Education and Sport Development
Department of Education and Sport Development
Departement van Onderwys en Sport Ontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko
NORTH WEST PROVINCE

PROVINCIAL MID YEAR EXAMINATION

GRADE 11

PHYSICAL SCIENCE

MAY/JUNE 2019

QUESTION PAPER

MARKS: 150

TIME: 3 hours

This question paper consists of 13 pages, a graph paper, 3 data sheets and a periodic table.

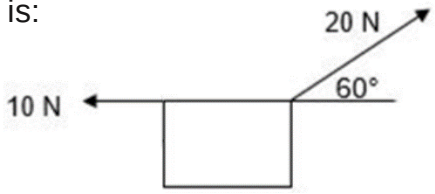
INSTRUCTIONS AND INFORMATION

1. Write your name on your ANSWER SHEET.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER SHEET.
3. Complete the table and **QUESTION 9.5** on the **GRAPH PAPER.**
4. Start EACH question on a NEW page on the ANSWER SHEET.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
7. You may use a non-programmable calculator.
8. You may use appropriate mathematical instruments.
9. You are advised to use the attached DATA SHEETS.
10. Show ALL formulae and substitutions in ALL calculations.
11. Round off your final numerical answers to **a minimum** of TWO decimal places.
12. Give brief motivations, discussions, et cetera where required.
13. 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 (1.1-1.10) on your ANSWER SHEET, for example 1.1 D.

1.1 Two forces are acting on a block as shown in the diagram. The resultant force in the horizontal direction is:



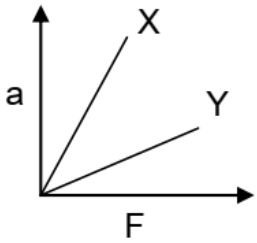
A zero

B 10 N to the right

C 10 N to the left

D 20 N to the right (2)

1.2 The graphs below show the relationship between the net force and the acceleration for two masses X and Y.



Which one of the following statements is true?

A The bodies have equal masses.

B Body X has a smaller mass.

C Body Y has a smaller mass.

D The mass does not affect the gradient of the graphs. (2)

1.3 An artificial satellite circles around the earth at a height where the gravitational force is a ¼ of that at the surface of the earth. If the earth's radius is R, the height of the satellite **above the surface** of the earth is

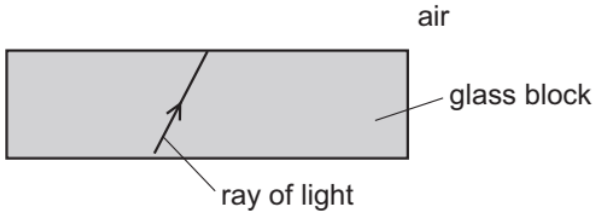
A 2R

B R

C ½ R

D ¼ R (2)

1.4 A ray of light in a glass block strikes the edge of the block. The angle of incidence is much smaller than the critical angle.



What happens to this ray?

A It is completely reflected.

B It is completely refracted.

C It is partially reflected and partially refracted.

D It is refracted at an angle of refraction of 90°. (2)

1.5 A wave passes from a medium of high optical density to one of low optical density. Which ONE of the following is correct?

A The frequency of the wave remains constant.

B The speed of the wave remains constant.

C The frequency of the wave increases.

D The frequency of the wave decreases. (2)

1.6 The molecular shape of a molecule with the formula AB_2 is either …

A linear or bent.

B linear or trigonal planar

C linear or tetrahedral

D linear or trigonal bipyramidal (2)

1.7 Iodine crystals ($I_2(s)$) are soluble in ethanol ($CH_3CH_2OH(l)$) because the …

A hydrogen bonds between ethanol molecules are much stronger than the dispersion forces between iodine molecules.

B hydrogen bonds between ethanol molecules and the covalent bonds between iodine molecules are of comparable strength.

C iodine molecules and the ethanol molecules are non-polar and “like dissolve like”.

D London/dispersion forces between ethanol molecules and iodine molecules are of comparable strength and “like dissolve like”. (2)

1.8 Which ONE of the bonds between the atoms below has the highest polarity?

A H – C

B H – Cl

C H – O

D H – N (2)

1.9 0.5 dm^3 of a gas at 20 °C and 130 kPa is cooled down while the volume is kept constant. The pressure on the gas at a temperature of -5 °C is …

A 142,13 kPa.

B 123,34 kPa.

C 118,91 kPa.

D 32,5 kPa. (2)

1.10 The calculation in ***QUESTION 1.9*** is an illustration of …

A Avogadro's Law.

B Charles's Law.

C Guy-Lussac's Law.

D The ideal gas law. (2)

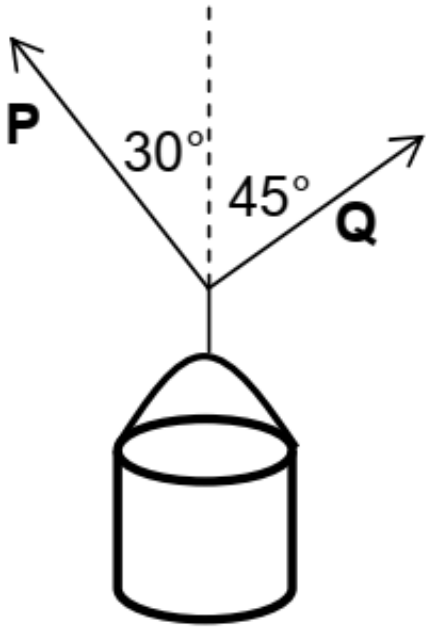
[20]

QUESTION 2

The grade 11 learners learn that there is more than one way to determine the resultant of two vectors. One way is die COMPONENT METHOD. They want to use THIS METHOD to find the resultant of the forces acting on a bucket by the ropes from which the bucket is suspended. The bucket is *stationary.*

2.1 Define the term *resultant.* (2)

2.2 The tension in rope **P** is 130N at an angle of 30º to the vertical and the tension in **Q** is 91,92N at 45º to the vertical.



Calculate the MAGNITUDE of the:

2.2.1 Horizontal components of P and Q respectively. (4)

2.2.2 Vertical components of P and Q respectively. (4)

2.2.3 Resultant of the horizontal components. (1)

2.2.4 Resultant of the vertical components. (1)

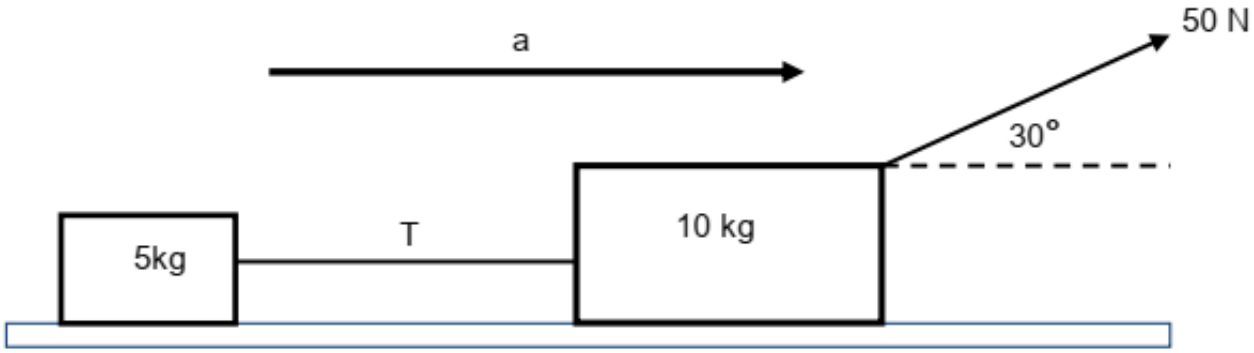
2.2.5 Resultant of the forces exerted by P and Q on the bucket. (1)

2.3 Determine the MASS of the bucket. (3)

[16]

QUESTION 3

Keanon pulls a 10kg block, attached to a 5 kg block by a light, inextensible string of negligible mass, with a force of 50 N at an angle of 30º with the horizontal as shown below. The 10 kg block experience a kinetic frictional force of 20 N. The coefficient of kinetic friction between die surface and the 5 kg block is 0,2.



3.1 State *Newton's Second Law of Motion* in words. (2)

3.2 Draw a labelled free body diagram showing all the forces acting on the 10 kg block.
Note: *No components of forces may be used in the diagram.* (5)

