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

Section A

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

1 What is the total number of atoms present in one molecule of acesulfame potassium, $C_4H_4KNO_4S$?

A 1
B 6
C 13
D 15

2 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.

3 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

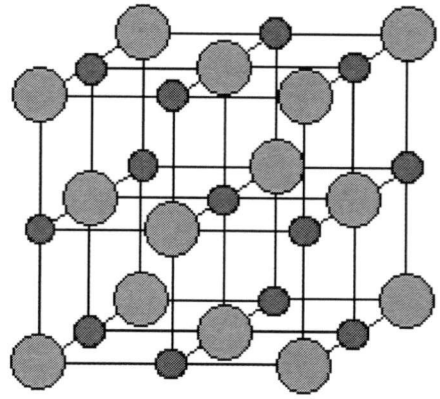
4 Which one of the following ions has the same electronic configuration as an atom of argon?

A Al^{3+}
B K^{+}
C F^{-}
D O^{2-}

5 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 AB_2
C A_2B_3
D A_3B_2

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

$$C_2H_4 + \mathbf{x}\, O_2 \rightarrow 2\, CO_2 + \mathbf{y}\, H_2O$$

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, $C_6H_{13}NO_5$?

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.

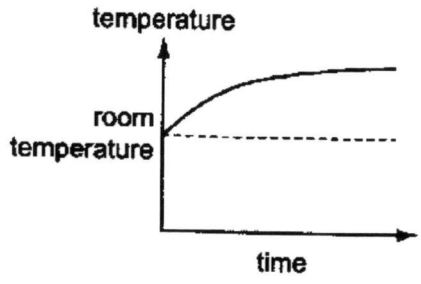
$$2\, Na + Cl_2 \rightarrow 2\, NaCl$$

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

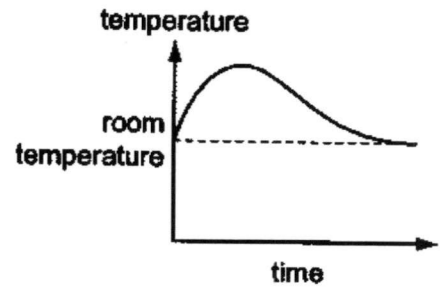
A 23 g
B 92 g
C 117 g
D 234 g

14 Which of the following graphs describes a combustion reaction?

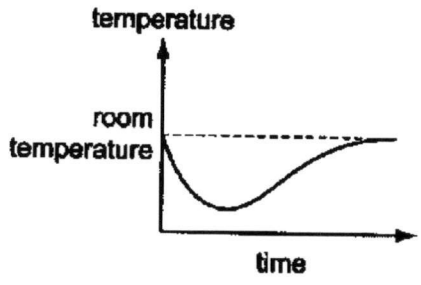
A



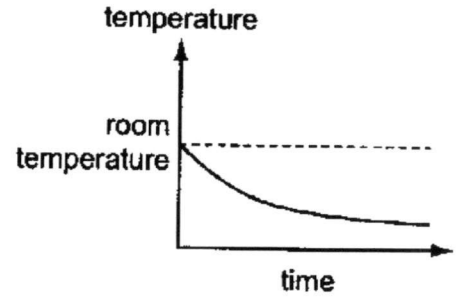
B



C



D



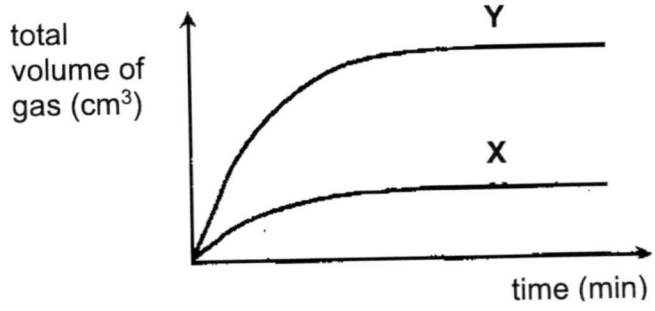
15 Which of the following processes represents an endothermic change?

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.

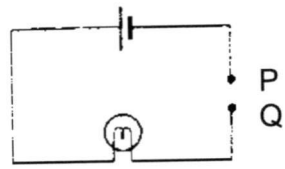
17 In the following graph, curve **Y** represents the reaction between 3.6 g of powdered calcium carbonate in an excess of dilute sulfuric acid at 24°C.



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 B

Answer **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:

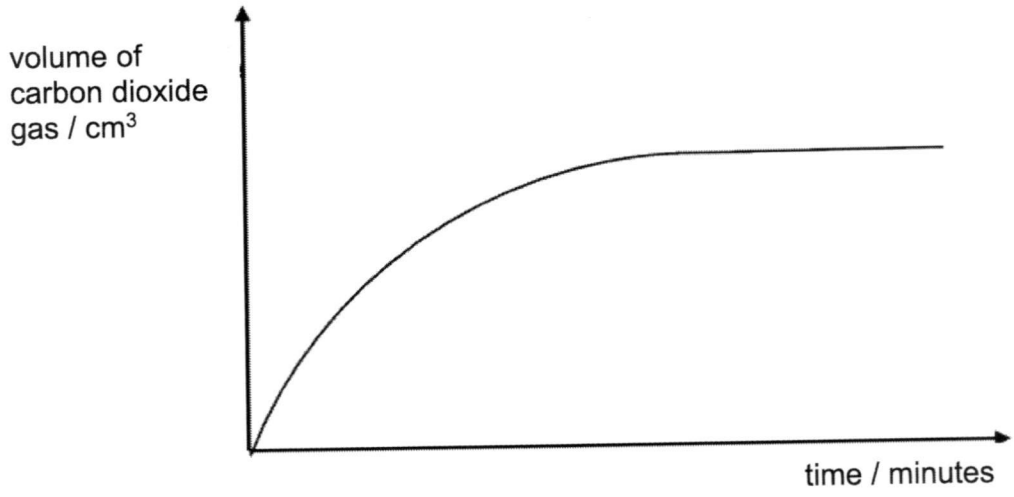
$$N_2 + 3\,H_2 \rightarrow 2\,NH_3$$

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]

_____

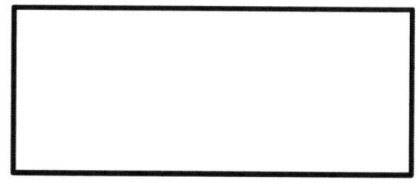
_____

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 cm^3 of hydrogen at room temperature and pressure, according to the following chemical equation:

$$2\,Li + 2\,H_2O \rightarrow 2\,LiOH + H_2$$

(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/dm^3 if there was 400 cm^3 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. Draw a dot-and-cross diagram to show the bonding in carbon tetrafluoride, showing all of the electrons present. [2]

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									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 –	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 –

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	$2Na + 2H_2O \rightarrow 2NaOH + H_2$	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 = 56g / 2(14) = 2 mol [1] 2 mol of N_2 : 6 mol of H_2 [1] Mass of Hydrogen = 6 mol X 2 = 12g	3
5b	2 mol of N_2 : 4 mol of NH_3 [1] Volume of NH_3 = 4 mol X 24 dm^3 = 96 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 forces 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 dm^3 / 24 dm^3 = 0.002 mol [1] 0.002 mol H_2 : 0.004 mol LiOH [1] Concentration of LiOH = 0.004 mol / 0.4 dm^3 = 0.01 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