

Surname	Centre Number	Candidate Number
Other Names		0



**New GCSE**

4472/01

**ADDITIONAL SCIENCE  
FOUNDATION TIER  
CHEMISTRY 2**

A.M. MONDAY, 14 January 2013

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	6	
2	5	
3	4	
4	5	
5	8	
6	4	
7	4	
8	3	
9	7	
10	8	
11	6	
<b>Total</b>	<b>60</b>	

4472  
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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.

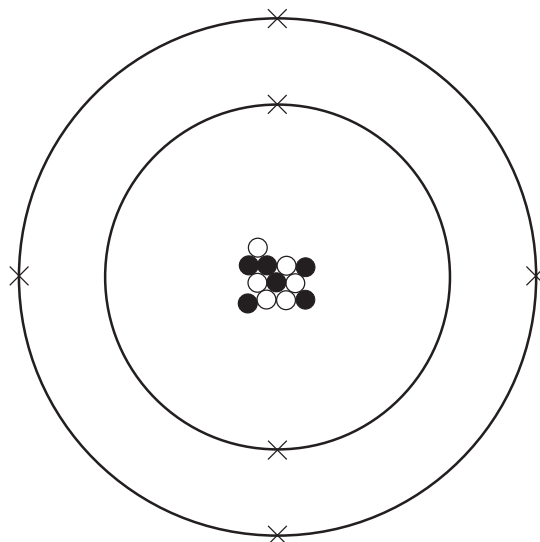
Assessment will take into account the quality of written communication (QWC) in your answer to question **11**.

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.

Answer **all** questions.

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only

1. (a) The diagram below shows an atom of carbon.



electron	neutron	proton
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- (i) Choose from the box above the names of the two types of particle found in the nucleus of a carbon atom. [1]  
 ..... and .....
- (ii) Using the information in the diagram state why an atom of carbon is neutral. [1]  
 .....
- (b) (i) Calculate the relative molecular mass ( $M_r$ ) of methane,  $\text{CH}_4$ . [2]

$$A_r(\text{H}) = 1 \quad A_r(\text{C}) = 12$$

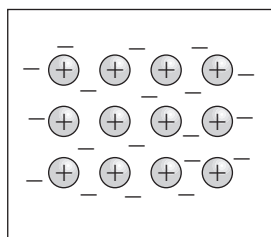
$$M_r(\text{CH}_4) = \dots\dots\dots$$

- (ii) Calculate the percentage (%) by mass of carbon in a molecule of methane. [2]

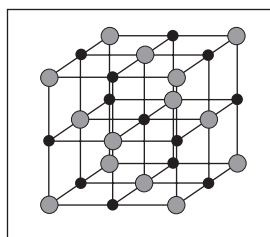
$$\text{Percentage by mass} = \dots\dots\dots\%$$

6

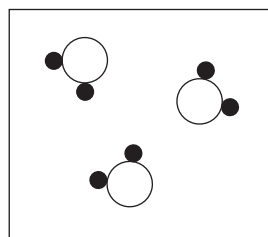
2. (a) The following diagrams show the structures of some substances.



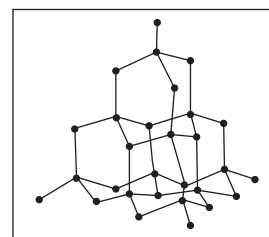
A



B



C



D

Give the **letter** of the substance which

- (i) conducts electricity as a solid, ..... [1]
- (ii) has the lowest boiling point, ..... [1]
- (iii) contains ionic bonds. .... [1]

(b) The box below contains some observations describing the results of different chemical tests.

<b>cream precipitate</b>	<b>yellow flame</b>	<b>yellow precipitate</b>
<b>lilac flame</b>	<b>white precipitate</b>	<b>white flame</b>

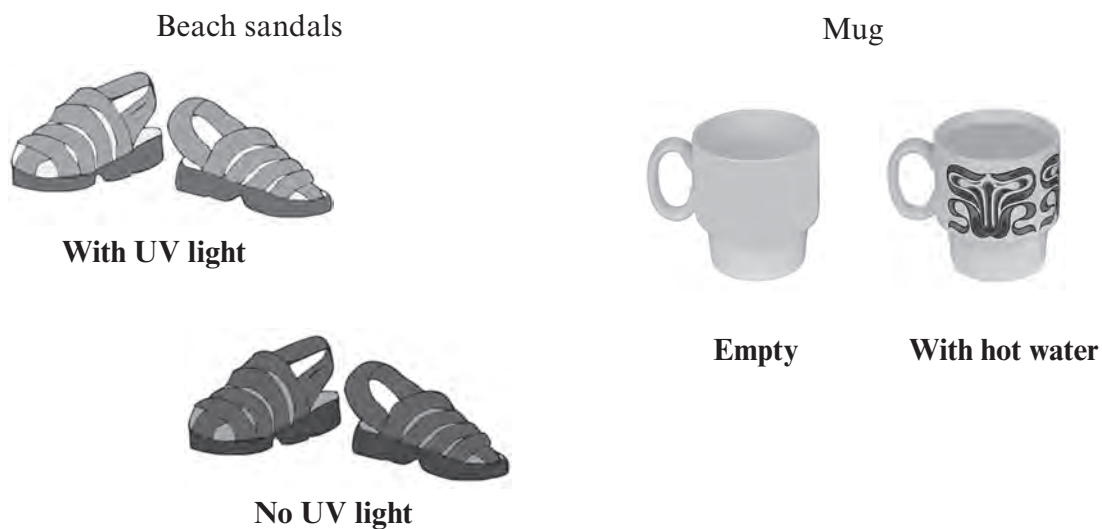
The chemical name for table salt is sodium chloride.

Choose from the box the observation made when

- (i) a flame test is carried out on a sample of solid table salt, ..... [1]
- (ii) silver nitrate solution is added to a solution of table salt. .... [1]

3. Smart materials are becoming widely used in everyday life.

The diagrams below show uses of two different types of smart material.



For each of the items shown, name the **type** of smart material being used and describe the **unusual property** that makes it a smart material.

(a) Beach sandals [2]

*Type of smart material* .....

*Unusual property* .....

.....

(b) Mug [2]

*Type of smart material* .....

*Unusual property* .....

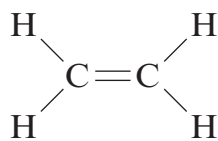
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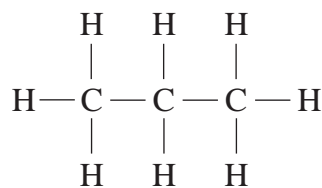


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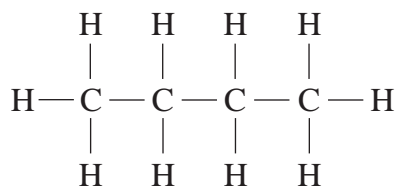
4. (a) The diagrams below show the structural formulae of some hydrocarbons.



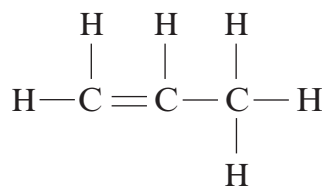
A



B



C



D

- (i) Give the **letters** of the two hydrocarbons which are alkenes. [1]

..... and .....

- (ii) Give the **letter** of the hydrocarbon which is represented by the molecular formula  $\text{C}_3\text{H}_6$ . [1]

.....

- (b) An alkane contains two carbon atoms and six hydrogen atoms. Draw its **structural** formula. [1]

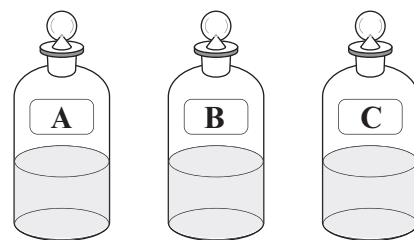
- (c) The table below shows some information about monomers and the polymers that can be made from them.

Complete the table.

[2]

Name of monomer	Structural formula of monomer	Name of polymer	Repeating unit for the polymer
tetrafluoroethene	$  \begin{array}{c}  \text{F} \quad \quad \text{F} \\  \diagdown \quad \diagup \\  \text{C} = \text{C} \\  \diagup \quad \diagdown \\  \text{F} \quad \quad \text{F}  \end{array}  $	polytetrafluoroethene PTFE	
vinylchloride (chloroethene)		polyvinylchloride PVC	$  \left[ \begin{array}{cc}  \text{H} & \text{H} \\    &   \\  -\text{C} & -\text{C}- \\    &   \\  \text{H} & \text{Cl}  \end{array} \right]  $

5. (a) A water company has provided your class with three samples of water from different parts of Wales. The water company is asking for the hardness of the water samples to be investigated.



Water samples

Describe an experiment you would carry out to show which sample is the hardest.

You are provided with soap solution and basic laboratory equipment.

Include in your answer

- the ways in which you will make the experiment a fair test,
- how you will know which sample is the hardest.

[5]

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- (b) The box below contains some statements about hard water.

<b>forms limescale when heated</b>	<b>reduces heart disease</b>
<b>strengthens bones and teeth</b>	<b>forms a scum with soap</b>
<b>wastes soap</b>	<b>tastes better</b>

Choose **one** statement which

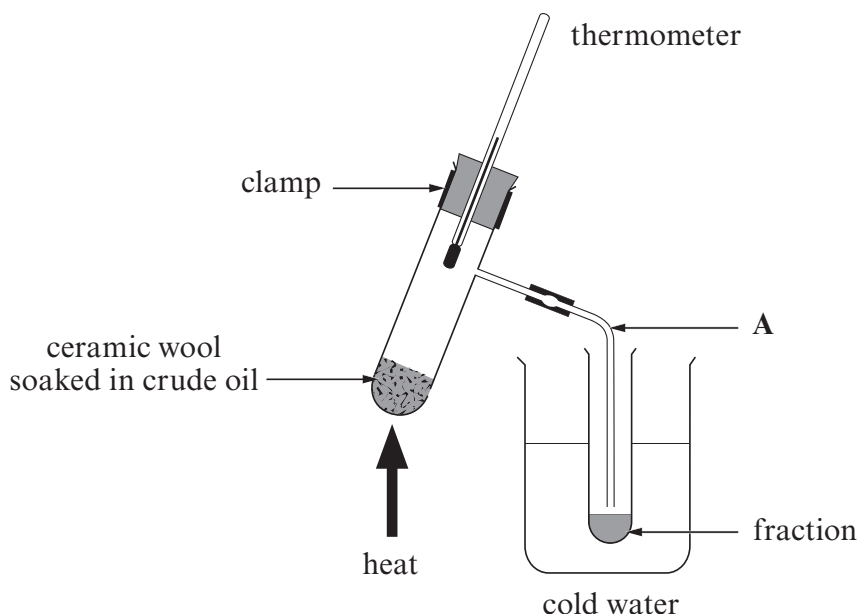
- (i) gives a health benefit, ..... [1]
- (ii) describes why hard water causes problems in boilers and water pipes,  
..... [1]
- (iii) is an opinion and not a scientific fact. .... [1]

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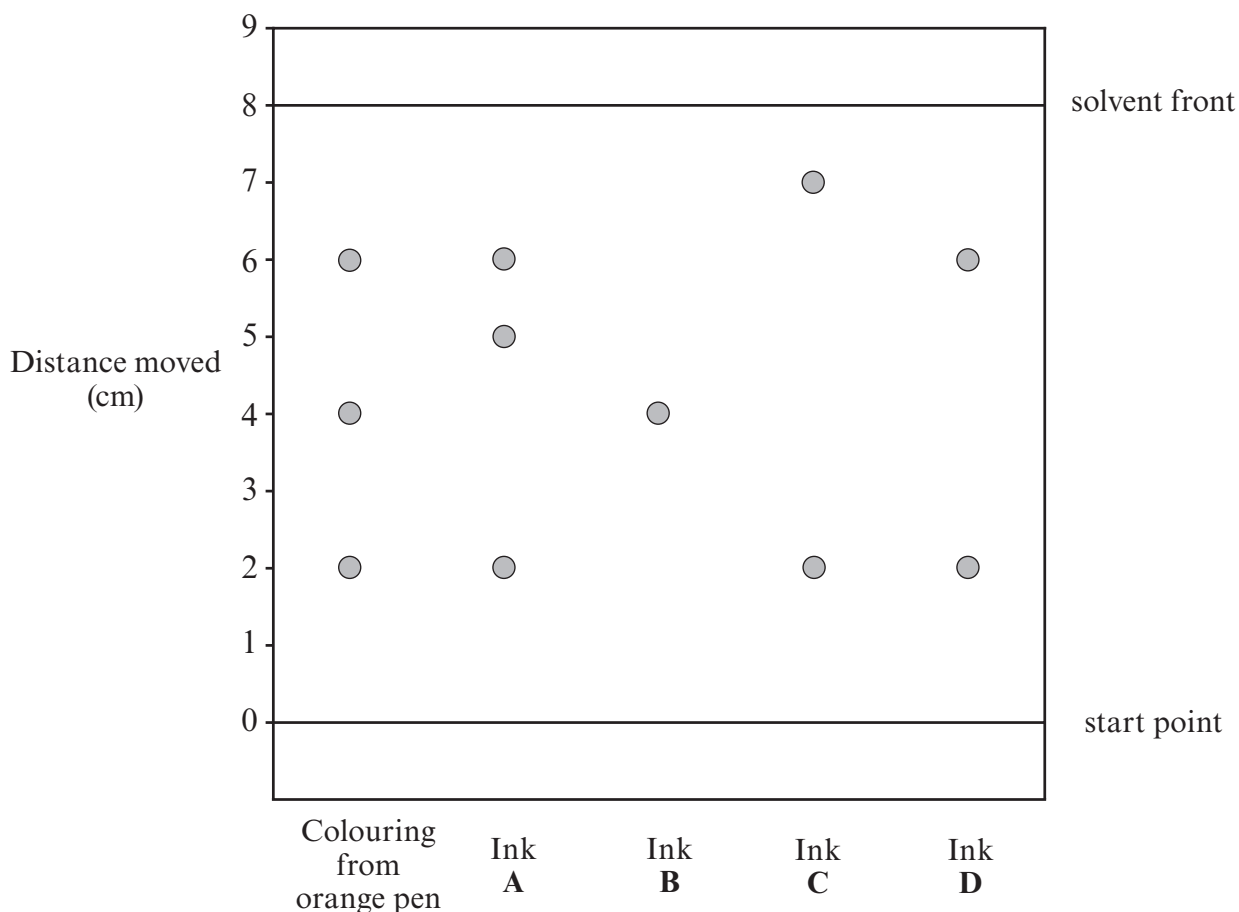
6. The diagram below shows the laboratory apparatus that can be used to separate crude oil into more useful chemicals.

Crude oil is gently heated and the first fraction is collected over the range from room temperature to 100 °C. When the temperature reaches 100 °C the collection tube is changed. Three more fractions are collected over the temperature ranges 100-150 °C, 150-200 °C and 200-250 °C.



- (a) Name the **physical** property that allows the different fractions to be separated. [1]  
 .....
- (b) The fractions are collected as liquids in test tubes. Name the physical process taking place at **A**. [1]  
 .....
- (c) State why the thermometer bulb is positioned near the opening of the side arm. [1]  
 .....
- (d) Give the name of the industrial process used to separate crude oil into fractions. [1]  
 .....

7. The chromatogram of an orange felt-tipped pen was compared with various orange inks **A**, **B**, **C** and **D**. The results are shown below.

Examiner  
only

- (a) Give the **letters** of the two inks that are mixed to make the orange felt-tipped pen. [1]

..... and .....

- (b) Give the **letter** of the ink which contains the most soluble substance. [1]

.....

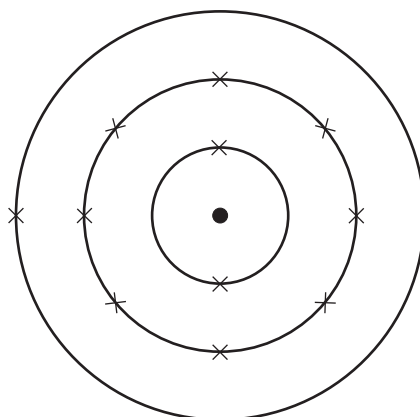
- (c) The  $R_f$  value of a substance can be used to identify that substance. The  $R_f$  value is given by the formula below.

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent front}}$$

Calculate the  $R_f$  value of the substance in ink **B**. [2]

$R_f =$  .....

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



Using  $\times$  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  $^{12}_6\text{C}$  and  $^{13}_6\text{C}$ .

