Candidate Name	Centre Number	Candidate Number
		0

WJEC CBAC

GCSE

240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. THURSDAY, 5 June 2008

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**7**	
3.	**2**	
4.	**5**	
5.	**5**	
6.	**5**	
7.	**6**	
8.	**7**	
9.	**7**	
Total	**50**	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

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

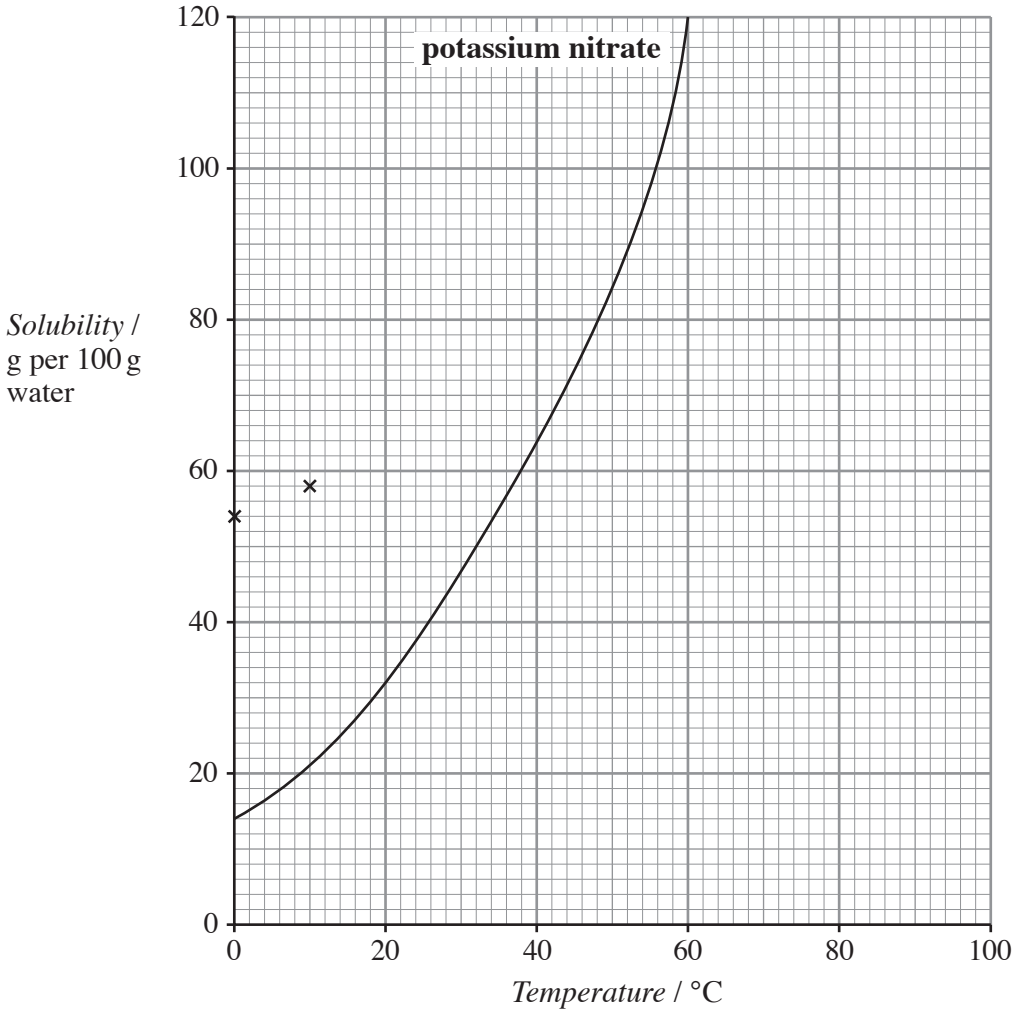
The number of marks is given in brackets at the end of each question or part-question.

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

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.*

1. The graph below shows the solubility of potassium nitrate in water at different temperatures.



(i) The table below shows the solubility of potassium bromide in water at different temperatures. The solubility at 60 °C is missing from the table.

Temperature / °C	0	10	20	30	40	50	60	70	80
Solubility / g per 100 g water	54	58	64	70	76	82		92	98

I. Draw the graph of the solubility of potassium bromide on the grid on page 2. Two points have been plotted for you. [3]

II. Use the graph to give the solubility of potassium bromide at 60 °C.

..... g per 100 g water [1]

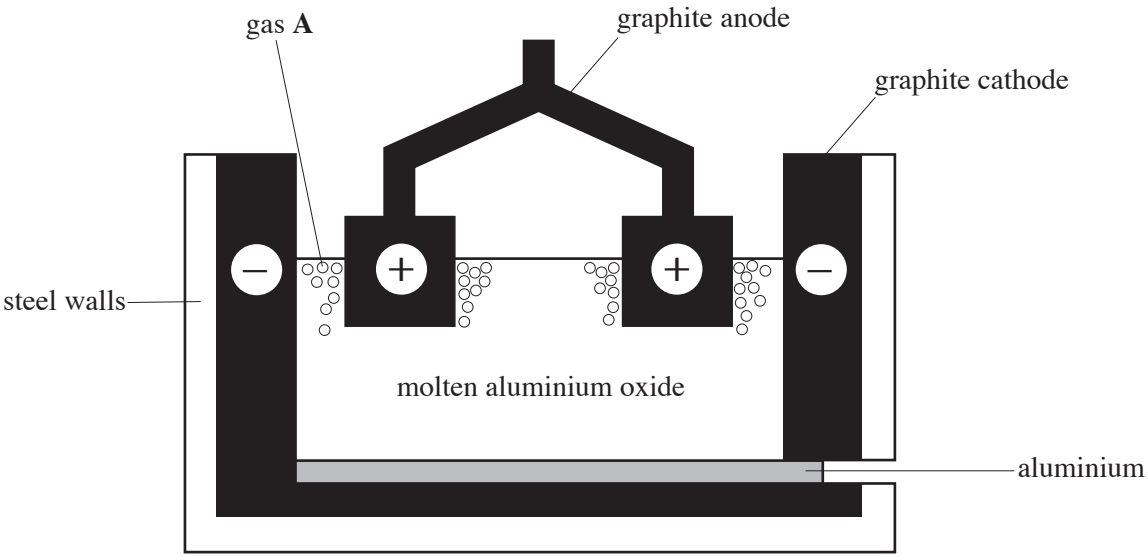
III. Give the temperature at which the two compounds have the **same** solubility.

..... °C [1]

(ii) State why the temperature scale on solubility graphs ranges between 0 °C and 100 °C. [1]

.....

2. (i) The diagram below shows the industrial extraction of aluminium by the electrolysis of aluminium oxide.



I. Give the reason why electrolysis is used to extract aluminium from its oxide. [1]

.....

II. Write the **word** equation for the overall reaction that takes place during the electrolysis of aluminium oxide. [2]

..... ⟶ ..... + ...

III. Give the **formula** of the **ion** attracted to the cathode during the electrolysis process. Use the table of formulae for common ions on the inside of the back cover of this examination paper to help in answering this question. [1]

.....

(ii) Many factors, such as available work force, road and rail links and distance from built up areas are considered when locating any **new** chemical plant.

Give **one** other factor that is important when locating a new **aluminium** extraction plant. [1]

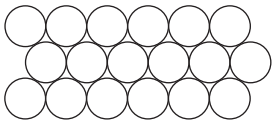
.....

(iii) Aluminium has the property of being a good electrical conductor and is therefore used to make overhead power cables.
Give a **different** property of aluminium and **one** use which relies on this property. [2]

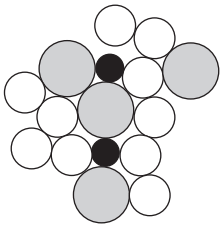
Property .....

Use .....

3. The diagrams below show how the atoms are arranged in a metal and in a metallic glass.



atoms in a metal



atoms in a metallic glass

Give **two** differences between the **structures** shown above. [2]

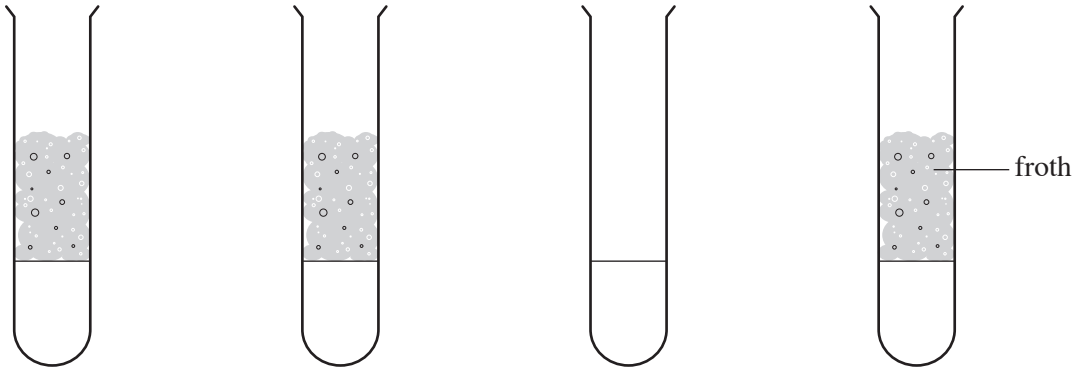
Difference 1 .....

.....

Difference 2 .....

.....

4. (i) 1 cm^3 of soap solution was shaken, for the same number of times, with 20 cm^3 of four different metal chloride solutions with equal concentrations of the chloride part of the solution. The results are shown in the diagram below.



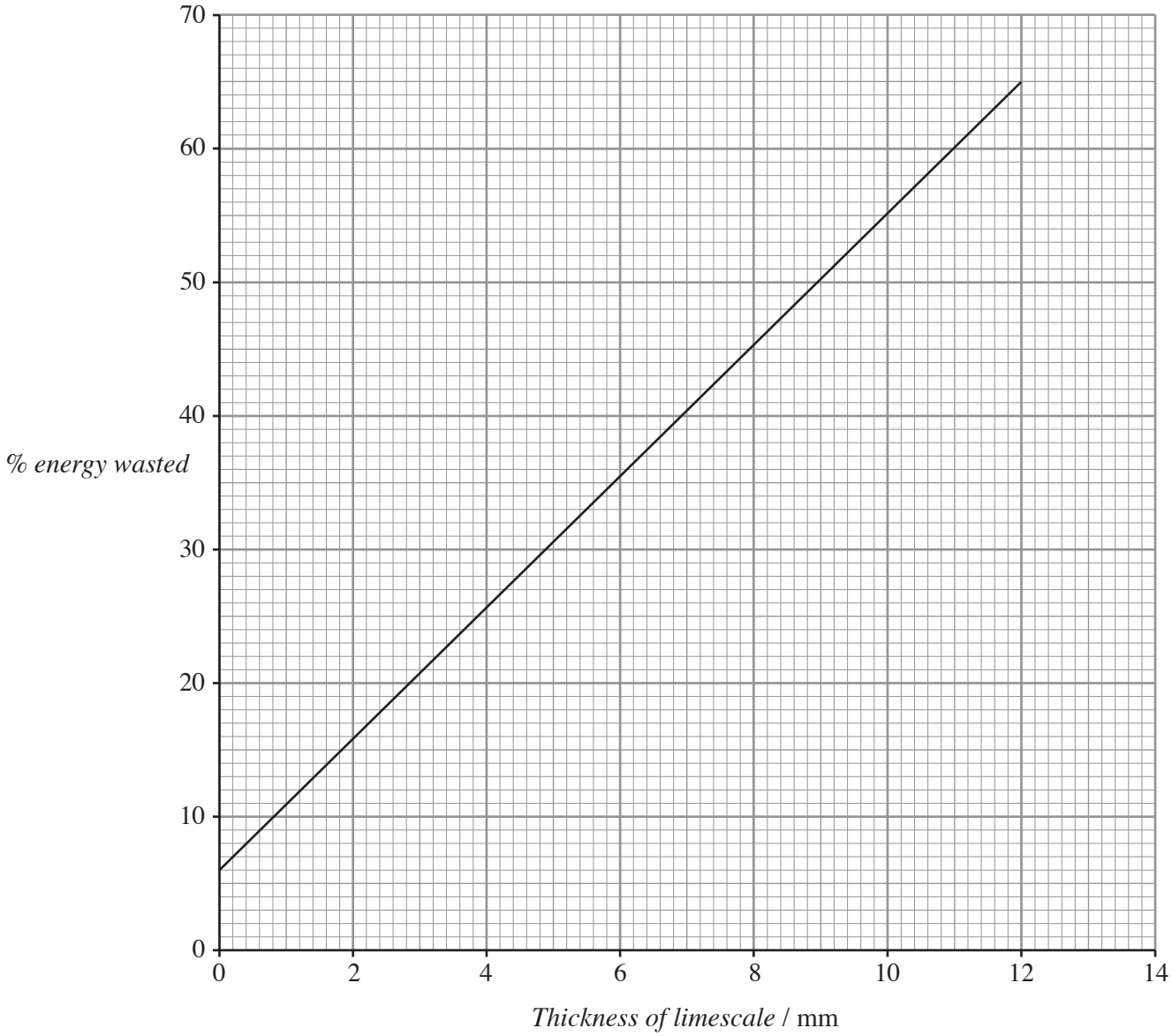
sodium chloride solution | potassium chloride solution | calcium chloride solution | lithium chloride solution

I. Name the **metal ion** which makes the water hard. ..... [1]

II. How do the observations tell you that it is **not** the chloride part of the compounds that makes the water hard? [1]

.....

(ii) Boiling hard water forms scale on filaments in electric kettles. The presence of limescale results in energy being wasted. The graph below shows the effect of limescale on the % of energy wasted.



I. State how the % energy wasted depends on the thickness of limescale. [1]

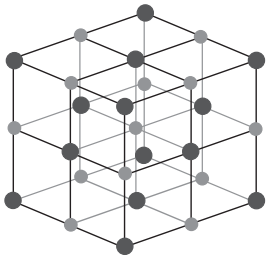
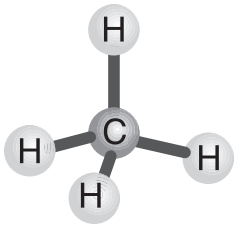
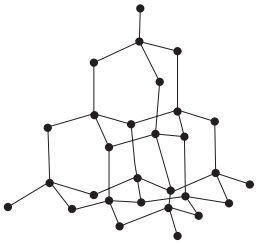
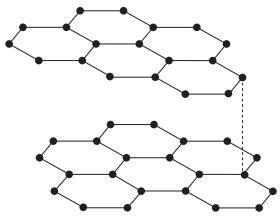
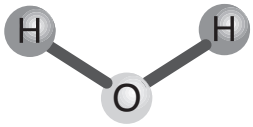
.....

II. Use the graph to give the % energy wasted if no limescale was present. ..... [1]

(iii) Give **one** reason why living in a hard water area can be beneficial to your health. [1]

.....

5. The table below shows some properties of five substances. Each substance is represented by a model of its structure. ***The models are not to scale.***

Model of structure	*Melting point* / °C	*Boiling point* / °C	*Electrical Conductivity*
 sodium chloride	801	1413	good *when molten or dissolved*
 methane	–182	–161	poor
 diamond	3550	4827	poor
 graphite	between 3652-3697 (3675)	4200	good
 water	0	100	poor

Use the information in the table opposite to answer this question.
Each name may be used once, more than once or not at all.

(i) Give the **name** of the substance which

I. has the **lowest** melting point,

..... [1]

II. is made up of ions,

..... [1]

III. is an element,

..... [1]

IV. is soluble in water.

..... [1]

(ii) The chemical formula for water is H_2O. Give the chemical formula for methane.

..... [1]

6. The table below shows the electronic structures of three elements.

Element	Electronic structure
hydrogen	1
sodium	2,8,1
sulphur	2,8,6

Sulphur forms sodium sulphide with sodium, and it forms hydrogen sulphide with hydrogen.

Show, by means of diagrams or otherwise, the electronic changes that take place during the formation of

I. sodium sulphide from sodium and sulphur **(include charges on the ions)**, [3]

II. hydrogen sulphide from hydrogen and sulphur. [2]

5

7. Ammonia is made industrially from nitrogen and hydrogen by the Haber process.

(i) Complete and balance the **symbol** equation below, which represents the formation of ammonia.

$$N_2 + \ldots\ldots\ldots H_2 \rightleftharpoons \ldots\ldots\ldots \quad [2]$$

(ii) The table below shows the yield of ammonia under different pressure and temperature conditions.

Pressure / atmospheres	*Temperature* / °C				
	100	200	300	400	500
	Yield of ammonia (%)				
10	88·2	50·7	14·7	3·9	1·2
50	94·5	75·0	39·5	15·3	5·6
100	96·7	81·7	52·5	25·2	10·6
200	98·4	89·0	66·7	40·0	18·3
400	99·4	94·6	79·7	55·4	31·9
1000	99·9	98·3	92·6	79·8	57·5

Use the table to answer parts I, II and III.

I. State what happens to the **yield** of ammonia as the temperature increases.

..... [1]

II. State the % yield of ammonia at a temperature of 200 °C and a pressure of 400 atmospheres. [1]

..... %

III. State the pressure needed to obtain 40% yield of ammonia at 400 °C. [1]

..... atmospheres

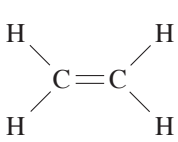
(iii) Refer to the table of common ions on the inside of the back cover of this examination paper to answer this question.

Ammonia is used to make the fertiliser ammonium nitrate.

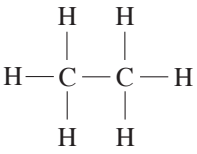
Give the chemical formula of ammonium nitrate. ..... [1]

Examiner only

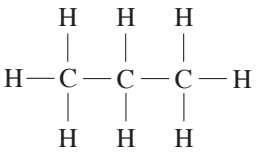
8. *(a)* The structural formulae of five hydrocarbons are shown below.



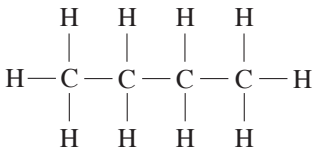
A



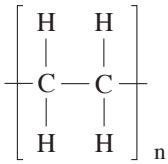
B



C



D



E

Use only the information above to answer parts (i), (ii)I and (iii).

(i) Give the molecular formula for hydrocarbon **B**. ..... [1]

(ii) I. Give the **letter** of an **unsaturated** hydrocarbon. ..... [1]

II. Explain your choice of letter in part (ii) I. [1]

.....

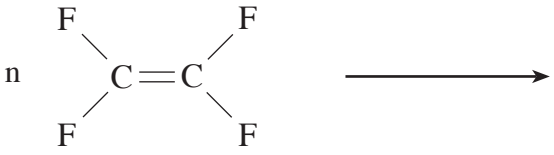
.....

(iii) State what is meant by the letter '**n**' in hydrocarbon **E**. [1]

.....

.....

(b) (i) Poly(tetrafluoroethene), PTFE, is formed by addition polymerisation. Complete the **symbol** equation below for making the polymer PTFE. [2]



.....

(ii) Give the **main** reason why PTFE is used to **coat** the inside of a frying pan. [1]

.....

9. *(a)* Smart materials have unique properties. Describe the **unusual** property that

(i) smart alloys show on heating, [1]

.....

(ii) thermochromic material shows on heating. [1]

.....

(b) The most effective and widely used smart alloy is nitinol which contains 50% titanium.

Titanium, Ti, is a metal which is extracted from ores containing titanium(IV) oxide. This oxide is converted into titanium(IV) chloride, $TiCl_4$, which is then reacted with either sodium or magnesium to form titanium metal. The equation below shows the formation of titanium from titanium chloride using sodium.

$$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$$

A_r (Na) = 23 A_r (Ti) = 48

(i) Use the equation above to calculate how many tonnes of sodium would be needed to produce 96 tonnes of titanium. [3]

.....

.....

.....

(ii) Titanium forms another chloride in which 48 g of titanium is combined with 71 g of chlorine. Calculate the simplest formula for this chloride of titanium. **Show your working.** [2]

A_r (Cl) = 35·5 A_r (Ti) = 48

.....

.....

.....

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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^{+}	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		

(240-01)

PERIODIC TABLE OF ELEMENTS

1	2	Group										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 Sulphur	$^{35}_{17}$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 Radium	$^{227}_{89}$Ac Actinium															

Key: