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YUYING SECONDARY SCHOOL

END-OF-YEAR EXAMINATION

Secondary 3 Express

NAME

CLASS

REG. NO

SCIENCE

Chemistry

5076, 5078

9 October 2017

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet and the separate Answer Sheet.

Write in dark blue or black pen on both sides of the paper.

You may use a pencil for any diagrams, graphs, tables or rough working.

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

Section A

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.

Read the instructions on the Answer Sheet very carefully.

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

Section B

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

Section C

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

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

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

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

For Examiner's Use	
Total	65

This document consists of **15** printed pages.

Section A

Answer **all** the questions in this paper on the separate Answer Sheet.
The total mark for this section is 20.

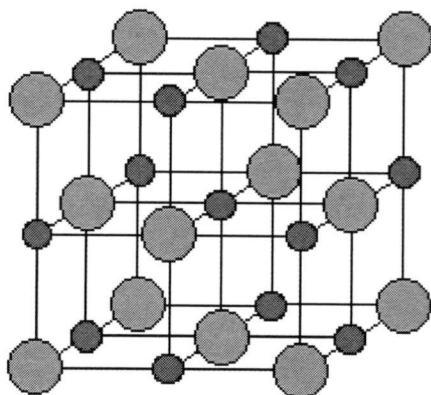
- What is the total number of atoms present in one molecule of acesulfame potassium, $\text{C}_4\text{H}_4\text{KNO}_4\text{S}$?
 A 1
 B 6
 C 13
 D 15
- When a sample of solid sodium chloride is dissolved in an excess of water, an aqueous solution of sodium chloride is formed.
This aqueous solution can be described as a
 A compound.
 B mixture of elements.
 C mixture of compounds.
 D mixture of elements and compounds.

- The nucleon number of an isotope of bromine is 81.
How many protons, neutrons and electrons are present in an atom of this isotope?

	protons	neutrons	electrons
A	35	46	35
B	35	46	46
C	37	44	35
D	37	44	37

- Which one of the following ions has the same electronic configuration as an atom of argon?
 A Al^{3+}
 B K^+
 C F^-
 D O^{2-}
- Which of the following pairs of elements will form a compound by sharing electrons?
 A sodium and chlorine
 B neon and oxygen
 C magnesium and sulfur
 D carbon and chlorine

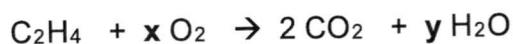
- 6 A compound has the following structure:



It will most likely

- A conduct electricity in the solid state.
 - B dissolve in organic solvent only.
 - C have a high melting and boiling point.
 - D have weak intermolecular forces of attraction between its particles.
- 7 Which of the following statements about the Periodic Table is **not** true?
- A The elements in the same group have the same number of valence electrons.
 - B The chemical reactivity of the elements decreases down Group VII.
 - C The melting points of the elements decrease down Group I.
 - D The elements show an increasing metallic character from left to right across the Periodic Table.
- 8 The elements in the periodic table are arranged according to their
- A ability to conduct electricity.
 - B chemical reactivity.
 - C number of isotopes.
 - D number of protons.
- 9 Atoms **A** and **B** have electronic configurations of 2,8,3 and 2,8,6 respectively. The chemical formula of the compound formed between **A** and **B** will be
- A AB
 - B AB₂
 - C A₂B₃
 - D A₃B₂

- 10 Ethene, C_2H_4 , undergoes complete combustion to produce carbon dioxide and water according to the following chemical equation.



What are the values of x and y ?

	x	y
A	1	1
B	1	2
C	2	3
D	3	2

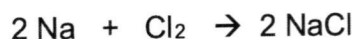
- 11 What is the relative molecular mass of one molecule of glucosamine, $\text{C}_6\text{H}_{13}\text{NO}_5$?

- A** 90
- B** 124
- C** 179
- D** 235

- 12 0.8 mol of calcium carbonate, CaCO_3 , was dissolved in 500 cm^3 of water. The concentration of the resulting solution is

- A** 0.0016 mol/dm^3
- B** 0.4 mol/dm^3
- C** 1.6 mol/dm^3
- D** 400 mol/dm^3

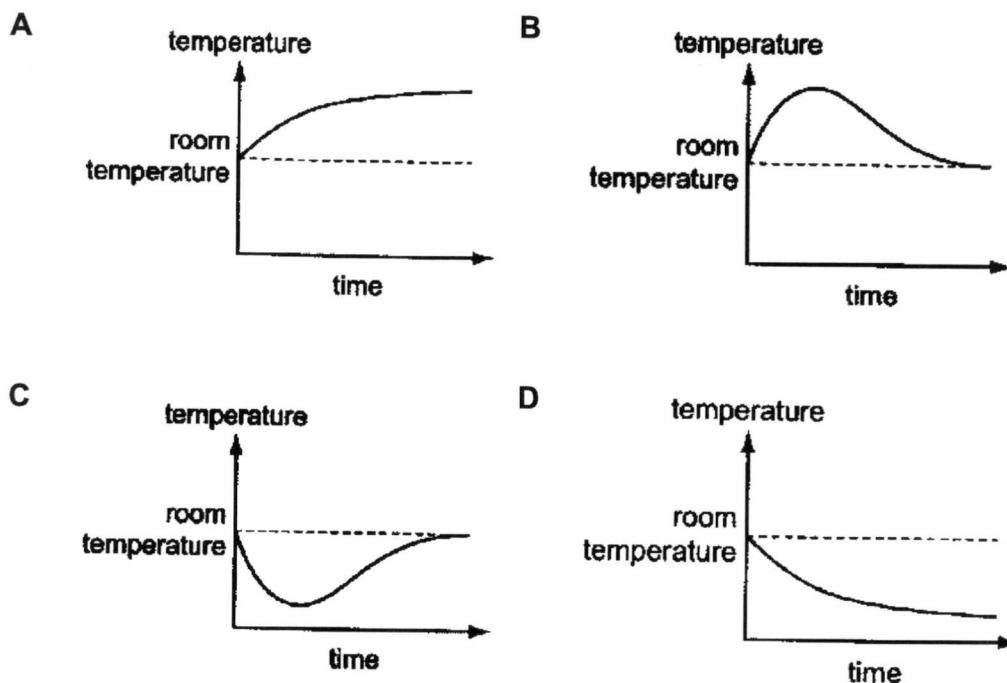
- 13 Sodium reacts with chlorine gas to produce sodium chloride according to the following equation.



What is the mass of sodium chloride produced if 46 g of sodium reacts with excess chlorine gas?

- A** 23 g
- B** 92 g
- C** 117 g
- D** 234 g

14 Which of the following graphs describes a combustion reaction?



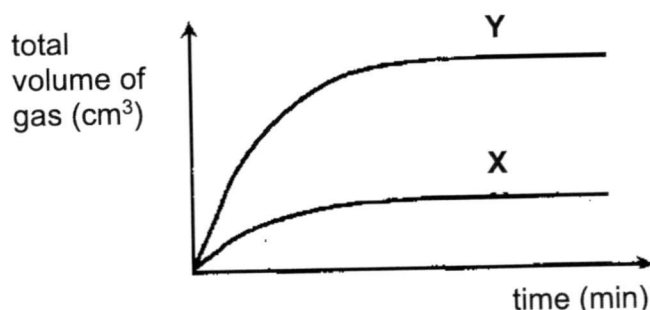
15 Which of the following processes represents an endothermic change?

- A** photosynthesis
- B** condensation
- C** freezing
- D** neutralisation

16 The speed of reaction between a piece of magnesium ribbon and excess dilute hydrochloric acid can be increased by

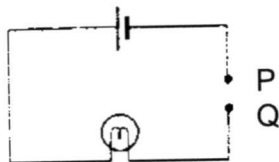
- A** adding more pieces of magnesium ribbon.
- B** diluting the dilute hydrochloric acid.
- C** increasing the temperature of the dilute hydrochloric acid.
- D** increasing the pressure of the reaction.

- 17 In the following graph, curve **Y** represents the reaction between 3.6 g of powdered calcium carbonate in an excess of dilute sulfuric acid at 24°C.



Which change would produce curve **X**?

- A** using 1.2 g of powdered calcium carbonate
 - B** using 3.6 g of calcium carbonate lumps
 - C** using concentrated dilute sulfuric acid
 - D** using dilute sulfuric acid at 8°C
- 18 Which substance, when placed between terminals P and Q in the circuit below, would **not** cause the light bulb to light up?



- A** cobalt
 - B** magnesium
 - C** phosphorus
 - D** potassium
- 19 Metal **X** is able to react vigorously with lukewarm water. What is another conclusion that can be made about metal **X**?
- A** It does not react with dilute sulfuric acid.
 - B** It does not react with steam.
 - C** It reacts violently with boiling water.
 - D** It reacts vigorously with cold water.
- 20 What does brass consist of?
- A** copper and iron
 - B** copper and zinc
 - C** iron and zinc
 - D** iron and carbon

Section BAnswer **all** questions in this section.

The total mark for this section is 25.

- 1 The table shows the atomic structure of particles, **A** to **E**. These particles are either atoms or ions, and the letters are not the symbols of the elements.

particle	no. of electrons	no. of protons	no. of neutrons
A	5	5	6
B	4	4	5
C	5	5	8
D	9	9	10
E	10	9	10

Each answer can be used once, more than once, or not at all.

- (a) Which particles are isotopes? [1]

- (b) Which particles belong to the 2nd period of the Periodic Table? [1]

- (c) Which particles are of the same element? [1]

- (d) Which particle has an electronic configuration of a noble gas? [1]

- 2 Space shuttles are typically powered by liquid hydrogen fuel. The reaction between hydrogen and oxygen can produce enough heat and light energy to propel the space shuttle.

(a) Would you describe the reaction between hydrogen and oxygen as an endothermic or exothermic process? Why? [2]

(b) Hydrogen gas is changed into a liquid form before it is placed in the fuel tanks of space shuttles. Is this change in state of hydrogen an endothermic or exothermic process? [1]

- 3 Some information about substances **W**, **X**, **Y** and **Z** are given in the table below.

substance	melting point	electrical conductivity	solubility in water
W	-38°C	conducts in the solid and molten state	insoluble in water
X	-15°C	does not conduct in any state	insoluble in water
Y	650°C	conducts in the solid and molten state	insoluble in water
Z	770°C	conducts in the aqueous and molten state	soluble in water

(a) Which substance(s) exists as simple molecules at room temperature and pressure? [1]

(b) Which substance could be potassium chloride? Explain your answer. [2]

(c) Which of the substance(s) are metals? Explain your answer. [2]

- 4 Metals such as lithium and sodium are known as alkali metals, a group of elements in the periodic table with unique properties.

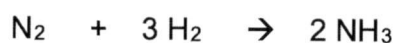
(a) State one physical property unique to the alkali metals. [1]

(b) Describe the reaction of sodium with cold water. [1]

(c) Write the balanced chemical equation for the reaction in (b) [2]

(d) Would you expect lithium to be more reactive or less reactive than sodium? Explain your answer. [1]

- 5 In the Haber process, nitrogen and hydrogen react to form ammonia gas, according to the following equation:

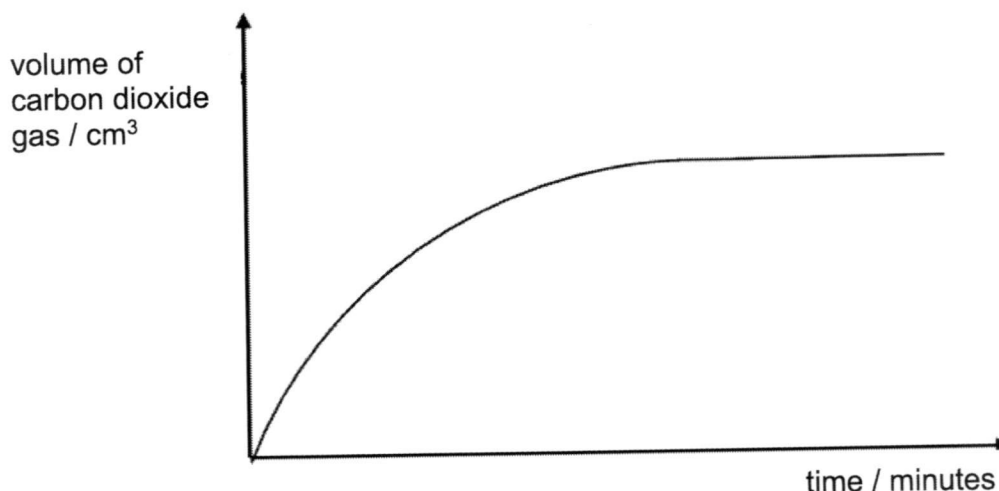


If 56 g of nitrogen were used in the reaction,

(a) Calculate the mass of hydrogen needed for the reaction. [3]

- (b) Determine the volume of ammonia gas produced at room temperature and pressure. [2]

- 6 The speed of reaction between calcium carbonate and dilute hydrochloric acid is measured by recording the volume of carbon dioxide produced over a period of time. The graph below shows the results obtained when 5.0 g lumps of calcium carbonate was added to an excess of 2.0 mol/dm^3 dilute hydrochloric acid.



- (a) In separate experiments,
- (i) 1.0 mol/dm^3 dilute hydrochloric acid was used, with all other conditions being unchanged. Sketch the curve you would expect on the graph above for this reaction and label it as experiment **A**. [1]
 - (ii) 2.5 g powdered calcium carbonate was used, with all other conditions being unchanged. Sketch the curve you would expect on the graph above for this reaction and label it as experiment **B**. [1]
- (b) Describe another method you could use to measure the speed of reaction between calcium carbonate and dilute hydrochloric acid. [1]

Section C

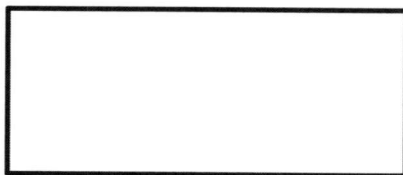
Answer **only two** questions in this section.

The total mark for this section is 20.

1 Metals such as gold and aluminium have many different uses.

- (a) Rose gold is an alloy used in rings, bracelets and ornaments. It typically contains a mixture of 75% gold and 25% copper. [3]

Draw the structure of rose gold in the box below, and use it to explain why rose gold is harder and stronger than pure gold.



- (b) Unlike rose gold, aluminium is not used for decorative purposes. Aluminium reacts easily with oxygen in the air to form aluminium oxide, which is useful due to its strength, durability and high melting and boiling point.

- (i) Draw a dot-and-cross diagram to show the bonding in aluminium oxide, showing only the valence electrons. [2]

- (ii) Explain why aluminium oxide has a high melting and boiling point. [2]

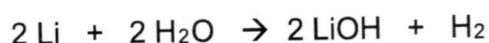
- (c) Describe a chemical test to differentiate between gold and aluminium. [3]

test: _____

observation with gold: _____

observation with aluminium: _____

- 2 A sample of solid lithium lumps was reacted with an excess of distilled water at 50°C to produce lithium hydroxide solution and 48 cm³ of hydrogen at room temperature and pressure, according to the following chemical equation:



- (a) Describe the effect of increasing the temperature of the distilled water to 80°C on the reaction above, in terms of the reacting particles. [3]

- (b) Besides increasing the temperature of the distilled water, suggest one other way to increase the speed of the reaction. [1]

- (c) Calculate the concentration of the lithium hydroxide solution in mol/dm³ if there was 400 cm³ of solution present at the end of the reaction. [3]

- (d) With the aid of suitable apparatus, describe how you would show whether the reaction between lithium and distilled water was an exothermic or endothermic change. [3]

- 3 Fluorine and chlorine are reactive elements known as the Halogens and they belong to group VII of the periodic table.

- (a) State two trends on going down the group of halogens. [2]

- (b) Explain why the halogens are reactive elements while elements such as the noble gases are not reactive. [2]

- (c) Fluorine is able to react with a solution of sodium chloride to produce sodium fluoride and chlorine. Write the balanced chemical equation for this reaction. [2]

- (d) Explain why reactions of the halogens such as those in (c) are able to take place. [2]

- (e) Fluorine is able to combine with carbon to form carbon tetrafluoride. [2]
Draw a dot-and-cross diagram to show the bonding in carbon tetrafluoride, showing all of the electrons present.

END OF PAPER

The Periodic Table of Elements

Group																	
I	II	Key										III	IV	V	VI	VII	0
		1 H hydrogen 1															
		proton (atomic) number atomic symbol name relative atomic mass															
3	4											5	6	7	8	9	
Li	Be											B	C	N	O	F	He
lithium	beryllium											boron	carbon	nitrogen	oxygen	fluorine	helium
7	9											11	12	14	16	19	4
Na	Mg											Al	Si	P	S	Cl	Ne
sodium	magnesium											aluminium	silicon	phosphorus	sulfur	chlorine	neon
23	24											27	28	31	32	35.5	20
19	20											31	32	33	34	35	36
K	Ca											Ga	Ge	As	Se	Br	Kr
potassium	calcium											gallium	germanium	arsenic	selenium	bromine	krypton
39	40											70	73	75	79	80	84
37	38											49	50	51	52	53	54
Rb	Sr											In	Sn	Sb	Te	I	Xe
rubidium	strontium											indium	tin	antimony	tellurium	iodine	xenon
85	88											115	119	122	128	127	131
55	56											81	82	83	84	85	86
Cs	Ba											Tl	Pb	Bi	Po	At	Rn
caesium	barium											thallium	lead	bismuth	polonium	astatine	radon
133	137											204	207	209	—	—	—
87	88											114	114	116	116	—	—
Fr	Ra											Fl	Fl	—	—	—	—
francium	radium											—	—	—	—	—	—

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
lanthanoids	La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium —	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175
actinoids	Ac actinium —	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium —	Pu plutonium —	Am americium —	Cm curium —	Bk berkelium —	Cf californium —	Es einsteinium —	Fm fermium —	Md mendelevium —	No nobelium —	Lr lawrencium —

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

3E Science (Chemistry) EOY 2017 Mark Scheme

Section A

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

Section B

Q	Ans	Mark
1a	A, C	1
1b	A, B, C, D, E	1
1c	A & C or D & E	1
1d	E	1
2a	Exothermic reaction [1] heat and light energy were released to the surroundings [1]	2
2b	Exothermic process.	1
3a	X.	1
3b	Z [1]. Potassium chloride is an ionic compound [0.5] and ionic compounds can conduct electricity in the molten and aqueous states [0.5]	2
3c	W [0.5] and Y [0.5]. Metals are able to conduct electricity in the solid and molten state.	2
4a	Soft and can be cut easily with a knife / silvery and shiny	1
4b	A violent reaction occurs and a yellow flame is produced / Effervescence is observed and a yellow flame is produced	1
4c	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$	1
4d	Lithium is less reactive than sodium. Sodium is below lithium in group I and the chemical reactivity of the alkali metals increase down the group. – must have correct explanation to get 1m.	1
5a	No. moles of Nitrogen = $56\text{g} / 2(14) = 2\text{ mol}$ [1] 2 mol of N_2 : 6 mol of H_2 [1] Mass of Hydrogen = $6\text{ mol} \times 2 = 12\text{g}$	3
5b	2 mol of N_2 : 4 mol of NH_3 [1] Volume of NH_3 = $4\text{ mol} \times 24\text{ dm}^3 = 96\text{ dm}^3$ [1]	2
6ai	Curve ends at the same total volume of gas but has a smaller gradient than the original curve	1
6aii	Curve ends at half the total volume of gas but has a larger gradient than the original curve	1
6b	Measure the loss in mass of the reaction mixture over time	1

Section C

Q	Ans	Mark
1a	Structure contains 75% of gold atoms and 25% of copper atoms, with a disrupted arrangement. Gold and copper atoms must be of different sizes. [1] Rose gold contains elements of different sizes [0.5] This disrupts the orderly arrangement of gold atoms [0.5] and hence it is more difficult for atoms to slide over each other when a force is applied [1]	3
1bi	1m each for correct aluminium and oxide ion. 1m deducted for any mistake.	2
1bii	It is an ionic compound [0.5] and a large amount of energy [0.5] is needed to overcome the strong electrostatic forces of attraction [0.5] between ions [0.5]	2
1c	Test: add dilute acid to both gold and aluminium [1] Gold: there is no visible reaction. [1] Aluminium: effervescence is observed [1]	3
2a	The speed of the reaction would increase [1] at a higher temperature, reacting particles have more kinetic energy [1], this increases the frequency of effective	3
2b	By using powdered lithium	1
2c	No. of moles of $H_2 = 0.048 \text{ dm}^3 / 24 \text{ dm}^3 = 0.002 \text{ mol}$ [1] $0.002 \text{ mol } H_2 : 0.004 \text{ mol LiOH}$ [1] Concentration of $LiOH = 0.004 \text{ mol} / 0.4 \text{ dm}^3 = 0.01 \text{ mol/dm}^3$ [1]	3
2d	Use a thermometer [0.5] to measure the initial and final temperature of the reaction mixture [0.5]. If the final temperature is greater than the initial temperature [0.5], the reaction is an exothermic reaction [0.5]. If the final temperature is lower than the initial temperature [0.5], the reaction is an endothermic reaction [0.5]	3
3a	Melting and boiling points increase, chemical reactivity decreases, colour intensity becomes darker. (any 2)	2
3b	The atoms of the halogens do not have a filled valence shell [0.5] but the atoms of the noble gases have filled valence shells [0.5]. The halogens need to lose, gain, or share electrons but the noble gases do not have to lose, gain, or share electrons [0.5] to achieve a stable electronic configuration [0.5]	2
3c	$F_2 + 2NaCl \rightarrow 2NaF + Cl_2$	2
3d	Fluorine is a more chemically reactive element than chlorine [1] so fluorine is able to displace [0.5] chlorine from a solution of sodium chloride [0.5]	2
3e	1m each for the correct number of valence electrons shared between carbon and fluorine and 1m for the correct number of fluorine atoms (4).	2