

Surname	Centre Number	Candidate Number
Other Names		0



**GCSE**

4493/02

**CHEMISTRY**

**CHEMISTRY 3  
HIGHER TIER**

A.M. THURSDAY, 15 May 2014

1 hour

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

**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.

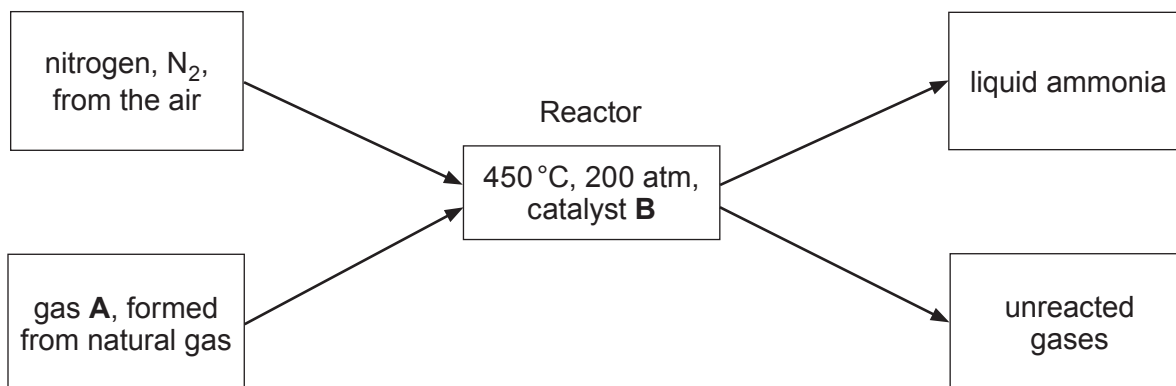
You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used 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.

Answer **all** questions.

1. Ammonia is produced during the Haber process. The reaction is summarised in the diagram below.



(a) Give the name of gas **A**. ..... [1]

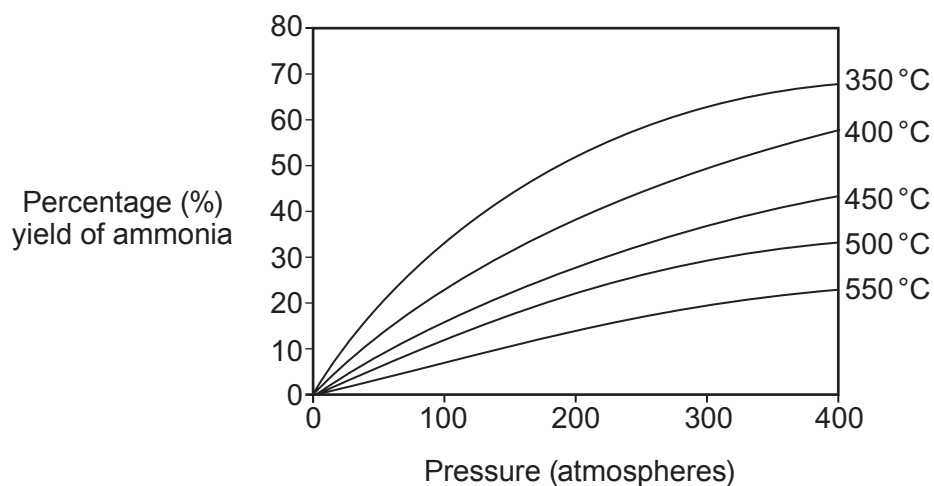
(b) Name catalyst **B** and state why it is used. [2]

.....  
 .....

(c) The yield of ammonia is only 28% therefore 72% of the gases remain unreacted.  
 Describe what happens to these unreacted gases and state why this is important. [2]

.....  
 .....

- (d) The following graph shows the effect of temperature and pressure on the yield of ammonia during the Haber process.



Describe how the yield of ammonia varies with temperature and pressure.

[2]

*Temperature*

.....

.....

*Pressure*

.....

