

Candidate Name \_\_\_\_\_

Centre Number				Candidate Number										

# EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

5124-2-01840

## Science

5124/2

### Paper 2

Thursday

1 August 2019

**Additional Material(s):**

- Electronic calculator (non programmable) or Mathematical tables
- Soft clean eraser
- Soft pencil (HB is recommended)

**Time 2 hours**



### Instructions to Candidates

**Do not open this booklet until you are told to do so.**

Write your **name**, **centre number** and **candidate number** in the spaces provided at the top of the page and any separate answer booklet/paper used.

There are **three (3)** sections in this paper.

#### Section A

There are **twenty (20)** questions in this section. Answer all questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the one you consider correct and record your choice by marking it in ink with a cross (X) on the **answer grid provided** on the question paper.

#### Section B

Answer all questions. Write your answers in the **spaces provided** on the question paper. Read very carefully the instructions on the answer sheet.

#### Section C

Answer any two questions. Write your answers on a separate **answer booklet provided**.

#### Information for candidates

Any rough working should be done in this question paper.

#### At the end of the examination:

- 1 Fasten the separate answer booklet/papers used securely to the question paper.
- 2 Circle the numbers of the section C questions you have answered in the grid below.

The Periodic Table is printed on page 17.

Candidate's Use	Examiner's Use
Section A	
Section B	
Section C	1
	2
	3
<b>Total</b>	

**Cell phones are not allowed in the examination room.**

ANSWER GRID FOR SECTION A

Put a cross (X) in ink on the letter indicating your choice of answer.

1	A	B	C	D
---	---	---	---	---

2	A	B	C	D
---	---	---	---	---

3	A	B	C	D
---	---	---	---	---

4	A	B	C	D
---	---	---	---	---

5	A	B	C	D
---	---	---	---	---

6	A	B	C	D
---	---	---	---	---

7	A	B	C	D
---	---	---	---	---

8	A	B	C	D
---	---	---	---	---

9	A	B	C	D
---	---	---	---	---

10	A	B	C	D
----	---	---	---	---

11	A	B	C	D
----	---	---	---	---

12	A	B	C	D
----	---	---	---	---

13	A	B	C	D
----	---	---	---	---

14	A	B	C	D
----	---	---	---	---

15	A	B	C	D
----	---	---	---	---

16	A	B	C	D
----	---	---	---	---

17	A	B	C	D
----	---	---	---	---

18	A	B	C	D
----	---	---	---	---

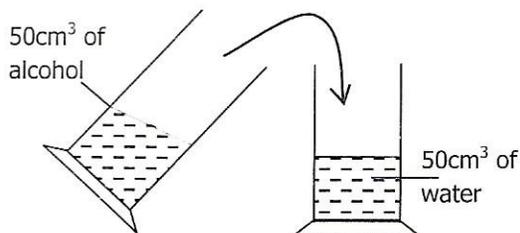
19	A	B	C	D
----	---	---	---	---

20	A	B	C	D
----	---	---	---	---

## SECTION A [20 marks]

Answer **all** the questions on the answer grid provided.

**A1** 50cm<sup>3</sup> sample of alcohol is mixed with 50cm<sup>3</sup> of water.



The volume of the mixture is found to be 97cm<sup>3</sup>. Which of the following is the best explanation for this observation?

- A** Some alcohol molecules evaporated.
  - B** The alcohol molecules fit into the gaps between water molecules.
  - C** Water and alcohol react to form a gas which escapes.
  - D** Water and alcohol react to produce a salt which then dissolves.
- A2** A mixture **Q** contains three compounds **T**, **U** and **V** whose solubilities in ethanol and water are as shown in the table below.

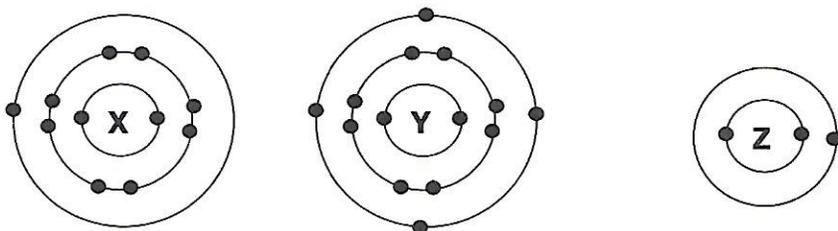
Compound	Solubility in	
	Ethanol	Water
<b>T</b>	Very soluble	Sparingly soluble
<b>U</b>	Insoluble	Very soluble
<b>V</b>	Insoluble	Insoluble

How would you separate the mixture **Q** to obtain pure crystals of compound **U**?

- A** Add ethanol → filter → dry the residue
  - B** Add water → filter → crystalize
  - C** Add ethanol → filter → add water → filter → crystalize
  - D** Add water → filter → add ethanol → filter → crystalize
- 3** The chemical formula of ammonium sulphate is ...
- A** NH<sub>4</sub>SO<sub>4</sub>.
  - B** (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>.
  - C** (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.
  - D** NH<sub>4</sub>SO<sub>3</sub>.
- A4** The atoms  $^{31}_{15}\text{P}$  and  $^{32}_{16}\text{S}$  have the same ...

- A** nucleon number.
- B** number of electrons.
- C** number of neutrons
- D** number of protons.

- A5** Which pair of elements can combine chemically to form single covalent bonds?
- A** Hydrogen and Nitrogen
  - B** Potassium and Oxygen
  - C** Oxygen and Carbon
  - D** Sodium and Chlorine
- A6** Which one of the following is **not** an example of a mineral acid?
- A** Sulphuric acid
  - B** Nitric acid
  - C** Hydrochloric acid
  - D** Citric acid
- A7** Lead (II) iodide is a yellow insoluble salt. Which of the following should be reacted with lead (II) nitrate solution to produce lead (II) iodide?
- A** Iodine crystals
  - B** Iodine solution
  - C** Copper (II) chloride solution
  - D** Potassium iodide solution
- A8** Zinc hydroxide can react with sodium hydroxide because it is ...
- A** acidic.
  - B** amphoteric.
  - C** basic.
  - D** neutral.
- A9** Calcium burns in oxygen according to the following equation:  
 $2\text{Ca}_{(s)} + \text{O}_{2(g)} \rightarrow 2\text{CaO}_{(s)}$   
If 5.2g of calcium burns completely, what will be the mass of calcium oxide produced?
- A** 6.8g
  - B** 7.3g
  - C** 7.8g
  - D** 8.0g
- A10** Barium sulphate is best prepared by ...
- A** crystallisation.
  - B** neutralisation.
  - C** oxidation.
  - D** precipitation.
- A11** The order of the reactivity of the elements below starting from the least reactive is ...



<b>A</b>	X	Y	Z
<b>B</b>	Z	X	Y
<b>C</b>	Y	Z	X
<b>D</b>	Y	X	Z

**A12** Which of the following explains the importance of catalysts in chemical reactions? They ...

- A** enable the activation energy to be lowered.
- B** enable reactants to be consumed completely.
- C** help to conserve reactants and products.
- D** offer more energy for the reaction to take place.

**A13** An element was described as shown in the table below. Which description is correct about the element at r.t.p?

	Number of Shells	Valency	Period	Group	State
<b>A</b>	3	4	5	3	Solid
<b>B</b>	3	3	3	6	Gas
<b>C</b>	3	6	6	3	Liquid
<b>D</b>	3	5	3	5	Solid

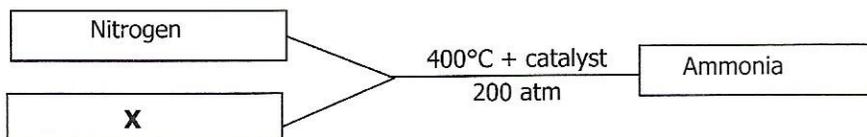
**A14** Which of the following sets corresponds to a metal and the main ore from which it is extracted?

	Metal	Ore
<b>A</b>	Zinc	Calamine
<b>B</b>	Iron	Bronze
<b>C</b>	Copper	Magnetite
<b>D</b>	Aluminium	Haematite

**A15** Which of the following observations most strongly suggests that a solid element **X** is a non-metal?

- A** **X** reacts vigorously with chlorine.
- B** **X** is a conductor of electricity.
- C** **X** forms an acidic oxide.
- D** **X** has more than one valency.

**A16** Nitrogen is used to produce ammonia as shown in the diagram below.



What is **X**?

- A** Air
- B** Hydrogen
- C** Oxygen
- D** Water

**A17** Ethene,  $C_2H_4$  burns completely in air to form carbon dioxide and water. What is the balanced equation for the reaction?

- A**  $C_2H_4 + O \rightarrow CO_2 + H_2O$
- B**  $C_2H_4 + O_2 \rightarrow CO + H_2O$
- C**  $C_2H_4 + 2O_2 \rightarrow 2CO_2 + 2H_2O$
- D**  $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

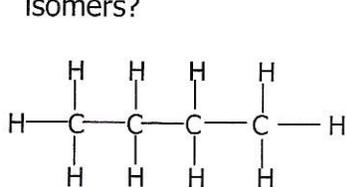
**A18** The organic product of the reaction between  $CH_3OH$  and  $HCOOH$  is ...

- A**  $CH_3OCH_3$ .
- B**  $HCOOCH_3$ .
- C**  $CHOCH_3$ .
- D**  $CH_3OOH$ .

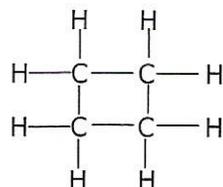
**A19** Choose the correct monomers for terylene.

- A** Alcohol and carboxylic acid.
- B** Amine and carboxylic acid.
- C** Ethene and diol.
- D** Ethene and carboxylic acid.

