Surname	Centre Number	Candidate Number
Other Names		0

WJEC CBAC

New GCSE

4472/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. MONDAY, 14 January 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**3**	
2	**7**	
3	**8**	
4	**6**	
5	**6**	
6	**5**	
7	**9**	
8	**7**	
9	**3**	
10	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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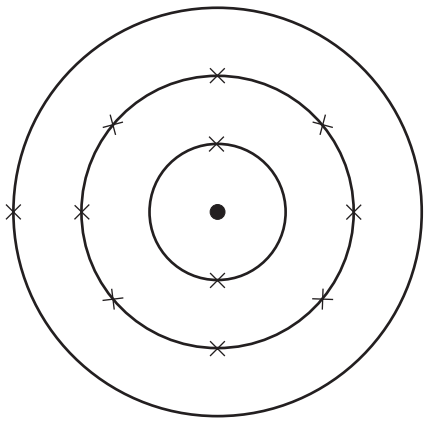
Answer **all** *questions.*

1. *(a)* The diagram below shows the electronic structure of an element in the Periodic Table.



Using × to represent an electron, draw a similar diagram to show the electronic structure of the element which

(i) lies directly **below** this one in the Periodic Table, [1]

(ii) lies directly to the **right** of this one in the Periodic Table. [1]

(b) Carbon has two different types of atom which are represented by $^{12}_{6}C$ and $^{13}_{6}C$.

Give the term used for different types of atom of the same element. [1]

.....

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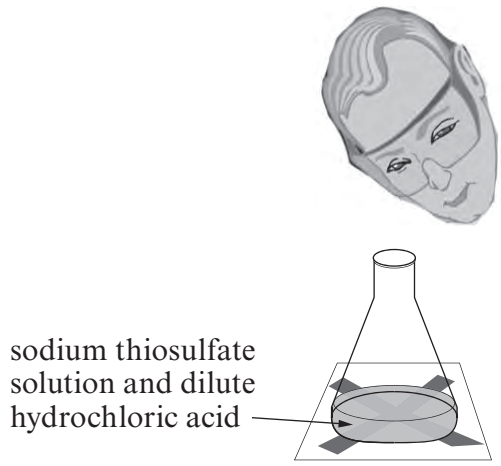
2. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the 'disappearing cross' experiment. The yellow precipitate formed during the reaction causes a cross marked on a piece of white paper to disappear (see diagram below). The time taken for this to happen can be measured.



10 cm^3 of dilute hydrochloric acid was added separately to 50 cm^3 sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm^3)	Time for cross to disappear (s)			
	1	2	3	Mean
8	37	38	39	38
16	20	17	17	18
24	10	8	12	10
32	10	7	7	8
40	3	7	8	6

(a) State which concentration gave the most repeatable set of reaction times. Give the reason for your choice. [2]

Concentration ..... g/dm^3

Reason .....

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(b) Apart from taking more readings, suggest **one** way to improve the repeatability of the readings. [1]

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(c) Apart from the volumes of both reactants and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

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(d) State and explain, using particle theory, your conclusion from the investigation. [3]

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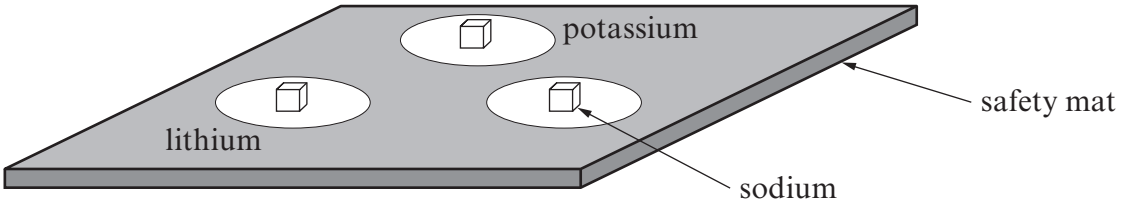
3. *(a)* Freshly cut pieces of lithium, potassium and sodium are left exposed to the atmosphere.