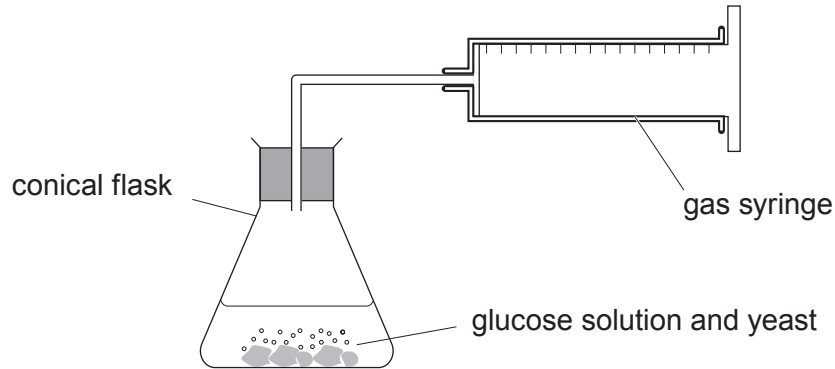
.....

- (e) Write a balanced **symbol** equation for the production of ammonia.

[3]



2. A pupil investigated the effect of temperature on the rate of fermentation using the apparatus shown below.



The experiment was carried out three times at five different temperatures. The volume of gas collected after 10 minutes was recorded each time. The results are shown below.

Temperature (°C)	Volume of gas collected after 10 minutes (cm <sup>3</sup> )			
	1	2	3	Mean
20	9	8	7	8
30	38	40	32	39
40	52	53	54	53
50	35	32	33	33
60	12	11	12	12

- (a) Suggest why the circled value is considered to be anomalous.

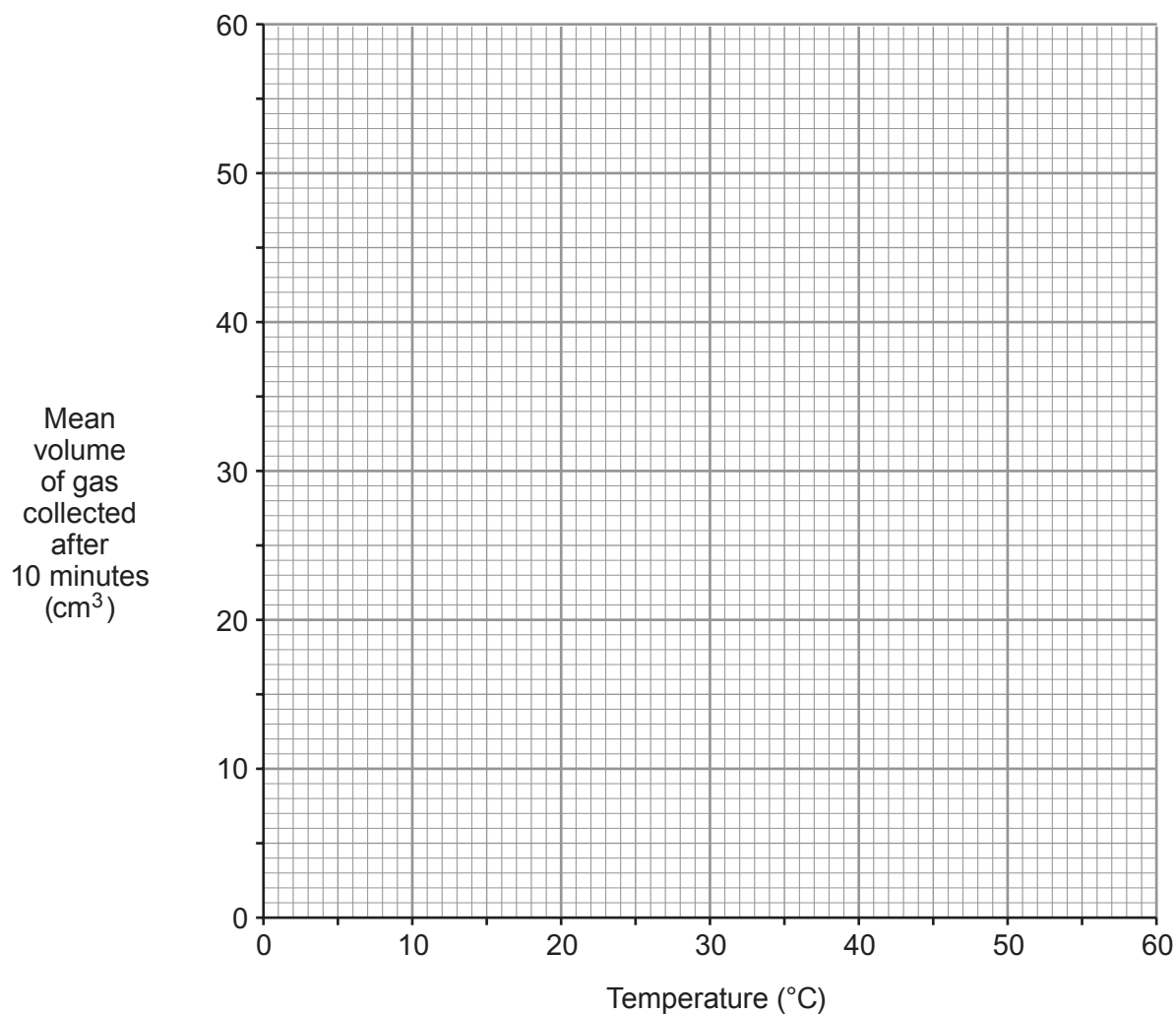
[1]

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- (b) Plot a graph of the **mean** volume of gas collected against temperature on the grid opposite.

[2]



(c) State what conclusions can be drawn from the graph. [2]

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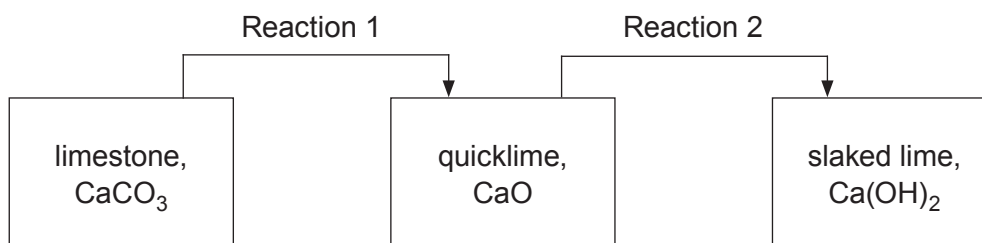
(d) Write a **word** equation for the reaction taking place. [2]

.....  $\longrightarrow$  ..... + .....

(e) Yeast produces a catalyst that allows this reaction to take place. Name the **type** of catalyst produced by yeast. [1]

.....

3. Limestone,  $\text{CaCO}_3$ , is an important raw material. It can be converted into other useful materials as shown in the diagram below.



Describe how these reactions can be carried out in a laboratory.  
Your answer should include:

- the conditions required for each reaction;
- observations at each stage;
- equations for the reactions taking place.

[6 QWC]

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4. Sulfuric acid is produced in industry by the contact process.

(a) The contact process involves four stages. The first two are shown below.

Stage 1    sulfur + oxygen  $\longrightarrow$  sulfur dioxide

Stage 2    sulfur dioxide + oxygen  $\rightleftharpoons$  sulfur trioxide

(i) Name the **raw material** that provides oxygen in stage 1. [1]

.....

(ii) Describe the last two stages in the contact process (stages 3 and 4). [2]

Stage 3 .....

.....

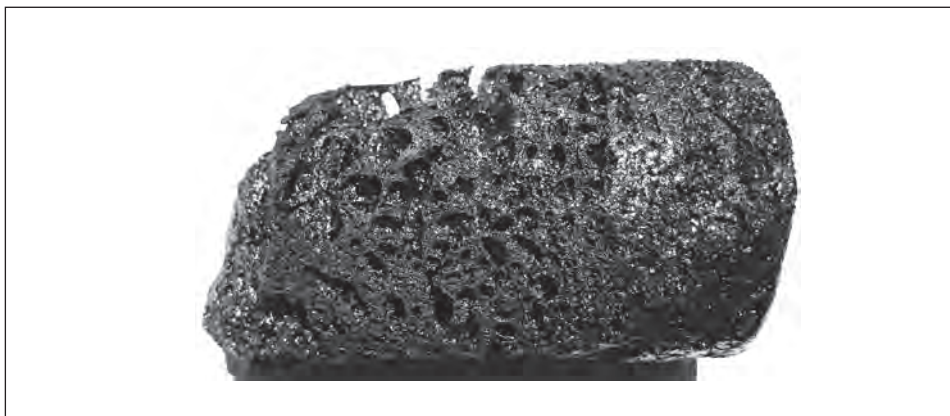
Stage 4 .....

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(iii) Name the catalyst used in stage 2. [1]

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(b) When concentrated sulfuric acid is added to sugar a black solid is formed.



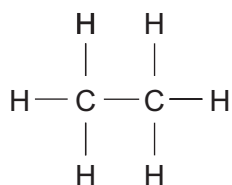
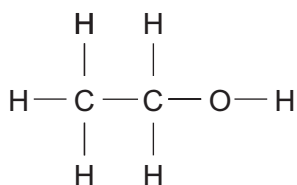
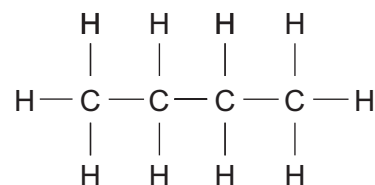
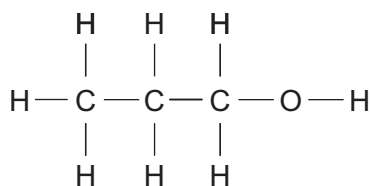
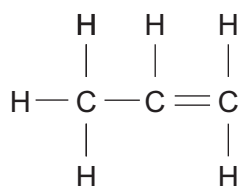
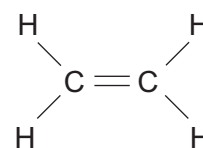
In terms of the elements present in sugar, describe what happens during this reaction. [2]

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5. The following diagram shows the structures of six organic compounds.

**A****B****C****D****E****F**

(a) Name the family to which each of the following pairs of compounds belong. [2]

**B and D** .....

**E and F** .....

(b) Describe a chemical test that could be carried out to distinguish between compounds **C** and **E**. Give the expected result for **both** compounds. [2]

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(c) Compound **C** is one of two isomers that have the molecular formula  $C_4H_{10}$ .

(i) Give the meaning of the term *isomer*.

[1]

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.....

(ii) Draw in the space below the structure of the other isomer of  $C_4H_{10}$ .

[1]

(d) Give the letter, **A-F**, of **one other** compound that has an isomer. Draw the structure of its isomer.

[2]

Compound .....

Structure

6. (a) The following box contains the names of six ionic compounds.

<b>sodium chloride</b>	<b>sodium carbonate</b>	<b>copper(II) sulfate</b>
<b>ammonium chloride</b>	<b>potassium sulfate</b>	<b>lithium carbonate</b>

State which of the compounds in the box you would expect to

- (i) give a yellow flame in a flame test, [1]

.....

- (ii) produce bubbles when reacting with hydrochloric acid. [1]

.....

- (b) A student has two colourless solutions in unlabelled bottles. He knows that one is potassium chloride and that the other is potassium iodide. Describe a test that could be carried out to distinguish between the solutions, giving the observations expected in **both** cases. [3]

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- (c) Compounds containing ammonium ions can be identified by heating gently with sodium hydroxide solution and testing the gas produced.

Name the gas produced and describe how you would positively identify this gas. [2]

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- (d) Iron(III) chloride solution produces a brown precipitate when it reacts with sodium hydroxide solution.