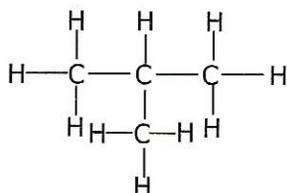
**A20** The displayed structural formulae below are of different compounds. Which ones are isomers?



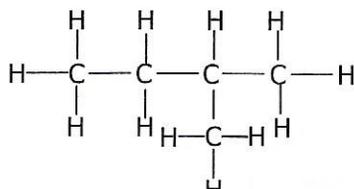
**V**



**W**



**X**



**Y**

- A** X and Y
- B** V and X
- C** Y and W
- D** V and Y

**Section B [45 marks]**

Answer **all** questions in this section.

Write your answers in the spaces provided on the question paper.

**B1** The table below shows some common gases and their particulars.

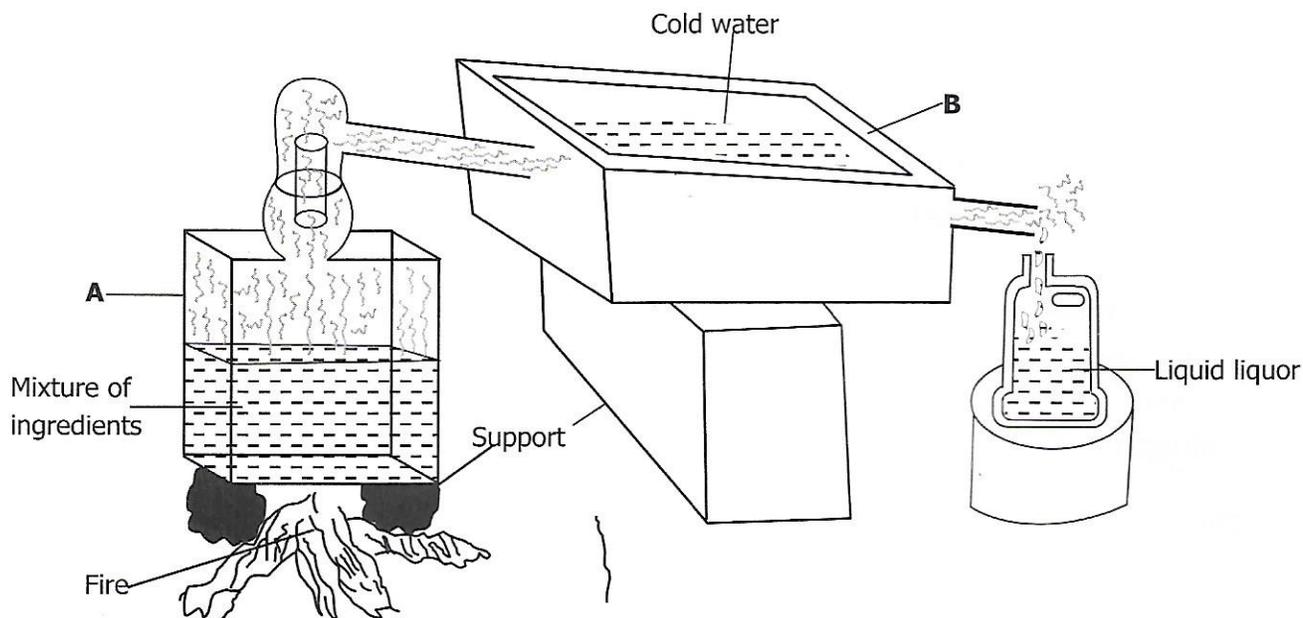
Gas	Relative Molecular formula mass	Vapour density
Ammonia	17	8.5
Carbon dioxide	44	22
Carbon monoxide	28	14
Helium	4	2
Nitrogen	28	14

Choose from the list given, the gas(es) that best suits the following descriptions. A gas may be chosen once, more than once or not at all.

- (a) (i) The gas that diffuses fastest.  
 ..... [1]
- (ii) The names of the gases that diffuse at the same rate.  
 ..... [1]
- (b) State the name of the gas that would diffuse faster than any other gas shown in the table.  
 ..... [1]
- (c) What is the relationship between relative molecular mass of a gas and its vapour density?  
 ..... [1]
- (d) Under what condition would carbon dioxide diffuse faster than ammonia both of equal volumes?  
 ..... [1]

**[Total: 5 marks]**

**B2** The diagram below shows the preparation of liquor in a village.



(a) Name the process demonstrated above.

..... [1]

(b) (i) Name apparatus **B**.

..... [1]

(ii) If this experiment was done in the school laboratory, what name would be apparatus **A** and **B**?

Apparatus **A** .....

Apparatus **B** ..... [2]

(c) What is the scientific term for the liquor/liquid in the experiment?

..... [1]

**[Total: 5 marks]**

**B3** Aluminium metal was reacted with aqueous Copper (II) sulphate.

(a) Construct a balanced chemical equation for the above reaction. Include state symbols.

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

(b) Deduce an ionic equation from (a).

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

**[Total: 4 marks]**

**B4** Below is a list of substances which are either deliquescent or hygroscopic and some which are not.

Aluminium hydroxide, calcium oxide, sodium hydroxide, sulphuric acid, anhydrous calcium chloride, anhydrous copper (II) sulphate, iron (III) oxide and sodium carbonate.

(a) From the list given above, choose **one** substance which is

(i) deliquescent.

..... [1]

(ii) hygroscopic.

..... [1]

(iii) neither deliquescent nor hygroscopic.

..... [1]

(b) What is the difference between a deliquescent and hygroscopic substance?

..... [1]

(c) Some substances are said to be efflorescent. What is an efflorescent substance?

..... [1]

**[Total: 5 marks]**

**B5** A learner reacted a certain mass of magnesium with 150cm<sup>3</sup> of dilute hydrochloric acid. 240cm<sup>3</sup> of hydrogen gas evolved at room temperature and pressure.

(a) Construct a balanced chemical equation for the reaction.

..... [2]

(b) Calculate

(i) the number of moles of hydrogen in 240cm<sup>3</sup> of the gas.

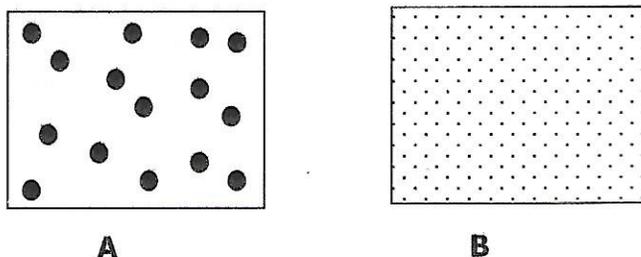
..... [2]

(ii) the mass of magnesium used in the experiment to produce 240cm<sup>3</sup> of hydrogen at room temperature and pressure.

..... [2]

**[Total: 6 marks]**

**B6** Study the two diagrams below showing different sizes of sodium metal.



(a) (i) Which diagram would the sodium react faster if put in a beaker containing water?

..... [1]

(ii) Give a reason for your answer in (a) i.

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

(b) State **one** other factor that can affect the rate of this chemical reaction.

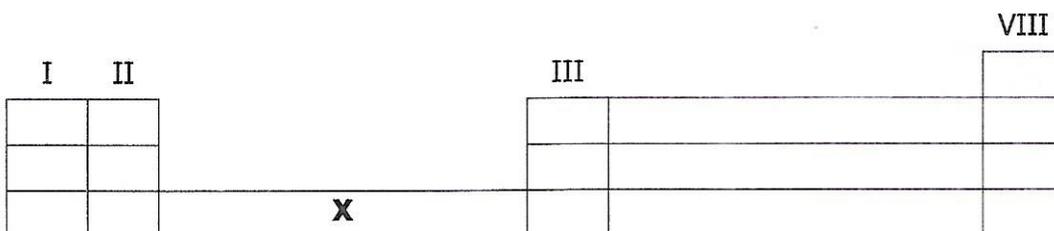
.....  
 ..... [1]

(c) State the effect of a catalyst on the activation energy.

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

[Total: 4 marks]

**B7** Below is a skeleton diagram of the Periodic Table.



(a) Give the name of the region marked **X** on the Periodic Table above.

..... [1]

(b) Give any **two** general properties of elements found in the region marked **X**.

(i) ..... [1]

(ii) ..... [1]

- (c) State any **two** uses of the elements found in the region marked **X**.
  - (i) ..... [1]
  - (ii) ..... [1]

[Total: 5 marks]

**B8** Generally some metals easily corrode when exposed to certain conditions.

- (a) Explain what is meant by corrosion.  
..... [1]
- (b) Which of the metals zinc, potassium or copper corrodes fastest when exposed to certain conditions?  
..... [1]
- (c) Give **two** conditions that easily promote corrosion.  
.....  
..... [2]
- (d) Give **two** methods of preventing corrosion of metals.  
.....  
..... [2]

[Total: 6 marks]

**B9** Carbon is asymmetrical and exists in many forms of allotropes.

- (a) What are allotropes?  
.....  
..... [1]
- (b) Give **two** crystalline allotropes of carbon.
  - (i) ..... [1]
  - (ii) ..... [1]
- (c) Give **one** property and the use, based on the property, of one of the allotropes you have named in (b) above.  
.....  
..... [2]

[Total: 5 marks]

Section C [20 marks]

Answer any **two (2)** questions from this section. Write your answers in the separate answer booklet provided.

**C1** The equations below show the thermal decomposition of the nitrates of three metals represented by **W**, **X** and **Y** (not their real chemical symbols).



- (a) Which one of the three metals is the
- (i) most reactive? Give a reason for your answer. [2]
  - (ii) least reactive? Give a reason for your answer. [2]
- (b) Which one of the three metals is likely to be sodium? [1]
- (c) Which one of the three metals is
- (i) more reactive than zinc? Give a reason for your answer. [2]
  - (ii) less reactive than zinc? Give a reason for your answer. [2]
- (d) State the chemical test for oxygen. [1]

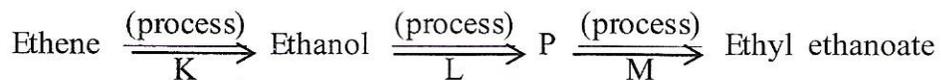
[Total: 10 marks]

**C2** 8.0g of impure sodium hydroxide solution reacted with exactly 40.0cm<sup>3</sup> of 2.0mol/dm<sup>3</sup> sulphuric acid.

- (a) (i) Write the balanced chemical equation for the reaction. Include state symbols. [3]
- (ii) Construct a simplified net ionic equation for the reaction. [1]
- (b) Calculate the number of moles for sulphuric acid that reacted with 8.0g of impure sodium hydroxide. [2]
- (c) Find the mass of pure sodium hydroxide from the impure solution that reacted with 40.0cm<sup>3</sup> of sulphuric acid. [2]
- (d) Determine the percentage purity of sodium hydroxide. [2]

[Total: 10 marks]

- C3** The series of processes below show the links to the formation of an ester known as ethyl ethanoate.



- (a) From the reaction scheme above, name processes **K**, **L** and **M**. [3]
- (b) Construct the chemical equation describing process **K**. Include state symbols. [2]
- (c) State both the chemical name and common name for substance **P**. [2]
- (d) State the general formula of the series where substance **P** belongs. [1]
- (e) Give any **two** uses of ethyl ethanoate. [2]

[Total: 10 marks]

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	9	3 <b>Li</b> Lithium 4	4 <b>Be</b> Beryllium 9	5 <b>B</b> Boron 11	6 <b>C</b> Carbon 12	7 <b>N</b> Nitrogen 14	8 <b>O</b> Oxygen 16	9 <b>F</b> Fluorine 19	10 <b>Ne</b> Neon 20
11	12	11 <b>Na</b> Sodium 23	12 <b>Mg</b> Magnesium 24	13 <b>Al</b> Aluminium 27	14 <b>Si</b> Silicon 28	15 <b>P</b> Phosphorus 31	16 <b>S</b> Sulphur 32	17 <b>Cl</b> Chlorine 35.5	18 <b>Ar</b> Argon 40
13	14	19 <b>K</b> Potassium 39	20 <b>Ca</b> Calcium 40	21 <b>Sc</b> Scandium 45	22 <b>Ti</b> Titanium 48	23 <b>V</b> Vanadium 51	24 <b>Cr</b> Chromium 52	25 <b>Mn</b> Manganese 55	26 <b>Fe</b> Iron 56
15	16	37 <b>Rb</b> Rubidium 85	38 <b>Sr</b> Strontium 88	39 <b>Y</b> Yttrium 89	40 <b>Zr</b> Zirconium 91	41 <b>Nb</b> Niobium 93	42 <b>Mo</b> Molybdenum 96	43 <b>Tc</b> Technetium 98	44 <b>Ru</b> Ruthenium 101
17	18	55 <b>Cs</b> Cesium 133	56 <b>Ba</b> Barium 137	57 <b>La</b> Lanthanum 139	58 <b>Ce</b> Cerium 140	59 <b>Pr</b> Praseodymium 141	60 <b>Nd</b> Neodymium 144	61 <b>Pm</b> Promethium 147	62 <b>Sm</b> Samarium 150
19	20	87 <b>Fr</b> Francium 223	88 <b>Ra</b> Radium 226	89 <b>Ac</b> Actinium 227	90 <b>Th</b> Thorium 232	91 <b>Pa</b> Protactinium 231	92 <b>U</b> Uranium 238	93 <b>Np</b> Neptunium 237	94 <b>Pu</b> Plutonium 244
21	22	101 <b>Bi</b> Bismuth 209	102 <b>Pb</b> Lead 208	103 <b>Tl</b> Thallium 205	104 <b>Pb</b> Lead 208	105 <b>Bi</b> Bismuth 209	106 <b>Po</b> Polonium 209	107 <b>At</b> Astatine 210	108 <b>Rn</b> Radon 222
23	24	113 <b>In</b> Indium 115	114 <b>Sn</b> Tin 119	115 <b>Sb</b> Antimony 122	116 <b>Te</b> Tellurium 128	117 <b>I</b> Iodine 127	118 <b>Xe</b> Xenon 131	119 <b>At</b> Astatine 127	120 <b>Rn</b> Radon 222
25	26	121 <b>Tl</b> Thallium 205	122 <b>Pb</b> Lead 208	123 <b>Bi</b> Bismuth 209	124 <b>Po</b> Polonium 209	125 <b>At</b> Astatine 210	126 <b>Rn</b> Radon 222	127 <b>At</b> Astatine 210	128 <b>Rn</b> Radon 222
27	28	133 <b>Fr</b> Francium 223	134 <b>Ra</b> Radium 226	135 <b>Ac</b> Actinium 227	136 <b>Th</b> Thorium 232	137 <b>Pa</b> Protactinium 231	138 <b>U</b> Uranium 238	139 <b>Np</b> Neptunium 237	140 <b>Pu</b> Plutonium 244
29	30	151 <b>Bi</b> Bismuth 209	152 <b>Pb</b> Lead 208	153 <b>Tl</b> Thallium 205	154 <b>Po</b> Polonium 209	155 <b>At</b> Astatine 210	156 <b>Rn</b> Radon 222	157 <b>At</b> Astatine 210	158 <b>Rn</b> Radon 222
31	32	163 <b>Bi</b> Bismuth 209	164 <b>Pb</b> Lead 208	165 <b>Tl</b> Thallium 205	166 <b>Po</b> Polonium 209	167 <b>At</b> Astatine 210	168 <b>Rn</b> Radon 222	169 <b>At</b> Astatine 210	170 <b>Rn</b> Radon 222
33	34	173 <b>Bi</b> Bismuth 209	174 <b>Pb</b> Lead 208	175 <b>Tl</b> Thallium 205	176 <b>Po</b> Polonium 209	177 <b>At</b> Astatine 210	178 <b>Rn</b> Radon 222	179 <b>At</b> Astatine 210	180 <b>Rn</b> Radon 222
35	36	183 <b>Bi</b> Bismuth 209	184 <b>Pb</b> Lead 208	185 <b>Tl</b> Thallium 205	186 <b>Po</b> Polonium 209	187 <b>At</b> Astatine 210	188 <b>Rn</b> Radon 222	189 <b>At</b> Astatine 210	190 <b>Rn</b> Radon 222
37	38	193 <b>Bi</b> Bismuth 209	194 <b>Pb</b> Lead 208	195 <b>Tl</b> Thallium 205	196 <b>Po</b> Polonium 209	197 <b>At</b> Astatine 210	198 <b>Rn</b> Radon 222	199 <b>At</b> Astatine 210	200 <b>Rn</b> Radon 222
39	40	203 <b>Bi</b> Bismuth 209	204 <b>Pb</b> Lead 208	205 <b>Tl</b> Thallium 205	206 <b>Po</b> Polonium 209	207 <b>At</b> Astatine 210	208 <b>Rn</b> Radon 222	209 <b>At</b> Astatine 210	210 <b>Rn</b> Radon 222
41	42	213 <b>Bi</b> Bismuth 209	214 <b>Pb</b> Lead 208	215 <b>Tl</b> Thallium 205	216 <b>Po</b> Polonium 209	217 <b>At</b> Astatine 210	218 <b>Rn</b> Radon 222	219 <b>At</b> Astatine 210	220 <b>Rn</b> Radon 222
