GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

JUNE 2017

GRADE 11

PHYSICAL SCIENCES
PAPER 2

CHEMISTRY

TIME: 3 hours

MARKS: 150

14 pages + 2 data sheets

P.T.O.

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

PHYSICAL SCIENCES
Paper 2: CHEMISTRY

TIME: 3 hours
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached data sheets.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your final numerical answers to a minimum of TWO decimal places.
11. Give brief substantiations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK. For example: **1.11 E**

1.1 Which of the following is NOT true of hydrogen bonds?

A. Form between hydrogen atoms in different molecules
B. Are strong intra-molecular bonds
C Hold water molecules together
D Is an attractive force between two (2) electro-negative atoms (2)

1.2 Which ONE of the following best describes the bond formed between an H^+ ion and the ammonia molecule?

A Ionic bond
B Dative covalent bond
C Covalent bond
D Metallic bond (2)

1.3 When water in its liquid form is heated, most of the energy that the water initially absorbs is used to ...

A raise the temperature of the water.
B break the covalent bonds between the hydrogen and oxygen atoms in water.
C make the water boil.
D break the hydrogen bonds between the water molecules. (2)

1.4 The correct order of intermolecular forces arranged from weakest to strongest will be:

A dipole-dipole, London / dispersion, ionic, and hydrogen-bonding
B London / dispersion, ionic, dipole-dipole, and hydrogen-bonding
C London / dispersion, dipole-dipole, hydrogen and ionic-bonds
D hydrogen, dipole-dipole, London / dispersion and ionic-bonds (2)

1.5 The gaseous substances which have polar covalent bonds between the atoms, but the molecule as a whole is non-polar :

A CO_2 (g)
B $CC\ell_4$ (g)
C $HC\ell$ (g)
D NH_3 (g) (2)

1.6 If the pressure on 100 g of an enclosed nitrogen gas is doubled and the temperature is kept constant, the average speed of the nitrogen gas molecules will ...

A be doubled.
B be four times greater.
C be four times smaller.
D remain the same. (2)

1.7 Two gas syringes, **A** and **B**, each contain the same gas at STP. The volume of syringe **A** is 15 cm^3 and that of syringe **B** is 25 cm^3 as shown below. Assume ideal gas behaviour.



Which ONE of the following statements is CORRECT?

A The average kinetic energy of the molecules in **A** is less than that of the molecules in **B**.
B The total kinetic energy of the molecules in **A** is more than that of the molecules in **B**.
C The number of gas molecules in **A** is equal to the number of gas molecules in **B**.
D The product pV in **A** is equal to the product pV in **B**. (2)

1.8 0,3 mole of carbon dioxide (CO_2) gas and 0,3 mole of methane (CH_4) gas at STP have

I the same amount of particles.
II the same volume.
III the same mass.

A Only (I) is true.
B I, II and III are true.
C Only I and II are true.
D Only I and III are true. (2)

1.9 The mass of 4,48 dm^3 of oxygen (O_2 gas) at STP is ...

A 6,4 g.
B 3,2 g.
C 4,48 g.
D 0,8 g. (2)

1.10 A certain solid has the following properties:

- Very high melting point
- Soluble in a polar solvent
- Conducts electricity only in the molten state

The solid is probably ...

A iodine.
B potassium chloride.
C lead sulphide.
D graphite. (2)

[20]

QUESTION 2 (Start on a new page.)

In the table below, the melting points and boiling points of different substances at standard pressure are given. Use the information given in the table to answer the following questions.

Substance /Molecule	Melting point in C°	Boiling point in C°
$CC\ell_4$	-23	77
CH_4	-18	-162
He	-272	-269
$NaC\ell$	800	1413
NH_3	−77.73	−33.34
$HC\ell$	-114.9	-85.06

2.1. Define the term *boiling point*. (2)

2.2 Which substance ...

2.2.1 has the weakest intermolecular forces? (1)

2.2.2 has hydrogen bonds between the molecules? (1)

2.2.3 requires the most energy to undergo phase change? (1)

2.2.4 is liquid at room temperature? (1)

2.3 Name the type of forces that exist between the molecules of:

2.3.1 CH_4 (2)

2.3.2 $HC\ell$ (2)

2.3.3 $NaC\ell$ (2)
[12]

QUESTION 3 (Start on a new page.)

South Africa is amongst the top 10 countries internationally that have been accused of contributing towards the Greenhouse effect. The main air pollutants that are generated by industries in the country are

- Carbon dioxide,
- Methane (CH_4),
- Sulphur dioxide and
- Ammonia.

3.1 Define:

3.1.1 A covalent bond (2)

3.1.2 Electronegativity (2)

3.2 Draw Lewis structures to show the bonding in one (1) carbon dioxide molecule. (2)

3.3 The chemical bonds within the methane molecule are polar and yet methane is known to be a non-polar molecule. Explain how this phenomenon comes about. (4)

3.4 Choose ONE of the greenhouse gases above, with a molecule shape that is:

3.4.1 Pyramidal (1)

3.4.2 Tetrahedral (1)

3.4.3 Angular (1)

3.4.4 Linear (1)

3.5 Of the pollutants listed above, choose ONE that should dissolve well in water. Give a reason for your answer. (2)

[16]

QUESTION 4 (Start on a new page.)

Life cannot exist without water. All the chemical reactions that give life occur in an aqueous solution. Water molecules are polar molecules and are capable of forming hydrogen bonds with other polar molecules.

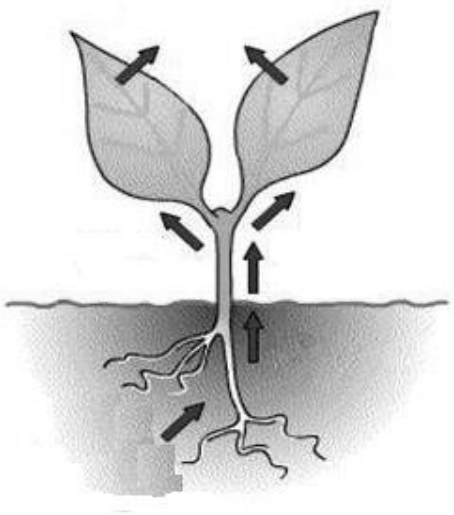
4.1 Give the chemical formula for water. (1)

4.2 The water molecule is said to be a polar molecule. Explain this statement, making reference to the electronegativity values for oxygen and hydrogen. (2)

4.3 Draw a diagram showing how water molecules are arranged in water in its liquid state. (2)

4.4 Discuss the difference in density of water in its liquid and solid states. (2)

4.5 Water movement in plants seems to disobey gravity. Explain this statement.



(2)
[9]

QUESTION 5 (Start on a new page.)

A group of learners investigate the relationship between the volume, temperature and pressure of a fixed amount of helium gas in a closed balloon.

5.1 When the pressure is 102 kPa, the temperature is 29 ^{0}C and the volume is 31,8 cm^3, the balloon is then released to a higher altitude. Calculate the temperature inside the balloon at this higher altitude when the pressure drops to 75 kPa and the volume changes to 34,5 cm^3. (5)

5.2 Explain, in terms of the kinetic molecular theory, the effect that a decrease in the temperature of a gas will have on its pressure at constant volume. (2)

5.3 Helium gas can behave as an *ideal gas*.

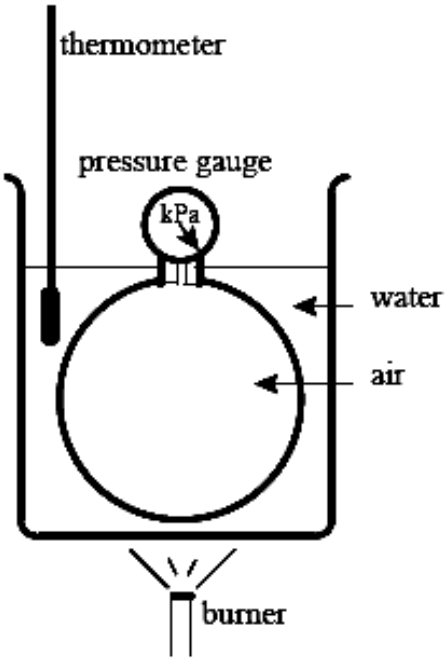
5.3.1 Define an *ideal gas.* (2)

5.3.2 List THREE properties of an ideal gas. (3)

5.3.3 List TWO conditions when a real gas behaves like an ideal gas. (2)

5.4 Write down the magnitude of the molar gas volume at STP. (2)
[16]

QUESTION 6 (Start on a new page.)



6.1 Name and state the gas law which is investigated in this experiment. (3)

6.2 Identify and write down the following for this experiment:

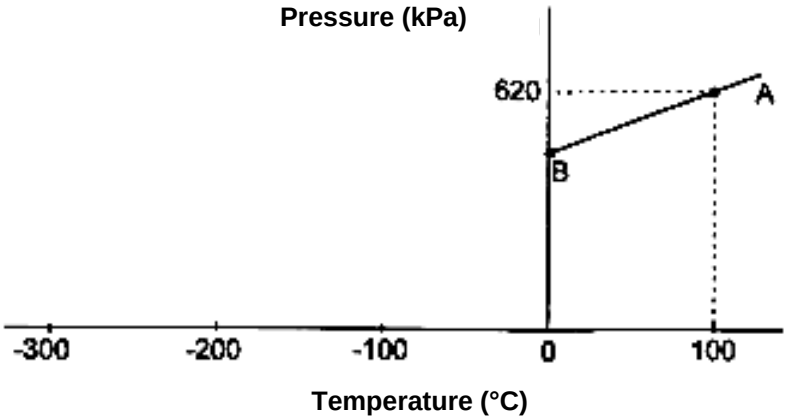
6.2.1 The dependent variable (2)

