education

Department of Education
FREE STATE PROVINCE

# CONTROL TEST

## GRADE 10

# TECHNICAL SCIENCES

## SEPTEMBER 2019

## MARKS: 100

## TIME: 2 HOURS

**This paper consists of 10 pages and two data sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of SIX 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 between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket 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 where applicable.

11. Give brief motivations, discussions, et cetera where required.

12. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 Which one of the following elements is a non-metal?

A Helium

B Copper

C Mercury

D Aluminium (2)

1.2 Which one of the following elements is an insulator?

A Plastic

B Zinc

C Copper

D Aluminium (2)

1.3 Which one of the following elements is an example of a semiconductor?

A Boron

B Sodium

C Calcium

D Beryllium (2)

1.4 Which one of the following is an example of a ductile material?

A Iron

B Clay

C Glass

D Granite (2)

1.5 To which one of the following physical quantities does the mass number of an atom refer?

A Number of protons

B Number of neutrons

C Number of electrons

D Number of protons and neutrons (2)

1.6 Which one of the following is the correct sp-notation for the electron distribution in one atom of sodium?

A $1s^2\ 2s^2 2p^6 3s^1$

B $1s^2 2s^2 2p^6 3s^2$

C $1s^2 2s^2 2p^7$

D $1s^2 2s^2 2p^8$ (2)

1.7 Which one of the following atoms has the most protons?

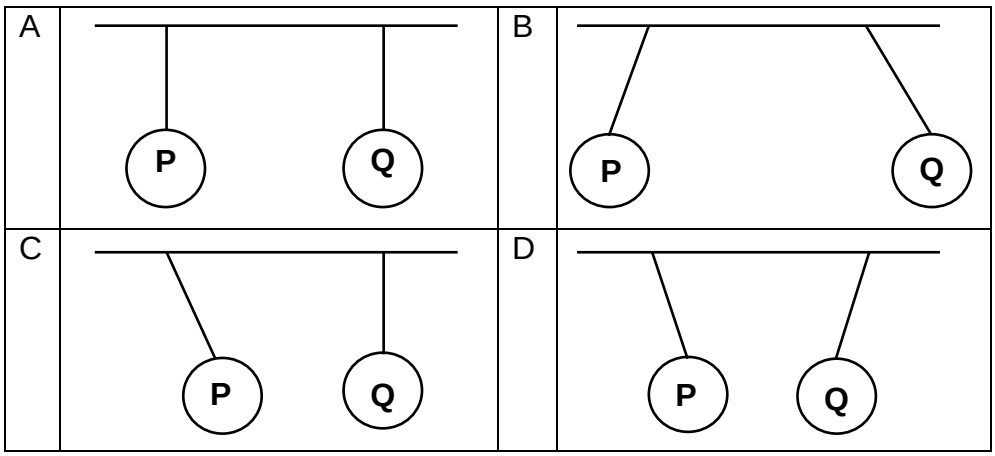
A I

B Cℓ

C Li

D He (2)

1.8 A learner rubs two identical balloons **P** and **Q** with the same cloth. Without touching them, he then suspends the balloons from a ceiling by means of light strings. Which one of the following represents what the learner will observe?




(2)

1.9 Which statement is true about a positively charged object?

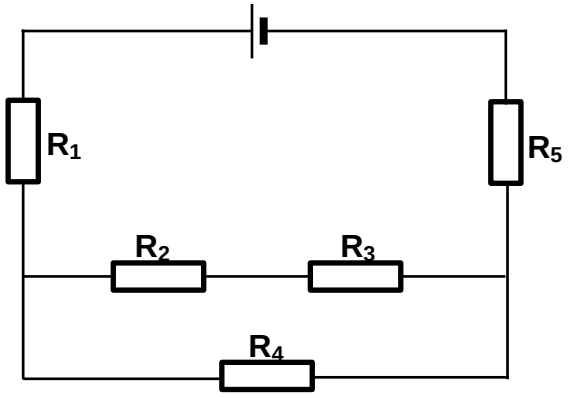
A A positively charged object does not have any electrons.

B A positively charged object does not have neutrons or electrons.

C There are more protons than electrons in a positively charged object.

D Protons and electrons are both positively charged on a positively charged object. (2)

1.10 The circuit diagram below consists of one cell and five resistors $\mathbf{R_1}$ to $\mathbf{R_5}$.




Which one of the following is correct?

A $\mathbf{R_3}$ and $\mathbf{R_4}$ are connected in series.

B $\mathbf{R_1}$ and $\mathbf{R_5}$ are connected in parallel.

C The combination $\mathbf{R_2}$, $\mathbf{R_3}$ and $\mathbf{R_4}$ is connected in parallel with $\mathbf{R_1}$.

D $\mathbf{R_2}$ and $\mathbf{R_3}$ are connected in series and together connected in parallel with $\mathbf{R_4}$. (2)

**[20]**

## QUESTION 2

2.1 Grade 10 learners investigate the properties of the materials listed below in order to classify them into different categories.

| | | |
|---|---|---|
| Aluminium | Phosphorus | Paper clip (made from an alloy) |
| Neon | Silicon | |

Refer to the items listed above to answer questions 2.1.1 to 2.1.4.

2.1.1 What is a metalloid? (2)

2.1.2 Write down one material from the list which is a metalloid. (1)

2.1.3 Write down one material from the list which is magnetic. (1)

2.1.4 Write down one material from the list which is a gas. (1)

2.2 Complete the following table by writing down only the question number and correct answer.

| Name | Symbol | Protons | Neutrons | Electrons | Nucleons |
|---|---|---|---|---|---|
| Lithium | Li | 3 | 4 | **2.2.1** | 7 |
| **2.2.2** | **2.2.3** | 8 | 8 | 8 | 16 |
| Iron ion | $Fe^{3+}$ | **2.2.4** | 30 | 23 | **2.2.5** |
| Sodium | **2.2.6** | 11 | **2.2.7** | 11 | 23 |

(7)
**[12]**

## QUESTION 3

The letters **N** to **Z** in the simplified periodic table below represent some of the elements. The letters **N** to **Z** are NOT the chemical symbols of the elements.

| | 1 (I) | 2 (II) | | 13 (III) | 14 (IV) | 15 (V) | 16 (VI) | 17 (VII) | 18 (VIII) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **N** | | | | | | | | **Z** |
| 2 | **O** | **R** | | **T** | **U** | **V** | **X** | **Y** | |
| 3 | **P** | **S** | | | | **W** | | | |
| 4 | **Q** | | | | | | | | |

3.1 Write down the NAME of the GROUP to which elements **N**, **O**, **P** and **Q** belong. (1)

3.2 How many protons does one atom of element **V** have? (1)

3.3 Write down the NAME of the GROUP to which element **Z** belongs. (1)

3.4 Choose from **N** to **Z** and write down the letter that represents the following elements:

3.4.1 Has three valence electrons. (1)

3.4.2 Has an atomic number of eight. (1)

3.4.3 Is a non-metal but is grouped with the metals on the periodic table. (1)

3.4.4 Appears in period four of the periodic table. (1)

3.4.5 Has a completely filled highest energy level. (1)

3.4.6 Has an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. (1)

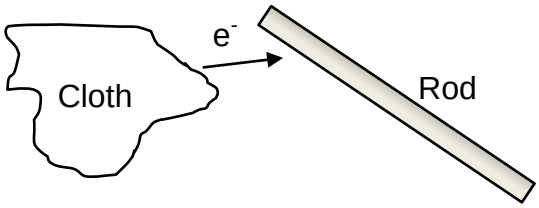
3.4.7 Is in the same group as bromine. (1)

3.5 Draw the Aufbau diagram of element **S**. (4)

**[14]**

## QUESTION 4

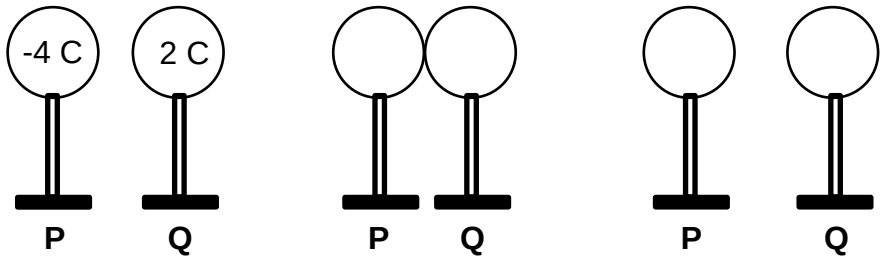
4.1 A neutral rod is rubbed with a neutral cloth and electrons are transferred from the cloth to the rod. The resulting charge on the rod has a MAGNITUDE of 6 nC.




4.1.1 Is the rod negatively charged or positively charged after it has been rubbed? (2)

4.1.2 How does the MAGNITUDE and NATURE of the charge on the CLOTH compare with the charge on the rod? (2)

4.2 Two identical metal spheres, **P** and **Q**, on insulated stands, carry charges -4 C and 2 C respectively. The spheres are allowed to touch and they are then returned to their original positions as shown below.




4.2.1 On which sphere, **P** or **Q**, are more electrons than protons before they are allowed to touch? (1)

4.2.2 State the principle of *conservation of charge* in words. (2)

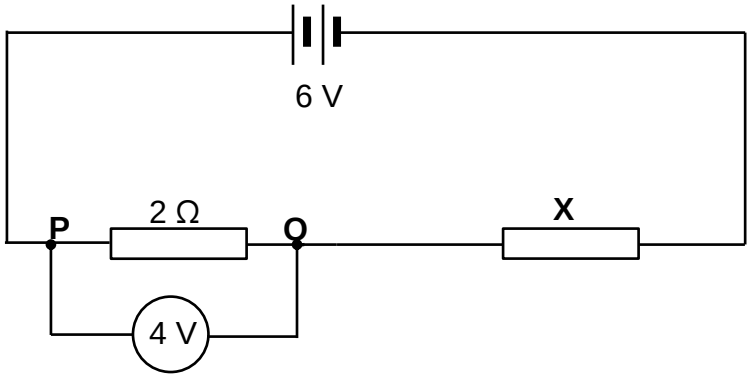
4.2.3 Calculate the charge on sphere **P** after the spheres have been separated. (4)

4.2.4 When you comb your hair on a dry, warm day with a plastic comb, your hair stand on ends. Explain this phenomenon. (3)

**[14]**

## QUESTION 5

Consider the following circuit diagram. The emf of the battery is 6 V. The voltmeter across the 2 Ω resistor registers a reading of 4 V. The 2 Ω resistor is connected to resistor **X** with an unknown resistance.




5.1 Explain in words what an *electric current* is. (2)

5.2 What is the direction of the current in the circuit? Choose your answer from "**P** to **Q**" or "**Q** to **P**". Explain your answer as well. (3)

5.3 Calculate the current in the 2 Ω resistor. (3)

5.4 Write down the amount of current, in ampere, in resistor **X**. (1)

5.5 What is the total potential difference, in volt, across BOTH resistors? (2)

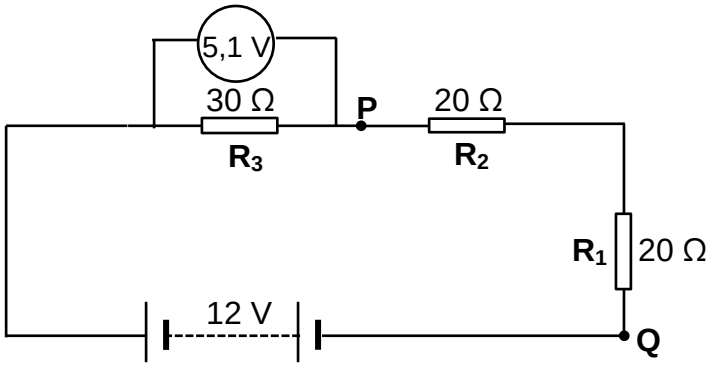
5.6 Explain the difference between the total potential difference and emf. (4)

5.7 Calculate the amount of work done when 120 C of charge moves through resistor **X**. (4)
**[19]**

## QUESTION 6

In the circuit diagram on the right, the resistance of the connecting wires and the battery can be ignored.

The emf of the battery is 12 V and the voltage (potential difference) across $\mathbf{R_3}$ is 5,1 V. The resistance of resistors $\mathbf{R_1}$ to $\mathbf{R_3}$ are given in the diagram.




6.1 How does the amount of charge which flows through $\mathbf{R_1}$ compare with the amount of charge that flows through $\mathbf{R_3}$ in the same time interval? Choose from MORE, THE SAME or LESS. (2)

6.2 Calculate:

6.2.1 The total resistance of the circuit. (3)

6.2.2 The potential difference between **P** and **Q**. (3)

6.3 Calculate the current in $\mathbf{R_1}$ if 1,71 C of charge flows through the resistor in 10 seconds. (3)

6.4 A resistor $\mathbf{R_4}$ is connected in series with resistor $\mathbf{R_3}$. No other changes are made to the circuit. What influence does this have on the following (choose your answer each time from DECREASES, REMAINS THE SAME or INCREASES)?

6.4.1 The total resistance of the circuit. (2)

6.4.2 The total current in the circuit. (2)

6.5 Consider the ORIGINAL CIRCUIT as shown in the circuit diagram to answer the following questions.

Resistor $\mathbf{R_2}$ is disconnected from the circuit and REPLACED with a wire that is similar to the other connecting wires. What influence does this have on the following (choose your answer each time from DECREASES, REMAINS THE SAME or INCREASES)?

6.5.1 The total resistance of the circuit. (2)

6.5.2 The total current in the circuit. (2)

6.6 How many cells do you need in this circuit if each cell has an emf of 1,5 V? (2)

**[21]**

**GRAND TOTAL: 100**

# DATA FOR TECHNICAL SCIENCES GRADE 10
# *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10*

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

| NAME / *NAAM* | SYMBOL / *SIMBOOL* | VALUE / *WAARDE* |
|---|---|---|
| Charge on electron<br>*Lading op elektron* | e | $-1,6 \times 10^{-19}$ C |

## TABLE 2: FORMULAE / *TABEL 2: FORMULES*

## ELECTROSTATICS / *ELEKTROSTATIKA*

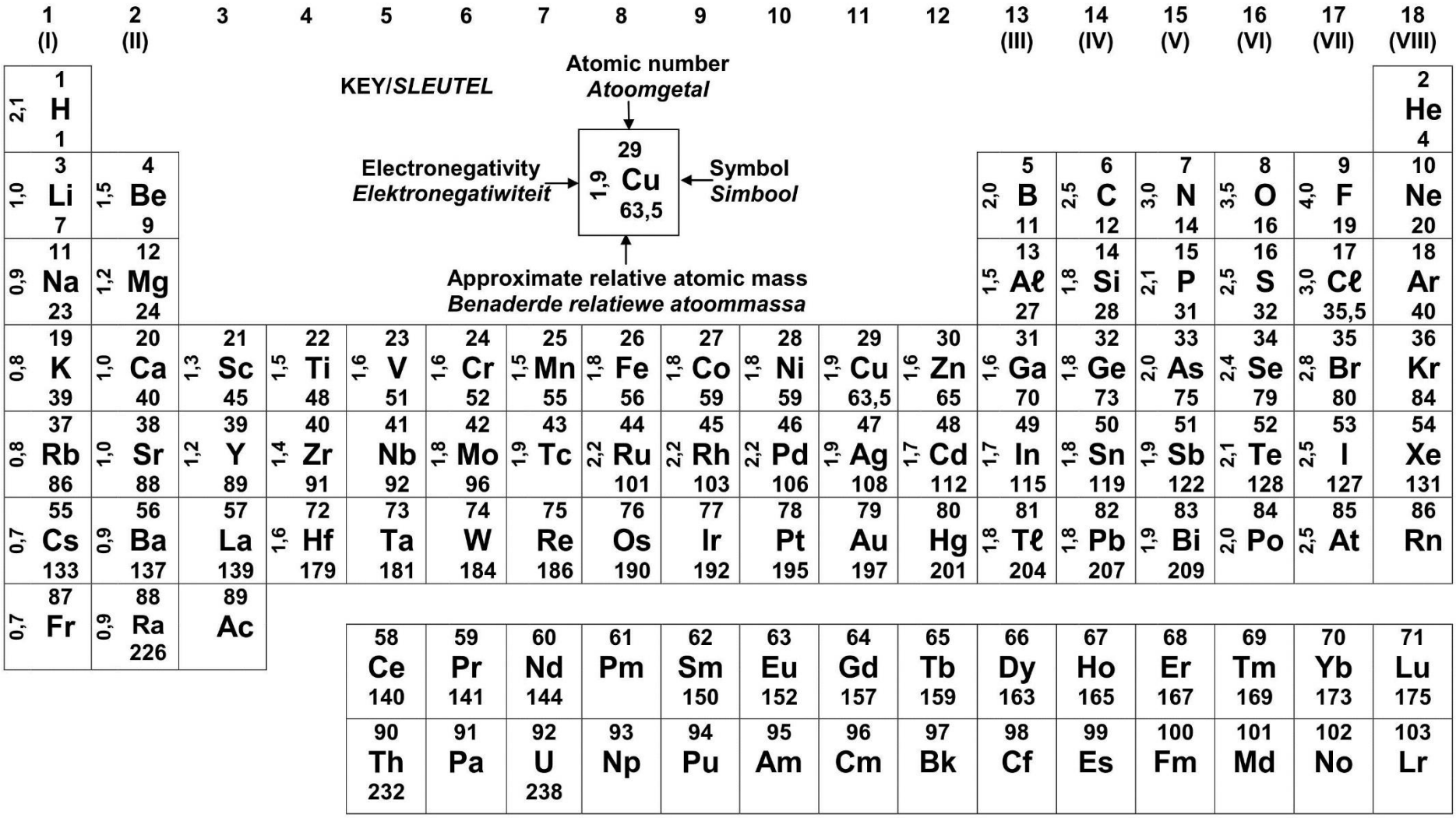
$$Q = \frac{Q_1 + Q_2}{2}$$

## ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

| | Serie | Parallel |
|---|---|---|
| $I = \frac{Q}{\Delta t}$ | $R_T = R_1 + R_2 + R_3$ | $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ |
| $V = \frac{W}{Q}$ | $I_T = I_1 = I_2 = I_3$ | $I_T = I_1 + I_2 + I_3$ |
| $R = \frac{V}{I}$ | $V_T = V_1 + V_2 + V_3$ | $V_T = V_1 = V_2 = V_3$ |

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