ST EDWARD'S

OXFORD

16+ ENTRANCE EXAMINATION

For entry in

September 2015

CHEMISTRY

Time: 1 hour

Candidates Name: ……

THE PERIODIC TABLE

Period	1	2					Group						3	4	5	6	7	0
1							1 H Hydrogen 1											4 He Helium 2
2	7 Li Lithium 3	9 Be Berylium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

1. Complete the table below.

Element	Symbol
calcium	
	Pb
	S

(Total 3 marks)

2. (a) Sulphur is a yellow element. It is a non-metal.

(i) Complete the sentence.

In an element, all the atoms .....

.....

(1)

(ii) Give **two** properties you would expect sulphur to have because it is a non-metal.

1. .....

.....

2. .....

.....

(2)

(b) Use the names of metals from the box to complete the table.

copper	**iron**	**magnesium**	**manganese**	**zinc**

Use	**Name of metal**
for electric wiring in a house	.....
for manhole covers	.....
to galvanise iron	.....

(3)

(c) Copper is used to make hot water pipes. Both iron and steel are cheaper.

Suggest **two** reasons why copper is used rather than iron or steel.

1. .....

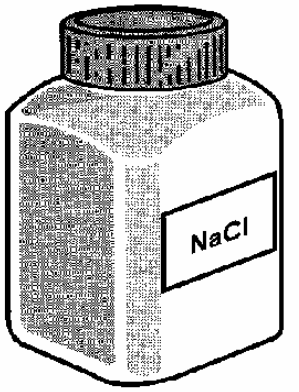
.....

2. .....

.....

(2)

(d) The drawing shows a container of a compound called sodium chloride.



(i) Which other element has combined with sodium to form this compound?

.....

(1)

(ii) For every atom of sodium, how many atoms of the other element have combined with it?

.....

(1)

(Total 10 marks)

3. (a) Balance the symbol equation.

$$H_2 + O_2 \rightarrow H_2O$$

(2)

(b) What atoms does each molecule of H_2O contain?

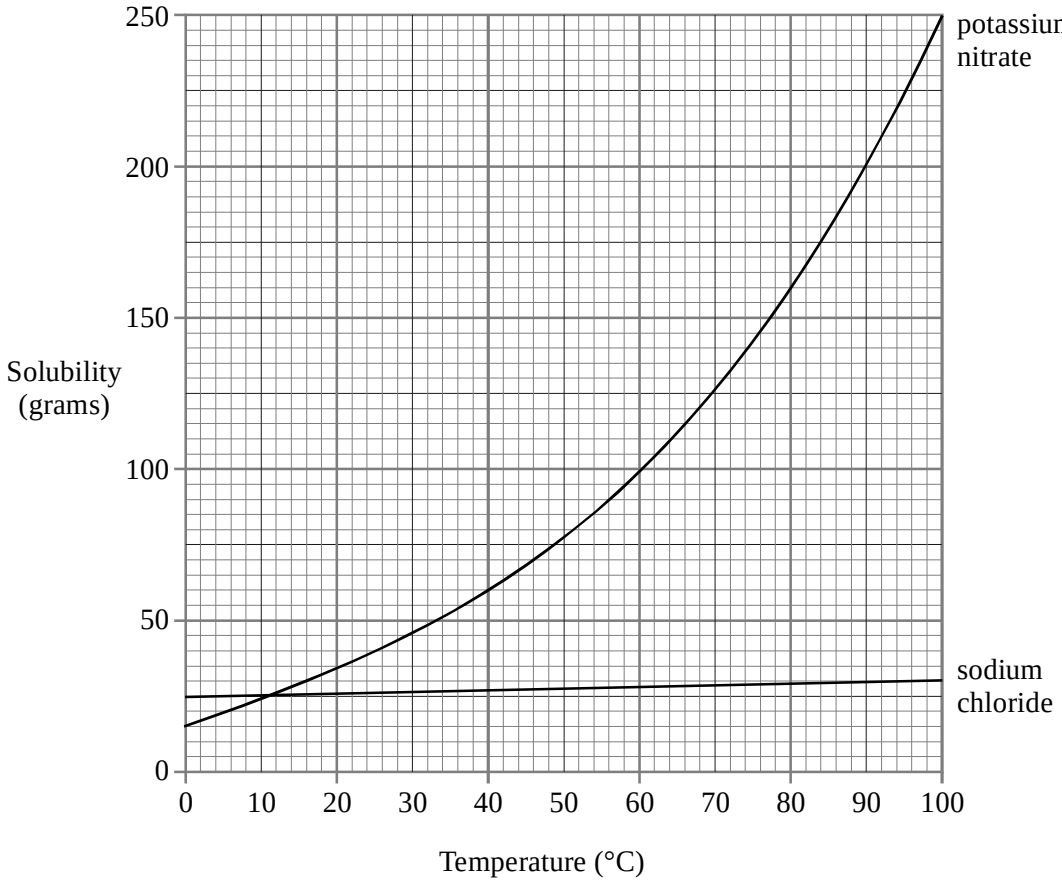
.....

(2)
(Total 4 marks)

4. Some substances dissolve in water.

The solubility of a substance is the number of grams that will dissolve in 100 grams of water.

The diagram below shows how the solubilities of two substances, potassium nitrate and sodium chloride, vary between 0 – 100°C.



(a) How much potassium nitrate dissolves in 100 grams of water at 60°C?

..... grams

(1)

(b) Describe what happens to the solubilities of potassium nitrate and sodium chloride between 0 – 100°C.

Answer in as much detail as you can.

.....

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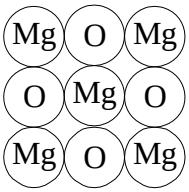
.....

(5)

(Total 6 marks)

5. Magnesium oxide is a compound, made up of magnesium ions and oxide ions.



(a) What is the charge on each magnesium ion? .....

(1)

(b) Explain how the magnesium ions get this charge.

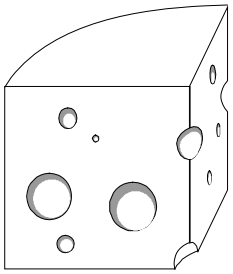
.....

.....

.....

(2)
(Total 3 marks)

6. The salt sodium hydrogen phosphate (Na_2HPO_4) is used as a softening agent in processed cheese.



It can be made by reacting phosphoric acid (H_3PO_4) with an alkali.

(a) Complete the name of an alkali that could react with phosphoric acid to make sodium hydrogen phosphate.

..... hydroxide

(1)

(b) What is the name given to a reaction in which an acid reacts with an alkali to make a salt?

.....

(1)

(c) How would the pH change when alkali is added to the phosphoric acid solution?

.....

.....

(1)

(d) What ions are present when any acid is dissolved in water?

.....

(1)

(e) What ions are present when any alkali is dissolved in water?

.....

(1)

(f) Write a chemical equation for the reaction which takes place between the ions you have named in (e) and (f).

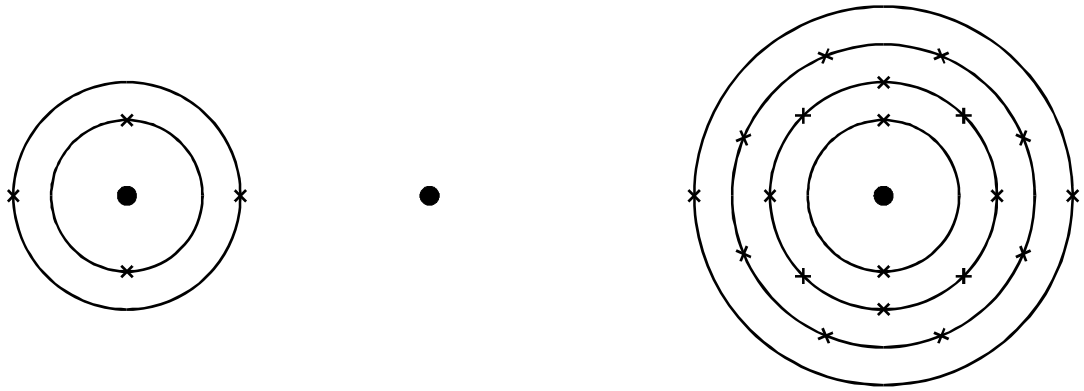
.....

(1)

(Total 6 marks)

7. Three elements in Group 2 of the periodic table are beryllium (Be), magnesium (Mg) and calcium (Ca). Their mass numbers and proton numbers are shown below. The electronic structure is shown for beryllium and calcium.

9	24	40
Be	Mg	Ca
4	12	20



(a) In a similar way, draw the electronic structure for magnesium.

(3)

(b)
- The three elements have similar chemical properties
- The reactivity of these elements with non-metals, increases from beryllium to magnesium to calcium.

Explain these two statements in terms of atomic structure.

.....

.....

.....

.....

.....

.....

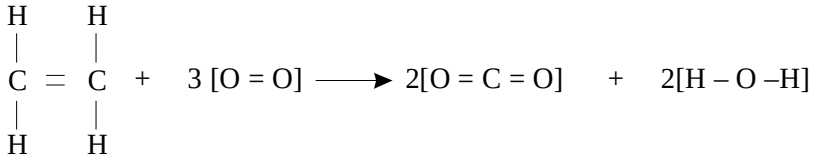
(6)
(Total 9 marks)

8. You will find the information on the Data Sheet helpful when answering this question.

This equation shows the reaction between ethene and oxygen.

$$C_2H_4 \quad + \quad 3O_2 \quad \rightarrow \quad 2CO_2 \quad + \quad 2H_2O$$

The structural formulae in the equation below show the bonds in each molecule involved.



Use the three stages shown at (a), (b) and (c) below to calculate the net energy transfer when the formula mass (1 mole) of ethene reacts with oxygen

(a) Write down the bonds broken and the bonds formed during the reaction. (Some have already been done for you.)

Bonds broken	
Number	Type
4	[C – H]
1	[C = C]

Bonds formed	
Number	Type
4	[C = O]

(2)

(b) Calculate the total energy changes involved in breaking and in forming all of these bonds. (Some have already been done for you.)

Total energy change in breaking bonds
[4 × 413] = 1652
[1 × 612] = 612
Total = kJ

Total energy change in forming bonds
4 × [805] = 3220
Total = kJ

(4)

(c) Describe, as fully as you can, what the figures in (b) tell you about the overall reaction.

.....

.....

.....

.....

.....

(2)
(Total 8 marks)

9. John Newland produced a periodic table in 1866. The first 21 elements in his table are shown in the diagram.

Column						
1	**2**	**3**	**4**	**5**	**6**	**7**
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe

Use the periodic table on the Data Sheet to help you to answer these questions.

(a) In which **two** columns of Newland's periodic table do all the elements have similar properties?

.....

(1)

(b) The modern periodic table is arranged in a different order to Newland's table.

(i) What order is used in the modern periodic table?

.....

(1)

(ii) Argon has a higher relative atomic mass than potassium. Explain why.

.....

.....

(1)

(iii) Describe the changes in the number of electrons in the atoms of elements in the period which begins with potassium and ends with krypton.

.....

.....

.....

(2)

(Total 5 marks)

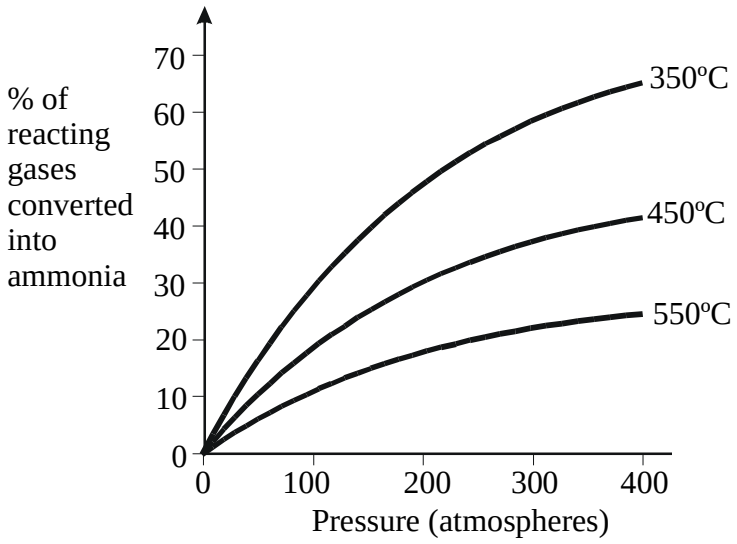
10. Ammonia is manufactured in the Haber Process, from nitrogen and hydrogen.

(a) Balance this symbol equation for the process.

$$N_2 + \quad H_2 \rightleftharpoons \quad NH_3$$

(2)

(b) The graph below shows the percentage of reacting gases converted into ammonia, at different temperatures and pressures.



(i) What does the graph suggest about the temperature and pressure needed to convert the maximum percentage of reacting gases into ammonia?

.....

.....

.....

(2)

(ii) Suggest reasons why the manufacture of ammonia in the Haber Process is usually carried out at about 400°C and 200 atmospheres pressure.

.....

.....

.....

(2)
(Total 6 marks)