Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

W16-4462-02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

P.M. TUESDAY, 12 January 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**11**	
3.	**6**	
4.	**6**	
5.	**7**	
6.	**5**	
7.	**12**	
8.	**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.
Do not use gel pen or correction fluid.

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.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

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 **3** and **8**.

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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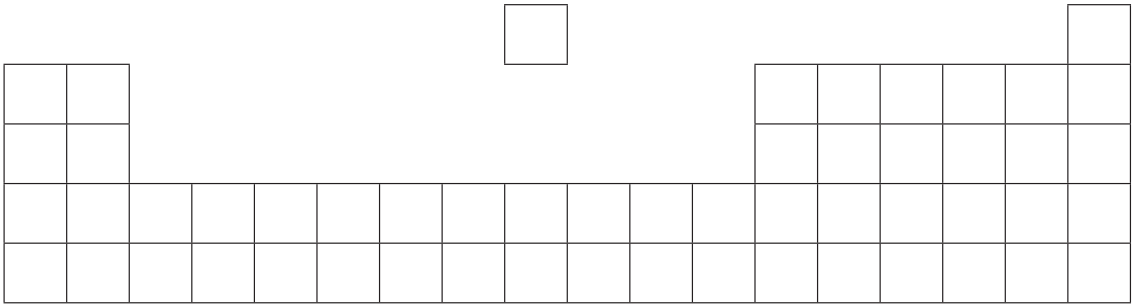
Answer **all** *questions*.

1. *(a)* The following diagram shows an outline of part of the Periodic Table of Elements shown on the back page of this paper.



Place letters **X**, **Y**, and **Z** in the correct spaces on the diagram to show the following.

X – an element in Group 3

Y – the element with the smallest atomic number

Z – the element in Period 2 and Group 1 [3]

(b) Mendeleev published the first accepted 'periodic table' in 1869. Give **one** similarity and **one** difference between his table and the Periodic Table we use today. [2]

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(c) Give the formulae of the following compounds.

calcium oxide .....

magnesium hydroxide ..... [2]

7

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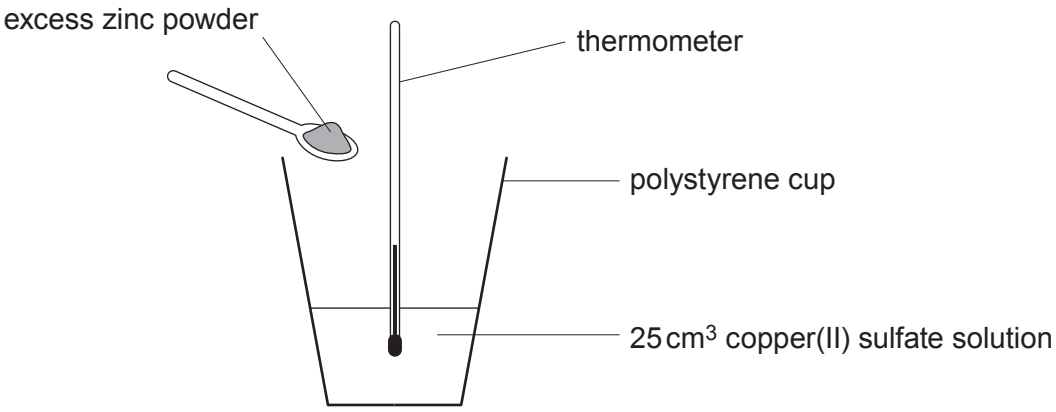
2. A group of students used the following apparatus to carry out a displacement reaction between zinc powder and copper(II) sulfate solution.



Excess zinc was added to 25 cm^3 of the copper(II) sulfate solution at room temperature. The temperature was recorded every 20 s. The results are shown in the table below.

Time after adding the zinc powder to the copper(II) sulfate solution (s)	Temperature of the reaction mixture (°C)		
	Result 1	Result 2	Mean
0	22.0	22.0	22.0
20	22.8	23.0	22.9
40	24.8	25.2	25.0
60	27.3		27.1
80	26.6	26.6	26.6
100	25.7	25.9	25.8
120	24.8	24.4	24.6

(a) From the data in the table, calculate the missing result for 60 s that must have been used in working out the mean value. [1]

Temperature = ... °C

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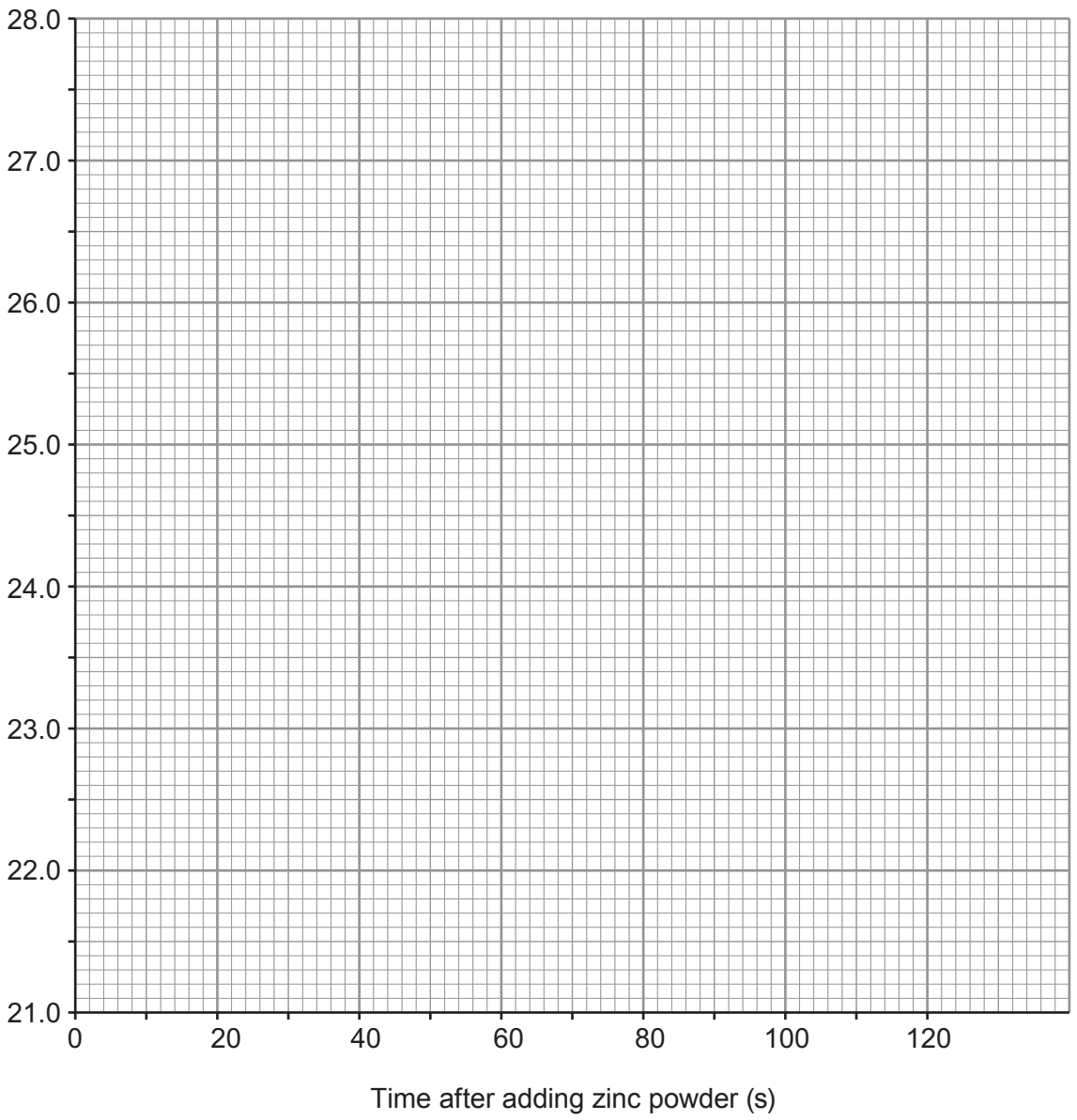
(b) On the grid below plot the time after adding the zinc powder against the **mean** temperature of the reaction mixture and draw a suitable line. [3]



(c) One of the students checked the thermometer reading 15 minutes later. State what the temperature would be at this point. Give a reason for your answer. [2]

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(d) Explain why the results recorded in the table can be described as *repeatable*. [2]

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(e) The maximum temperature recorded is not as high as expected. Give the main reason for this and suggest **one** way that this effect could be reduced. [2]

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(f) Balance the following symbol equation that represents the displacement reaction that takes place between zinc and silver nitrate solution. [1]

$$Zn + \square\ AgNO_3 \longrightarrow Zn(NO_3)_2 + \square\ Ag$$

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3. Briefly outline the theory of plate tectonics and use this to describe what happens at **one** type of plate boundary. [6 QWC]

6

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4. The table below shows some properties of eight elements.

Element	Metal/ non-metal	Melting point (°C)	Boiling point (°C)	Malleable	Ductile	Appearance at room temperature (20 °C)
bromine	non-metal	−7	59	no	no	brown liquid
carbon	non-metal	3500	4800	no	no	black solid
iodine	non-metal	114	184	no	no	shiny grey solid
chromium	metal	1907	2671	yes	yes	shiny grey solid
lead	metal	327	1740	yes	yes	shiny grey solid
lithium	metal	180	1340	yes	yes	shiny grey solid
potassium	metal	63	760	yes	yes	shiny grey solid
oxygen	non-metal	−218	−183	no	no	colourless gas

Use **only** the information in the table to answer the following questions.

(a) Explain which element is a liquid at 100 °C. [2]

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(b) Carbon and iodine are non-metals but each shows some properties associated with metals.

Give **one** property of each element that is unusual for a non-metal. [2]

Carbon .....

Iodine .....

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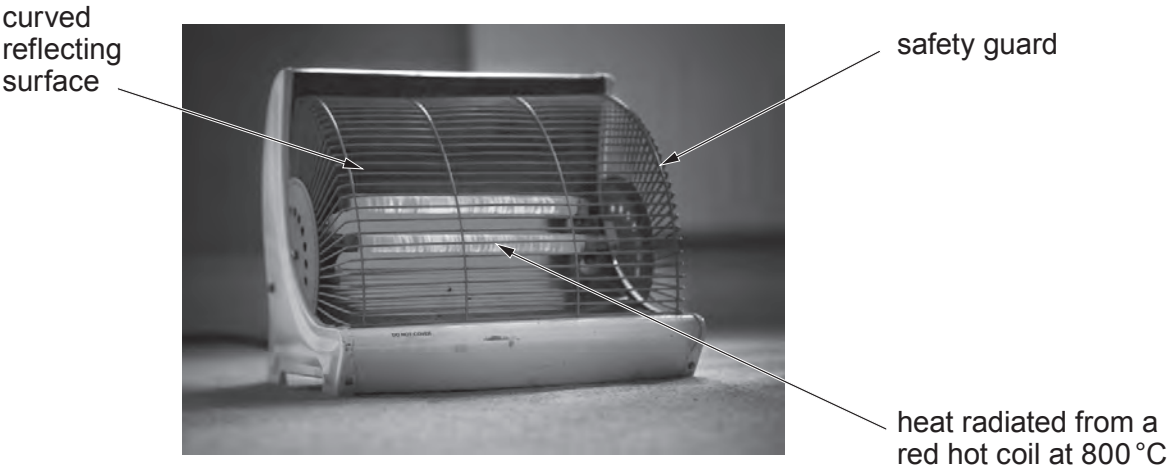
(c) An electric fire, such as the one shown in the photograph below, has a curved reflecting surface to increase the heating effect.



Name the element from the table that would be most suitable for making the curved reflecting surface. Explain your choice. [2]

Element .....

Explanation .....

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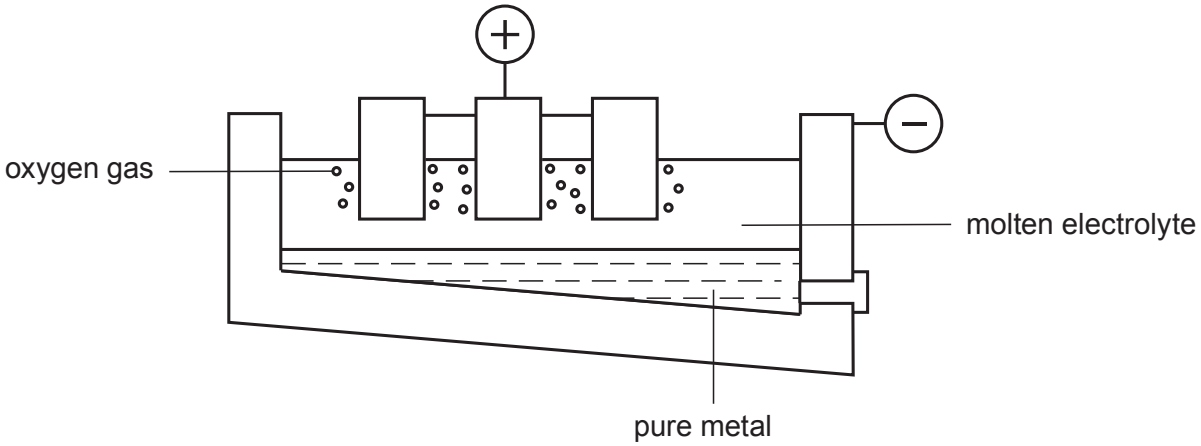
5. *(a)* The process of electrolysis can be used to extract aluminium from aluminium oxide.



(i) State what is meant by the term *electrolysis*. [1]

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(ii) The process is expensive because of the cost of the large amounts of heat and electricity used. Explain why the aluminium oxide is dissolved in cryolite. [2]

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(iii) Balance the symbol equation that represents the reaction taking place. [1]

$$\square\ Al_2O_3 \longrightarrow \square\ Al + \square\ O_2$$

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(b) Iron is extracted from its ore inside the blast furnace.

The table below lists the raw materials needed for the extraction of one tonne of iron. The cost of one tonne of each raw material is also shown.

Raw material needed to extract iron from its ore	Number of tonnes needed to produce one tonne of iron	Cost per tonne of the raw material (£)
iron ore	2	40
coke	1	152
limestone	0.5	90
hot air	4	2

The cost of recycling one tonne of iron is only 10 % of the cost of extracting one tonne of the metal from its ore.

Use the information in the table to calculate how much money would be saved per tonne of recycled iron. [3]

Saving = £ ..... per tonne

7

Turn over.

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6. The table below shows the results of research into the effect of water fluoridation on the teeth of children aged 12 years from different countries.

DMFT – decayed, missing and filled teeth

Country	Average number of DMFT in sample tested	Percentage of sample with fluoridated water (%)
Denmark	0.7	0
England	0.7	11
Australia	1.0	80
United States	1.2	64
Spain	1.3	11
New Zealand	1.4	61
Norway	1.7	0
Japan	1.7	0

(a) Explain whether or not this information supports the argument that fluoridation of water supplies reduces the average number of DMFT in children. [3]

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(b) Without referring to the table above, give **two** reasons why some people oppose the addition of fluoride to water supplies. [2]

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7. Some scientists believe that carbon dioxide and water vapour were the two main gases present in the original atmosphere formed by volcanic outgassing.

(a) State and explain how the levels of these two gases have changed over geological time. [4]

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(b) Explain how the processes of respiration and photosynthesis affect the atmosphere. [3]

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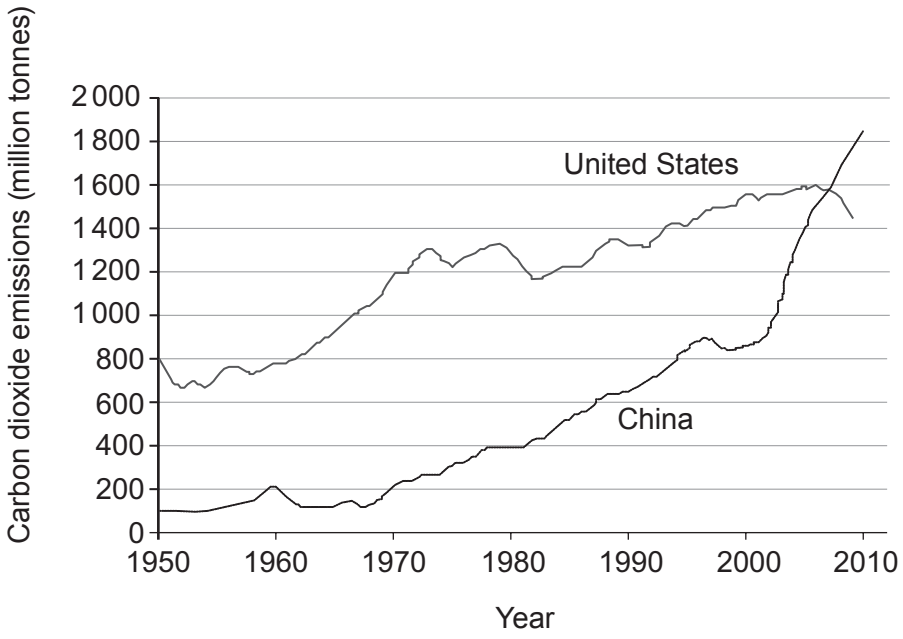
(c) The graphs below show the carbon dioxide emissions from the combustion of fossil fuels in the United States and China between 1950 and 2009.



(i) Use data from the graph to compare the increase in carbon dioxide emissions in the United States and China between 1950 and 2009. [3]

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(ii) Explain how the information in the graph could be used to support the argument that the combustion of fossil fuels is playing a significant part in causing global warming in recent years. [2]

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8. Explain how, without using indicators, sodium carbonate, sodium chloride and sodium hydroxide can be identified.

Use the names of any products formed and relevant equations to support your answer.
[6 QWC]

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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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+}		

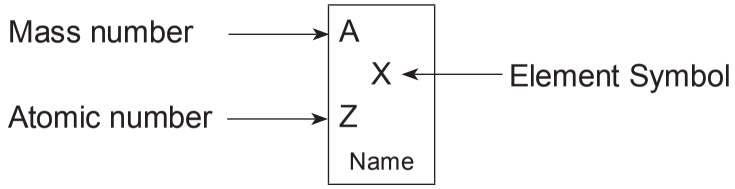
PERIODIC TABLE OF ELEMENTS

20

(4462-02)

Group 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 Radium	$^{227}_{89}$Ac Actinium															

Key:



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