(i) Describe how the appearance of all the metals will change. [1]

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(ii) Describe how the reactions will differ. [1]

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(b) **A**, **B** and **C** represent the Group 7 elements bromine, chlorine and iodine, but not necessarily in that order. The table below shows the results observed when **A**, **B** and **C** react with hot iron wool.

Group 7 element	Reaction with hot iron wool
A	After a few seconds the iron wool glows. An orange solid is formed.
B	After a few minutes of constant heating the iron wool glows a little. A red-brown solid is formed.
C	The iron wool burns instantly glowing brightly. An orange solid is formed.

(i) Use the above results to identify the Group 7 elements **A**, **B** and **C** and give a reason for your choice. [3]

A ..... **B** ..... **C** .....

Reason .....

.....

(ii) Chlorine reacts with iron forming iron(III) chloride.

Write a balanced **symbol** equation for the reaction between chlorine and iron. [3]

..... + ... ⟶ .....

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4. Describe the treatment of the public water supply.

Include in your answer the three main stages in the purification process and the reason why each one is required. [6 QWC]

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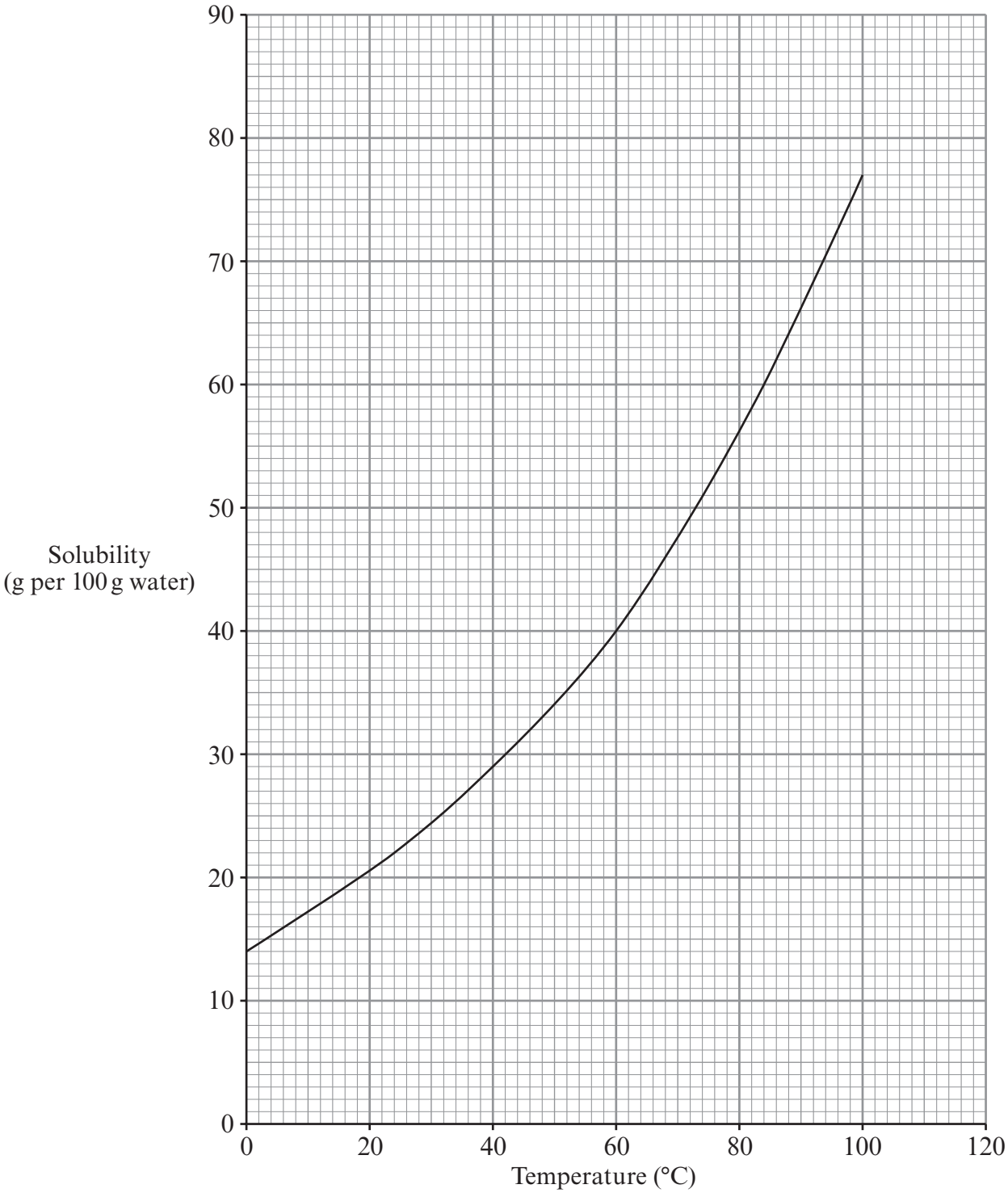
5. The graph below shows the solubility of copper sulfate in water at different temperatures.



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The table below shows the solubility of potassium chloride in water at different temperatures.

Temperature (°C)	0	20	40	60	80	100
Solubility (g per 100 g water)	25	31	37	43	49	55

(a) Plot the results from the table on the grid opposite and draw a suitable line. [3]

(b) Give the temperature at which the two compounds have the same solubility. [1]

Temperature = ... °C

(c) Calculate the mass of solid copper sulfate that forms when a saturated solution in 100 g of water at 60 °C cools to 24 °C. [2]

Mass of solid copper sulfate = ... g

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6. The electronic structures of calcium, fluorine and phosphorus are as follows.

calcium = 2,8,8,2 fluorine = 2,7 phosphorus = 2,8,5

(a) Draw dot and cross diagrams to show the transfer of electrons and the formation of ions as calcium reacts with fluorine to form calcium fluoride. [3]

(b) Draw a dot and cross diagram to show the bonding in a molecule of phosphorus trifluoride, PF_3. [2]

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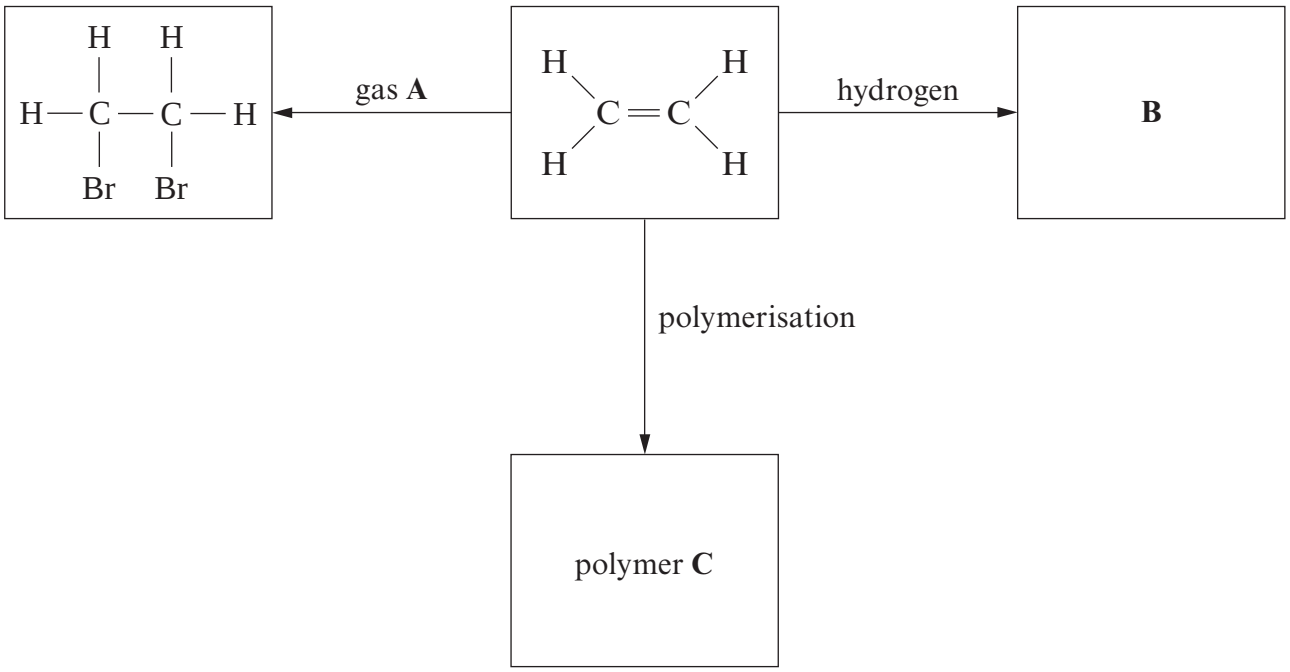
7. *(a)* The flow diagram below shows three reactions of ethene.



