



# education

Department of  
Education  
FREE STATE PROVINCE

**EXAMINATION**

**GRADE 10**

**TECHNICAL SCIENCES**

**NOVEMBER 2018**

**MARKS: 200**

**TIME: 3 HOURS**

**This paper consists of 15 pages and three information 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 11 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 (1.1–1.15) in your ANSWER BOOK.

1.1 Which one of the following is the SI unit of heat?

- A watt
- B joule
- C kelvin
- D celsius (2)

1.2 Which one of the following gives the correct combination of units for the physical quantity?

	Quantity	Unit
A	Energy	$V \cdot C^{-1}$
B	Current	$C \cdot s^{-1}$
C	Resistance	$V \cdot A$
D	Potential difference	$A \cdot \Omega^{-1}$

(2)

1.3 Which one of the following has the same value as  $1,225 \times 10^{-3}$ ?

- A 122,5
- B 12,25
- C 0,01225
- D 0,001225 (2)

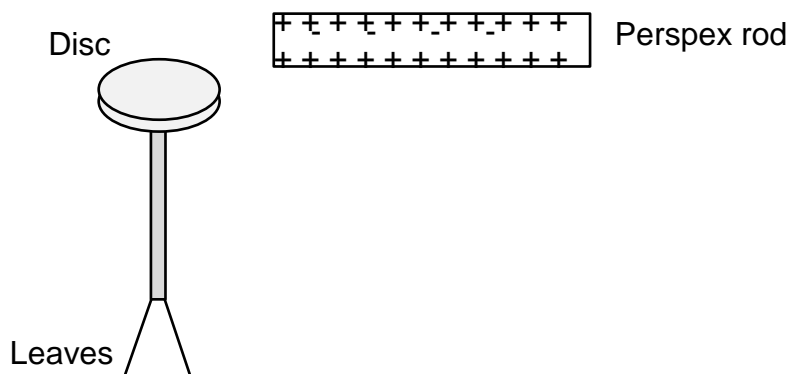
1.4 Which one of the following represents a physical quantity per unit time?

- A Rate
- B Time
- C Force
- D Displacement (2)

1.5 Which one of the following is a vector quantity?

- A Time
- B Energy
- C Distance
- D Acceleration (2)

1.6 A learner brings a positively charged perspex rod near the disc of a neutral electroscope without touching the disc. The learner observes that the leaves of the electroscope move apart.



Which one of the following statements best explains this observation?

- A Negative charges move from the perspex to the electroscope disc.
- B Negative charges move from the electroscope disc to the perspex.
- C Negative charges are repelled from the electroscope disc to the leaves.
- D Negative charges are attracted from the electroscope leaves to the disc. (2)

1.7 Which one of the following does NOT influence the resistance of a metal wire?

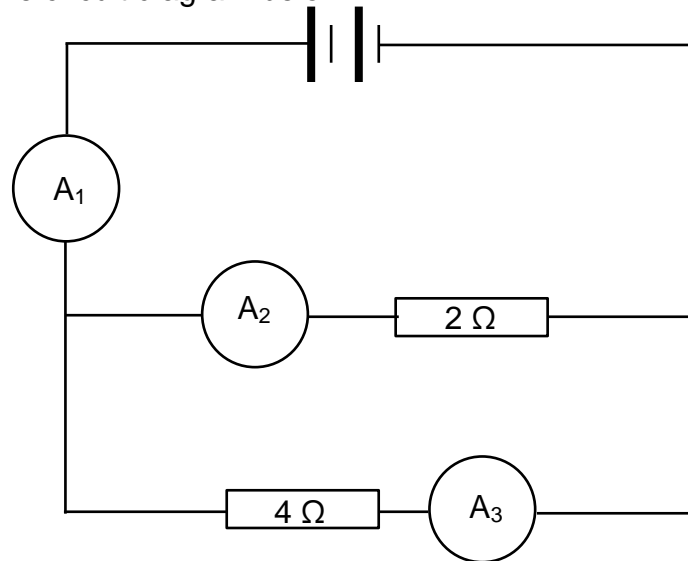
- A Shape of the wire
- B Length of the wire
- C Thickness of the wire
- D Temperature of the wire (2)

- 1.8 Which one of the following combinations correctly represents the physical quantities measured by the respective instruments?

	<b>Voltmeter</b>	<b>Ammeter</b>
A	Resistance	Current
B	Potential difference	Current
C	Potential difference	Resistance
D	Current	Potential difference

(2)

- 1.9 Consider the circuit diagram below.



How do the readings on ammeters **A<sub>1</sub>**, **A<sub>2</sub>** and **A<sub>3</sub>** compare?

- A  $A_1 = A_2 = A_3$
- B  $A_1 = A_2 + A_3$
- C  $A_2 < A_3 > A_1$
- D  $(A_2 + A_3) > A_1$

(2)

- 1.10 Which one of the following is an example of a non-contact force?

- A Air resistance
- B Tension
- C Gravity
- D Normal

(2)

- 1.11 Which one of the following is the best description of a lever?
- A A vertical bar used to support heavy buildings.
  - B A curved structure that supports entrances to buildings.
  - C A rigid bar supported by one fulcrum and used to lift heavy objects.
  - D A single rigid length of material supported horizontally to carry vertical loads. (2)
- 1.12 Which one of the following is NOT a characteristic of a beam?
- A A beam is bendable and stretchable.
  - B The centre of gravity of a beam is in the middle.
  - C The weight of the beam acts through the midpoint.
  - D The cross-sectional area of a beam is usually uniform (2)
- 1.13 Which one of the following represents an element?
- A He
  - B FeO
  - C LiCl
  - D H<sub>2</sub>O (2)
- 1.14 Which one of the following symbols represents an element that is an alkali metal?
- A B
  - B Mg
  - C K
  - D Ca (2)
- 1.15 Which one of the following correctly represents the sp-notation for the electron distribution in one atom of sodium?
- A  $1s^2 2s^2 2p^7$
  - B  $1s^2 2s^2 2p^8$
  - C  $1s^2 2s^2 2p^6 3s^1$
  - D  $1s^2 2s^2 2p^6 3s^2$  (2)

[30]

## QUESTION 2

A homeowner wants to tile his kitchen floor. The floor has a rectangular shape of 2,5 m by 3,24 m. The dimensions of each tile are 0,3 m by 0,3 m and a box contains 18 tiles.

2.1 What is the SI unit of length? (1)

2.2 Convert 2,5 m to mm. (2)

2.3 Calculate the:

2.3.1 Area of the kitchen floor (3)

2.3.2 Area of one tile (2)

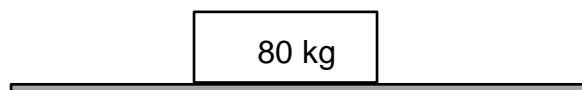
2.3.3 Minimum number of tiles needed to tile the floor. (3)

2.3.4 Minimum number of boxes that the homeowner should buy in order to tile the floor. (3)

**[14]**

## QUESTION 3

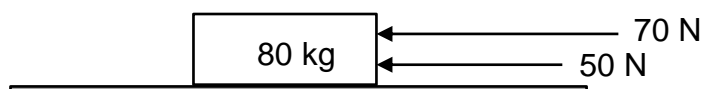
3.1 An 80 kg box is at rest on a rough, horizontal surface.



3.1.1 Calculate the magnitude of the weight of the box. (3)

3.1.2 Explain why the box does not fall through the surface. (2)

3.2 Thabo and Jimmy push the box to the left with horizontal forces of 50 N and 70 N respectively. The box DOES NOT MOVE.



3.2.1 Draw a labelled free-body diagram of ALL the forces acting on the box. (5)

3.2.2 Calculate the magnitude and direction of the resultant of the 50 N and 70 N forces. (4)

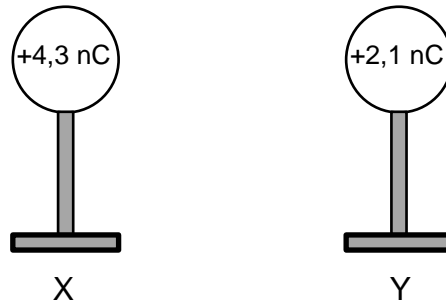
3.2.3 Write down the magnitude and direction of the force that keeps the box stationary. (2)

3.2.4 What *name* is given to the force mentioned in question 3.2.3? (1)

**[17]**

#### QUESTION 4

Two identical metal spheres, **X** and **Y**, on insulated stands, carry charges of +4,3 nC and +2,1 nC respectively. The spheres are allowed to touch and then they are moved back to their original positions.



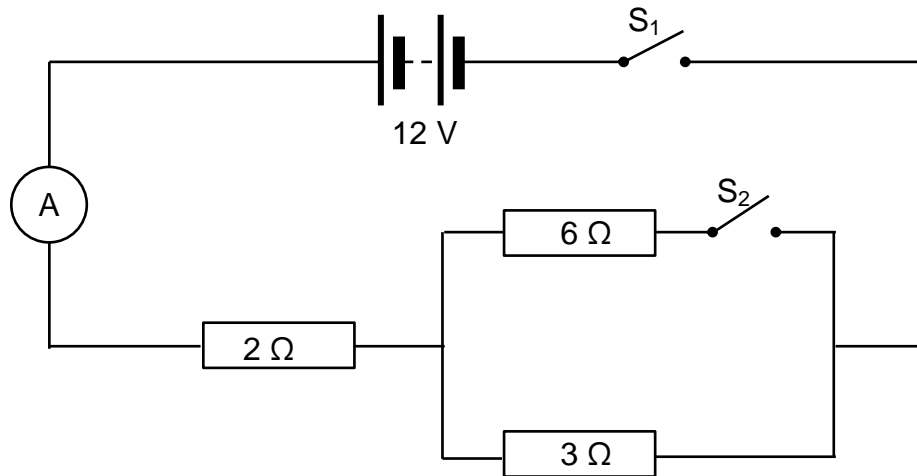
- 4.1 Write down the *principle of conservation of charge* in words. (2)
- 4.2 Calculate the charge, in coulomb, on sphere **Y** after the spheres have been separated. (3)
- 4.3 From which sphere did electrons move when the spheres touched each other? Write down only **X to Y** or **Y to X**. Give a reason for your answer. (3)
- 4.4 Calculate how many electrons were transferred between the spheres during contact. Use  $1,6 \times 10^{-19}$  C as the magnitude of the charge on one electron. (4)
- [12]**

#### QUESTION 5

- 5.1 A charge of 10 coulomb passes through a resistor in 5 seconds.
- 5.1.1 Define the term *electric current* in words. (2)
- 5.1.2 Calculate the current in the resistor. (3)
- 5.1.3 Define the term *potential difference* in words. (2)
- 5.1.4 Calculate the potential difference across the resistor if 120 J of energy is used to move the 10 C of charge through the resistor. (3)



- 5.2 The resistance of the battery and connecting wires in the following circuit diagram can be ignored. The emf of the battery is 12 V.



- 5.2.1 Define the term *electromotive force (emf)*. (2)

**SWITCHES  $S_1$  AND  $S_2$  ARE NOW CLOSED.**

- 5.2.2 Calculate the effective resistance of the parallel resistors. (4)

- 5.2.3 Calculate the total resistance of the circuit. (3)

- 5.2.4 Calculate the reading on the ammeter. (3)

**SWITCH  $S_2$  IS NOW OPENED.**

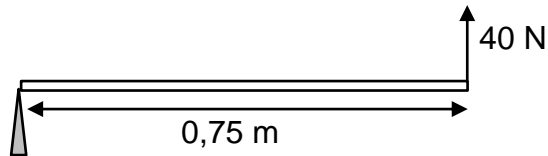
- 5.2.5 Calculate the total resistance of the circuit. (2)

- 5.2.6 Calculate the reading on the ammeter. (2)

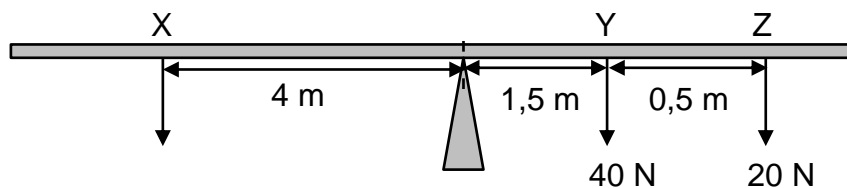
**[26]**

## QUESTION 6

- 6.1 Consider the following diagram of a lever. A force of 40 N is applied perpendicularly to the lever and the distance between the pivot and the force is 0,75 m.



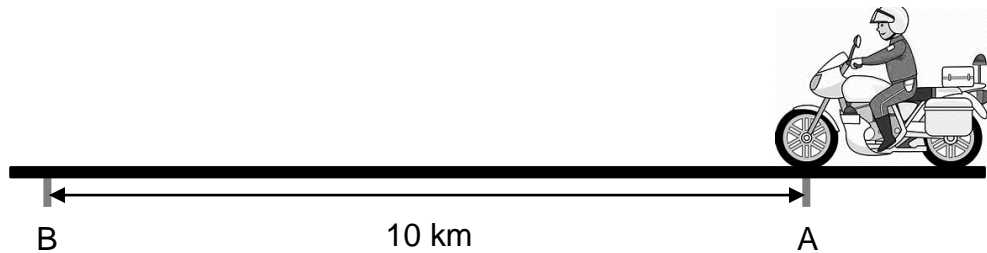
- 6.1.1 Define the *moment of force (torque)*. (2)
- 6.1.2 Calculate the torque of the lever. (4)
- 6.2 In the diagram, a horizontal rod is balanced by three vertical forces. The force at **Y**, magnitude 40 N, acts at a distance of 1,5 m from the pivot. A force at **Z**, magnitude 20 N, acts at a distance of 0,5 m from **Y**. An unknown force at **X** is applied at a point 4 m from the pivot. Ignore the mass of the rod.



- 6.2.1 State the *law of moments* in words. (2)
- 6.2.2 Calculate the magnitude of the clockwise moments. (3)
- 6.2.3 Calculate the magnitude of the force applied at **X**. (3)
- 6.2.4 What is the magnitude of the force exerted by the pivot on the rod? (2)
- 6.3 Calculate the mechanical advantage of a lever which uses a force of 20 N to lift a load of 60 N. (3)
- [19]**

### QUESTION 7

A motorcyclist travels on a straight, level road at a constant velocity of  $120 \text{ km}\cdot\text{h}^{-1}$  for 10 km between **A** and **B**.



- 7.1 What is the difference between *distance* and *displacement*? (4)
- 7.2 What is the magnitude of the acceleration of the motorcyclist?  
Explain your answer. (3)
- 7.3 Calculate, in hour, the time taken by the motorcyclist to cover the distance of 10 km. (4)
- 7.4 Convert  $120 \text{ km}\cdot\text{h}^{-1}$  to  $\text{m}\cdot\text{s}^{-1}$ . (3)
- 7.5 Once the motorcyclist has reached **B**, he slows down, stops, turns around and accelerate again to travel in the opposite direction. Between **A** and **B** his velocity is constant again.

Calculate:

- 7.5.1 The total distance he travelled from **A** to **B** and back to **A**. (2)
- 7.5.2 His total displacement when he is back at **A**. (2)
- 7.5.3 His acceleration if he accelerated from rest to  $20 \text{ m}\cdot\text{s}^{-1}$  in 7,6 s. (4)
- [22]**

### QUESTION 8

A 0,8 kg hammer lies on a shelf 2 m above the floor of the workshop.

8.1 What form of energy does the hammer have when it lies on the shelf? Give a reason for your answer. (3)

8.2 Calculate the gravitational potential energy of the hammer while it is on the shelf. (3)

8.3 The hammer accidentally falls to the floor. Assume that only the force of gravity acts on the hammer while it falls.

8.3.1 Define the term *kinetic energy*. (2)

8.3.2 Define the term *mechanical energy*. (2)

8.3.3 Calculate the speed at which the hammer hits the floor. (4)

8.3.4 Write down the magnitude of the mechanical energy of the hammer at any position between the shelf and the floor while it is falling. (2)  
**[16]**

### QUESTION 9

9.1 Define the term *temperature*. (2)

9.2 Name TWO types of thermometers. (2)

9.3 Name any two uses of thermometers in everyday life. (2)

9.4 Convert 25°C to K. (2)

9.5 Rhodium metal melts at 1 964°C. You have two flames available to melt the rhodium with. Flame 1 has a temperature of 2 223 K; flame 2 has a temperature of 1 970°C. Which flame can be used or can both perhaps be used? (1)  
**[9]**

## QUESTION 10

10.1 The letters **A** to **M** in the simplified periodic table below represent some of the elements. The letters are NOT chemical symbols of the elements.

	1	2		13	14	15	16	17	18
	I	II		III	IV	V	VI	VII	VIII
1	A								B
2	C	D		E	F	G	H	I	
3	J	K				L			
4	M								

Write down the letter (choose from **A** to **M**) that represents an element which:

10.1.1 Has six electrons. (1)

10.1.2 Is a non-metal in the same group as the metals. (1)

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

10.1.4 Has seven valence electrons. (1)

10.2 Complete the following table by writing down ONLY the question number in your answer book and next to it ONLY the correct answer.

Name	Symbol	No of protons	No of neutrons	No of electrons	No of nucleons
Sodium atom	<b>10.2.1</b>	11	<b>10.2.2</b>	11	23
Lithium ion	Li <sup>+</sup>	3	4	<b>10.2.3</b>	7
Carbon atom	C	6	6	6	<b>10.2.4</b>
Chlorine atom	Cl	17	18	<b>10.2.5</b>	35

(5)

10.3 Consider the following table of substances listed from **A** to **I**.

A	$\text{Na}_2\text{S}$
B	Copper(II) oxide
C	$\text{K}^+$
D	Potassium chloride
E	$\text{NaOH}$
F	$\text{FeSO}_4$
G	$\text{F}^-$
H	$\text{Li}_2\text{SO}_3$
I	$\text{HCl}$

Write down:

10.3.1 Name of compound **A** (2)

10.3.2 Name of compound **H** (2)

10.3.3 A substance which is a cation (1)

10.3.4 A substance which is an anion (1)

10.3.5 Formula for compound **B** (2)

10.4 Write down a balanced equation for the reaction between compounds **E** and **I**. (3)  
**[20]**

## QUESTION 11

11.1 Classify the following materials as magnetic or non-magnetic:

11.1.1 Rubber (1)

11.1.2 Steel (1)

11.1.3 Germanium (1)

11.2 Give TWO examples of the use of magnets in your daily live. (2)

11.3 Use the table below to answer the questions that follow.

MATERIAL	THERMAL CONDUCTIVITY ( $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ) at 25 °C
Air	0,0262
Aluminium	205
Brick	0,15
Polyester	0,05
Glass	1,05
Copper	401
Stainless steel	16

11.3.1 Identify the TWO most effective CONDUCTORS.  
Explain your choice. (3)

11.3.2 Identify the TWO most effective INSULATORS.  
Explain your choice. (3)

11.4 The table below represents a part of the periodic table. Use it to answer the questions that follow.

	1 I	2 II		13 III	14 IV
2	Li			B	C
3	Na	Mg		Al	Si

Write down the symbol of a:

11.4.1 Metal in period 2 (1)

11.4.2 Metal in group 13 (1)

11.4.3 Non-metal in period 3 (1)

11.4.4 Semi-conductor (1)

[15]

**GRAND TOTAL: 200**

**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
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Charge on an electron <i>Lading op 'n elektron</i>	e <sup>-</sup>	-1,6 x 10 <sup>-19</sup> C

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

**PERIMETER / OMTREK**

Perimeter of a rectangle = 2ℓ + 2w  
*Omtrek van 'n reghoek = 2ℓ + 2b*

**AREA / OPPERVLAKTE**

Area of a rectangle = ℓ x b  
*Oppervlakte van 'n reghoek = ℓ x b*

**ELECTROSTATICS / ELEKTROSTATIKA**

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

**ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE**

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



### FORCE / KRAAG

$$F_g = mg \text{ OR / OF } w = mg$$

### MOMENT OF FORCE (TORQUE)

#### KRAGMOMENT / DRAAIMOMENT / WRINGKRAAG

$$\Gamma = F \times d_{\perp}$$

### SIMPLE MACHINES / EENVOUDIGE MASJIENE

$$MA = \frac{\text{Load}}{\text{Effort}} \quad \text{OR} \quad MA = \frac{\text{Effort distance}}{\text{Load distance}}$$

$$MV = \frac{L_{as}}{Krag} \quad \text{OF} \quad MV = \frac{Kragafstand}{L_{asafstand}}$$