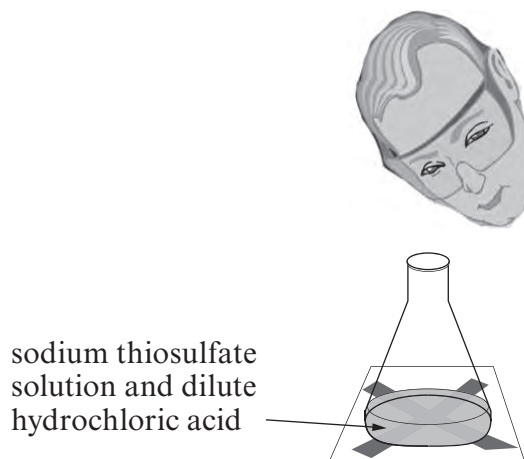
Give the term used for different types of atom of the same element. [1]

.....

Examiner  
only

3

9. 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<sup>3</sup> of dilute hydrochloric acid was added separately to 50 cm<sup>3</sup> sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm <sup>3</sup> )	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<sup>3</sup>

Reason .....

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

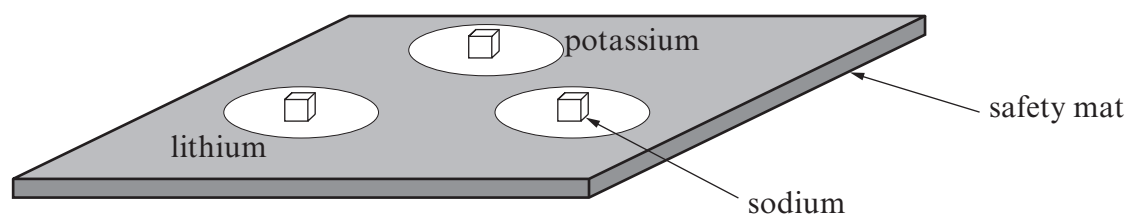
(c) Apart from the volumes of both reactants and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

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

Examiner  
only

7

10. (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]

.....

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

.....

- (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
<b>A</b>	After a few seconds the iron wool glows. An orange solid is formed.
<b>B</b>	After a few minutes of constant heating the iron wool glows a little. A red-brown solid is formed.
<b>C</b>	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]

..... + ..... → .....

11. 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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**FORMULAE FOR SOME COMMON IONS**

<b>POSITIVE IONS</b>		<b>NEGATIVE IONS</b>	
<b>Name</b>	<b>Formula</b>	<b>Name</b>	<b>Formula</b>
<b>Aluminium</b>	<b>Al<sup>3+</sup></b>	<b>Bromide</b>	<b>Br<sup>-</sup></b>
<b>Ammonium</b>	<b>NH<sub>4</sub><sup>+</sup></b>	<b>Carbonate</b>	<b>CO<sub>3</sub><sup>2-</sup></b>
<b>Barium</b>	<b>Ba<sup>2+</sup></b>	<b>Chloride</b>	<b>Cl<sup>-</sup></b>
<b>Calcium</b>	<b>Ca<sup>2+</sup></b>	<b>Fluoride</b>	<b>F<sup>-</sup></b>
<b>Copper(II)</b>	<b>Cu<sup>2+</sup></b>	<b>Hydroxide</b>	<b>OH<sup>-</sup></b>
<b>Hydrogen</b>	<b>H<sup>+</sup></b>	<b>Iodide</b>	<b>I<sup>-</sup></b>
<b>Iron(II)</b>	<b>Fe<sup>2+</sup></b>	<b>Nitrate</b>	<b>NO<sub>3</sub><sup>-</sup></b>
<b>Iron(III)</b>	<b>Fe<sup>3+</sup></b>	<b>Oxide</b>	<b>O<sup>2-</sup></b>
<b>Lithium</b>	<b>Li<sup>+</sup></b>	<b>Sulfate</b>	<b>SO<sub>4</sub><sup>2-</sup></b>
<b>Magnesium</b>	<b>Mg<sup>2+</sup></b>		
<b>Nickel</b>	<b>Ni<sup>2+</sup></b>		
<b>Potassium</b>	<b>K<sup>+</sup></b>		
<b>Silver</b>	<b>Ag<sup>+</sup></b>		
<b>Sodium</b>	<b>Na<sup>+</sup></b>		
<b>Zinc</b>	<b>Zn<sup>2+</sup></b>		

# PERIODIC TABLE OF ELEMENTS

1
2
3
4
5
6
7
0

**Group**

<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <math>{}^1_1\text{H}</math> Hydrogen         </div>																		${}^4_2\text{He}$ Helium	
${}^7_3\text{Li}$ Lithium	${}^9_4\text{Be}$ Beryllium																	${}^{19}_9\text{F}$ Fluorine	${}^{20}_{10}\text{Ne}$ Neon
${}^{23}_{11}\text{Na}$ Sodium	${}^{24}_{12}\text{Mg}$ Magnesium																	${}^{35}_{17}\text{Cl}$ Chlorine	${}^{40}_{18}\text{Ar}$ Argon
${}^{39}_{19}\text{K}$ Potassium	${}^{40}_{20}\text{Ca}$ Calcium	${}^{45}_{21}\text{Sc}$ Scandium	${}^{48}_{22}\text{Ti}$ Titanium	${}^{51}_{23}\text{V}$ Vanadium	${}^{52}_{24}\text{Cr}$ Chromium	${}^{55}_{25}\text{Mn}$ Manganese	${}^{56}_{26}\text{Fe}$ Iron	${}^{59}_{27}\text{Co}$ Cobalt	${}^{59}_{28}\text{Ni}$ Nickel	${}^{64}_{29}\text{Cu}$ Copper	${}^{65}_{30}\text{Zn}$ Zinc	${}^{70}_{31}\text{Ga}$ Gallium	${}^{73}_{32}\text{Ge}$ Germanium	${}^{75}_{33}\text{As}$ Arsenic	${}^{79}_{34}\text{Se}$ Selenium	${}^{80}_{35}\text{Br}$ Bromine	${}^{84}_{36}\text{Kr}$ Krypton		
${}^{86}_{37}\text{Rb}$ Rubidium	${}^{88}_{38}\text{Sr}$ Strontium	${}^{89}_{39}\text{Y}$ Yttrium	${}^{91}_{40}\text{Zr}$ Zirconium	${}^{93}_{41}\text{Nb}$ Niobium	${}^{96}_{42}\text{Mo}$ Molybdenum	${}^{99}_{43}\text{Tc}$ Technetium	${}^{101}_{44}\text{Ru}$ Ruthenium	${}^{103}_{45}\text{Rh}$ Rhodium	${}^{106}_{46}\text{Pd}$ Palladium	${}^{108}_{47}\text{Ag}$ Silver	${}^{112}_{48}\text{Cd}$ Cadmium	${}^{115}_{49}\text{In}$ Indium	${}^{119}_{50}\text{Sn}$ Tin	${}^{122}_{51}\text{Sb}$ Antimony	${}^{128}_{52}\text{Te}$ Tellurium	${}^{127}_{53}\text{I}$ Iodine	${}^{131}_{54}\text{Xe}$ Xenon		
${}^{133}_{55}\text{Cs}$ Caesium	${}^{137}_{56}\text{Ba}$ Barium	${}^{139}_{57}\text{La}$ Lanthanum	${}^{179}_{72}\text{Hf}$ Hafnium	${}^{181}_{73}\text{Ta}$ Tantalum	${}^{184}_{74}\text{W}$ Tungsten	${}^{186}_{75}\text{Re}$ Rhenium	${}^{190}_{76}\text{Os}$ Osmium	${}^{192}_{77}\text{Ir}$ Iridium	${}^{195}_{78}\text{Pt}$ Platinum	${}^{197}_{79}\text{Au}$ Gold	${}^{201}_{80}\text{Hg}$ Mercury	${}^{204}_{81}\text{Tl}$ Thallium	${}^{207}_{82}\text{Pb}$ Lead	${}^{209}_{83}\text{Bi}$ Bismuth	${}^{210}_{84}\text{Po}$ Polonium	${}^{210}_{85}\text{At}$ Astatine	${}^{222}_{86}\text{Rn}$ Radon		
${}^{223}_{87}\text{Fr}$ Francium	${}^{226}_{88}\text{Ra}$ Radium	${}^{227}_{89}\text{Ac}$ Actinium																	

Key:

