



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
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**CHEMISTRY**

**0620/33**

Paper 3 (Extended)

**October/November 2013**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 12.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

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

This document consists of **12** printed pages.



1 Zirconium (Zr) is a metal in Period 5. Its main oxidation state is +4.

(a) The following are all zirconium atoms:  ${}_{40}^{90}\text{Zr}$ ,  ${}_{40}^{91}\text{Zr}$  and  ${}_{40}^{92}\text{Zr}$ .

In terms of numbers of electrons, neutrons and protons, how are these three atoms the same and how are they different?

They are the same because .....

.....

They are different because .....

..... [3]

(b) Containers for fuel rods in nuclear reactors are made of zirconium.  
Nuclear reactors are used to produce energy and to make radioactive isotopes.

(i) Which isotope of a different element is used as a fuel in nuclear reactors?

..... [1]

(ii) State one medical and one industrial use of radioactive isotopes.

.....

..... [2]

(iii) Above 900 °C, zirconium reacts with water to form zirconium(IV) oxide,  $\text{ZrO}_2$ , and hydrogen. Write an equation for this reaction.

..... [2]

(iv) In a nuclear accident, water may come in contact with very hot zirconium.  
Explain why the presence of hydrogen inside the reactor greatly increases the danger of the accident.

..... [1]

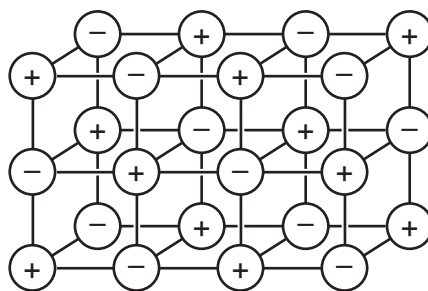
(c) It is possible to determine whether zirconium(IV) oxide is acidic, neutral, basic or amphoteric using an acid and an alkali. Complete the table of possible results. If the oxide is predicted to react write 'R', if it is predicted not to react write 'NR'.

if the oxide is	predicted result with hydrochloric acid	predicted result with aqueous sodium hydroxide
acidic		
neutral		
basic		
amphoteric		

[4]

[Total: 13]

- 2 (a) The diagram shows the lattice of a typical ionic compound.



- (i) Explain the term *ionic lattice*.

.....  
 ..... [2]

- (ii) In this lattice, the ratio of positive ions to negative ions is 1:1.  
 In the lattice of a different ionic compound, the ratio of positive ions to negative ions is 1:2.  
 Suggest why this ratio varies in different ionic compounds.

..... [1]

- (iii) Give **three** physical properties of ionic compounds.

.....  
 .....  
 ..... [3]

- (b) Strontium oxide is an ionic compound. Draw a diagram which shows its formula, the charges on the ions and the arrangement of the **valency** electrons around the negative ion.

The electron distribution of a strontium atom is  $2 + 8 + 18 + 8 + 2$ .

Use o to represent an electron from a strontium atom.

Use x to represent an electron from an oxygen atom.

[3]

[Total: 9]

3 The main uses of zinc are preventing steel from rusting and making alloys.

(a) The main ore of zinc is zinc blende. Zinc blende consists mainly of zinc sulfide, ZnS. There are two major methods of extracting zinc from its ore. They are the direct reduction of zinc oxide to zinc and by electrolysis. In both methods, zinc oxide is made from the zinc sulfide in the ore.

(i) How is zinc oxide made from zinc sulfide?

.....  
..... [1]

(ii) Write an equation for the reaction used to reduce zinc oxide to zinc.

..... [1]

(b) In the electrolytic method, zinc oxide reacts with sulfuric acid to form impure aqueous zinc sulfate. This solution contains  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$  and  $\text{Cu}^{2+}$  ions as impurities.

(i) Write the equation for the reaction between zinc oxide and sulfuric acid.

..... [1]

(ii) Nickel, cobalt and copper are all less reactive than zinc. Explain why the addition of zinc powder removes these ions from the solution.

.....  
..... [2]

(c) The solution of zinc sulfate is electrolysed using inert electrodes. This electrolysis is similar to that of copper(II) sulfate with inert electrodes.

(i) Write the equation for the reaction at the negative electrode (cathode).

..... [1]

(ii) Complete the equation for the reaction at the positive electrode (anode).



(iii) The electrolyte changes from zinc sulfate to

..... [1]

(d) (i) Brass is an alloy of copper and zinc. Suggest **two** reasons why brass is often used in preference to copper.

.....  
..... [2]

(ii) Sacrificial protection is a method of rust prevention. Explain in terms of electron transfer why steel, which is in electrical contact with zinc, does not rust.

.....  
.....  
.....  
..... [4]

[Total: 15]



- (d) (i)** Sulfuric acid is a strong acid.  
You are given aqueous sulfuric acid, concentration  $0.1 \text{ mol/dm}^3$ , and aqueous hexanesulfonic acid, concentration  $0.2 \text{ mol/dm}^3$ . Describe how you could show that hexanesulfonic acid is also a strong acid.

.....  
..... [2]

- (ii)** Deduce why, for a fair comparison, the two acid solutions must have different concentrations.

.....  
..... [1]

- (iii)** Explain the terms *strong acid* and *weak acid*.

.....  
.....  
..... [2]

[Total: 17]

- 5 Domestic rubbish is disposed of in landfill sites. Rubbish could include the following items.

item of rubbish	approximate time for item to break down
newspaper	one month
cotton rag	six months
woollen glove	one year
aluminium container	up to 500 years
styrofoam cup	1000 years

- (a) Explain why aluminium, a reactive metal, takes so long to corrode.

..... [1]

- (b) Both paper and cotton are complex carbohydrates. They can be hydrolysed to simple sugars such as glucose.

The formula of glucose can be represented as:



Draw the structural formula of a complex carbohydrate, such as cotton.  
Include at least **two** glucose units.

[2]



(c) Wool is a protein. It can be hydrolysed to a mixture of monomers by enzymes.

(i) What are enzymes?

.....  
..... [2]

(ii) Name another substance which can hydrolyse proteins.

..... [1]

(iii) What type of compound are the monomers formed by the hydrolysis of proteins?

..... [1]

(iv) Which technique could be used to identify the individual monomers in the mixture?

..... [1]

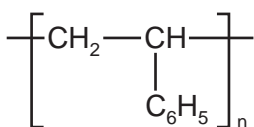
(v) Proteins contain the amide linkage. Name a synthetic macromolecule which contains the same linkage.

..... [1]

(d) (i) What is the scientific term used to describe polymers which do not break down in landfill sites?

..... [1]

(ii) Styrofoam is poly(phenylethene). It is an addition polymer. Its structural formula is given below. Deduce the structural formula of the monomer, phenylethene.



[1]

[Total: 11]

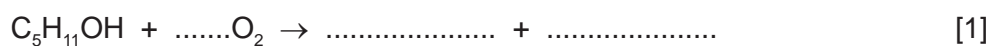
6 The alcohols form a homologous series. The first five members are given in the table below.

(a)

alcohol	formula	heat of combustion in kJ/mol
methanol	CH <sub>3</sub> OH	730
ethanol	CH <sub>3</sub> -CH <sub>2</sub> -OH	1380
propan-1-ol		
butan-1-ol	CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -OH	2680
pentan-1-ol	CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -OH	3350

(i) Complete the table. [2]

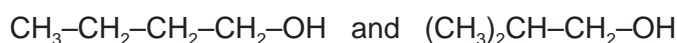
(ii) Complete the equation for the combustion of pentan-1-ol in excess oxygen.



(b) State **three** characteristics of a homologous series other than the variation of physical properties down the series.

.....  
 .....  
 ..... [3]

(c) The following alcohols are isomers.



(i) Explain why they are isomers.

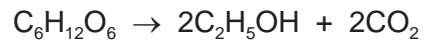
.....  
 .....  
 ..... [2]

(ii) Draw the structural formula of another isomer of the above alcohols.

[1]

(d) Alcohols can be made by fermentation and from petroleum.

(i) Ethanol is made from sugars by fermentation.



The mass of one mole of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ , is 180 g.

Calculate the maximum mass of ethanol which could be obtained from 72 g of glucose.

.....

.....

.....

..... [3]

(ii) Describe how ethanol is made from petroleum.

**petroleum (alkanes) → ethene → ethanol**

.....

.....

.....

..... [3]

[Total: 15]

**DATA SHEET**  
**The Periodic Table of the Elements**

Group		I	II	III	IV	V	VI	VII	0																																																																																																																																																																																																																																																														
		1 <b>H</b> Hydrogen 1							4 <b>He</b> Helium 2																																																																																																																																																																																																																																																														
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4				11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10																																																																																																																																																																																																																																																									
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12			25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36																																																																																																																																																																																																																																																								
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20		41 <b>V</b> Vanadium 23	42 <b>Cr</b> Chromium 24	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54																																																																																																																																																																																																																																																							
85 <b>Rb</b> Rubidium 37	86 <b>Sr</b> Strontium 38		48 <b>Ti</b> Titanium 22	49 <b>V</b> Vanadium 23	50 <b>Cr</b> Chromium 24	51 <b>Mn</b> Manganese 25	52 <b>Fe</b> Iron 26	53 <b>Co</b> Cobalt 27	54 <b>Ni</b> Nickel 28	55 <b>Cu</b> Copper 29	56 <b>Zn</b> Zinc 30	57 <b>Ga</b> Gallium 31	58 <b>Ge</b> Germanium 32	59 <b>As</b> Arsenic 33	60 <b>Se</b> Selenium 34	61 <b>Br</b> Bromine 35	62 <b>Kr</b> Krypton 36																																																																																																																																																																																																																																																						
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56		51 <b>Nb</b> Niobium 41	52 <b>Mo</b> Molybdenum 42	53 <b>Tc</b> Technetium 43	54 <b>Ru</b> Ruthenium 44	55 <b>Rh</b> Rhodium 45	56 <b>Pd</b> Palladium 46	57 <b>Ag</b> Silver 47	58 <b>Cd</b> Cadmium 48	59 <b>In</b> Indium 49	60 <b>Sn</b> Tin 50	61 <b>Sb</b> Antimony 51	62 <b>Te</b> Tellurium 52	63 <b>I</b> Iodine 53	64 <b>Xe</b> Xenon 54	65 <b>Kr</b> Krypton 36	66 <b>Rn</b> Radon 86																																																																																																																																																																																																																																																					
226 <b>Fr</b> Francium 87	227 <b>Ra</b> Radium 88		59 <b>Zr</b> Zirconium 40	60 <b>Nb</b> Niobium 41	61 <b>Mo</b> Molybdenum 42	62 <b>Tc</b> Technetium 43	63 <b>Ru</b> Ruthenium 44	64 <b>Rh</b> Rhodium 45	65 <b>Pd</b> Palladium 46	66 <b>Ag</b> Silver 47	67 <b>Cd</b> Cadmium 48	68 <b>In</b> Indium 49	69 <b>Sn</b> Tin 50	70 <b>Sb</b> Antimony 51	71 <b>Te</b> Tellurium 52	72 <b>I</b> Iodine 53	73 <b>Xe</b> Xenon 54	74 <b>Kr</b> Krypton 36	75 <b>Rn</b> Radon 86																																																																																																																																																																																																																																																				
			69 <b>Y</b> Yttrium 39	70 <b>Zr</b> Zirconium 40	71 <b>Nb</b> Niobium 41	72 <b>Mo</b> Molybdenum 42	73 <b>Tc</b> Technetium 43	74 <b>Ru</b> Ruthenium 44	75 <b>Rh</b> Rhodium 45	76 <b>Pd</b> Palladium 46	77 <b>Ag</b> Silver 47	78 <b>Cd</b> Cadmium 48	79 <b>In</b> Indium 49	80 <b>Sn</b> Tin 50	81 <b>Sb</b> Antimony 51	82 <b>Te</b> Tellurium 52	83 <b>I</b> Iodine 53	84 <b>Xe</b> Xenon 54	85 <b>Kr</b> Krypton 36	86 <b>Rn</b> Radon 86																																																																																																																																																																																																																																																			
			89 <b>La</b> Lanthanum 57	90 <b>Ce</b> Cerium 58	91 <b>Pr</b> Praseodymium 59	92 <b>Nd</b> Neodymium 60	93 <b>Pm</b> Promethium 61	94 <b>Sm</b> Samarium 62	95 <b>Eu</b> Europium 63	96 <b>Gd</b> Gadolinium 64	97 <b>Tb</b> Terbium 65	98 <b>Dy</b> Dysprosium 66	99 <b>Ho</b> Holmium 67	100 <b>Er</b> Erbium 68	101 <b>Tm</b> Thulium 69	102 <b>Yb</b> Ytterbium 70	103 <b>Lu</b> Lutetium 71	104 <b>La</b> Lanthanum 57	105 <b>Ce</b> Cerium 58	106 <b>Pr</b> Praseodymium 59	107 <b>Nd</b> Neodymium 60	108 <b>Pm</b> Promethium 61	109 <b>Sm</b> Samarium 62	110 <b>Eu</b> Europium 63	111 <b>Gd</b> Gadolinium 64	112 <b>Tb</b> Terbium 65	113 <b>Dy</b> Dysprosium 66	114 <b>Ho</b> Holmium 67	115 <b>Er</b> Erbium 68	116 <b>Tm</b> Thulium 69	117 <b>Yb</b> Ytterbium 70	118 <b>Lu</b> Lutetium 71	119 <b>La</b> Lanthanum 57	120 <b>Ce</b> Cerium 58	121 <b>Pr</b> Praseodymium 59	122 <b>Nd</b> Neodymium 60	123 <b>Pm</b> Promethium 61	124 <b>Sm</b> Samarium 62	125 <b>Eu</b> Europium 63	126 <b>Gd</b> Gadolinium 64	127 <b>Tb</b> Terbium 65	128 <b>Dy</b> Dysprosium 66	129 <b>Ho</b> Holmium 67	130 <b>Er</b> Erbium 68	131 <b>Tm</b> Thulium 69	132 <b>Yb</b> Ytterbium 70	133 <b>Lu</b> Lutetium 71	134 <b>La</b> Lanthanum 57	135 <b>Ce</b> Cerium 58	136 <b>Pr</b> Praseodymium 59	137 <b>Nd</b> Neodymium 60	138 <b>Pm</b> Promethium 61	139 <b>Sm</b> Samarium 62	140 <b>Eu</b> Europium 63	141 <b>Gd</b> Gadolinium 64	142 <b>Tb</b> Terbium 65	143 <b>Dy</b> Dysprosium 66	144 <b>Ho</b> Holmium 67	145 <b>Er</b> Erbium 68	146 <b>Tm</b> Thulium 69	147 <b>Yb</b> Ytterbium 70	148 <b>Lu</b> Lutetium 71	149 <b>La</b> Lanthanum 57	150 <b>Ce</b> Cerium 58	151 <b>Pr</b> Praseodymium 59	152 <b>Nd</b> Neodymium 60	153 <b>Pm</b> Promethium 61	154 <b>Sm</b> Samarium 62	155 <b>Eu</b> Europium 63	156 <b>Gd</b> Gadolinium 64	157 <b>Tb</b> Terbium 65	158 <b>Dy</b> Dysprosium 66	159 <b>Ho</b> Holmium 67	160 <b>Er</b> Erbium 68	161 <b>Tm</b> Thulium 69	162 <b>Yb</b> Ytterbium 70	163 <b>Lu</b> Lutetium 71	164 <b>La</b> Lanthanum 57	165 <b>Ce</b> Cerium 58	166 <b>Pr</b> Praseodymium 59	167 <b>Nd</b> Neodymium 60	168 <b>Pm</b> Promethium 61	169 <b>Sm</b> Samarium 62	170 <b>Eu</b> Europium 63	171 <b>Gd</b> Gadolinium 64	172 <b>Tb</b> Terbium 65	173 <b>Dy</b> Dysprosium 66	174 <b>Ho</b> Holmium 67	175 <b>Er</b> Erbium 68	176 <b>Tm</b> Thulium 69	177 <b>Yb</b> Ytterbium 70	178 <b>Lu</b> Lutetium 71	179 <b>La</b> Lanthanum 57	180 <b>Ce</b> Cerium 58	181 <b>Pr</b> Praseodymium 59	182 <b>Nd</b> Neodymium 60	183 <b>Pm</b> Promethium 61	184 <b>Sm</b> Samarium 62	185 <b>Eu</b> Europium 63	186 <b>Gd</b> Gadolinium 64	187 <b>Tb</b> Terbium 65	188 <b>Dy</b> Dysprosium 66	189 <b>Ho</b> Holmium 67	190 <b>Er</b> Erbium 68	191 <b>Tm</b> Thulium 69	192 <b>Yb</b> Ytterbium 70	193 <b>Lu</b> Lutetium 71	194 <b>La</b> Lanthanum 57	195 <b>Ce</b> Cerium 58	196 <b>Pr</b> Praseodymium 59	197 <b>Nd</b> Neodymium 60	198 <b>Pm</b> Promethium 61	199 <b>Sm</b> Samarium 62	200 <b>Eu</b> Europium 63	201 <b>Gd</b> Gadolinium 64	202 <b>Tb</b> Terbium 65	203 <b>Dy</b> Dysprosium 66	204 <b>Ho</b> Holmium 67	205 <b>Er</b> Erbium 68	206 <b>Tm</b> Thulium 69	207 <b>Yb</b> Ytterbium 70	208 <b>Lu</b> Lutetium 71	209 <b>La</b> Lanthanum 57	210 <b>Ce</b> Cerium 58	211 <b>Pr</b> Praseodymium 59	212 <b>Nd</b> Neodymium 60	213 <b>Pm</b> Promethium 61	214 <b>Sm</b> Samarium 62	215 <b>Eu</b> Europium 63	216 <b>Gd</b> Gadolinium 64	217 <b>Tb</b> Terbium 65	218 <b>Dy</b> Dysprosium 66	219 <b>Ho</b> Holmium 67	220 <b>Er</b> Erbium 68	221 <b>Tm</b> Thulium 69	222 <b>Yb</b> Ytterbium 70	223 <b>Lu</b> Lutetium 71	224 <b>La</b> Lanthanum 57	225 <b>Ce</b> Cerium 58	226 <b>Pr</b> Praseodymium 59	227 <b>Nd</b> Neodymium 60	228 <b>Pm</b> Promethium 61	229 <b>Sm</b> Samarium 62	230 <b>Eu</b> Europium 63	231 <b>Gd</b> Gadolinium 64	232 <b>Tb</b> Terbium 65	233 <b>Dy</b> Dysprosium 66	234 <b>Ho</b> Holmium 67	235 <b>Er</b> Erbium 68	236 <b>Tm</b> Thulium 69	237 <b>Yb</b> Ytterbium 70	238 <b>Lu</b> Lutetium 71	239 <b>La</b> Lanthanum 57	240 <b>Ce</b> Cerium 58	241 <b>Pr</b> Praseodymium 59	242 <b>Nd</b> Neodymium 60	243 <b>Pm</b> Promethium 61	244 <b>Sm</b> Samarium 62	245 <b>Eu</b> Europium 63	246 <b>Gd</b> Gadolinium 64	247 <b>Tb</b> Terbium 65	248 <b>Dy</b> Dysprosium 66	249 <b>Ho</b> Holmium 67	250 <b>Er</b> Erbium 68	251 <b>Tm</b> Thulium 69	252 <b>Yb</b> Ytterbium 70	253 <b>Lu</b> Lutetium 71	254 <b>La</b> Lanthanum 57	255 <b>Ce</b> Cerium 58	256 <b>Pr</b> Praseodymium 59	257 <b>Nd</b> Neodymium 60	258 <b>Pm</b> Promethium 61	259 <b>Sm</b> Samarium 62	260 <b>Eu</b> Europium 63	261 <b>Gd</b> Gadolinium 64	262 <b>Tb</b> Terbium 65	263 <b>Dy</b> Dysprosium 66	264 <b>Ho</b> Holmium 67	265 <b>Er</b> Erbium 68	266 <b>Tm</b> Thulium 69	267 <b>Yb</b> Ytterbium 70	268 <b>Lu</b> Lutetium 71	269 <b>La</b> Lanthanum 57	270 <b>Ce</b> Cerium 58	271 <b>Pr</b> Praseodymium 59	272 <b>Nd</b> Neodymium 60	273 <b>Pm</b> Promethium 61	274 <b>Sm</b> Samarium 62	275 <b>Eu</b> Europium 63	276 <b>Gd</b> Gadolinium 64	277 <b>Tb</b> Terbium 65	278 <b>Dy</b> Dysprosium 66	279 <b>Ho</b> Holmium 67	280 <b>Er</b> Erbium 68	281 <b>Tm</b> Thulium 69	282 <b>Yb</b> Ytterbium 70	283 <b>Lu</b> Lutetium 71	284 <b>La</b> Lanthanum 57	285 <b>Ce</b> Cerium 58	286 <b>Pr</b> Praseodymium 59	287 <b>Nd</b> Neodymium 60	288 <b>Pm</b> Promethium 61	289 <b>Sm</b> Samarium 62	290 <b>Eu</b> Europium 63	291 <b>Gd</b> Gadolinium 64	292 <b>Tb</b> Terbium 65	293 <b>Dy</b> Dysprosium 66	294 <b>Ho</b> Holmium 67	295 <b>Er</b> Erbium 68	296 <b>Tm</b> Thulium 69	297 <b>Yb</b> Ytterbium 70	298 <b>Lu</b> Lutetium 71	299 <b>La</b> Lanthanum 57	300 <b>Ce</b> Cerium 58	301 <b>Pr</b> Praseodymium 59	302 <b>Nd</b> Neodymium 60	303 <b>Pm</b> Promethium 61	304 <b>Sm</b> Samarium 62	305 <b>Eu</b> Europium 63	306 <b>Gd</b> Gadolinium 64	307 <b>Tb</b> Terbium 65	308 <b>Dy</b> Dysprosium 66	309 <b>Ho</b> Holmium 67	310 <b>Er</b> Erbium 68	311 <b>Tm</b> Thulium 69	312 <b>Yb</b> Ytterbium 70	313 <b>Lu</b> Lutetium 71	314 <b>La</b> Lanthanum 57	315 <b>Ce</b> Cerium 58	316 <b>Pr</b> Praseodymium 59	317 <b>Nd</b> Neodymium 60	318 <b>Pm</b> Promethium 61	319 <b>Sm</b> Samarium 62	320 <b>Eu</b> Europium 63	321 <b>Gd</b> Gadolinium 64	322 <b>Tb</b> Terbium 65	323 <b>Dy</b> Dysprosium 66	324 <b>Ho</b> Holmium 67	325 <b>Er</b> Erbium 68	326 <b>Tm</b> Thulium 69	327 <b>Yb</b> Ytterbium 70	328 <b>Lu</b> Lutetium 71	329 <b>La</b> Lanthanum 57	330 <b>Ce</b> Cerium 58	331 <b>Pr</b> Praseodymium 59	332 <b>Nd</b> Neodymium 60	333 <b>Pm</b> Promethium 61	334 <b>Sm</b> Samarium 62	335 <b>Eu</b> Europium 63	336 <b>Gd</b> Gadolinium 64	337 <b>Tb</b> Terbium 65	338 <b>Dy</b> Dysprosium 66	339 <b>Ho</b> Holmium 67	340 <b>Er</b> Erbium 68	341 <b>Tm</b> Thulium 69	342 <b>Yb</b> Ytterbium 70	343 <b>Lu</b> Lutetium 71	344 <b>La</b> Lanthanum 57	345 <b>Ce</b> Cerium 58	346 <b>Pr</b> Praseodymium 59	347 <b>Nd</b> Neodymium 60	348 <b>Pm</b> Promethium 61	349 <b>Sm</b> Samarium 62