(i) Give the chemical names for **A**, **B** and **C**. [3]

A .....

B .....

C .....

(ii) State the name given to the type of reaction occurring in **all** three cases. [1]

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(iii) When boiling water is poured into a cup made from polymer **C** the cup softens and loses its shape.

I Give the reason, in terms of structure, for this behaviour. [1]

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.....

II Name this **type** of polymer. [1]

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(b) A hydrocarbon was found to contain 0.96 g of carbon and 0.2 g of hydrogen.
Calculate the **simplest** formula for this hydrocarbon.
You must show your working. [3]

$A_r(H) = 1$ $A_r(C) = 12$

Simplest formula .....

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8. *(a)* Table **A** below shows the ions present in three different water samples **X**, **Y** and **Z**.

Ions present	Typical analysis (mg/dm^3)		
	X	**Y**	**Z**
calcium	145	54	80
magnesium	69	9	26
sodium	14	27	6
potassium	2	2	1
hydrogencarbonate	42	212	360
chloride	7	12	13
sulfate	303	15	6

Table **A**

An investigation was carried out to find the relative hardness of the water samples and the effect of boiling.

20 cm^3 of each water sample was accurately measured. 1 cm^3 of soap solution was added to each sample and the mixture shaken. This was repeated until a permanent lather was obtained. The volume of soap solution needed to obtain a permanent lather was recorded.

A fresh 20 cm^3 of each water sample was boiled for 5 minutes and cooled. The above procedure was repeated.

Table **B** below shows the results from the investigation.

Water sample	Volume of soap solution needed to obtain a permanent lather (cm^3)	
	Before boiling	After boiling
X	40	36
Y	32	4
Z	35	6

Table **B**

(i) State the conclusions that can be drawn from the results in Table **B**. [2]

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(ii) How do the compositions of the water samples in Table **A** support the results in Table **B**? [2]

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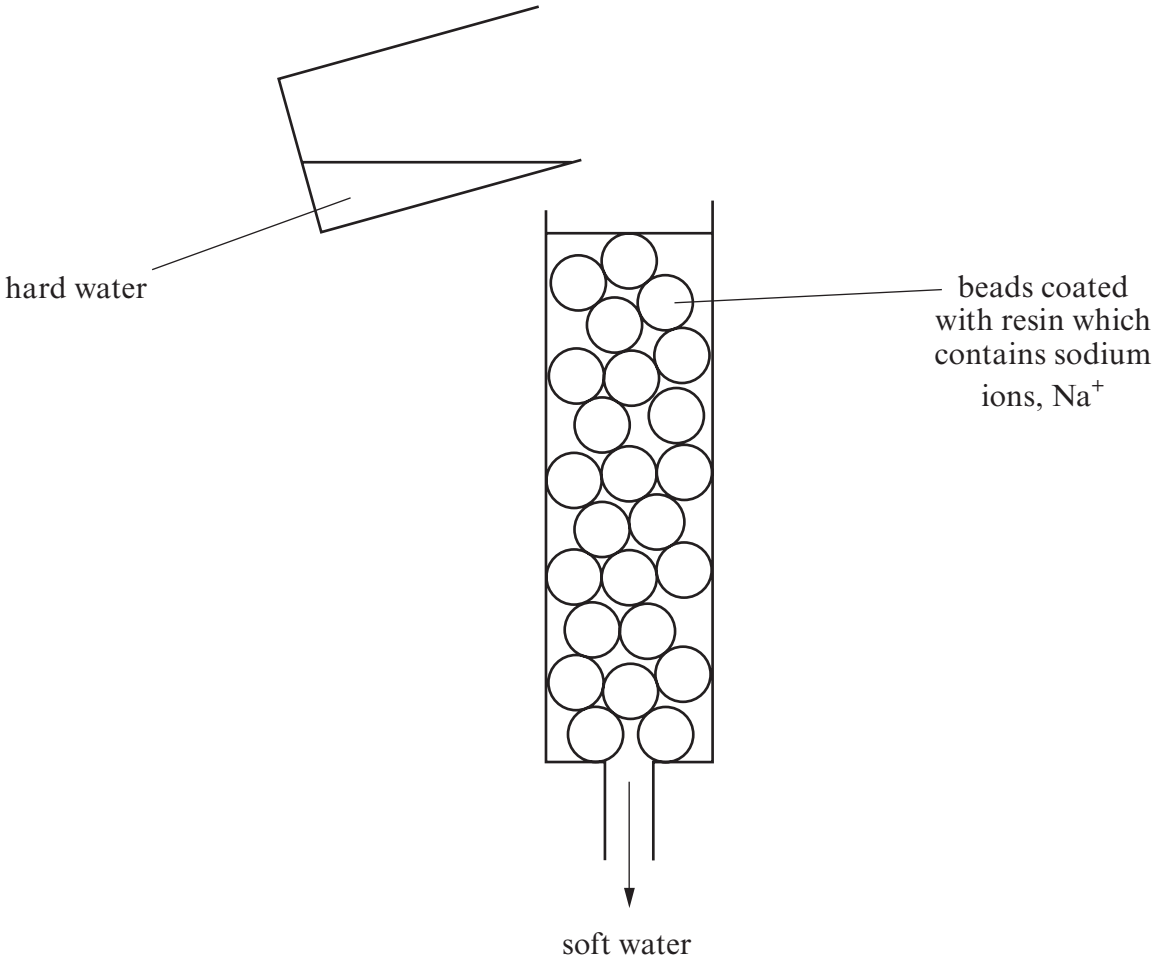
Examiner only

(b) The diagram below shows an ion exchange column used for softening water.



(i) Explain how the ion exchange column works. [2]

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(ii) Give **one** disadvantage of this water softening method. [1]

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9. Sodium carbonate is an important raw material and has many industrial and domestic uses.

The equation below shows one of the reactions in the Solvay process which converts sodium hydrogencarbonate into sodium carbonate.

$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

Use the equation to calculate the mass of sodium carbonate that could be obtained from 8.4 tonnes of sodium hydrogencarbonate. [3]

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$ $A_r(Na) = 23$

Mass of sodium carbonate = ... tonnes

3

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10. Describe and explain the properties of diamond and graphite, in terms of bonding and structure, and relate their uses to these properties. [6 QWC]

You may include diagrams as part of your answer.

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

PERIODIC TABLE OF ELEMENTS

1	2											3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radius	$^{227}_{89}$Ac Actinium															

Key: