter: Ms Elaine Koh

This paper consists of 16 printed pages.

Section A (45 marks)

Answer **all** the following questions in the space provided.

1. The following laboratory actions have to be taken.

(a) Name the pieces of apparatus most suitable to complete each action:

(i) measure exactly 23.1 cm³ of solution into a beaker [1]

.....

(ii) collect and measure the volume of a water-soluble gas [1]

.....

(b) The apparatus shown in Fig. 1.1 can be used to separate pure water from a mixture of ink dyes dissolved in water.

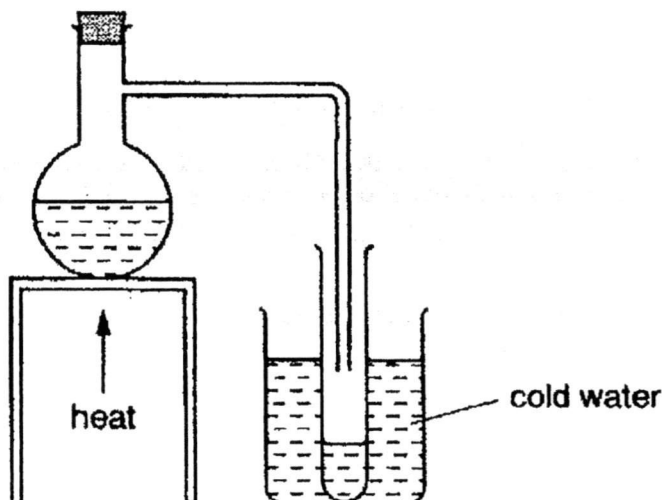


Fig. 1.1

(i) State the general name for this method of separation.

.....[1]

(ii) On the diagram, label with the letter 'X' to show the position of the thermometer that will measure accurately the boiling point of pure water. [1]

(iii) Predict the reading on the thermometer during the separation.

..... [1]

(iv) Suggest how you can improve this method of separation so as to maximise the amount of pure water collected.

.....[1]

(v) State a method that can be used to show that the ink collected is a mixture, and give the expected observation.

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

[Total: 8]

2. Most substances can be placed into only one of the five groups listed in Table 2.1.

group	letter
element	A
compound	B
mixture of elements	C
mixture of compounds	D
mixture of elements and compounds	E

Table 2.1

(a) State two differences between compounds and mixtures.

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

(b) Which of the groups, A, B, C, D and E in Table 2.1, best describes each of the following substances?

petroleum

bronze

oxygen

sodium oxide

[2]

[Total: 4]

3. Fig. 3.1 shows how the outer shell electrons are arranged in compound F.

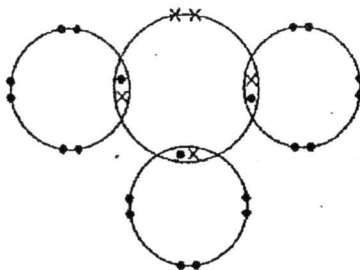


Fig. 3.1

(a) Put ticks (✓) in the boxes to show whether the following statements about compound F are true or false. [2]

	true	false
It is an unsaturated hydrocarbon		
It could be ammonia, NH ₃		
It is a halogen compound.		
It conducts electricity when molten.		

(b) Draw a dot-and-cross diagram to show the electronic structure of magnesium chloride. Show only the valence electrons. [Atomic numbers: Mg, 12; Cl, 17]

[2]

(c) Magnesium chloride has a much higher boiling point than compound F. Use your knowledge of the bonding in magnesium chloride and compound F to explain the difference in boiling point.

.....

.....

.....

.....

[2]
[Total: 6]

4. You have samples of three metals, **G**, **H** and **J**.
Only metal **G** is positioned below hydrogen in a reactivity series.
Only metal **H** is positioned above carbon in a reactivity series.

(a) State two general physical properties of the three metals.

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

(b) Explain why metal **H** reacts faster with water when

(i) the water is hot,

.....
.....
.....

(ii) the metal is powdered.

.....
.....
.....[4]

(c) Explain why

(i) metal **G** will **not** react with water no matter how hot the water is, or how finely powdered the metal,

.....

(ii) strong heating of the carbonate of metal **G** forms a gas, while no gas is produced when heating the carbonate of metal **H** strongly.

.....
.....
.....[3]

(d) Suggest a possible name for any two of the metals G, H or J.

	letter of metal (G, H or J)	name of metal
(i)		
(ii)		

[2]

[Total: 11]

5. Compound K has a relative molecular mass of 124. A 200 cm³ of another sample contains 248 g of K.

(a) Calculate the concentration of K in g/dm³.

concentration = g/dm³ [1]

(b) Calculate the concentration of K in mol/dm³.

concentration = mol/dm³ [1]

(c) Reacting K with dilute hydrochloric acid produced a colourless gas that formed a white precipitate in limewater. A blue solution was formed.

(i) Given that the relative molecular mass of K is 124, deduce the identity of K. Show your working.

K is [2]

- (ii) Using the identity of K found in (c)(i), write a balanced chemical equation for the reaction of K with dilute hydrochloric acid. State symbols are not required.

.....[1]

- (iii) Calculate the maximum volume of gas produced when 100 cm³ of 0.5 mol/dm³ of K was reacted with excess dilute hydrochloric acid. [The volume of one mole of any gas is 24 dm³ at room temperature and pressure.]

volume = dm³ [2]

- (iv) During the reaction, the temperature of the reaction mixture changed as shown in Fig. 5.1.

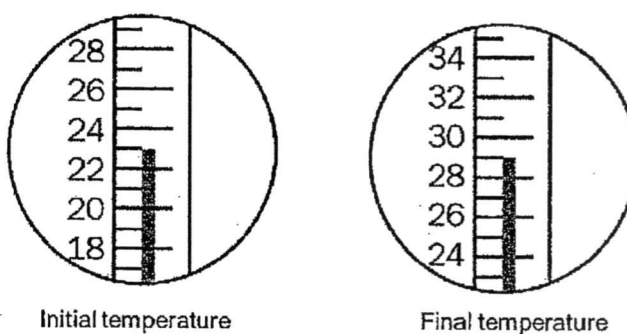


Fig. 5.1

State and explain whether this was an endothermic or exothermic reaction.

.....
[2]

[Total: 9]

6. Fig. 6.1 describes the formation and oxidation of an organic compound, **M**.

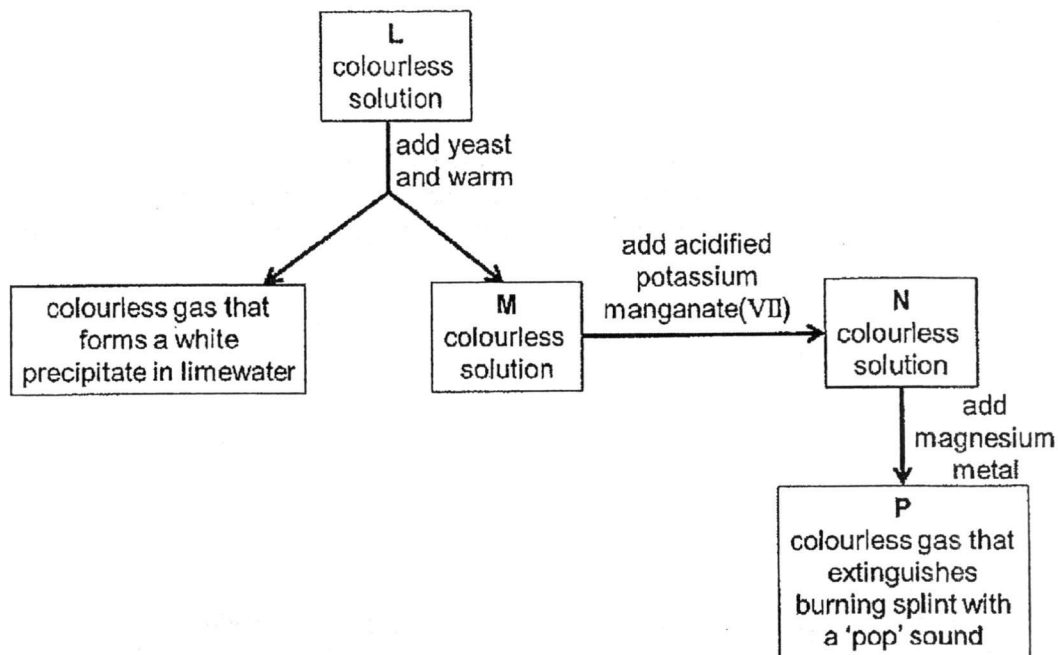


Fig. 6.1

(a) Identify **L** and **P**.

L is

P is

[2]

(b) Draw the structural formulae of **M** and **N**.

M:	N:
-----------	-----------

[2]

(c) With reference to (b), explain why the conversion of **M** to **N** is an oxidation.

.....

[1]

(d) Describe what is observed when **M** is converted to **N** in the presence of acidified potassium manganate(VII).

.....[1]

(e) Explain why the temperature of reactants **L** must not be allowed to rise much above 45 °C.

.....[1]

[Total: 7]

Section B (20 marks)

Answer any **two** questions in this section.

7. Iron can be extracted from its ore in a blast furnace.

(a) Explain, including **three** chemical equations, how iron is extracted from the ore in a blast furnace.

.....
.....
.....
.....[3]

(b) Choose an equation from (a) that represents a redox reaction. Explain why this is a redox reaction.

equation:
reason:
.....[2]

(c) Carbon dioxide is an acidic oxide. Classify the following oxides.

- (i) carbon monoxide
- (ii) iron(III) oxide
- (iii) silicon dioxide
- (iv) calcium oxide [2]

(d) Hence or otherwise, explain, including **two** chemical equations, how the impurities are removed from the ore in a blast furnace.

.....
.....
.....
.....[3]
[Total: 10]

8. Cooking oils contain a mixture of water, saturated fats and *polyunsaturated* fats. The ratio of the various components can vary.

(a) Explain the term *polyunsaturated*.

.....
[1]

(b) Cooking oil can be converted to margarine.

A chef prepared four samples of cooking oils, **Q**, **R** and **S** of 10 g each. He tried to convert each sample of cooking oil to margarine by bubbling 100 cm³ of hydrogen gas through each sample for ten minutes. He recorded the final volume of hydrogen gas remaining after ten minutes, as shown in **Table 8.1**.

sample	initial volume of hydrogen gas / cm ³	final volume of hydrogen gas / cm ³
Q	100	58
R	100	100
S	100	0

Table 8.1

(i) State the conditions needed for the conversion of cooking oil to margarine.

.....

(ii) Which sample of cooking oil did **not** contain any polyunsaturated fats? Explain your answer.

.....

.....

[3]

(c) Suggest another laboratory test to distinguish between cooking oils containing polyunsaturated fats and those without polyunsaturated fats. Describe the observations.

test:

observation for cooking oil **with** polyunsaturated fats:

.....

observation for cooking oil **without** polyunsaturated fats:

.....

[2]

(d) Briefly describe the manufacture of smaller alkenes from long-chain alkanes.

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

(e) Explain why the burning of sulfur- and nitrogen-containing substances can eventually damage buildings.

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

[Total: 10]

9. This question is about Group VII elements.

- (a) The element with an atomic number of 85 is so unstable that it has never been seen by the naked human eye.

Consider the properties of other elements in the same group as this element. Predict **one physical** property and **one chemical** property of this element with an atomic number of 85.

Write a balanced chemical equation to represent the chemical property that you have described.

.....
.....
.....
.....[3]

- (b) Chlorine gas is a mixture of two chlorine isotopes, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.

The relative atomic mass, A_r , of chlorine is 35.5. What does this tell you about the amounts of the two different isotopes in chlorine gas?

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

- (c) A clean and dry sample of copper(II) chloride, CuCl_2 , is to be prepared.

- (i) State the **two** reagents needed to prepare copper(II) chloride.

..... and[1]

- (ii) Describe the steps taken to prepare a clean and dry sample of copper(II) chloride, starting with the two reagents stated in (c)(i).

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

(d) A disproportionation reaction is one where the **same** element is oxidised and reduced simultaneously.

Chlorine undergoes a disproportionation reaction as shown:



(i) In terms of changes in oxidation state, explain why chlorine undergoes a disproportionation reaction.

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

(ii) This reaction is used in the large-scale production of bleach, NaClO_3 .

If 120 tonnes of bleach was produced in this reaction, calculate the volume of chlorine gas that was used.

[Relative atomic masses: A_r : Na: 23; Cl: 35.5]

[1 tonne = 10^6 g]

volume = dm^3 [2]

[Total: 10]

END OF PAPER 3

DATA SHEET

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of the Elements

		Group																																																																																														
I	II	III	IV	V	VI	VII	0					0																																																																																				
7 Li lithium 3	9 Be beryllium 4	11 B boron 5	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54	55 Cs caesium 55	56 Ba barium 56	57 La lanthanum 57	58-71 Lanthanoid series	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86	87 Fr francium 87	88 Ra radium 88	89 Ac actinium 89	90-103 Actinoid series	91 Th thorium 91	92 Pa protactinium 92	93 U uranium 93	94 Np neptunium 94	95 Pu plutonium 95	96 Am americium 96	97 Cm curium 97	98 Bk berkelium 98	99 Cf californium 99	100 Fm fermium 100	101 Md mendeleevium 101	102 No nobelium 102	103 Lr lawrencium 103	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109	110 Ds dubnium 110	111 Rg roentgenium 111	112 Cn copernicium 112	113 Nh nihonium 113	114 Fl flerovium 114	115 Mc moscovium 115	116 Lv livermorium 116	117 Ts tennessine 117	118 Og oganeson 118

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure.

Secondary 4 Express 5 Normal Academic
Science Chemistry
Prelim Examination 2017
Paper 1 MCQ

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

FCSS 4E/5NA Science Chemistry Prelim Paper 3

Section A

1 (a)

- (i) Burette [1]
- (ii) Gas syringe [1]

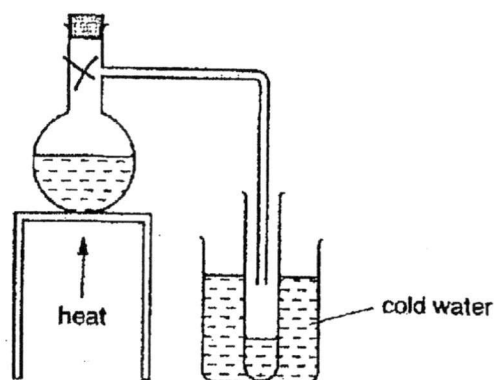
**No credit awarded for wrong spelling*

1 (b)

- (i) Simple distillation [1]

**Reject: Distillation; Fractional distillation*

(ii)



Correct position of "x" [1]

- (iii) 100 °C [1]
- (iv) Replace delivery tube with condenser [1]
- (v) Chromatography; [1]
Two or more/ more than one spots/ dots can be seen [1]

OR

Check for boiling point; [1]

Mixture boils over a range of temperatures [1]

2 (a) Any two:

- Compounds have a fixed ratio/ composition; mixtures have a variable ratio/ composition [1]
- Compounds are made up of two or more elements chemically combined together; mixtures are made up of two or more elements and/or compounds physically mixed together [1]
- Compounds can be separated into their constituent elements only by chemical reaction; mixture can be separated into their constituent components by physical methods [1]
- Compounds have different physical and chemical properties compared to their constituents; mixture has similar physical and chemical properties as their constituent components [1].

2 (b)

petroleum – D

bronze – C

oxygen – A

sodium oxide – B

[All correct – 2 marks; 1-3 correct – 1 mark; 0 correct – 0 mark]

3 (a)

	true	false
It is an unsaturated hydrocarbon		✓
It could be ammonia, NH ₃		✓
It is a halogen compound.	✓	
It conducts electricity when molten.		✓

[All correct – 2 marks; 1-3 correct – 1 mark; 0 correct – 0 mark]

3 (b)

For Mg²⁺ ion: [1]

- Correct charge of 2+
- Show 8 dots/ crosses

For Cl⁻ ion: [1]

- Correct charge of 1-
- Show 7 crosses and 1 dot (or vice versa)
- Show stoichiometric coefficient of 2 in front of ion

If all electron shells are drawn, deduct 1 mark throughout.

3 (c)

- Magnesium chloride is an ionic compound where oppositely charged ions are held at their fixed positions in a giant lattice structure by strong electrostatic forces of attraction;
- Compound F is a simple covalent molecule with weak intermolecular forces of attraction between its molecules;
- Much more energy/ heat is needed to overcome the stronger electrostatic forces of attraction in magnesium chloride, hence it has a higher boiling point.

[All 3 points – 2 marks; 1-2 points; 1 mark; 0 point – 0 mark]

4 (a) Any two [2]

- High boiling point/ melting point;

- High density;
- Shiny;
- Good conductors of heat and electricity in solid state;
- Malleable and ductile

4 (b) (i)

- When temperature increases, energy of particles increases.
- Proportion of particles with energy larger or equal to activation energy increases.
- Frequency of effective collisions increases. Speed of reaction increases.

[All 3 points – 2 marks; 1-2 points; 1 mark; 0 point – 0 mark]

4 (b) (ii)

- When metal is powdered, a smaller particle size results in a
- larger total surface area being exposed for reaction;
- Frequency of effective collisions increases. Speed of reaction increases.

[All 3 points – 2 marks; 1-2 points; 1 mark; 0 point – 0 mark]

4 (c) (i)

Metal G is highly unreactive. [1] (Rej: G is less reactive than H/ G is below H)

4 (c) (ii)

Carbonate of metal G is thermally less stable than carbonate of metal H. [1]

Carbonate of metal G can hence undergo thermal decomposition to form metal oxide, accounting for change in colour of solid.

Carbonate of metal H cannot undergo thermal decomposition. Hence, no change observed. [1]

4 (d)

Metal G: copper/ gold/ silver/ mercury/ platinum [1]

Metal H: sodium/ potassium [1]

(Reject: Calcium, magnesium, aluminium as these carbonates can undergo thermal decomposition to form metal oxide)

Metal J: zinc/ iron/ tin/ lead [1]

****Only names allowed; reject if symbol of metal given instead.**

5 (a)

Concentration of K = $248 / 0.2 = 1240 \text{ g/dm}^3$ [1]

5 (b)

Concentration of K = $(248 / 124) / 0.2 = 10 \text{ mol/dm}^3$ [1]

5 (c) (i)

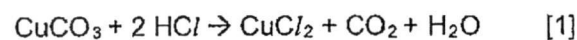
K is a metal carbonate since carbon dioxide is formed when reacting with dilute acid.

K is a copper(II) salt since blue solution formed.

$$\begin{aligned}\text{Mass of metal left} &= 124 - 12 - (3 \times 16) \\ &= 124 - 60 \\ &= \underline{64} \text{ [1]}\end{aligned}$$

Hence, K is copper(II) carbonate (CuCO₃) [1]

5 (c) (ii)



***Allow for ecf based on formula of K given in 5(c)(i)**

5 (c) (iii)

$$\text{No. of mol of K} = 0.1 \times 0.5 = 0.05 \text{ mol [1]}$$

By mole ratio, 1 K : 1 CO₂

$$\text{No. of mol of CO}_2 = 0.05 \text{ mol}$$

$$\text{Vol of CO}_2 = 24 \times 0.05 = \underline{1.2 \text{ dm}^3} \text{ [1]}$$

***Allow for ecf based on equation stated in 5(c)(ii)**

5 (c) (iv)

Exothermic reaction. [1]

Temperature of reaction mixture increases, which means that heat is released to the surroundings. [1]

6 (a)

L is glucose (C₆H₁₂O₆); [1]

P is hydrogen gas (H₂). [1]

6 (b)

M is ethanol [correct drawing – 1]

N is ethanoic acid [correct drawing – 1]

6 (c)

Ethanol gains 1 oxygen atom and/or loses 2 hydrogen atoms. [1]

6 (d)

Purple potassium manganate decolourises. [1]

**Starting colour of manganate must be given to get credit.*

6 (e)

Too high temperatures would cause enzymes in yeast to denature. [1] Fermentation hence cannot occur.

Section B

7 (a)

3 equations [3]

1. $C + O_2 \rightarrow CO_2$
2. $CO_2 + C \rightarrow 2 CO$
3. $Fe_2O_3 + 3 CO \rightarrow 2 Fe + 3 CO_2$

Coke combines with oxygen to form carbon dioxide, which reacts with more coke to form carbon monoxide.

Carbon monoxide reduces haematite to form iron and carbon dioxide gas.