43	44	223 <b>Bi</b> Bismuth 209	224 <b>Pb</b> Lead 208	225 <b>Tl</b> Thallium 205	226 <b>Po</b> Polonium 209	227 <b>At</b> Astatine 210	228 <b>Rn</b> Radon 222	229 <b>At</b> Astatine 210	230 <b>Rn</b> Radon 222
45	46	233 <b>Bi</b> Bismuth 209	234 <b>Pb</b> Lead 208	235 <b>Tl</b> Thallium 205	236 <b>Po</b> Polonium 209	237 <b>At</b> Astatine 210	238 <b>Rn</b> Radon 222	239 <b>At</b> Astatine 210	240 <b>Rn</b> Radon 222
47	48	243 <b>Bi</b> Bismuth 209	244 <b>Pb</b> Lead 208	245 <b>Tl</b> Thallium 205	246 <b>Po</b> Polonium 209	247 <b>At</b> Astatine 210	248 <b>Rn</b> Radon 222	249 <b>At</b> Astatine 210	250 <b>Rn</b> Radon 222
49	50	253 <b>Bi</b> Bismuth 209	254 <b>Pb</b> Lead 208	255 <b>Tl</b> Thallium 205	256 <b>Po</b> Polonium 209	257 <b>At</b> Astatine 210	258 <b>Rn</b> Radon 222	259 <b>At</b> Astatine 210	260 <b>Rn</b> Radon 222
51	52	263 <b>Bi</b> Bismuth 209	264 <b>Pb</b> Lead 208	265 <b>Tl</b> Thallium 205	266 <b>Po</b> Polonium 209	267 <b>At</b> Astatine 210	268 <b>Rn</b> Radon 222	269 <b>At</b> Astatine 210	270 <b>Rn</b> Radon 222
53	54	273 <b>Bi</b> Bismuth 209	274 <b>Pb</b> Lead 208	275 <b>Tl</b> Thallium 205	276 <b>Po</b> Polonium 209	277 <b>At</b> Astatine 210	278 <b>Rn</b> Radon 222	279 <b>At</b> Astatine 210	280 <b>Rn</b> Radon 222
55	56	283 <b>Bi</b> Bismuth 209	284 <b>Pb</b> Lead 208	285 <b>Tl</b> Thallium 205	286 <b>Po</b> Polonium 209	287 <b>At</b> Astatine 210	288 <b>Rn</b> Radon 222	289 <b>At</b> Astatine 210	290 <b>Rn</b> Radon 222
57	58	293 <b>Bi</b> Bismuth 209	294 <b>Pb</b> Lead 208	295 <b>Tl</b> Thallium 205	296 <b>Po</b> Polonium 209	297 <b>At</b> Astatine 210	298 <b>Rn</b> Radon 222	299 <b>At</b> Astatine 210	300 <b>Rn</b> Radon 222
59	60	303 <b>Bi</b> Bismuth 209	304 <b>Pb</b> Lead 208	305 <b>Tl</b> Thallium 205	306 <b>Po</b> Polonium 209	307 <b>At</b> Astatine 210	308 <b>Rn</b> Radon 222	309 <b>At</b> Astatine 210	310 <b>Rn</b> Radon 222
61	62	313 <b>Bi</b> Bismuth 209	314 <b>Pb</b> Lead 208	315 <b>Tl</b> Thallium 205	316 <b>Po</b> Polonium 209	317 <b>At</b> Astatine 210	318 <b>Rn</b> Radon 222	319 <b>At</b> Astatine 210	320 <b>Rn</b> Radon 222
63	64	323 <b>Bi</b> Bismuth 209	324 <b>Pb</b> Lead 208	325 <b>Tl</b> Thallium 205	326 <b>Po</b> Polonium 209	327 <b>At</b> Astatine 210	328 <b>Rn</b> Radon 222	329 <b>At</b> Astatine 210	330 <b>Rn</b> Radon 222
65	66	333 <b>Bi</b> Bismuth 209	334 <b>Pb</b> Lead 208	335 <b>Tl</b> Thallium 205	336 <b>Po</b> Polonium 209	337 <b>At</b> Astatine 210	338 <b>Rn</b> Radon 222	339 <b>At</b> Astatine 210	340 <b>Rn</b> Radon 222
67	68	343 <b>Bi</b> Bismuth 209	344 <b>Pb</b> Lead 208	345 <b>Tl</b> Thallium 205	346 <b>Po</b> Polonium 209	347 <b>At</b> Astatine 210	348 <b>Rn</b> Radon 222	349 <b>At</b> Astatine 210	350 <b>Rn</b> Radon 222
69	70	353 <b>Bi</b> Bismuth 209	354 <b>Pb</b> Lead 208	355 <b>Tl</b> Thallium 205	356 <b>Po</b> Polonium 209	357 <b>At</b> Astatine 210	358 <b>Rn</b> Radon 222	359 <b>At</b> Astatine 210	360 <b>Rn</b> Radon 222
71	72	363 <b>Bi</b> Bismuth 209	364 <b>Pb</b> Lead 208	365 <b>Tl</b> Thallium 205	366 <b>Po</b> Polonium 209	367 <b>At</b> Astatine 210	368 <b>Rn</b> Radon 222	369 <b>At</b> Astatine 210	370 <b>Rn</b> Radon 222
73	74	373 <b>Bi</b> Bismuth 209	374 <b>Pb</b> Lead 208	375 <b>Tl</b> Thallium 205	376 <b>Po</b> Polonium 209	377 <b>At</b> Astatine 210	378 <b>Rn</b> Radon 222	379 <b>At</b> Astatine 210	380 <b>Rn</b> Radon 222
75	76	383 <b>Bi</b> Bismuth 209	384 <b>Pb</b> Lead 208	385 <b>Tl</b> Thallium 205	386 <b>Po</b> Polonium 209	387 <b>At</b> Astatine 210	388 <b>Rn</b> Radon 222	389 <b>At</b> Astatine 210	390 <b>Rn</b> Radon 222
77	78	393 <b>Bi</b> Bismuth 209	394 <b>Pb</b> Lead 208	395 <b>Tl</b> Thallium 205	396 <b>Po</b> Polonium 209	397 <b>At</b> Astatine 210	398 <b>Rn</b> Radon 222	399 <b>At</b> Astatine 210	400 <b>Rn</b> Radon 222
79	80	403 <b>Bi</b> Bismuth 209	404 <b>Pb</b> Lead 208	405 <b>Tl</b> Thallium 205	406 <b>Po</b> Polonium 209	407 <b>At</b> Astatine 210	408 <b>Rn</b> Radon 222	409 <b>At</b> Astatine 210	410 <b>Rn</b> Radon 222
81	82	413 <b>Bi</b> Bismuth 209	414 <b>Pb</b> Lead 208	415 <b>Tl</b> Thallium 205	416 <b>Po</b> Polonium 209	417 <b>At</b> Astatine 210	418 <b>Rn</b> Radon 222	419 <b>At</b> Astatine 210	420 <b>Rn</b> Radon 222
83	84	423 <b>Bi</b> Bismuth 209	424 <b>Pb</b> Lead 208	425 <b>Tl</b> Thallium 205	426 <b>Po</b> Polonium 209	427 <b>At</b> Astatine 210	428 <b>Rn</b> Radon 222	429 <b>At</b> Astatine 210	430 <b>Rn</b> Radon 222
85	86	433 <b>Bi</b> Bismuth 209	434 <b>Pb</b> Lead 208	435 <b>Tl</b> Thallium 205	436 <b>Po</b> Polonium 209	437 <b>At</b> Astatine 210	438 <b>Rn</b> Radon 222	439 <b>At</b> Astatine 210	440 <b>Rn</b> Radon 222
87	88	443 <b>Bi</b> Bismuth 209	444 <b>Pb</b> Lead 208	445 <b>Tl</b> Thallium 205	446 <b>Po</b> Polonium 209	447 <b>At</b> Astatine 210	448 <b>Rn</b> Radon 222	449 <b>At</b> Astatine 210	450 <b>Rn</b> Radon 222
89	90	453 <b>Bi</b> Bismuth 209	454 <b>Pb</b> Lead 208	455 <b>Tl</b> Thallium 205	456 <b>Po</b> Polonium 209	457 <b>At</b> Astatine 210	458 <b>Rn</b> Radon 222	459 <b>At</b> Astatine 210	460 <b>Rn</b> Radon 222
91	92	463 <b>Bi</b> Bismuth 209	464 <b>Pb</b> Lead 208	465 <b>Tl</b> Thallium 205	466 <b>Po</b> Polonium 209	467 <b>At</b> Astatine 210	468 <b>Rn</b> Radon 222	469 <b>At</b> Astatine 210	470 <b>Rn</b> Radon 222
93	94	473 <b>Bi</b> Bismuth 209	474 <b>Pb</b> Lead 208	475 <b>Tl</b> Thallium 205	476 <b>Po</b> Polonium 209	477 <b>At</b> Astatine 210	478 <b>Rn</b> Radon 222	479 <b>At</b> Astatine 210	480 <b>Rn</b> Radon 222
95	96	483 <b>Bi</b> Bismuth 209	484 <b>Pb</b> Lead 208	485 <b>Tl</b> Thallium 205	486 <b>Po</b> Polonium 209	487 <b>At</b> Astatine 210	488 <b>Rn</b> Radon 222	489 <b>At</b> Astatine 210	490 <b>Rn</b> Radon 222
97	98	493 <b>Bi</b> Bismuth 209	494 <b>Pb</b> Lead 208	495 <b>Tl</b> Thallium 205	496 <b>Po</b> Polonium 209	497 <b>At</b> Astatine 210	498 <b>Rn</b> Radon 222	499 <b>At</b> Astatine 210	500 <b>Rn</b> Radon 222
99	100	503 <b>Bi</b> Bismuth 209	504 <b>Pb</b> Lead 208	505 <b>Tl</b> Thallium 205	506 <b>Po</b> Polonium 209	507 <b>At</b> Astatine 210	508 <b>Rn</b> Radon 222	509 <b>At</b> Astatine 210	510 <b>Rn</b> Radon 222
101	102	513 <b>Bi</b> Bismuth 209	514 <b>Pb</b> Lead 208	515 <b>Tl</b> Thallium 205	516 <b>Po</b> Polonium 209	517 <b>At</b> Astatine 210	518 <b>Rn</b> Radon 222	519 <b>At</b> Astatine 210	520 <b>Rn</b> Radon 222
103	104	523 <b>Bi</b> Bismuth 209	524 <b>Pb</b> Lead 208	525 <b>Tl</b> Thallium 205	526 <b>Po</b> Polonium 209	527 <b>At</b> Astatine 210	528 <b>Rn</b> Radon 222	529 <b>At</b> Astatine 210	530 <b>Rn</b> Radon 222
105	106	533 <b>Bi</b> Bismuth 209	534 <b>Pb</b> Lead 208	535 <b>Tl</b> Thallium 205	536 <b>Po</b> Polonium 209	537 <b>At</b> Astatine 210	538 <b>Rn</b> Radon 222	539 <b>At</b> Astatine 210	540 <b>Rn</b> Radon 222
107	108	543 <b>Bi</b> Bismuth 209	544 <b>Pb</b> Lead 208	545 <b>Tl</b> Thallium 205	546 <b>Po</b> Polonium 209	547 <b>At</b> Astatine 210	548 <b>Rn</b> Radon 222	549 <b>At</b> Astatine 210	550 <b>Rn</b> Radon 222
109	110	553 <b>Bi</b> Bismuth 209	554 <b>Pb</b> Lead 208	555 <b>Tl</b> Thallium 205	556 <b>Po</b> Polonium 209	557 <b>At</b> Astatine 210	558 <b>Rn</b> Radon 222	559 <b>At</b> Astatine 210	560 <b>Rn</b> Radon 222
111	112	563 <b>Bi</b> Bismuth 209	564 <b>Pb</b> Lead 208	565 <b>Tl</b> Thallium 205	566 <b>Po</b> Polonium 209	567 <b>At</b> Astatine 210	568 <b>Rn</b> Radon 222	569	