### MOTION / BEWEGING

$speed = \frac{\text{distance}}{\text{time}}$	$spoed = \frac{\text{afstand}}{\text{tyd}}$
$velocity = \frac{\text{displacement}}{\text{time}}$	$snelheid = \frac{\text{verplasing}}{\text{tyd}}$
$acceleration = \frac{\text{change in velocity}}{\text{time}}$	$versnelling = \frac{\text{verandering in snelheid}}{\text{tyd}}$

### ENERGY / ENERGIE

$$E_p = mgh \quad \text{OR / OF} \quad U = mgh$$

$$E_k = \frac{1}{2}mv^2 \quad \text{OR / OF} \quad K = \frac{1}{2}mv^2$$

**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)
1 2,1 <b>H</b> 1																	2 <b>He</b> 4
3 1,0 <b>Li</b> 7	4 1,5 <b>Be</b> 9											5 2,0 <b>B</b> 11	6 2,5 <b>C</b> 12	7 3,0 <b>N</b> 14	8 3,5 <b>O</b> 16	9 4,0 <b>F</b> 19	10 <b>Ne</b> 20
11 0,9 <b>Na</b> 23	12 1,2 <b>Mg</b> 24											13 1,5 <b>Al</b> 27	14 1,8 <b>Si</b> 28	15 2,1 <b>P</b> 31	16 2,5 <b>S</b> 32	17 3,0 <b>Cl</b> 35,5	18 <b>Ar</b> 40
19 0,8 <b>K</b> 39	20 1,0 <b>Ca</b> 40	21 1,3 <b>Sc</b> 45	22 1,5 <b>Ti</b> 48	23 1,6 <b>V</b> 51	24 1,6 <b>Cr</b> 52	25 1,5 <b>Mn</b> 55	26 1,8 <b>Fe</b> 56	27 1,8 <b>Co</b> 59	28 1,8 <b>Ni</b> 59	29 1,9 <b>Cu</b> 63,5	30 1,6 <b>Zn</b> 65	31 1,6 <b>Ga</b> 70	32 1,8 <b>Ge</b> 73	33 2,0 <b>As</b> 75	34 2,4 <b>Se</b> 79	35 2,8 <b>Br</b> 80	36 <b>Kr</b> 84
37 0,8 <b>Rb</b> 86	38 1,0 <b>Sr</b> 88	39 1,2 <b>Y</b> 89	40 1,4 <b>Zr</b> 91	41 <b>Nb</b> 92	42 1,8 <b>Mo</b> 96	43 1,9 <b>Tc</b> 98	44 2,2 <b>Ru</b> 101	45 2,2 <b>Rh</b> 103	46 2,2 <b>Pd</b> 106	47 1,9 <b>Ag</b> 108	48 1,7 <b>Cd</b> 112	49 1,7 <b>In</b> 115	50 1,8 <b>Sn</b> 119	51 1,9 <b>Sb</b> 122	52 2,1 <b>Te</b> 128	53 2,5 <b>I</b> 127	54 <b>Xe</b> 131
55 0,7 <b>Cs</b> 133	56 0,9 <b>Ba</b> 137	57 <b>La</b> 139	72 1,6 <b>Hf</b> 179	73 <b>Ta</b> 181	74 <b>W</b> 184	75 <b>Re</b> 186	76 <b>Os</b> 190	77 <b>Ir</b> 192	78 <b>Pt</b> 195	79 <b>Au</b> 197	80 <b>Hg</b> 201	81 1,8 <b>Tl</b> 204	82 1,8 <b>Pb</b> 207	83 1,9 <b>Bi</b> 209	84 2,0 <b>Po</b>	85 2,5 <b>At</b>	86 <b>Rn</b>
87 0,7 <b>Fr</b>	88 0,9 <b>Ra</b> 226	89 <b>Ac</b>															

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

**KEY/SLEUTEL**

Atomic number  
*Atoomgetal*

Electronegativity  
*Elektronegatiwiteit*

Symbol  
*Simbool*

Approximate relative atomic mass  
*Benaderde relatiewe atoommassa*

(Diagram showing arrows pointing to the element Cu in the periodic table, with labels for Atomic number, Electronegativity, Symbol, and Approximate relative atomic mass.)