7 (b)

Choose any 1 of the 3 equations (all are redox)

For Equation 1:

Carbon is oxidised as its oxidation state increases from 0 in C to +4 in CO_2 . [1]

Oxygen is reduced as its oxidation state decreases from 0 in O_2 to -2 in CO_2 . [1]

OR

For Equation 2:

Carbon is oxidised as its oxidation state increases from 0 in C to +2 in CO. [1]

Carbon dioxide is reduced as its oxidation state decreases from +4 in CO_2 to +2 in CO. [1]

OR

For Equation 3:

Carbon monoxide is oxidised as its oxidation state increases from +2 in CO to +4 in CO_2 . [1]

Carbon monoxide is oxidised as it gains oxygen.

Iron (III) oxide is reduced as its oxidation state decreases from +3 in Fe_2O_3 to 0 in Fe. [1]

Iron (III) oxide is reduced as it loses oxygen.

7 (c)

- (i) Carbon monoxide: neutral
- (ii) Iron (III) oxide: basic
- (iii) Silicon dioxide: acidic
- (iv) Calcium oxide: basic

[All correct – 2 marks; 1-3 correct – 1 mark; 0 correct – 0 mark]

7 (d)

[1 mark per equation]

1. $CaCO_3 \rightarrow CaO + CO_2$
2. $CaO + SiO_2 \rightarrow CaSiO_3$

Limestone undergoes thermal decomposition to form CaO and CO_2 .

CaO, being a basic oxide, can react with SiO₂, an acidic oxide, to form slag. [1]

8 (a)

Polyunsaturated means that there are many C=C double covalent bonds present in the organic compound. [1]

8 (b) (i)

Nickel catalyst; 200 °C [1]

8 (b) (ii)

Sample R. [1]

The volume of hydrogen gas remains unchanged, which meant that there are no C=C bonds present in R to undergo addition reaction with hydrogen gas. [1]

8 (c)

Test: Add aqueous bromine/ bromine solution dropwise [1]

Observation for cooking oil with polyunsaturated fat:

Reddish-brown bromine decolourises;

Observation for cooking oil without polyunsaturated fat:

Reddish-brown bromine remains. [1]

8 (d)

Long-chain alkanes can undergo cracking [1], where they are broken down into smaller alkanes and alkenes. Conditions required are 500 °C and Al₂O₃ / SiO₂ catalyst. [1]

8 (e)

Burning of these substances produce sulfur dioxide and nitrogen dioxide, which dissolve in rain water to form sulfuric acid and nitric acid, leading to acid rain [1].

Acid rain corrodes buildings. [1]

9 (a)

Element is Astatine (At).

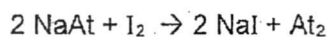
Physical property:

- Black solid at room temperature [1]
(Also accept: Highest melting/boiling point in Group VII)

Chemical property:

- Least reactive halogen in Group VII; or
- its halide ions can be displaced by any other halogen in Group VII [1]

Chemical equation [1]



(also accept KAt; any other halogen molecule: F_2 / Cl_2 / Br_2)

9 (b)

There are more Cl-35 isotopes than Cl-37 isotopes. [1]

9 (c) (i)

copper(II) carbonate/ copper(II) oxide and hydrochloric acid

[1]

9 (c) (ii)

Steps:

1. Add excess copper (II) carbonate/ copper (II) oxide to dilute hydrochloric acid. Stir.
2. Filter to remove excess solid.
3. Heat filtrate to get saturated solution.
4. Cool to form crystals.
5. Filter, rinse crystals with distilled water, dry crystals with filter paper.

[2]

9 (d) (i)

Chlorine is oxidised as its oxidation state increases from 0 in Cl_2 to +5 in NaClO_3 .

Chlorine is reduced as its oxidation state decreases from 0 in Cl_2 to -1 in NaCl . [1]

9 (d) (ii)

$$\begin{aligned} \text{No. of mol of NaClO}_3 &= (120 \times 10^6) / (23 + 35.5 + 48) \\ &= 1.13 \times 10^6 \text{ mol (3sf)} \quad [1] \end{aligned}$$

By mole ratio,



$$\begin{aligned} \text{No. of mol of Cl}_2 &= (1.13 \times 10^6) \times 3 \\ &= 3.38 \times 10^6 \text{ mol (3sf)} \end{aligned}$$

$$\begin{aligned} \text{Vol. of Cl}_2 &= 3.38 \times 10^6 \times 24.0 \\ &= \underline{\underline{8.11 \times 10^7 \text{ dm}^3}} \quad [1] \end{aligned}$$