Write a balanced **ionic** equation for this reaction. You should include state symbols. [3]



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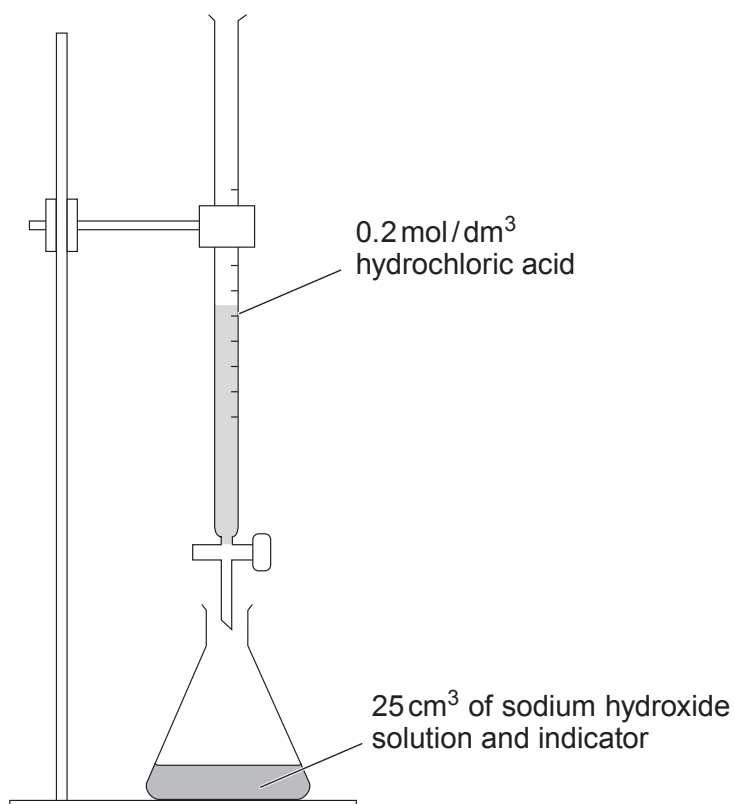
7. A laboratory technician prepared a solution of sodium hydroxide, NaOH, in the following way.
- He weighed out accurately 2.0 g of sodium hydroxide.
  - He dissolved the sodium hydroxide in 250 cm<sup>3</sup> of water.

The relative formula mass ( $M_r$ ) of sodium hydroxide is 40.

- (a) Use this information to calculate the concentration of this sodium hydroxide solution in mol/dm<sup>3</sup>. [2]

Concentration of sodium hydroxide solution = ..... mol/dm<sup>3</sup>

- (b) A student was asked to carry out a titration to check the concentration of the sodium hydroxide solution. She carried out the titration using the apparatus shown below.



The equation for the reaction taking place is as follows.



The titration was carried out three times and the results obtained are shown below.

Titration			
	1	2	3
Volume of hydrochloric acid added (cm <sup>3</sup> )	22.2	22.7	22.6

Calculate the number of moles of hydrochloric acid that reacted and hence the concentration of the sodium hydroxide solution. [4]

Concentration of sodium hydroxide solution = ..... mol/dm<sup>3</sup>

6

8. Describe the similarities in the reactions of ethanoic acid and sulfuric acid with metals, carbonates and bases. Describe and explain any differences observed. You should include relevant equations in your answer. [6 QWC]

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**END OF PAPER**

6

## FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
Aluminium	$\text{Al}^{3+}$	Bromide	$\text{Br}^-$
Ammonium	$\text{NH}_4^+$	Carbonate	$\text{CO}_3^{2-}$
Barium	$\text{Ba}^{2+}$	Chloride	$\text{Cl}^-$
Calcium	$\text{Ca}^{2+}$	Fluoride	$\text{F}^-$
Copper(II)	$\text{Cu}^{2+}$	Hydroxide	$\text{OH}^-$
Hydrogen	$\text{H}^+$	Iodide	$\text{I}^-$
Iron(II)	$\text{Fe}^{2+}$	Nitrate	$\text{NO}_3^-$
Iron(III)	$\text{Fe}^{3+}$	Oxide	$\text{O}^{2-}$
Lithium	$\text{Li}^+$	Sulfate	$\text{SO}_4^{2-}$
Magnesium	$\text{Mg}^{2+}$		
Nickel	$\text{Ni}^{2+}$		
Potassium	$\text{K}^+$		
Silver	$\text{Ag}^+$		
Sodium	$\text{Na}^+$		
Zinc	$\text{Zn}^{2+}$		