6.2.2 The independent variable (2)

6.2.3 The controlled variable (2)

6.3 Write down an investigative question for this experiment. (2)

The learner draws a graph AB (as shown below) using the results:

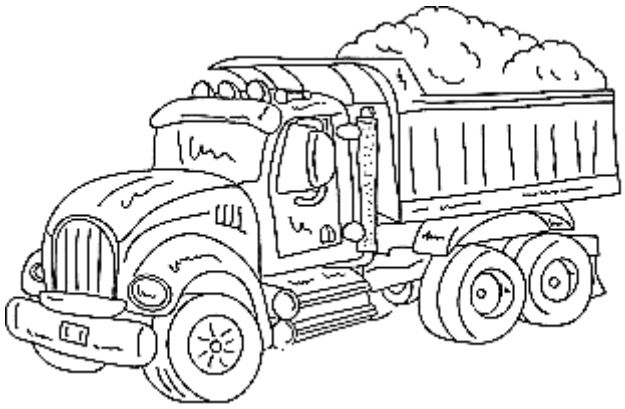


6.4 Use the graph to show how the relationship between the pressure and the temperature of a gas at a specific volume can be deduced. (2)

6.5 From the graph determine the temperature at which the graph would touch the x-axis. (2)

6.6 Give the name of the **temperature** determined in Question 6.5. (2)

6.7 Long journeys and overloading are some contributing factors to tyres bursting, especially on delivery trucks. A truck driver decided to fill ALL the tyres of a loaded truck with air to a pressure of 500 kPa instead of the maximum pressure of 600 kPa at room temperature (25°) just before the journey, remembering that the temperature is usually high at his destination.



Will the driver safely reach the destination if the temperature at his destination will be **40 ^{0}C** on arrival? Show all calculations to substantiate your answer. (6)

[23]

QUESTION 7 (Start on a new page.)

Na_2CO_3 is well known domestically for its everyday use as a water softener.

7.1 Give the name for Na_2CO_3. (2)

7.2 What mass of Na_2CO_3 is needed to prepare 500 cm^3 of a 0,25 $mol.dm^{-3}$ solution? (4)

7.3 What is the concentration of the sodium ions in the solution of Na_2CO_3 prepared in Question 7.2? (6)

7.4 The Leblanc process includes the following reaction.

$$\mathbf{Na_2SO_4 + CaCO_3 + C \rightarrow Na_2CO_3 + CO_2 + CaS}$$

7.4.1 Rewrite and balance the above equation. (2)

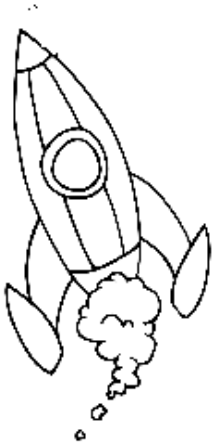
7.4.2 Define the term *limiting reactant*. (2)

7.4.3 In a closed container 52,54 g of Na_2SO_4 is allowed to react with 45 g of $CaCO_3$ in the presence of enough C. Determine the *limiting reactant*. (6)

7.4.4 How many grams of Na_2CO_3 will form during the reaction in Question 7.4.3? (4)

[26]

QUESTION 8 (Start on a new page.)



Spaceships liberate a great deal of carbon dioxide, with a high chance of carbon dioxide entering the living environment in the shuttle's cabin. To purge carbon dioxide from the air in the shuttle, solid lithium hydroxide is used to remove carbon dioxide and forms lithium carbonate and liquid water. 0,8 kg of lithium hydroxide is placed in these spaceships for this purpose.

8.1 Write down the balanced equation for the reaction between carbon dioxide and lithium hydroxide. (4)

8.2 Calculate the number of mole of lithium hydroxide available in the spaceship. (3)

8.3 How many moles of CO_2 are needed to react with the given mass of LiOH? (3)

8.4 What mass of carbon dioxide can be absorbed by 0,8 kg LiOH? Show all your calculations. (4)

[14]

QUESTION 9 (Start on a new page.)

Aluminium sulphate, also known as dialuminium trisulphate, is an aluminium salt used in the textile industry and also in the process of water purification. It is a white solid when it is not in contact with water.

9.1 How many oxygen atoms are present in 12 g of aluminium sulphate? (6)

9.2 Prove that the empirical formula of aluminium sulphide is Al_2S_3 using the following information:

36% of aluminium sulphide by mass is made up of aluminium. (5)

9.3 The hydrolysis reaction of aluminium sulphate generates gaseous hydrogen sulphide (H_2S).

Re-write the following reaction and balance it.

$$\mathbf{H_2O + Al_2S_3 \rightarrow H_2S + Al(OH)_3}$$ (3)

[14]

TOTAL 150

END

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

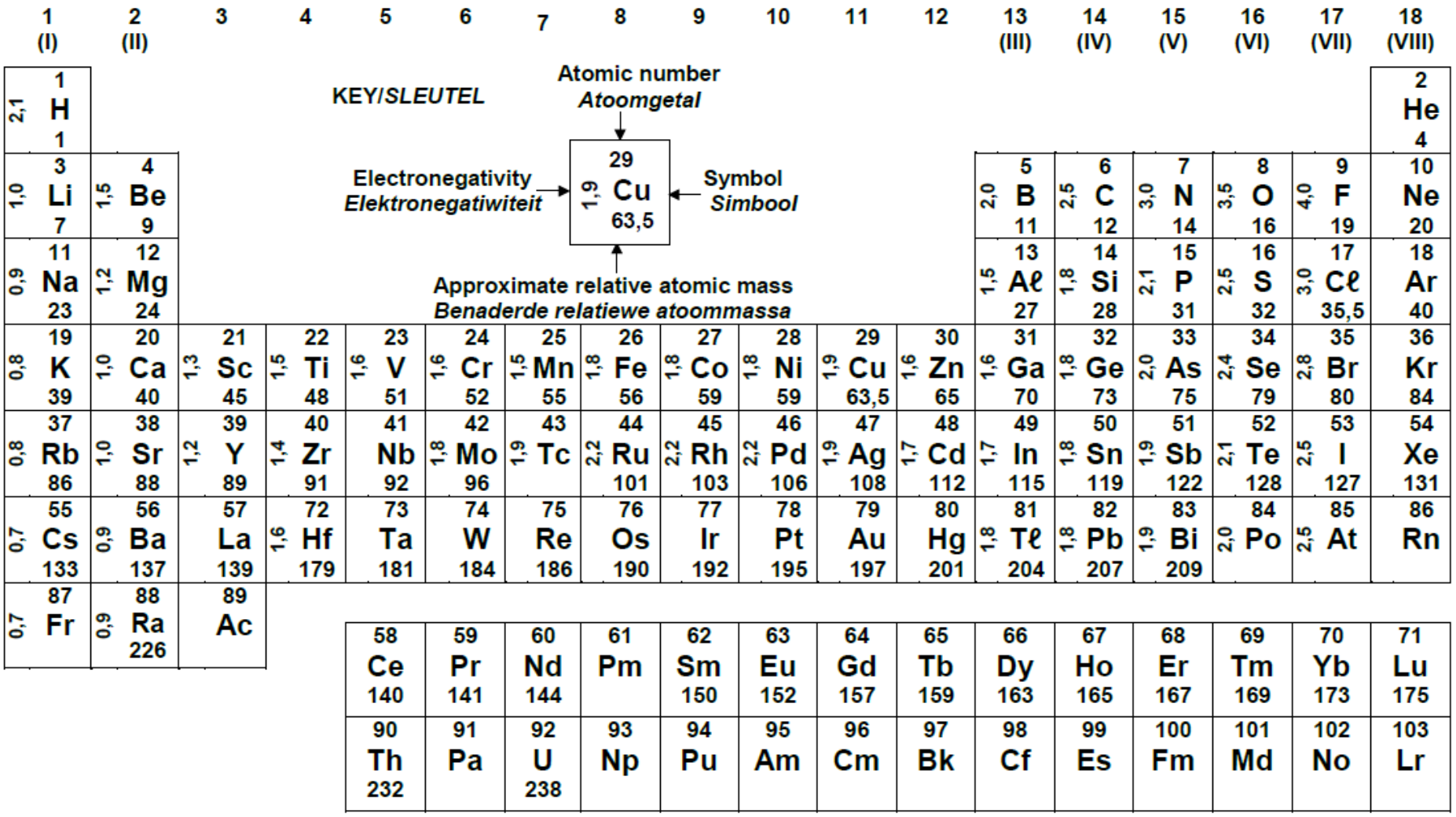
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Molar gas constant Molêre gaskonstante	R	$8{,}31\ J{\cdot}K^{-1}{\cdot}mol^{-1}$
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}\ Pa$
Molar gas volume at STP Molêre gasvolume by STD	V_m	$22{,}4\ dm^3{\cdot}mol^{-1}$
Standard temperature Standaardtemperatuur	T^{θ}	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$



1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr	0,9 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr