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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2018

MARKS: 150

TIME: 2 hours

This question paper consists of 14 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the 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 between two subquestions, e.g. 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 motivations, discussions, etc. where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1. 11 D.

- 1.1 Which ONE of the following substances is NOT a pure substance?
- A Iron
 - B Sugar
 - C Steel
 - D Graphite (2)
- 1.2 The CORRECT chemical formula for potassium nitrate is ...
- A K_3N
 - B PNO_3
 - C KNO_3
 - D K_2NO_3 (2)
- 1.3 Different isotopes of the same element have different ...
- A atomic numbers.
 - B numbers of neutrons.
 - C numbers of protons.
 - D numbers of electrons. (2)
- 1.4 Which ONE of the following ionisation equations represents the second ionisation of magnesium?
- A $Mg(g) + \text{energy} \rightarrow Mg^+ + e^-$
 - B $Mg^+(s) + \text{energy} \rightarrow Mg^{2+} + 2e^-$
 - C $Mg^+(g) + \text{energy} \rightarrow Mg^{2+} + 2e^-$
 - D $Mg(s) + \text{energy} \rightarrow Mg^+ + e^-$ (2)

- 1.5 Which PAIR of elements is most likely to have a similar arrangement of outer electrons and similar chemical behaviour?
- A Boron and aluminium
 - B Helium and fluorine
 - C Carbon and nitrogen
 - D Chlorine and oxygen (2)
- 1.6 Which ONE of the following statements is INCORRECT about the properties of a physical change?
- A When a physical change occurs, the compounds may rearrange themselves, but the bonds in between the atoms will not break.
 - B Physical change in matter is reversible.
 - C Energy is absorbed when matter changes from a solid to a liquid.
 - D Molecules are not conserved during a physical change. (2)
- 1.7 In the compound, H_2O , the ratio of the MASS of hydrogen to oxygen is always ...
- A 1 : 2.
 - B 2 : 1.
 - C 1 : 8.
 - D 1 : 16. (2)
- 1.8 One mole of H_2SO_4 contains ...
- A 7 atoms.
 - B 1 molecule.
 - C $6,02 \times 10^{23}$ molecules.
 - D $42,14 \times 10^{23}$ molecules. (2)

1.9 Which ONE of the following solutions will NOT form a precipitate if added to a solution of silver nitrate?

A NaCl(aq)

B $\text{MgBr}_2\text{(aq)}$

C KI(aq)

D $\text{Mg(NO}_3)_2\text{(aq)}$ (2)

1.10 The sphere in which minerals are found is known as ...

A atmosphere.

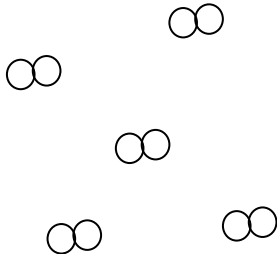
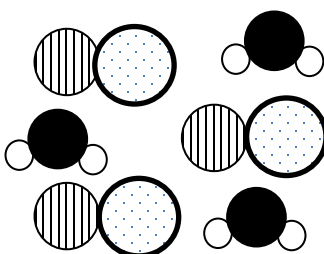
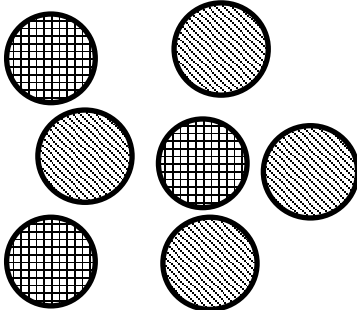
B biosphere.

C lithosphere.

D stratosphere. (2)
[20]

QUESTION 2 (Start on a new page.)

The diagram below shows three different substances, **P**, **Q** and **R**.

SUBSTANCE P	SUBSTANCE Q	SUBSTANCE R	
			
KEY			
	Hydrogen		Chlorine
	Oxygen		Sulphur
	Sodium		Iron

2.1 Define the term *element*. (2)

Use the diagram and the key provided to answer the questions that follow.

2.2 Write down a LETTER that represents the following:

2.2.1 Pure substance (1)

2.2.2 Homogeneous mixture (1)

2.2.3 Heterogeneous mixture (1)

2.3 Indicate whether the pure substance identified in QUESTION 2.2.1 is an element or a compound. (1)

2.4 Which physical method would you use to separate substance **Q** into its components? (1)

2.5 Write down the physical property upon which the separation techniques are based to separate the following substances into their individual components:

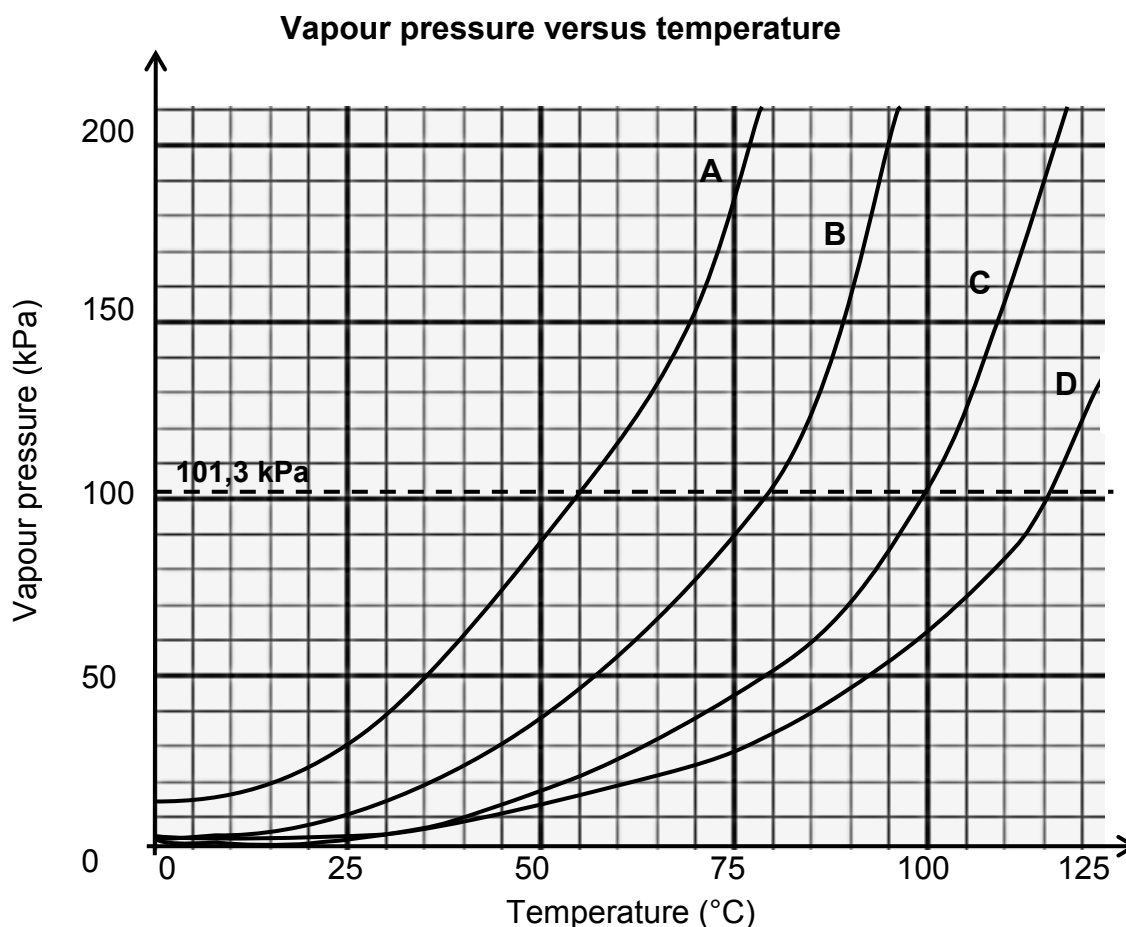
2.5.1 **Q** (1)

2.5.2 **R** (1)

[9]

QUESTION 3 (Start on a new page.)

The vapour pressure versus temperature graph below was obtained for four unknown liquids (**A**, **B**, **C** and **D**). Atmospheric pressure is measured as 101,3 kPa.



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

Use the information given in the graph to answer the questions that follow.

3.2 Write down the:

3.2.1 Boiling point of liquid **B** (1)

3.2.2 Liquid which remains a liquid at 115 °C (1)

3.2.3 Liquid that is most likely to be water (1)

3.3 State the PHASE CHANGE that takes place at the stage when the vapour pressure is equal to atmospheric pressure. (1)

3.4 What happens to the temperature of a liquid during a phase change? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

3.5 Explain the answer to QUESTION 3.4. (2)

3.6 Which liquid (**A**, **B**, **C** or **D**) has the weakest intermolecular forces? Give a reason for the answer. (3)

3.7 What is the relationship between vapour pressure of the liquid and temperature? (2)

[14]

QUESTION 4 (Start on a new page.)

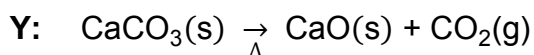
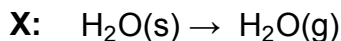
Study the table below and answer the questions that follow.

ELEMENT/ION	NUMBER OF PROTONS	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
P	11	12	11
Q	14	16	14
R	16	16	18

- 4.1 Define the term *atomic number*. (2)
- 4.2 Write down the:
- 4.2.1 Chemical symbol of element **Q** using the notation A_ZX (2)
- 4.2.2 Element (**P**, **Q** or **R**) that is an alkali metal (1)
- 4.2.3 Chemical symbol of **R** (2)
- 4.3 Element **P** reacts with oxygen to form the compound with the chemical formula P_2O .
- 4.3.1 Predict the chemical formula that element **R** in the periodic table will form when it reacts with oxygen. (2)
- 4.3.2 Explain the answer to QUESTION 4.3.1. (2)
- 4.4 What is the trend in ionisation energy as you move from element **P** to element **R**? Write down only INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (4)
- 4.5 How many electrons does an ION of element **P** have? Draw the Aufbau diagram of this ion. (3)
- 4.6 When orbitals of identical energy are available, electrons are placed in individual orbitals before they are paired. Give the name of this rule. (1)
- 4.7 Element **Y** occurs as these isotopes in the following proportions:
- Y** – 28(92,23%); **Y** – 29(4,68%); **Y** – 30(3,09%)
- Calculate the relative atomic mass of element **Y**. (3)
- [22]**

QUESTION 5 (Start on a new page.)

Study the physical and chemical processes below and answer the questions that follow.



5.1 Define the term *physical change*. (2)

5.2 Write down the LETTER of the process that represents the following:

5.2.1 Physical change (1)

5.2.2 Decomposition reaction (1)

5.3 Give the name of the physical change stated in QUESTION 5.2.1. (1)

5.4 State TWO properties of a reaction that indicate that a chemical change has taken place. (2)

5.5 For process **Z**, write down:

5.5.1 What the symbol Δ represents (1)

5.5.2 A BALANCED CHEMICAL EQUATION (Show the phases of ALL reactants and products.) (4)

5.6 A 20 g sample of $\text{CaCO}_3(\text{s})$ in process **Y** decomposes to form 11,2 g of CaO . In a second sample, 30 g decomposes to form x g of CO_2 .

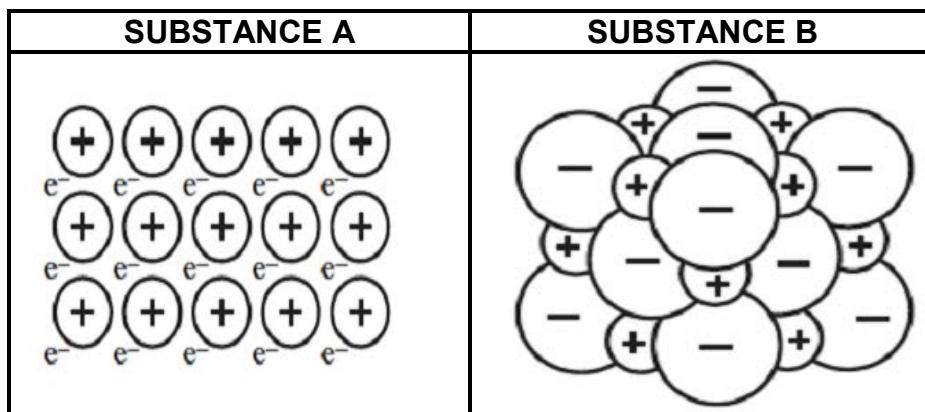
5.6.1 State the *law of constant composition*. (2)

5.6.2 Use the law in QUESTION 5.6.1 to calculate mass x of the CO_2 formed. (4)

[18]

QUESTION 6 (Start on a new page.)

Study the diagram below showing structures of two different substances (**A** and **B**) and answer the questions that follow.



- 6.1 Choose the substance (**A** or **B**) that describes the following: (1)
- 6.1.1 Metallic structure (1)
- 6.1.2 Structure of magnesium chloride (1)
- 6.2 Explain how the type of bond in substance **A** forms. (2)
- 6.3 Name the type of bond that exists in substance **B**. (1)
- 6.4 Magnesium and chlorine react to form compound magnesium chloride.
- 6.4.1 Define the term *compound*. (2)
- 6.4.2 Write down the NAME of the group to which magnesium belongs. (1)
- 6.4.3 Write down the valency of a chlorine atom. (1)
- 6.4.4 Use the Lewis dot diagram to show the formation of magnesium chloride. (3)
- [12]**

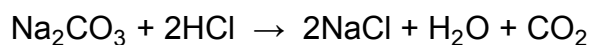
QUESTION 7 (Start on a new page.)

A group of learners prepare a $0,25 \text{ mol} \cdot \text{dm}^{-3}$ solution of sodium carbonate by dissolving a 14,2 g sample of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$) in 200 cm^3 of water.

7.1 Explain the meaning of the term *hydrated*. (1)

7.2 Write down a BALANCED CHEMICAL EQUATION to show how sodium carbonate dissociates in water. (2)

7.3 Learners then take 10 cm^3 of the prepared solution and allow it to react completely with 5 cm^3 of dilute hydrochloric acid, according the following balanced chemical equation:



7.3.1 Define the term *a mole of a substance*. (2)

7.3.2 What type of chemical reaction is represented by the chemical equation above? (1)

7.3.3 Calculate the number of moles of hydrochloric acid in 5 cm^3 of hydrochloric acid if its concentration is $1 \text{ mol} \cdot \text{dm}^{-3}$. (3)

7.4 Calculate the mass of sodium chloride formed in the reaction in QUESTION 7.3. (5)
[14]

QUESTION 8 (Start on a new page.)

Learners investigate how the type of substance affects electrical conductivity of the substance. They conduct three experiments using three different substances under the same conditions, as shown in the table below.

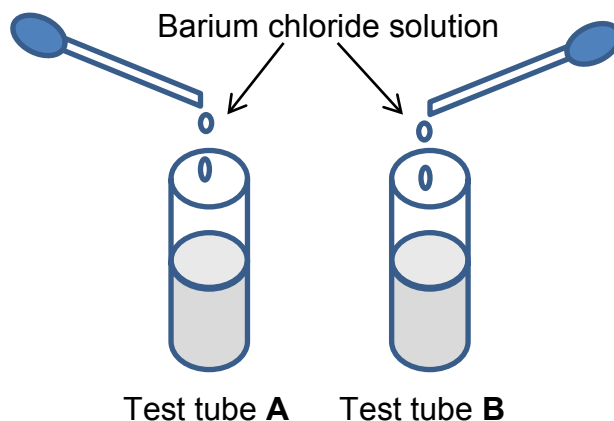
EXPERIMENT	MASS OF SUBSTANCE (g)	TYPE OF SUBSTANCE	TEMPERATURE (°C)
1	2	Solution of CaCl ₂	25
2	2	Solution of KCl	25
3	2	Solution of sugar	25

- 8.1 Define the term *electrolyte*. (2)
- 8.2 For the investigation, write down the:
- 8.2.1 Investigative question (2)
- 8.2.2 Dependent variable (1)
- 8.2.3 Independent variable (1)
- 8.2.4 Controlled variable (1)
- 8.3 For the investigation, predict with reasons the substance that will yield the following:
- 8.3.1 The highest conductivity (2)
- 8.3.2 Zero conductivity (2)
- 8.4 The substance tested in Experiment 3 was analysed. It was found to contain 40% carbon, 6,67% hydrogen and 53,33% oxygen.
- Determine the molecular formula if the molar mass is $180 \text{ g} \cdot \text{mol}^{-1}$. (7)

[18]

QUESTION 9 (Start on a new page.)

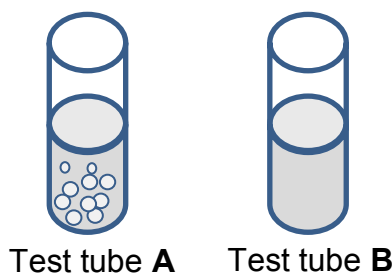
Two test tubes, **A** and **B**, both contain a sodium salt solution. After a small amount of barium chloride is added, the solution in both test tubes forms a white precipitate.



9.1 Write down the type of reaction that takes place in the test tubes. (1)

9.2 A concentrated nitric acid solution is then added into each test tube to establish which one contains carbonate ions and which one contains sulphate ions.

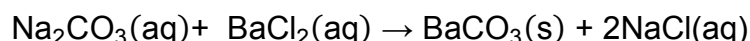
Bubbles are formed in test tube **A**. There is no reaction in test tube **B**.



9.2.1 Identify which IONS (CARBONATE or SULPHATE) are present in test tube **B**. (1)

9.2.2 Write down a BALANCED CHEMICAL EQUATION that represents the reaction between nitric acid and the precipitate formed in test tube **A**. (3)

9.3 A solution of sodium carbonate was prepared by dissolving 5 g of the powder in 100 cm³ of water. The solution reacted with a barium chloride solution, according to the following balanced chemical equation:



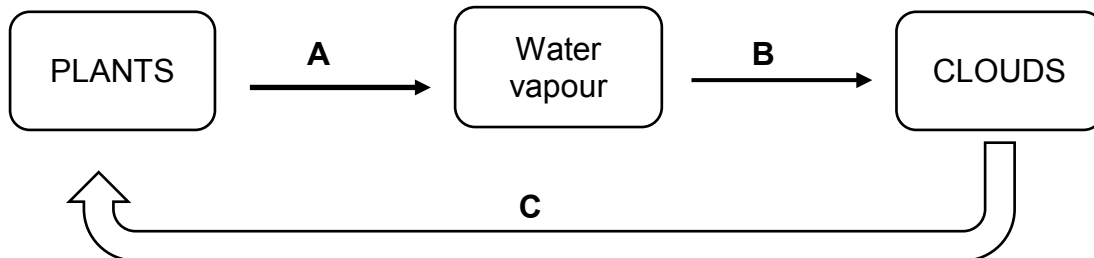
9.3.1 Calculate the mass of barium carbonate that should form in this reaction. (5)

It was found that only 8,3 g precipitate formed.

9.3.2 Calculate the percentage yield. (2) [12]

QUESTION 10 (Start on a new page)

The diagram below shows how the hydrosphere is linked to the biosphere. Study the diagram and answer the questions that follow.



- 10.1 Differentiate between the *hydrosphere* and *biosphere*. (2)
- 10.2 Write down the name of process:
- 10.2.1 **A** (1)
- 10.2.2 **B** (1)
- 10.2.3 **C** (1)
- 10.3 Describe the energy changes during processes **A** and **B**. Write down only ENERGY GAINED or ENERGY LOST. (2)
- 10.4 Describe the interaction between the hydrosphere and plants. (4)
- [11]**
- TOTAL: 150**

**DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$1,6 \times 10^{-19} \text{ C}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

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)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Al 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cl 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 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	81 1,8 Tl 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 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	

KEY/SLEUTEL

Atomic number
*Atoomgetal*Electronegativity
*Elektronegatiwiteit*Symbol
*Simbool*Approximate relative atomic mass
Benaderde relatiewe atoommassa