education

Department of
Education
FREE STATE PROVINCE

JUNE EXAMINATION

GRADE 10

PHYSICAL SCIENCES

JUNE 2024

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MARKS: 150

TIME: 3 HOURS

This paper consists of 14 pages and three information sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 10 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. Keep the sub questions of the same question together.
7. You may use a non-programmable pocket 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 where applicable.
12. Give brief motivations, discussions, et cetera where required.
13. Write neatly and legibly.

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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 statements is true for transverse waves?

A The oscillations of a transverse wave are perpendicular to the direction in which the waves transfer energy.

B The oscillations of a transverse wave are parallel to the direction in which the waves transfer energy.

C The oscillations of a transverse wave are at 45° to the direction in which the waves transfer energy.

D. The oscillations of a transverse wave are in the same direction in which the waves transfer energy. (2)

1.2 Ultrasound waves are sound waves of a frequency…

A above 2 kHz.

B above 20 kHz.

C above 20 MHz.

D above 200 kHz. (2)

1.3 The part of the spectrum of the electromagnetic radiation used to cook food is …

A X-rays

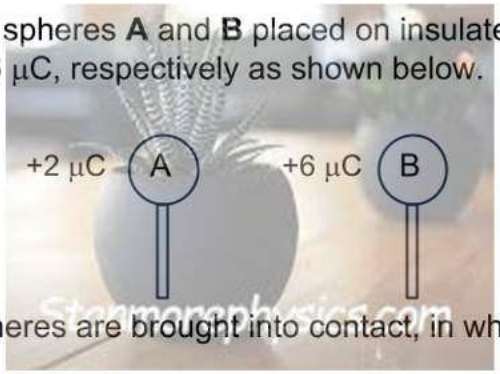
B gamma rays

C microwaves

D ultraviolet rays (2)

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1.4 Two identical spheres **A** and **B** placed on insulated stands, carry charges of +2 μC and +6 μC, respectively as shown below.



When the spheres are brought into contact, in which direction do electrons move?

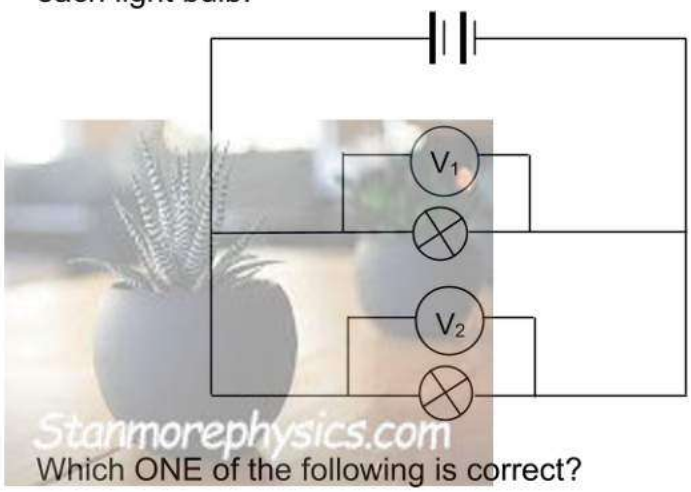
A From **A** to **B**

B From **B** to **A**

C No movement as both spheres are positively charged

D No movement, electrons remain in **A** (2)

1.5 Two identical light bulbs are connected in parallel, as shown in the circuit diagram below. Voltmeters V_1 and V_2 are connected across each light bulb.



Which ONE of the following is correct?

A $V_1 = \frac{1}{4}V_2$

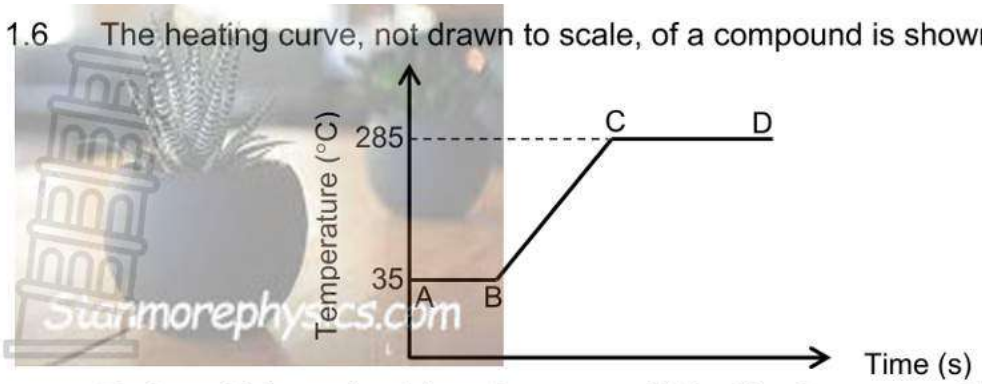
B $V_1 = \frac{1}{2}V_2$

C $V_1 = 2V_2$

D $V_1 = V_2$ (2)

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1.6 The heating curve, not drawn to scale, of a compound is shown below.



During which section(s) on the curve will the kinetic energy of the compound INCREASE?

A AB, BC and CD

B AB and CD

C CD only

D BC only (2)

1.7 Elements in the periodic table are arranged in order of increasing …

A mass number.

B number of protons.

C number of neutrons.

D number of nucleons. (2)

1.8 Ionic bonding occurs when a …

A metal reacts with a metal.

B metal reacts with noble gas.

C non-metal reacts with a metal.

D non-metal reacts with a non-metal.

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1.9 Which ONE of the following statements is INCORRECT about the properties of a physical change?

A When a physical change occur, the bonds in between the atoms will not break.

B Molecules are not conserved during a physical change.

C Physical change in matter is reversible.

D Energy is absorbed when matter changes from a solid to a liquid. (2)

1.10 In the compound, H_2O, the ratio of the MASS of hydrogen to oxygen is always …

A 1 : 2.

B 2 : 1.

C 1 : 8.

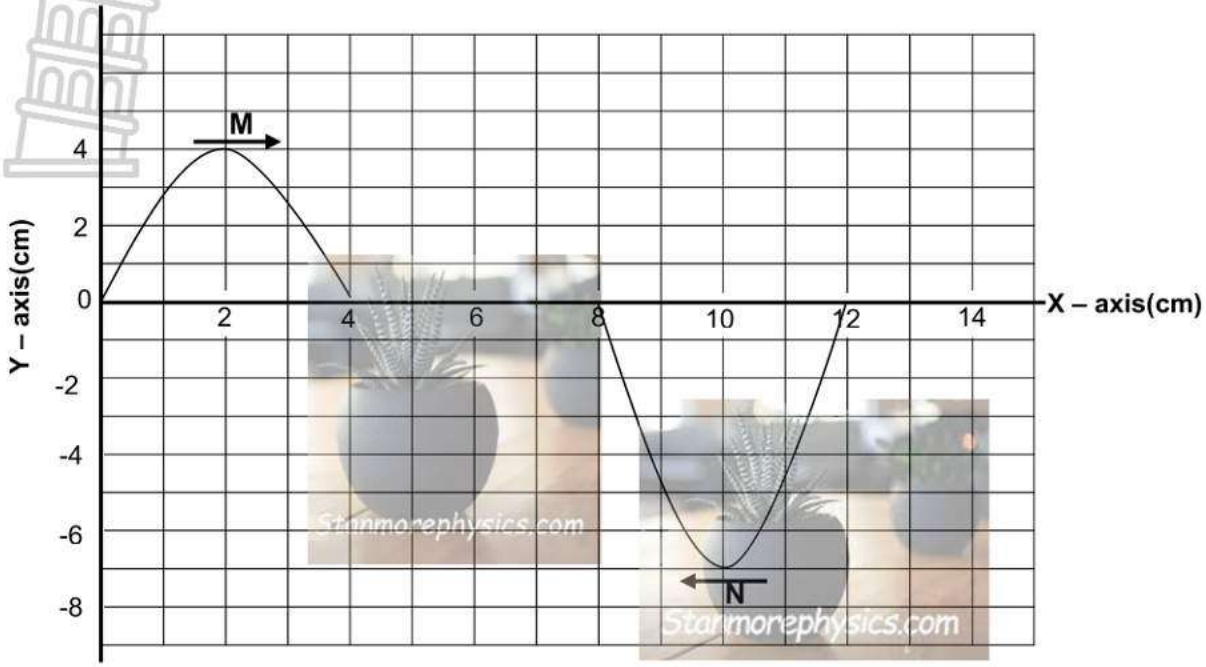
D 1 : 16. (2)

[20]

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QUESTION 2

Two pulses **M** and **N** travel towards each other through the same medium as shown in the diagram below.



2.1. Define the term *pulse*. (2)

2.2 Determine the magnitude of the:

2.2.1 Pulse length for pulse **M**. (1)

2.2.2 Amplitude of pulse **N.** (1)

The two pulses travel for 4 cm along the x-axis in opposite directions as shown and meet.

2.3 Draw the resulting pulse. Show the new amplitude and pulse length. (3)

2.4 Write down the name of the principle illustrated in QUESTION 2.1.3. (1)

2.5 Write down the type of interference that occurred when the pulses meet. (1)

2.6 Draw the shape of the resulting pulse(s) after pulses **M** and **N** have travelled for 8 cm along the x-axis. Indicate the direction of each pulse and their amplitudes. (4)

[13]

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QUESTION 3

3.1 **Diagram 1** shows the sound wave produced by a tuning fork on an oscilloscope.

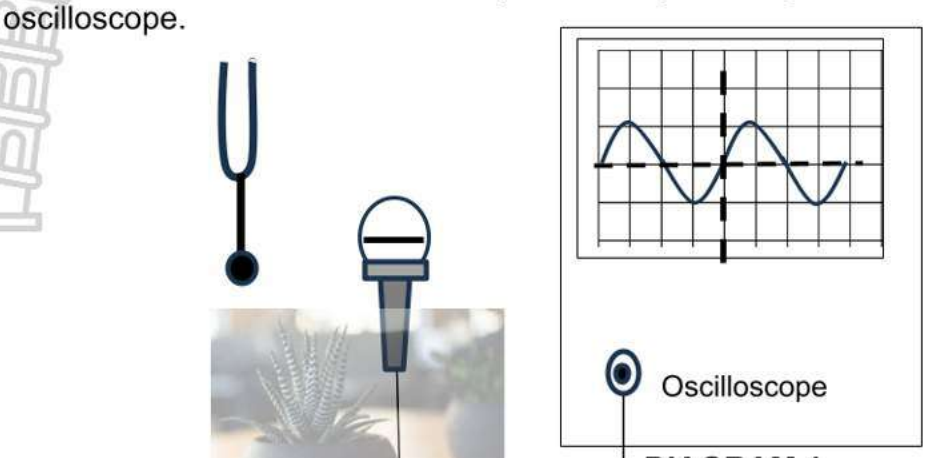


DIAGRAM 1

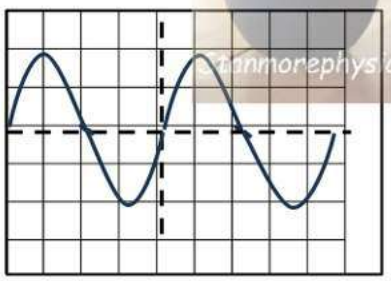


DIAGRAM 2

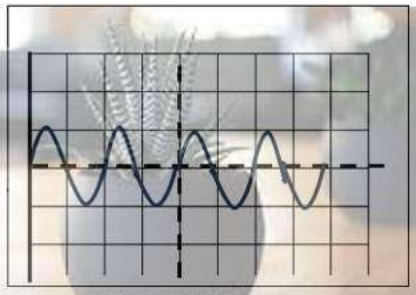


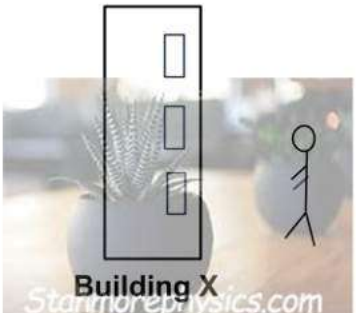
DIAGRAM 3

Diagrams 2 and **3** are produced when the pitch and loudness of the sound produced by the same tuning fork are changed.

Which diagram will be produced …

3.1.1 at high pitch? Explain the answer. (2)
3.1.2 by a louder sound? Explain the answer. (2)

3.2 A man stands between two tall buildings. When he claps his hands, he hears the echo from building **X** after 2 seconds and the echo from building **Y** after 3 seconds.



Building X **Building Y**

Calculate the distance between the two buildings. The speed of sound in air is 330 $m \cdot s^{-1}$. (6)
[10]

QUESTION 4

The table below shows different electromagnetic radiations and their corresponding wavelengths. All these radiations move through vacuum at a speed of $3x10^8$ m·s^{-1}.

Name of EMR spectrum	Radio waves	Micro waves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays
Wavelength (m)	$5x10^3$	$5x10^{-2}$	$5x10^{-4}$	$5x10^{-5}$	$5x10^{-8}$	$5x10^{-10}$	$5x10^{-13}$



4.1 Why are ALL these waves called electromagnetic radiation? (2)

4.2 Write down the name of the radiation that can be used in:

4.2.1 TV broadcasting. (1)

4.2.2 Remote controls. (1)

4.2.3 Killing of cancer cells. (1)

4.2.4 Production of food by plants. (1)

4.3 Write down TWO properties of electromagnetic radiations. (2)

4.4 Between infrared and ultraviolet light, which one has a higher:

4.4.1 Frequency? Use a calculation to support the answer. (4)

4.4.2 Penetrating ability? Explain the answer. (2)

4. 5 Define the term *photon*. (2)

4.6 Calculate the energy of a photon of gamma rays using the value in the table above (4)

[20]

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QUESTION 5

5.1 A grade 10 Physics teacher demonstrate to her class charging by induction. She uses a polythene rod and rub it with a cloth to charge it NEGATIVELY. She then brought the rod near an electroscope without the rod touching it (**diagram 1**) and the learners observed that the gold leaf rises (**diagram 2**).



Diagram 1

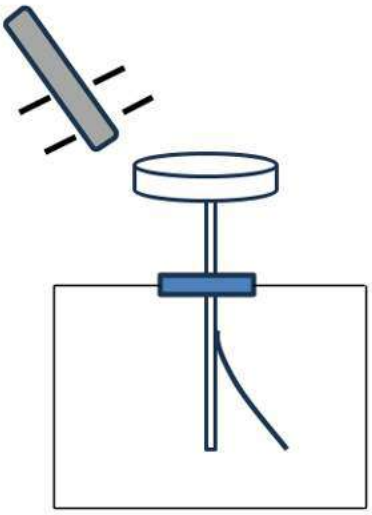


Diagram 2

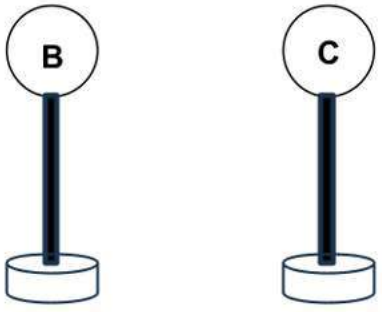
5.1.1 Write down the principle of conservation of charge in words. (2)

5.1.2 What is the charge of the disc in **diagram 2**? Explain. (3)

5.1.3 Explain why the gold leaf rises in **diagram 2**? (2)

5.2 Two small, metal spheres **B** and **C** on insulated stands, carry charges of $+2x10^{-6}$ C and $-8x10^{-6}$ C respectively.

5.2.1 Which sphere is carrying a bigger charge? Choose **B** or **C**. (1)



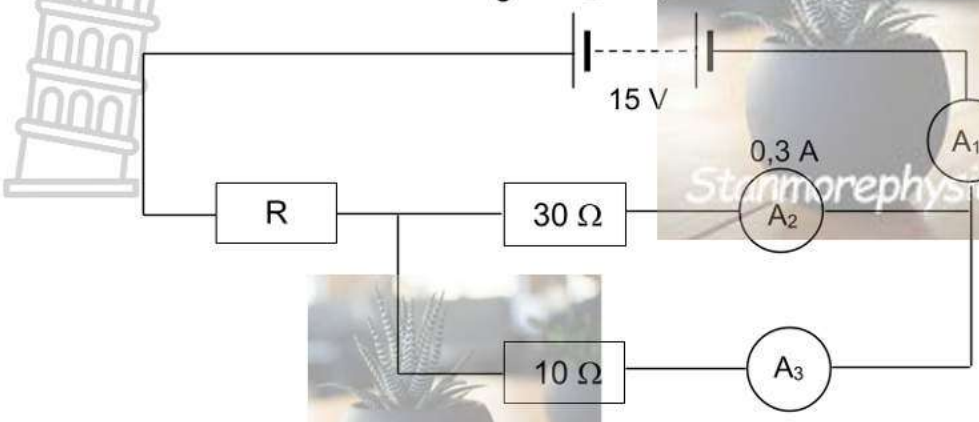
The spheres are allowed to touch, after which they are then separated and return to their original positions.

5.2.2 Calculate the new charge in each sphere after they are separated. (3)

[11]

QUESTION 6

A battery with a negligible internal resistance and emf of 15 V is connected in the circuit as shown below. The reading on A_2 is 0,3 A.



6.1 Define the term *emf* in words. (2)

6.2 Determine the potential difference across the 10 Ω. (3)

6.3 Calculate the:

6.3.1 Potential difference across resistor **R**. (2)

6.3.2 The total current in the circuit. (3)

6.3.4 Effective resistance of the parallel combination. (3)

6.3.4 Total resistance of the circuit. (3)

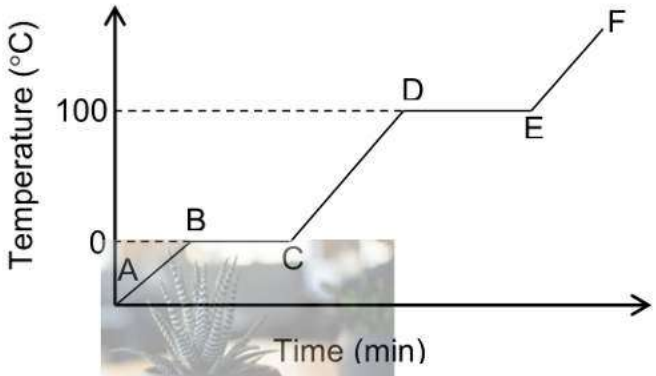
6.4 Calculate the amount of charge that passes through resistor **R** in 5 minutes. (4)

[20]

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QUESTION 7

The following diagram, not drawn to scale, represents the heating curve of a certain substance. At point **A** the substance is a solid.



7.1 Why is the curve, a heating curve? Explain the answer. (1)

Use the information in the diagram to answer the following questions.

7.2 Between which points:

7.2.1 Is the attraction force strongest? (1)

7.2.2 Are particles far from each other and the intermolecular forces the weakest? (1)

7.2.3 Is a substance showing mixture of solid and liquid? (1)

7.3 Explain the properties of the particles at point **A**, with regard to distance between particles and their motion. (2)

7.4 Write down the name of the process taking place at **DE**. (1)

7.5 Write down the boiling point of this substance in °C (1)
[8]

QUESTION 8

8.1 Define *atomic radius*. (2)

8.2 Explain the trend in the atomic radius across a period. (3)

8.3 Complete the table below for substances K and $A\ell^{3+}$. Write down ONLY the question number (8.3.1 to 8.3.4) and the answer in the answer book.

Atom / Ion	Number of Protons	Number of Electrons	Number of Neutrons
^{39}K	**8.3.1**	19	**8.3.2**
$^{27}A\ell^{3+}$	13	**8.3.3**	**8.3.4**

(4)

8.4 In nature, magnesium has the following common isotopes.

Isotopes	Molar Mass	Abundance (%)
^{24}Mg	23,985	**X**
^{25}Mg	24,959	10,13
^{26}Mg	25,983	11,17

8.4.1 Calculate the isotopic abundance (**X**) of ^{24}Mg. (1)

8.4.2 Which one of the three isotopes is most abundant? Explain the answer. (2)

8.4.3 Calculate the relative atomic mass of Mg. (4)

8.5 Write down the electronic configuration (sp notation) for the oxide ion. (2)
[18]

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QUESTION 9

9.1 HCℓ is a gaseous molecule.

9.1.1 Define *chemical bond*. (2)

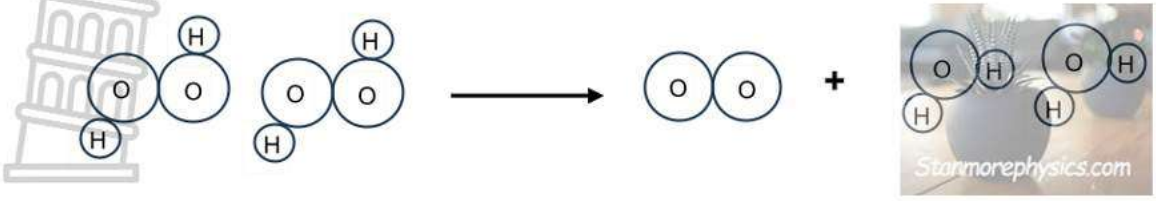
9.1.2 Write down the NAME of the HCℓ molecule. (1)

9.1.3 Name the type of bond between atoms in the HCℓ molecule. Explain the answer (2)

9.2 Use Lewis diagrams to show formation of ammonia (NH_3) (4)
[9]

QUESTION 10

10.1 The diagram below shows a reaction of hydrogen peroxide forming water and oxygen when a suitable catalyst is used.



10.1.1 Write down the balanced equation for the reaction using the diagram shown above. (3)

10.1.2 Is this an example of a SYNTHESIS or DECOMPOSITION reaction? Explain the answer. (2)

10.1.3 Does the diagram represent a CHEMICAL or PHYSICAL change? Explain the answer. (2)

10.1.4 Show by calculation that mass is conserved. (4)

10.2 10 g of sodium hydroxide completely reacts with copper (II) sulphate according to the following balanced equation:

$$2NaOH(aq) + CuSO_4(aq) \rightarrow Cu(OH)_2(s) + \mathbf{X}(aq)$$

10.2.1 Calculate the number moles of NaOH that have reacted with copper sulphate. (4)

10.2.2 Determine the mass of $Cu(OH)_2$ produced. (5)

10.2.3 Write down the chemical formula for **X.** (1)

[21]

GRAND TOTAL: 150

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DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
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	$6,63 \times 10^{-34}\ J{\cdot}s$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

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TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

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

$U = mgh$ or/*of* $E_P = mgh$	$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$
$E_M = E_k + E_p$ or/*of* $E_M = K + U$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	$Q = \frac{Q_1 + Q_2}{2}$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$Q = I\Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$R_s = R_1 + R_2 + \ldots$	$V = \frac{W}{Q}$

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DATA SHEETS – PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: 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}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

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

3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	

KEY/*SLEUTEL*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit* → 1,9 **Cu** 63,5 ← Symbol *Simbool*

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

										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	
										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	
	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	
	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	
	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	
	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	
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	

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