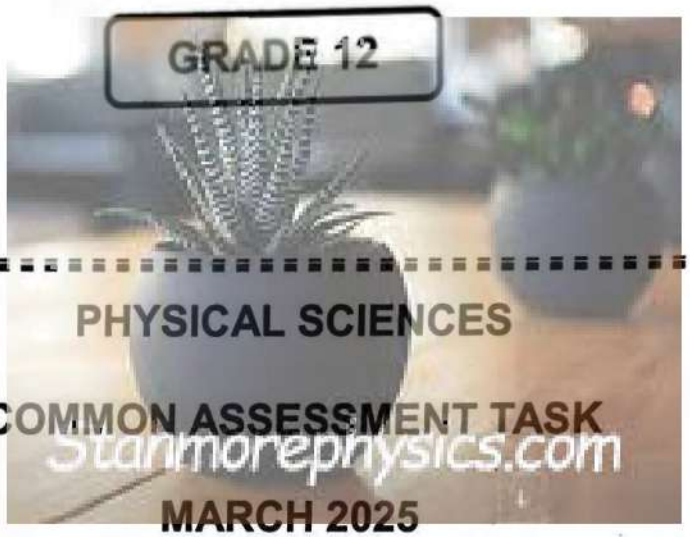
KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE



MARKS: 100

TIME: 2 hours

This question paper consists of 10 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

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

QUESTION 1: MULTIPLE CHOICE QUESTIONS

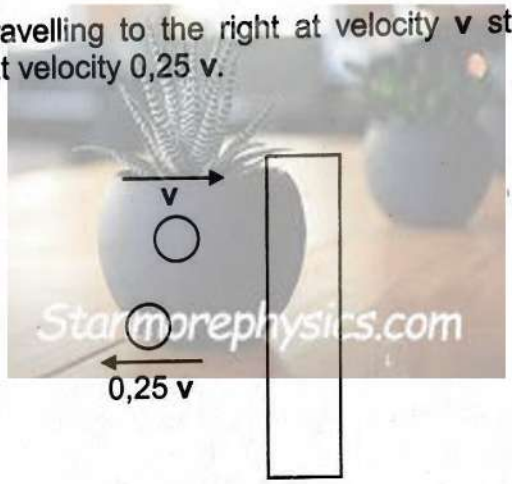
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.6) in the ANSWER BOOK.

1.1 An astronaut with a mass of 70 kg is on a planet where his weight is 550 N. The gravitational acceleration on the planet is … $m \cdot s^{-2}$.

A 7,86
B 0,13
C 38500
D 786

(2)

1.2 A ball of mass **m** travelling to the right at velocity **v** strikes a wall and rebounds to the left at velocity 0,25 **v**.



The change in momentum of the ball is …

A 0,75 **mv** left.
B 1,25 **mv** left.
C 0,75 **mv** right.
D 1,25 **mv** right.

(2)

1.3 A girl throws a ball upwards.

Which ONE of the following combinations give the DIRECTIONS of the ball's velocity, acceleration, and the net force that the ball experiences as it travels upwards just after leaving the girl's hand?

	Velocity	**Acceleration**	**Net Force**
A	Upward	Downward	Downward
B	Upward	Upward	Upward
C	Downward	Downward	Downward
D	Upward	Downward	Upward

(2)

Copyright reserved

1.4 Consider the molecular formula below:

C_3H_8O

The name of the homologous series that the above compound belongs to is a/an...

A ketone.
B alcohol.
C aldehyde.
D carboxylic acid. (2)

1.5 Given the following four organic molecules: Ethanal, ethanol, ethanoic acid, and ethane.

Which ONE of the following is CORRECT when the above compounds are arranged in their decreasing order of vapour pressure?

A Ethanoic acid, ethanol, ethanal, ethane.
B Ethanoic acid, ethanal, ethanol, ethane
C Ethane, ethanol, ethanal, ethanoic acid.
D Ethane, ethanal, ethanol, ethanoic acid. (2)

Stanmorephysics.com

1.6 Which ONE of the following reaction types will be used to prepare ethene and propane from pentane under high temperatures and pressures?

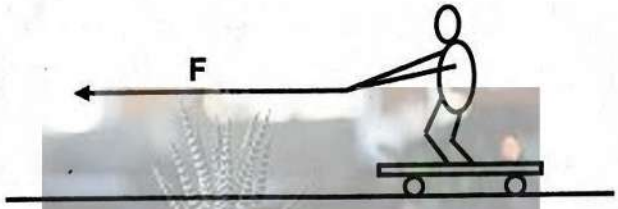
A Combustion
B Esterification
C Thermal cracking
D Photosynthesis (2)
[12]

Copyright reserved

QUESTION 2 (Start on a new page)

A boy on a skateboard is pulled by a horizontal force **F** to the left, as shown in the sketch below. The combined mass of the boy and skateboard is 60 kg. A total frictional force of 70 N opposes the motion. The boy and skateboard accelerate at 1,5 $m \cdot s^{-2}$ to the left.

Ignore the rotational effects of the wheels.



2.1 Draw a labelled free-body diagram showing all the forces acting on the boy and skateboard together. (4)

2.2 Calculate the magnitude of the force **F**. (4)

2.3 The force **F** is increased several times, and the acceleration is measured for each value of **F**, while all other forces remain constant.

Draw a sketch graph for the system showing the relationship between acceleration and **F**, from the moment the force **F** acts on the system. (3)

2.4 When force **F** is removed, the boy and skateboard continue to move to the left for a short distance. The skateboard then hits a stone and stops.

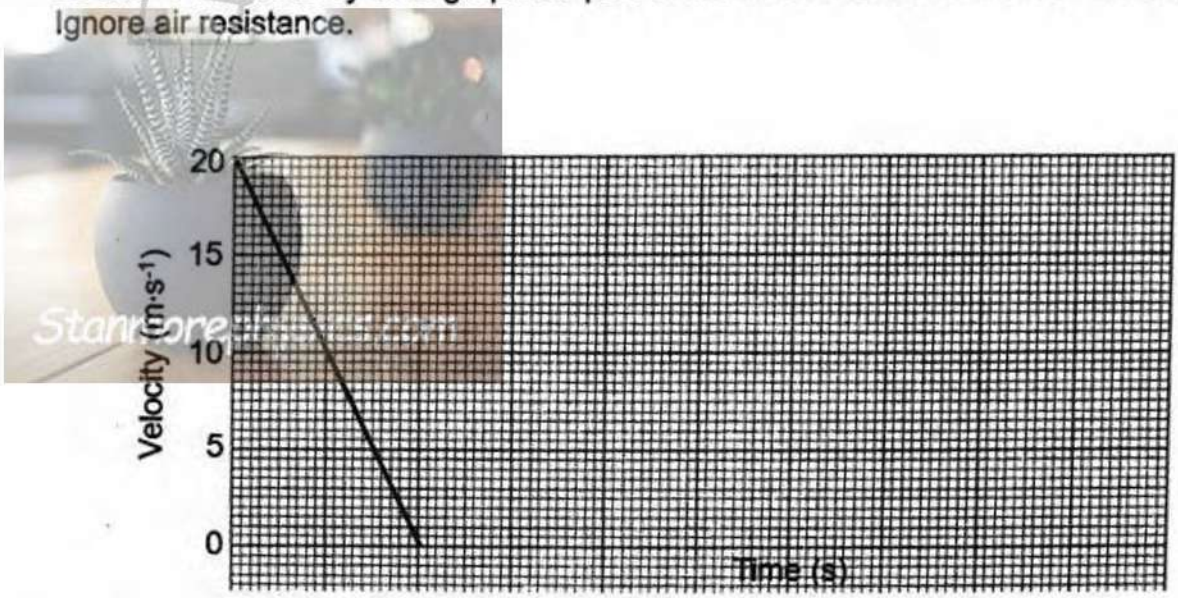
Explain what happens to the boy. (1)

2.5 Name and state the physics law which is applied in QUESTION 2.4. (3)
[15]

Stanmorephysics.com

QUESTION 3 (Start on a new page)

A ball is thrown vertically upwards from the top of a building at a velocity of 20 m·s^{-1}. The velocity-time graph for part of the motion of the ball is shown below. Ignore air resistance.



3.1 Define a *projectile*. (2)

3.2 Write down the magnitude and direction of the acceleration of the ball. (2)

3.3 Determine the:

3.3.1 Time taken for the ball to reach the maximum height (3)

3.3.2 Maximum height reached by the ball above the building (3)

The ball continues in its motion and hits the ground 5 seconds after it was thrown.

3.4 Calculate the:

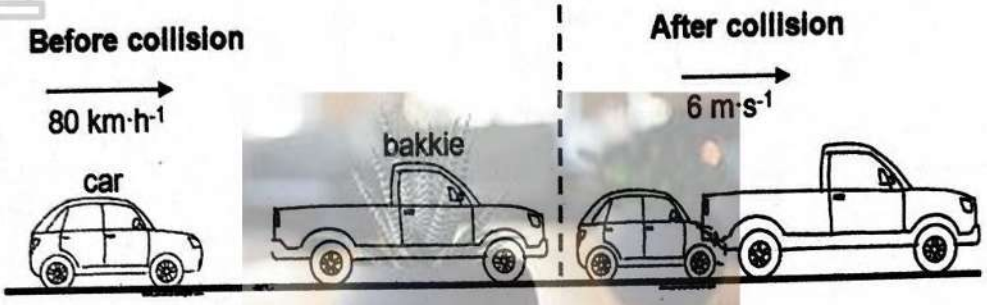
3.4.1 Speed with which the ball hits the ground (3)

3.4.2 Height of the building (4)

[17]

QUESTION 4 (Start on a new page)

A car of mass 1 600 kg travelling to the right at 80 km·h^{-1} runs into the back of a stationary bakkie of unknown mass. The two vehicles stick together and move to the right at 6 m·s^{-1}.



4.1 Convert 80 km·h^{-1} to m·s^{-1}. (2)

4.2 Calculate the change in momentum of the car. (3)

4.3 Write down the magnitude and direction of the change in momentum of the bakkie. (1)

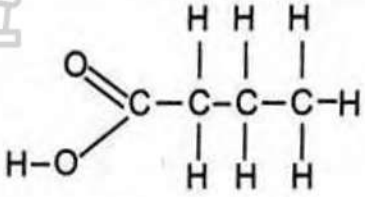
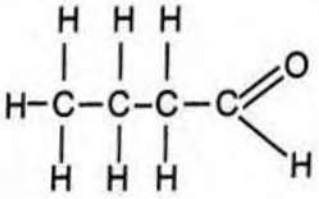
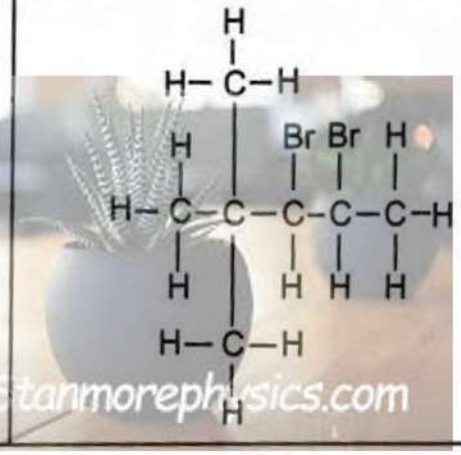
4.4 State the *principle of conservation of linear momentum* in words. (2)

4.5 Calculate the mass of the bakkie. (4)
[12]

Stanmorephysics.com

QUESTION 5 (Start on a new page)

The letters **A** to **F** in the table below represent organic compounds.

A		**B**	
C	Pentan-2-one	**D**	$CH_3CH_2COCH_2CH_3$
E		**F**	Methyl propanoate

Stanmorephysics.com

5.1 Define the term *homologous series*. (2)

5.2 Consider the organic compound **B**.

Write down the:

5.2.1 Homologous series to which this compound belongs (1)

5.2.2 IUPAC name of the functional isomer of this compound (2)

5.3 Write down the:

5.3.1 IUPAC name of compound **E** (3)

5.3.2 GENERAL FORMULA of the homologous series to which compound **A** belongs (1)

5.4 Write down the LETTER(s) of the compound(s) that represent(s):

5.4.1 The positional isomers (2)

5.4.2 An ester (1)

When making an ester, 60 g of propan-1-ol reacts with excess ethanoic acid to produce 90,78 g of the ester.

The balanced equation for the reaction is:

$$C_3H_7OH_{(l)} + CH_3COOH_{(aq)} \rightarrow C_5H_{10}O_{2\,(l)} + H_2O_{\,(l)}$$

5.5 Write down the:

5.5.1 STRUCTURAL FORMULA of the ester produced. (3)

5.5.2 IUPAC name of the ester. (2)

5.5.3 NAME or FORMULA of the catalyst used. (1)

5.6 Calculate the percentage purity of propan-1-ol. (5)
[23]

QUESTION 6 (Start on a new page)

Experiments **1** and **2** are performed to determine the boiling points of carboxylic acids and alcohols. The results obtained are shown in the table below.

EXPERIMENT	IUPAC NAME		MOLECULAR MASS ($g.mol^{-1}$)	BOILING POINT (^0C)
1	A	Methanoic acid	46	100,8
	B	Ethanol	46	78,4
2	C	Propanoic acid	74	141,2
	D	Butanol	74	117,7

6.1 Write down the property of alcohols which could make an experiment dangerous. (1)

6.2 Write down LETTERS of TWO compounds which are alcohols. (2)

6.3 What conclusion can be drawn from the results of these two experiments? (2)

6.4 Predict how the vapour pressure of compounds **A** and **B** will compare. (2)

6.5 From the table above, the boiling point of the carboxylic acid in experiment **2** is higher than the boiling point of the carboxylic acid in experiment **1**.

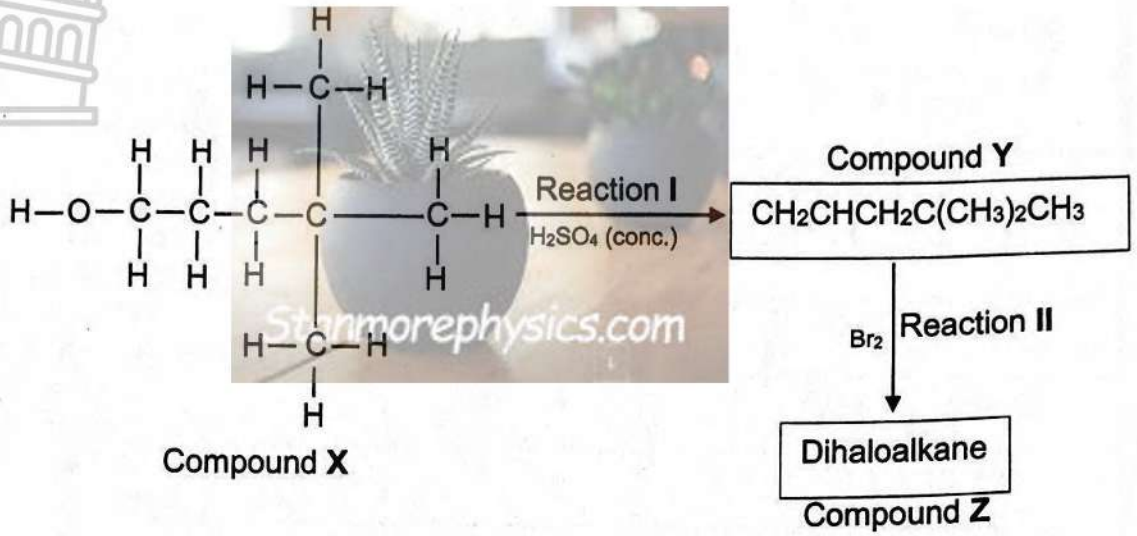
Explain this observation by referring to the molecular structure, intermolecular forces and energy. (3)
[10]

Copyright reserved

QUESTION 7 (Start on a new page)

Study the flow diagram below.

An organic compound **Z** is produced from compound **X** using reactions **I** and **II**.



7.1 NAME the functional group of compound **X**. (1)

7.2 Write down the IUPAC name of compound **X**. (3)

7.3 NAME the homologous series of the organic product that would be produced if compound **X** were now treated with a carboxylic acid in the presence of hot, concentrated sulphuric acid. (2)

7.4 Identify the homologous series of compound **Y**. (1)

7.5 NAME the type of addition reaction represented by reaction **II**. (1)

7.6 Using STRUCTURAL formulae, write down the balanced chemical equation for reaction **II**. (3)

[11]

TOTAL: 100

Copyright reserved

DATA FOR PHYSICAL SCIENCES GRADE 12

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op electron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Mass of Earth *Massa van Aarde*	M	$5,98 \times 10^{24}$ kg
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^6$ m

TABLE 2: PHYSICAL CONSTANTS/*TABEL 2: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
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
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}$ mol^{-1}

Copyright reserved

TABLE 3: PHYSICS FORMULAE / TABEL 3: FORMULES

MOTION / BEWEGING

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/of $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE / KRAG

$F_{net} = ma$	$p = mv$
$f_{s(max)} = \mu_s N$	$f_k = \mu_k N$
$w = mg$	$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$

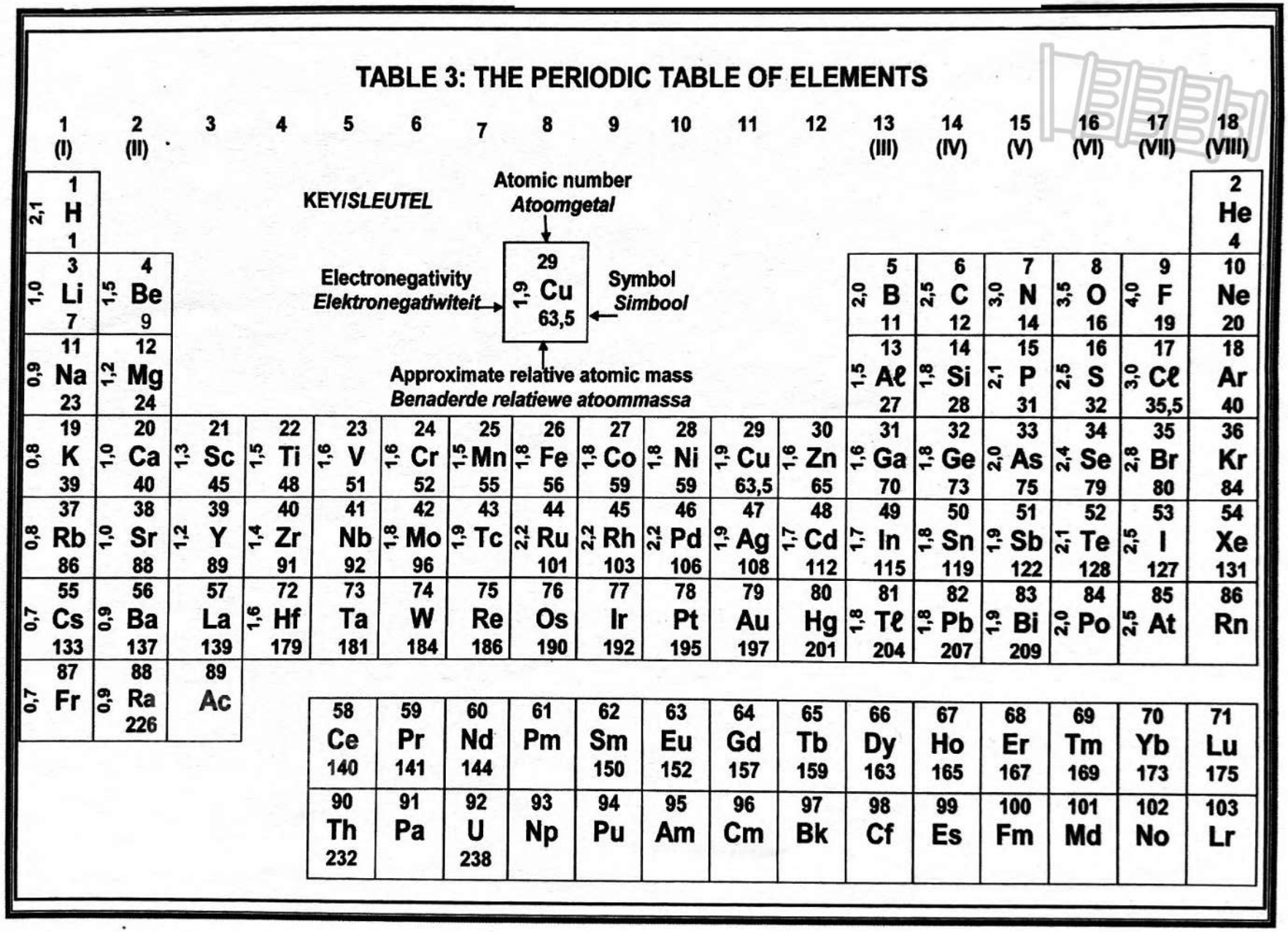
WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gem} = Fv_{gem}$	

TABLE 4: CHEMISTYRY FORMULAE/*TABEL 4: CHEMIE FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a v_a}{c_b v_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ or/*of* $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ or/*of* $E^\theta_{cell} = E^\theta_{oxidisingagent} - E^\theta_{reducingagent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	
$I = \frac{Q}{\Delta t}$	$n = \frac{Q}{e}$ where n is the number of electrons/ *waar n die aantal elektrone is*

TABLE 3: THE PERIODIC TABLE OF ELEMENTS



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