3.3 Calculate the magnitude of the:

3.3.1 Normal force exerted on the 10kg block. (4)

3.3.2 Acceleration of the blocks. (7)

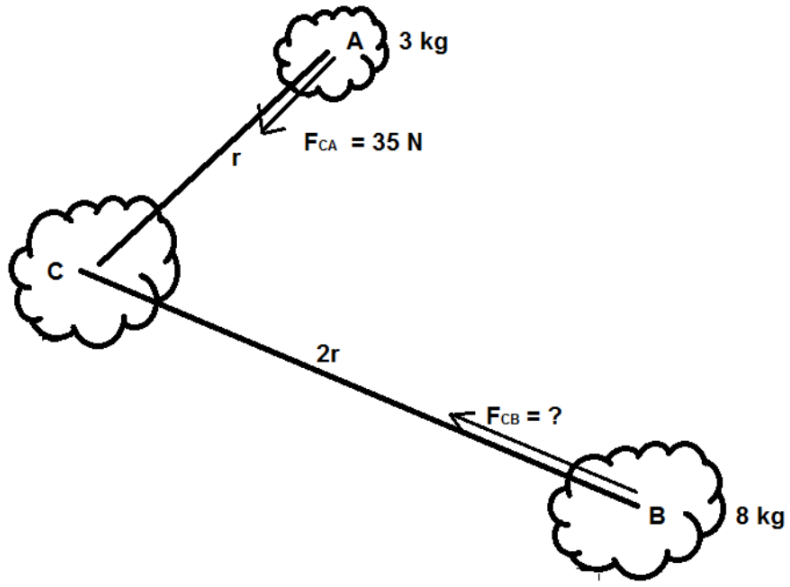
3.3.3 Tension in the string. (2)

3.4 How will the magnitude of the normal force calculated in QUESTION 3.3.1 be affected if the angle between the applied force and the horizontal decreases? Choose from INCREASES, DECREASES or REMAINS THE SAME.
Explain your answer. (3)

3.5 Use Physics principles to explain why it is very dangerous when children are not secured in a child's car seat when travelling by car. (3)
[26]

QUESTION 4

Three objects A, B and C are moving through space at right angles to each other. The mass of A is 3 kg and the mass of B is 8 kg. The distance between C and A is r and the distance between C and B is 2r. F_{CA} is 35 N.



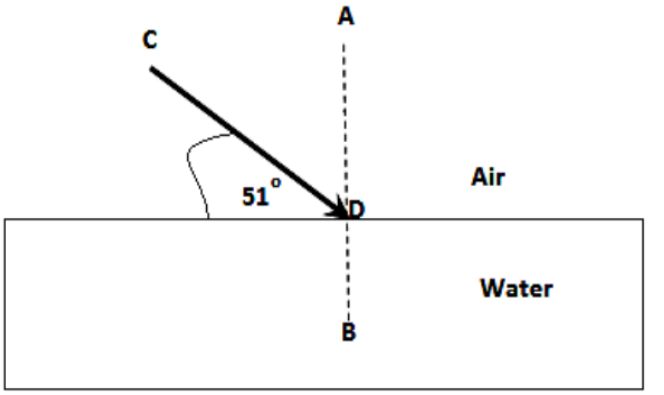
4.1 Define *Newton's Law of Universal Gravitation*, in words. (2)

4.2 Calculate the force between C and B. (6)

[8]

QUESTION 5

5.1 Consider the following diagram of the light ray (c) striking an interface between air and water. The angle that the light ray makes with the surface of the water is 51°, as shown in the diagram.



n_{air} = 1,00

n_{water} = 1,33

5.1.1 Name the line AB. (1)

5.1.2 Calculate the angle of refraction for the light ray when it travels from air to water. (4)

5.1.3 On your **ANSWER SHEET**, redraw the sketch above and show the path of the light ray as it moves from air to water and emerges into the air again. LABEL YOUR SKETCH. (2)

5.1.4 What happens to the speed of light as the light moves from AIR to WATER? Write only INCREASES, DECREASES or REMAINS THE SAME. (2)

5.1.5 Explain your answer to QUESTION 5.1.4. (2)

5.2 Optical fibres are generally composed of silica, with an index of refraction of 1,44. The outer layer has a low index of refraction.

5.2.1 Why is the outer layer optically less dense than the inner layer? (2)

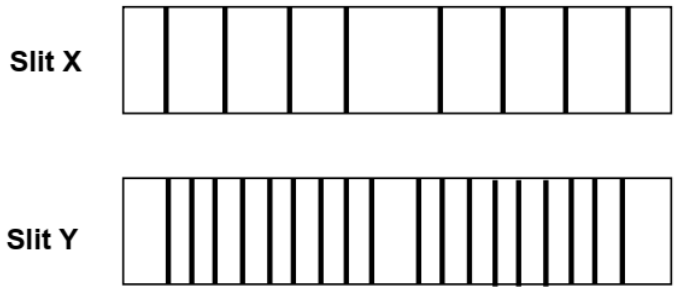
5.2.2 Name ONE use of optical fibres. (1)

5.2.3 Calculate how fast light travels in a silica fibre. (3)
[17]

QUESTION 6

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

In the first experiment, they use monochromatic **red light** and observe the two patterns of different widths.



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 Learners now pass **blue light** through **slit X**.

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

6.4.2 Explain the difference in these two patterns. (2)
[8]

QUESTION 7

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

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

7.2 Draw the Lewis structure for:

7.2.1 A water molecule (2)

7.2.2 A carbon dioxide molecule (2)

7.3 Write down the name of the intermolecular forces between:

7.3.1 Water molecules (1)

7.3.2 Carbon dioxide molecules. (1)

7.4 Write down the molecular shape of:

7.4.1 H_2O (1)

7.4.2 CO_2 (1)

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

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

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

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

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

[15]

QUESTION 8

Consider the following substances with their formulae and approximate boiling points at atmospheric pressure.

Name	Formula	Boiling point (°C)
Iodine	I_2	184
Water	H_2O	100
Ethanol	CH_3CH_2OH	78
Bromine	Br_2	59
Hydrogen bromide	HBr	-67

8.1 Explain the difference in boiling points between by **iodine and bromine** referring to the relevant *intermolecular forces* and their influences. (3)

8.2 Can ethanol dissolve in water? Choose from YES or NO. (1)

8.3 Explain your answer to ***QUESTION 8.2*** by referring to intermolecular forces. (3)

8.4 Hydrogen bromide has the highest vapour pressure of the substances in the table.

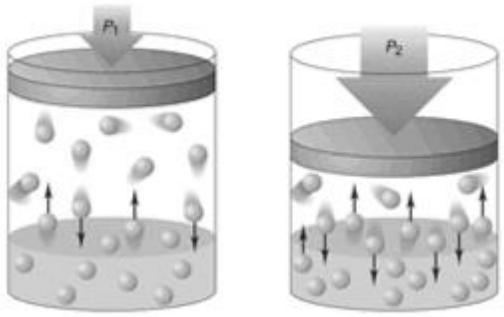
8.4.1 Define the term *vapour pressure*. (2)

8.4.2 Briefly explain why its vapour pressure is the highest. (2)

[11]

QUESTION 9

A learner investigates the relationship between the pressure and volume of a given amount of gas at a constant temperature.



The following readings are obtained:

Pressure (kPa)	Volume (cm^3)	$\frac{1}{\text{pressure}}$ (kPa^{-1})
62	103	
70	88	
80	73	
90	62	
110	42	
180	25	
250	18	
360	10	

Complete the **table on the GRAPH SHEET** and then answer the following questions.

9.1 *Name* and *state the law* that is being investigated in this experiment. (3)

9.2 Identify the following variables for this experiment:

9.2.1 Independent variable (1)

9.2.2 Dependent variable (1)

9.3 Name ONE variables that must be kept constant in this experiment. (1)

9.4 Write an investigative question for this experiment. (2)

9.5 Sketch a graph of *volume* (on y-axis) against $\frac{1}{\textit{pressure}}$ (on x-axis) using the **GRAPH PAPER** provided. (4)

[12]

QUESTION 10

10.1 Name TWO properties of an ideal gas. (2)

10.2 Under which circumstances do real gases behave like an ideal gas? (2)

10.3 A diver dives down into the sea, to where the temperature is 10ºC and the pressure is 150kPa. He releases a bubble of air from his lungs. The volume of the bubble, when released is 5 cm^3.

Calculate the volume of the bubble when it reaches the surface of the sea, where the temperature is 25ºC. (4)

10.4 For what does *STP* stand? (1)

10.5 When 35 g of an unknown gas is pumped into a closed, empty 12 dm^3 container at a constant temperatuur of 55ºC, the pressure inside the container is 285 kPa.

10.5.1 Calculate the number of mole gas in the container. (4)

10.5.2 Calculate the molar mass of the gas. (3)

10.5.3 Identify the gas. (1)

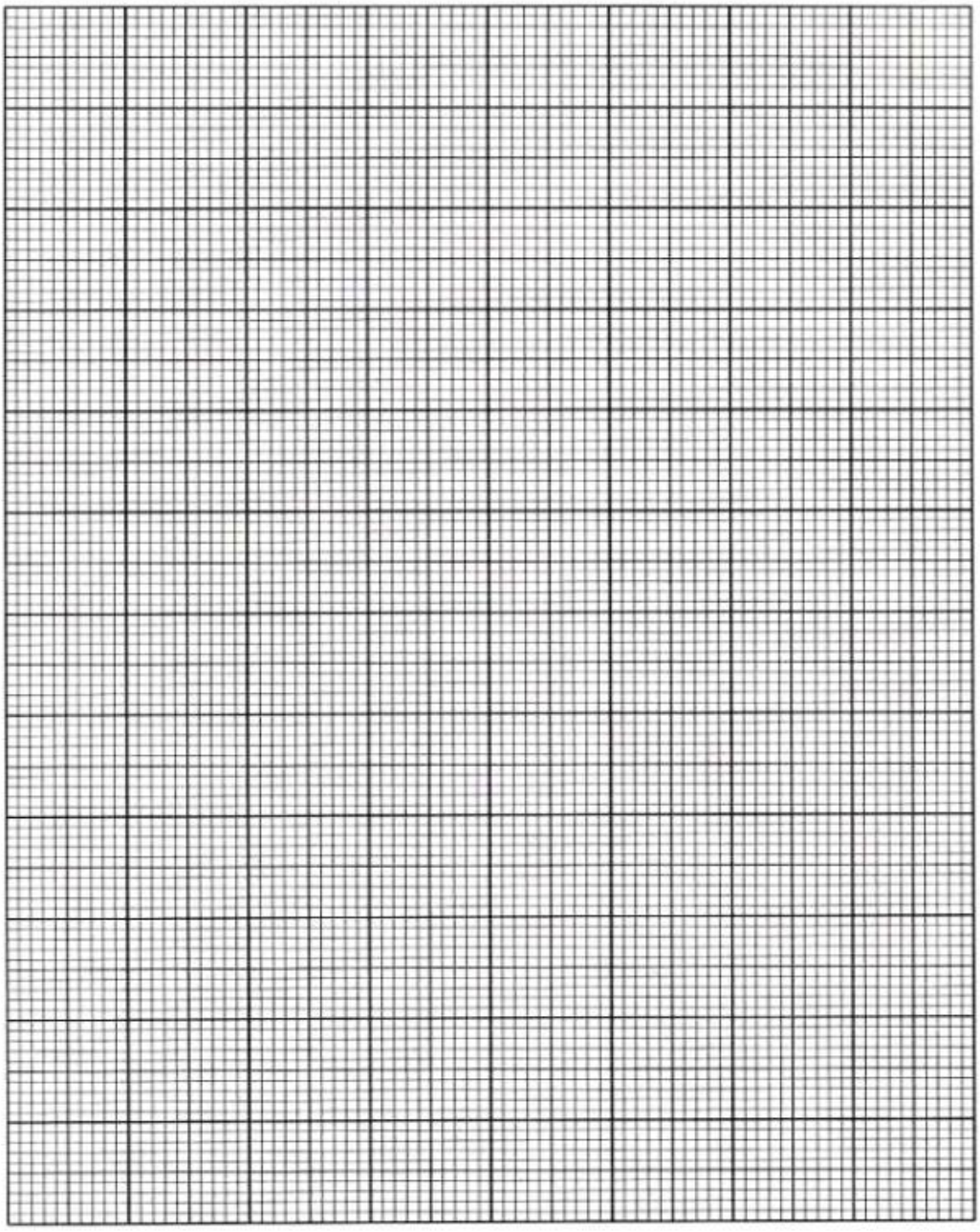
[17]

GRAND TOTAL: [150]

NAME:

TABLE AND GRAPH PAPER FOR QUESTION 9.5

Pressure (kPa)	Volume (cm^3)	$\frac{1}{\text{pressure}}$ (kPa^{-1})
62	103	
70	88	
80	73	
90	62	
110	42	
180	25	
250	18	
360	10	



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
Coulomb's constant *Coulomb se konstante*	K	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
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*

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

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$V = \frac{W}{Q}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$R = r_1 + r_2 + r_3 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

TABLE 3: CHEMISTRY PHYSICAL CONSTANTS
TABEL 3: CHEMIE FISIESE KONSTANTES

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}$ mol^{-1}
Molar gas constant *Molêre gaskonstante*	R	8,31 J·K^{-1}·mol^{-1}
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·mol^{-1}
Standard temperature *Standaardtemperatuur*	T^θ	273 K

TABLE 4: CHEMISTRY - FORMULAE

TABEL 4: CHEMIE - FORMULES

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$

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

KEY/*SLEUTEL*

Key
29 1,9 Cu 63,5

- Atomic number / *Atoomgetal*: 29
- Electronegativity / *Elektronegatiwiteit*: 1,9
- Symbol / *Simbool*: Cu
- Approximate relative atomic mass / *Benaderde relatiewe atoommassa*: 63,5

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