education

Department of Education
FREE STATE PROVINCE

GRADE 11
PROVINCIAL FORMAL ASSESSMENT TASK

JUNE 2015

PHYSICAL SCIENCES EXAMINATION (PHYSICS AND CHEMISTRY)

TIME: 3 HOURS

MARKS: 150

This paper consists of 12 pages and three information sheets.

INSTRUCTIONS AND INFORMATION

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

2. The question paper consists of NINE (9) 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.

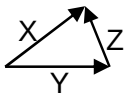
11. Give brief motivations, discussions, et cetera where required.

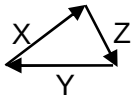
12. Write neatly and legibly.

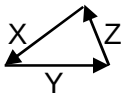
QUESTION 1

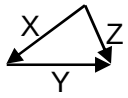
Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter A, B, C or D next to the question number (1.1 – 1.10) in your ANSWER BOOK.

1.1. Which ONE of the following diagrams is the best representation of the vector sum $\vec{X} + \vec{Y} = \vec{Z}$?

A 

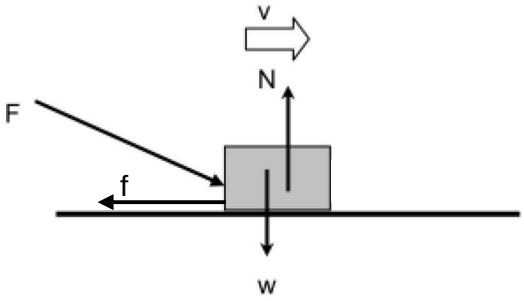
B 

C 

D 

(2)

1.2. A force **F** is applied to push a block across a rough horizontal surface at a CONSTANT speed **v.** The force diagram below shows the forces acting on the block whilst moving across the floor.



Which ONE of the following represents the correct relationship between the magnitudes of the given forces?

A F = f and N = w

B F > f and N > w

C F > f and N < w

D F > f and N = w (2)

1.3 A car moves at constant acceleration along a straight horizontal road. Which ONE of the following statements regarding this motion is TRUE?

A A zero normal force acts on the car.

B No forces act on the car.

C A non-zero resultant force acts on the car.

D The car experiences no frictional force. (2)

1.4. A person with a weight of 650 N stands on a bathroom scale in an elevator. While the elevator is moving, the reading on the scale is less than 650 N. Which ONE of the following statements regarding the movement of the lift is correct?

A The elevator moves upwards at constant velocity.

B The elevator moves downwards at constant velocity.

C The lift moves upwards at constant acceleration.

D The lift moves downwards at constant acceleration. (2)

1.5. A satellite circles around the earth at a height where the gravitational force is four times less than on the surface of the earth. If the earth's radius is R, then the height of the satellite above the surface is:

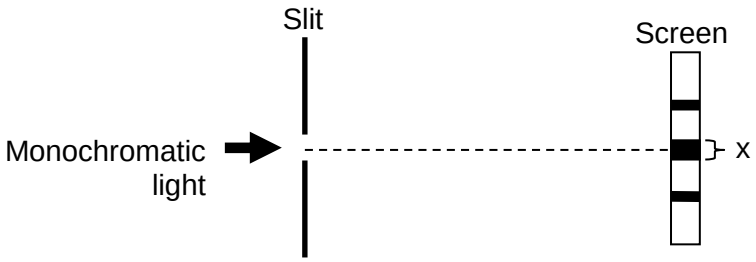
A 4R

B 3R

C 2R

D R (2)

1.6 Monochromatic light shines through a single slit. A diffraction pattern is observed on a screen a distance away from the slit. The width of the central colour band is x.



The wavelength of the light AND the slit width is now doubled. The width of the central colour band will now be:

A ½x

B x

C 2x

D 4x (2)

1.7 In which ONE of the following is the tendency to form ionic bonds, between the particles in the crystal lattice, the greatest?

A KBr(s)

B H_2O(s)

C HBr(s)

D CO_2(s) (2)

1.8 Which ONE of the following molecules contains non-polar bonds and is classified as a non-polar molecule?

A O = C = O

B I – I

C H – Cℓ

D H – O – H (2)

1.9 In which ONE of the following will hydrogen bonding occur between molecules?

A HF

B HBr

C HCℓ

D HNO_3 (2)

1.10 A certain amount of gas in a closed container occupies a volume ***V*** at a temperature ***T***. The temperature is now halved and the pressure is doubled.

Which ONE of the following correctly represents the new gas volume?

A 2*V*

B *V*

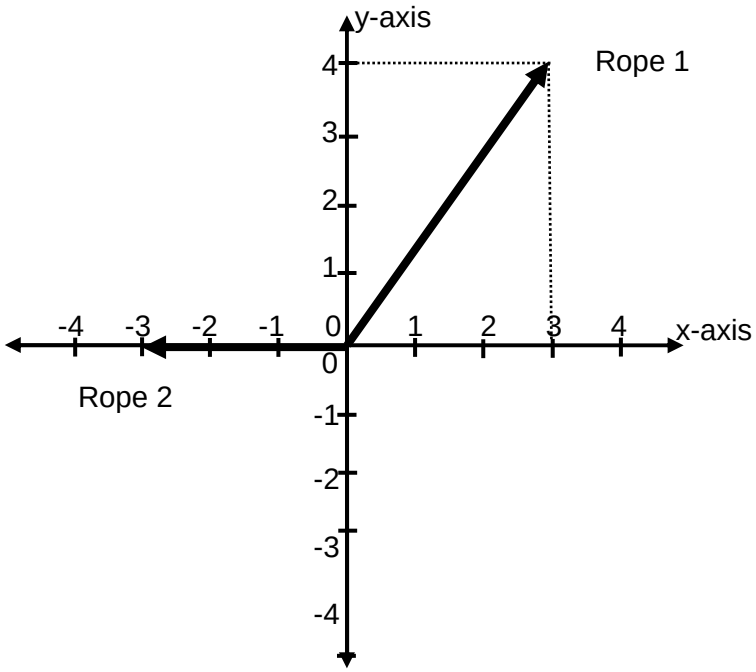
C ½*V*

D ¼*V* (2)

[20]

QUESTION 2

2.1 Two learners are supplied with two ropes of unknown lengths. Their teacher marks a Cartesian plane (in meters) on the floor and asks them to tie the ropes to a pole in the middle of the plane. They then pull the ropes and place the stretched ropes as indicated on the diagram below.

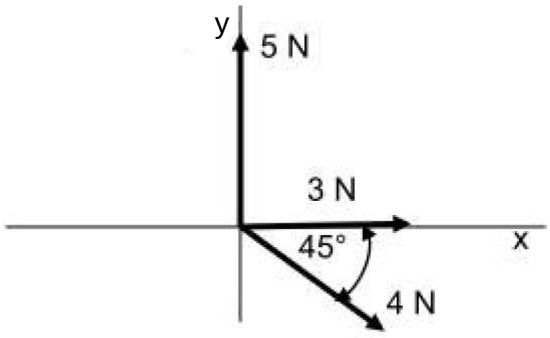


Use a calculation to determine each of the following:

2.1.1 The length of rope 1 in meters (2)

2.1.2 The length of rope 2 and the direction in which it is pulled, measured clockwise from the positive y-axis, (2)

2.2 Consider the following diagram showing three forces, 5 N, 4 N and 3 N respectively, acting on an object in the same Cartesian plane.



2.2.1 Define the term *vector*. (2)

2.2.2 Calculate the magnitude of the:

(a) Horizontal component of the 4 N force (2)

(b) Vertical component of the 4 N force (2)

2.2.3 USE THE COMPONENT METHOD to calculate the magnitude of the resultant of the 5 N and 3 N forces. (6)

2.2.4 Calculate the direction (measured clockwise from the positive y-axis) of the resultant of the 5 N and 3 N forces. (2)

[18]

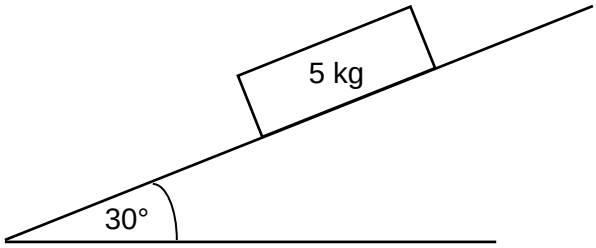
QUESTION 3

3.1 A lady, of mass 60 kg, injured her back when she slipped and fell in a supermarket. According to her, she kept on sliding along the wet floor and then fell down.

3.1.1 NAME and STATE the law of motion that explains why the lady kept on sliding across the floor. (3)

3.1.2 Calculate the static frictional force that the lady experienced before she started to slide, if the coefficient of static friction between the floor and her shoe is 0,4. (5)

3.2 A block of mass 5 kg is stationary on an inclined plane that makes an angle of 30° with the horizontal, as shown in the diagram below.



3.2.1 Draw a labelled free body diagram showing ALL the forces acting on the block. (3)

3.2.2 Calculate the magnitude of the:

(a) Component of the weight parallel to the inclined plane (2)

(b) Component of the weight perpendicular to the inclined plane (2)

3.2.3 Calculate the frictional force acting on the block. (3)

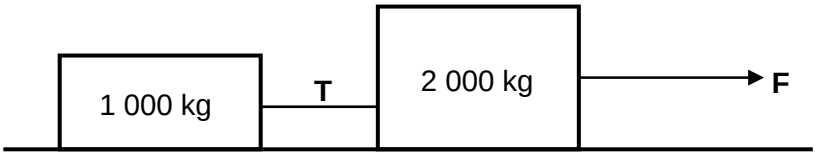
3.2.4 Calculate the coefficient of static friction, μ_s, between the block and the surface. (3)

[21]

QUESTION 4

Two crates, one of mass 2 000 kg and another of mass 1 000 kg, are joined by a rope. A force **F** is applied to pull the combination of the two crates across a rough horizontal surface as shown in the diagram below. The average frictional force experienced by the 2 000 kg crate is 150 N. The average frictional force experienced by the 1 000 kg crate is 100 N.

The mass of the rope between the crates can be ignored.



4.1 Draw a free body diagram showing ALL the forces acting on the 2 000 kg crate. (5)

4.2 Calculate the:

4.2.1 Magnitude of the force, **F**, needed to accelerate the combination of crates at 0,6 $m \cdot s^{-2}$ (5)

4.2.2 Tension, **T**, in the rope (5)

[15]

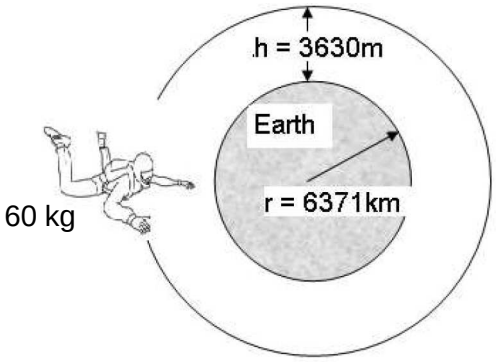
QUESTION 5

A parachutist performs experiments with different suits with the aim to eliminate the effect of air friction. He finally designs two suits, **A** and **B**.

Suit A: A very small frictional force is experienced.

Suit B: A very high frictional force is experienced.

The suits are of equal mass and the combined mass of the parachutist and the suit is 60 kg. He always jumps from a height of 3 630 m above the surface of the earth. The radius of the earth at that point is 6 371 km. The diagram below is not drawn to scale.



5.1 State *Newton's law of universal gravitation* in words. (3)

5.2 Draw a vector diagram to represent the direction of the displacement of the parachutist when he is at the position shown in the diagram. (1)

5.3 Calculate the magnitude of the gravitational force that the earth exerts on the parachutist at the start of his jump. (4)

5.4 The jumps of the parachutist wearing suits **A** and **B** are compared. Air friction cannot be ignored unless stated so.

5.4.1 How does the weight of the parachutist, when wearing suit **A**, compare to that when wearing suit **B**? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)

5.4.2 With which suit, **A** or **B**, would he hit the earth first should his parachute not open? (1)

5.4.3 Does the mass of the parachutist affect his acceleration when wearing suit **A**? Give a reason for the answer and write down an appropriate equation to support the answer. (3)

5.4.4 The parachutist, wearing suit **A**, now jumps from a height of 10 000 m above the surface of the earth. How will his gravitational acceleration differ from that when jumping from 3 630 m? Write down GREATER THAN, SMALLER THAN or EQUAL TO. Explain the answer, using an appropriate equation. (3)

[16]

QUESTION 6

Two learners investigate the patterns formed when light travels through two single slits, **X** and **Y**, of different widths.

In their first experiment, they use monochromatic red light and observe the two patterns illustrated below.

Slit X

Slit Y

6.1 Name the wave phenomenon investigated by the learner. (1)

6.2 Which slit, **X** or **Y**, is the NARROWER slit? (1)

6.3 Explain the formation of the light and dark areas in the patterns as illustrated above. (2)

6.4. The learners now pass blue light through slit **X**.

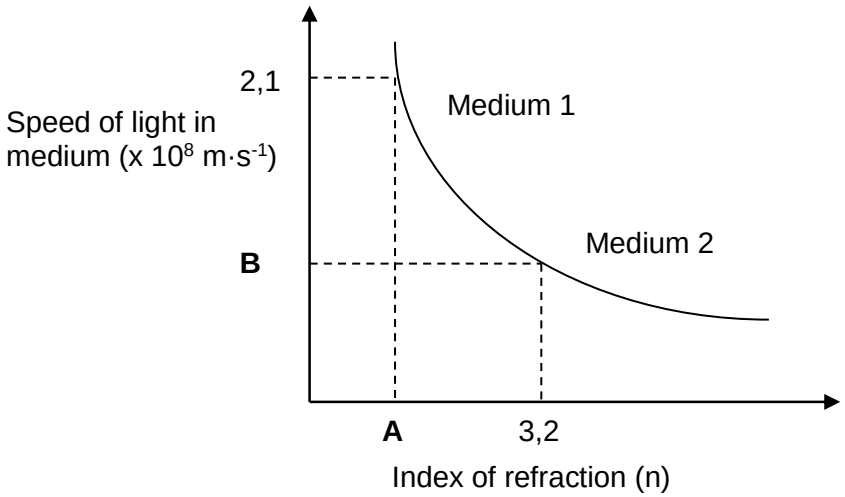
6.4.1 Redraw the above pattern, observed when passing red light through slit **X**, into your ANSWER BOOK. Below this pattern, draw the pattern that will be obtained for blue light. (2)

6.4.2 Explain the difference in the two patterns. (2)

[8]

QUESTION 7

Study the graph and answer the questions that follow.



7.1 Calculate the value of **A**. (3)

7.2 Calculate the value of **B**. (2)

7.3 Which medium (**1** or **2**) is the optically less dense medium? Give a reason for the answer. (2)

7.4 Calculate the critical angle for medium **2** when light moves from medium **2** to air. (4)
[11]

QUESTION 8

Hydrogen reacts with oxygen to form water and carbon reacts with oxygen to form carbon dioxide.

8.1 Write down the number of valence electrons in an atom of:

8.1.1 Hydrogen (1)

8.1.2 Carbon (1)

8.2 Define the term *covalent bond*. (2)

8.3 Draw the Lewis structure for:

8.3.1 A hydrogen molecule (2)

8.3.2 A carbon dioxide molecule (2)

8.4 Write down the name of the intermolecular forces between:

8.4.1 Water molecules (1)

8.4.2 Hydrogen molecules (1)

8.4.3 Carbon dioxide molecules (1)

8.5 Write down the molecular shape of:

8.5.1 H_2O (1)

8.5.2 CO_2 (1)

8.6 Consider the average bond energies and bond lengths given below.

	Bond	**Energy (kJ·mol^{-1})**	**Bond length (pm)**
1	H – H	432	74
2	H – C	415	109
3	C – O	326	143
4	C = O	803	120

8.6.1 Define the term *bond length*. (2)

8.6.2 Compare the bond lengths and the bond energies of bonds **1**, **2** and **3** given in the above table. Write down the relationship between bond energy and bond length. (2)

8.6.3 Give a reason for the difference in bond lengths of bonds **3** and **4**. (1)

8.7 The table below shows the boiling points of water and three compounds of carbon and hydrogen.

	Compound	**Relative molecular mass**	**Boiling point (°C)**
1	H_2O	18	100
2	CH_4	16	- 162
3	C_2H_6	30	- 89
4	C_3H_8	44	- 42

8.7.1 Compare the boiling point of water to that of the other three compounds. Refer to the type of intermolecular forces to explain the difference in boiling points. (2)

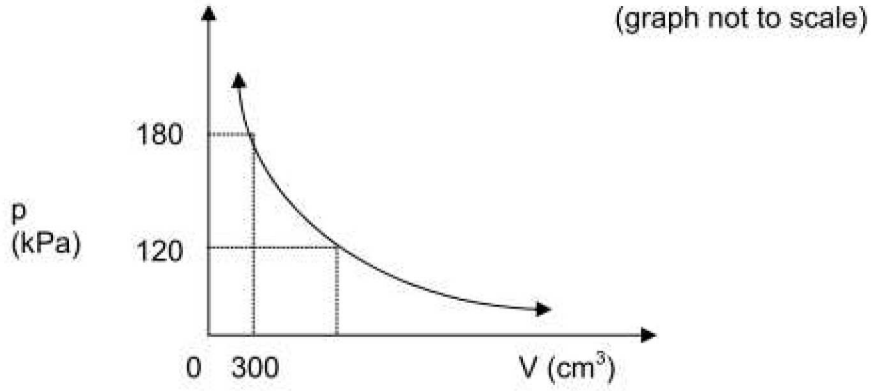
8.7.2 What is the trend in boiling points of compounds **2**, **3** and **4**. (1)

8.7.3 Fully explain the trend in QUESTION 8.7.2. (3)

[24]

QUESTION 9

Oxygen gas is used to investigate Boyle's law at constant temperature. The following graph is obtained:

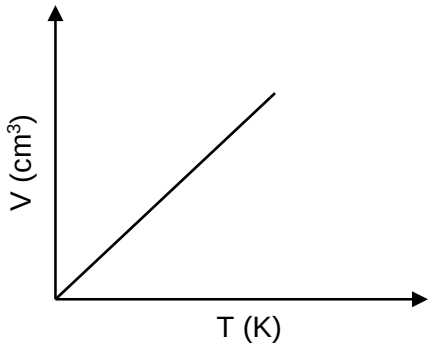


9.1 Use symbols to write down Boyle's law. (2)

9.2 Calculate the volume of the oxygen gas, in cm^3, at 120 kPa. (4)

9.3 When the temperature of 0,384 g of oxygen gas in a 200 cm^3 metal cylinder is 27 °C, an accurate pressure gauge shows a reading of 149,58 Pa. Use a calculation to show that oxygen is a diatomic gas. (7)

9.4 The graph below represents the relationship between volume and temperature for an ideal gas at a constant pressure.



9.4.1 Redraw the above graph in your ANSWER BOOK. On the same set of axes, use a BROKEN LINE to sketch the graph that will be obtained for oxygen gas. (1)

9.4.2 Explain the deviation of oxygen gas from ideal gas behaviour. (3)

[17]

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	6,38 x 10^6 m
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Mass of the Earth *Massa van die Aarde*	M	5,98 x 10^{24} kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max)}}{N}$
$\mu_k = \frac{f_k}{N}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

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*
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard pressure *Standaarddruk*	p^θ	1,013 x 10^5 Pa
Standard temperature *Standaardtemperatuur*	T^θ	273 K
Molar gas constant *Molêre gaskonstante*	R	8,31 $J \cdot K^{-1} \cdot mol^{-1}$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	

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)
2,1 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

KEY/*SLEUTEL*