# PERIODIC TABLE OF ELEMENTS

1 2 3 4 5 6 7 0

Group

		<div style="border: 1px solid black; padding: 2px; display: inline-block;"> <math>^1_1\text{H}</math> Hydrogen         </div>										<div style="border: 1px solid black; padding: 2px; display: inline-block;"> <math>^4_2\text{He}</math> Helium         </div>					
$^3_7\text{Li}$ Lithium	$^4_9\text{Be}$ Beryllium											$^9_19\text{F}$ Fluorine	$^{10}_{20}\text{Ne}$ Neon				
$^{11}_{23}\text{Na}$ Sodium	$^{12}_{24}\text{Mg}$ Magnesium											$^{16}_{32}\text{S}$ Sulfur	$^{17}_{35}\text{Cl}$ Chlorine	$^{18}_{40}\text{Ar}$ Argon			
$^{19}_{39}\text{K}$ Potassium	$^{20}_{40}\text{Ca}$ Calcium	$^{21}_{45}\text{Sc}$ Scandium	$^{22}_{48}\text{Ti}$ Titanium	$^{23}_{51}\text{V}$ Vanadium	$^{24}_{52}\text{Cr}$ Chromium	$^{25}_{55}\text{Mn}$ Manganese	$^{26}_{56}\text{Fe}$ Iron	$^{27}_{59}\text{Co}$ Cobalt	$^{28}_{59}\text{Ni}$ Nickel	$^{29}_{64}\text{Cu}$ Copper	$^{30}_{65}\text{Zn}$ Zinc	$^{31}_{70}\text{Ga}$ Gallium	$^{32}_{73}\text{Ge}$ Germanium	$^{33}_{75}\text{As}$ Arsenic	$^{34}_{79}\text{Se}$ Selenium	$^{35}_{80}\text{Br}$ Bromine	$^{36}_{84}\text{Kr}$ Krypton
$^{37}_{86}\text{Rb}$ Rubidium	$^{38}_{88}\text{Sr}$ Strontium	$^{39}_{89}\text{Y}$ Yttrium	$^{40}_{91}\text{Zr}$ Zirconium	$^{41}_{93}\text{Nb}$ Niobium	$^{42}_{96}\text{Mo}$ Molybdenum	$^{43}_{99}\text{Tc}$ Technetium	$^{44}_{101}\text{Ru}$ Ruthenium	$^{45}_{103}\text{Rh}$ Rhodium	$^{46}_{106}\text{Pd}$ Palladium	$^{47}_{108}\text{Ag}$ Silver	$^{48}_{112}\text{Cd}$ Cadmium	$^{49}_{115}\text{In}$ Indium	$^{50}_{119}\text{Sn}$ Tin	$^{51}_{122}\text{Sb}$ Antimony	$^{52}_{128}\text{Te}$ Tellurium	$^{53}_{127}\text{I}$ Iodine	$^{54}_{131}\text{Xe}$ Xenon
$^{55}_{133}\text{Cs}$ Caesium	$^{56}_{137}\text{Ba}$ Barium	$^{57}_{139}\text{La}$ Lanthanum	$^{72}_{179}\text{Hf}$ Hafnium	$^{73}_{181}\text{Ta}$ Tantalum	$^{74}_{184}\text{W}$ Tungsten	$^{75}_{186}\text{Re}$ Rhenium	$^{76}_{190}\text{Os}$ Osmium	$^{77}_{192}\text{Ir}$ Iridium	$^{78}_{195}\text{Pt}$ Platinum	$^{79}_{197}\text{Au}$ Gold	$^{80}_{201}\text{Hg}$ Mercury	$^{81}_{204}\text{Tl}$ Thallium	$^{82}_{207}\text{Pb}$ Lead	$^{83}_{209}\text{Bi}$ Bismuth	$^{84}_{210}\text{Po}$ Polonium	$^{85}_{210}\text{At}$ Astatine	$^{86}_{222}\text{Rn}$ Radon
$^{87}_{223}\text{Fr}$ Francium	$^{88}_{226}\text{Ra}$ Radium	$^{89}_{227}\text{Ac}$ Actinium															

Key:

