Hoërskool Dr. Johan Jurgens

Physical Science Gr. 10

June 2025

Mid-year exam

Marks: 100

Time: 2 hours

Examiner: S Stoltz

Moderator: M Botha

INSTRUCTIONS AND INFORMATION

1. The question paper consists of seven questions and thirteen pages. Answer all questions.
2. Start EACH question on a NEW page.
3. Number your answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, e.g., between QUESTION 2.1 and QUESTION 2.2.
5. A non-programmable calculator may be used.
6. Appropriate mathematical instruments may be used.
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, etc. where required.
10. You are advised to use the attached data sheets.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.5).

1.1 Series circuits can be described as:

A. Potential difference dividers.
B. Current dividers.
C. Electrical circuits with multiple paths for current flow.
D. Resistance dividers. (2)

1.2 No more than two electrons can occupy the same orbital and two electrons in the same orbital must have opposite spins, is known as:

A. Hund’s rule
B. Heisenberg's Uncertainty Principle
C. Pauli's Exclusion Principle
D. Bohr’s model (2)

1.3 Which one of the following terms best describes the ability of a metal to change shape when hammered?

A. Brittleness
B. Density
C. Ductile
D. Malleable (2)

1.4 Which ONE of the following statements is CORRECT? All waves …

A. are transverse.
B. are longitudinal.
C. transfers energy.
D. moves through a vacuum. (2)

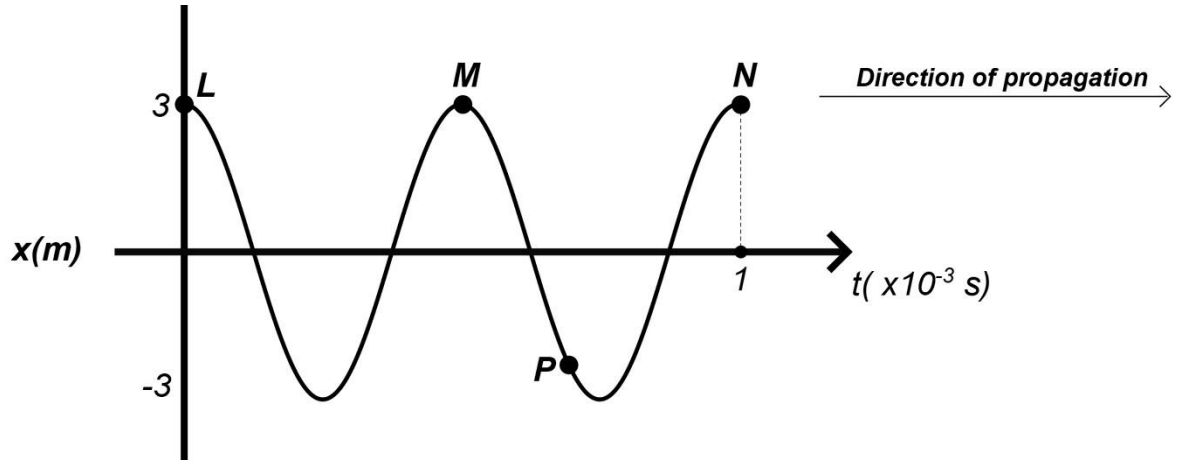
1.5 The atomic number of sulfur is:

A. 32
B. 2.5
C. VI
D. 16 (2)

[10]

QUESTION 2

Study the following wave form for a wave travelling at 340 $m.s^{-1}$ in air.



2.1 Define *wavelength*. (2)

2.2 How many wave cycles are there between points ***L*** and ***N***? (1)

2.3 How long does it take for the wave to make one complete wave cycle? (1)

2.4 Is point ***P*** moving UP or DOWN on the exact time as shown on the above wave form? (1)

2.5 Calculate the:

2.5.1 Frequency of this wave. (3)

2.5.2 Wavelength of this wave. (3)

2.6 Copy this wave diagram in your answer book. Label this wave **A**.

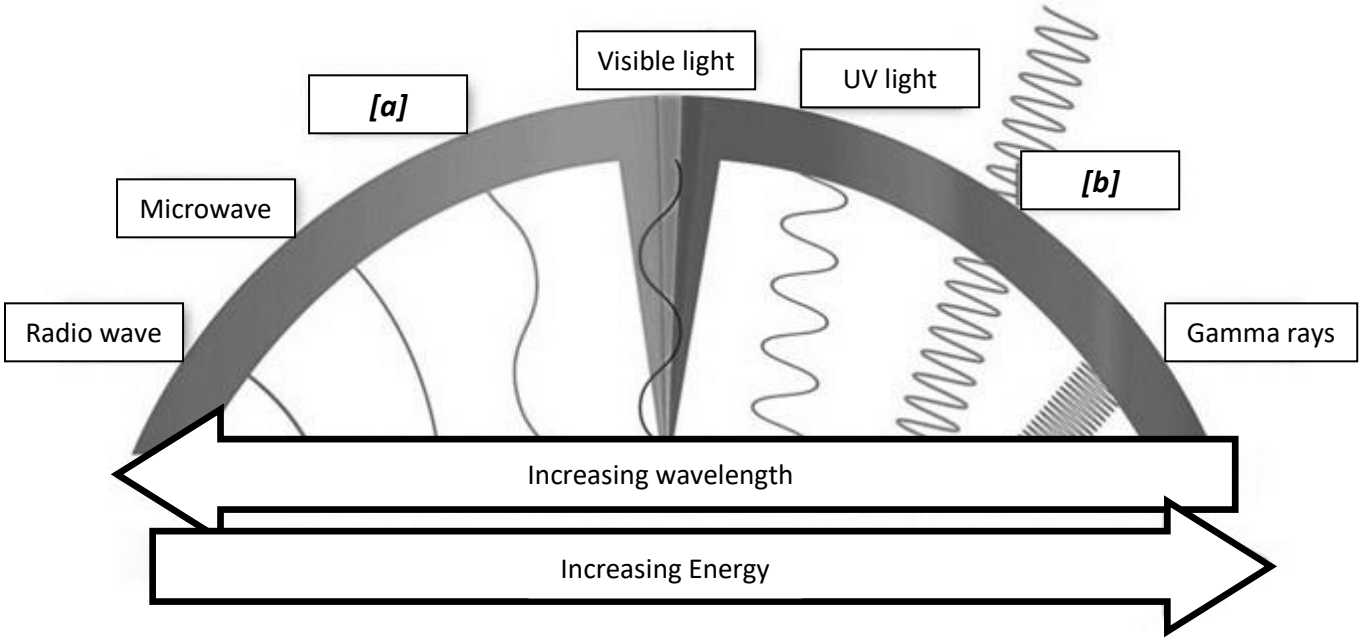
2.6.1 Draw a second wave (on the diagram which you have copied) with a pitch half that of wave **A** and an amplitude that is double that of wave **A**. Label this wave **B**. Indicate the relevant times and amplitude values for each wave cycle. (4)

2.6.2 How does the wavelength of wave **B** compare to that of wave **A**? Write LONGER THAN, EQUAL TO, or SHORTER THAN. (1)

[16]

QUESTION 3

The diagram depicts a representation of the EM spectrum.



3.1 What does the abbreviation ***EM*** stand for? (1)

3.2 Name TWO properties that all these types of waves possess. (2)

3.3 Give the NAME of wave ***[a].*** (1)

3.4 Define a *photon*. (1)

3.5 Calculate the wavelength of a photon of ***[b]*** whose energy is $1{,}989 \times 10^{-16}$ J. (3)

3.6 Will yellow light have a HIGHER or LOWER frequency than green light? (1)

[9]

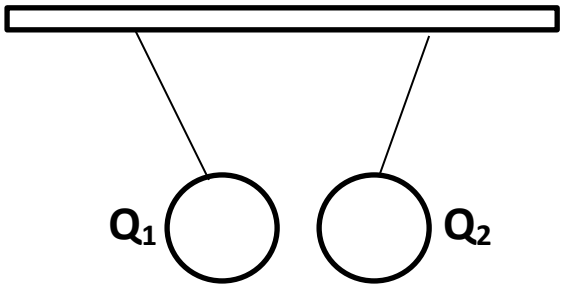
QUESTION 4

Two metal spheres are hanging on insulated threads.
Sphere Q_1 has **an excess of 3,75 x 10^{13} electrons** and sphere Q_2 has an unknown charge.

4.1 Will charge Q_1 be a positive or negative charge, why? (2)

4.2 Calculate the amount of charge on sphere Q_1. (3)

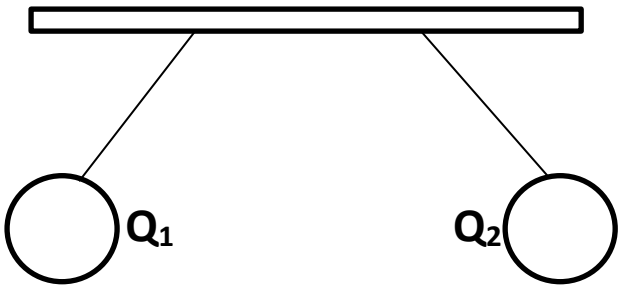
When the two spheres are allowed to move, they swing towards each other and makes contact.



4.3 What kind of charge (positive or negative) does sphere Q_2 have?
Explain your answer. (2)

4.4 In which direction did the electrons flow while the two speres are in contact?
Write only **FROM Q_1 TO Q_2** or **FROM Q_2 TO Q_1**. (1)

They then immediately swing apart and stay like shown in the diagram below.



4.5 State the principle of conservation of charge in words. (2)

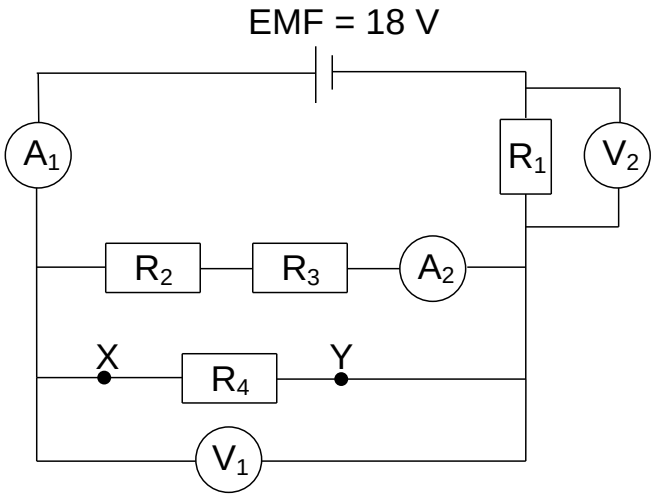
4.6 Explain why the two spheres swing apart after touching. (2)

4.7 The charge on both spheres after touching is +2 x 10^{-6} C.
Calculate the charge on sphere Q_2 before the two spheres touched. (3)

[15]

QUESTION 5

A battery with an emf of 18 V is connected to four resistors.
$R_1 = 4\ \Omega$; $R_2 = 2\ \Omega$; $R_3 = 1\ \Omega$ and $R_4 = 6\ \Omega$.



A charge of 180 C moves through the 2 Ω resistor in 1,5 minutes.

5.1 Define *one Coulomb.* (2)

5.2 Calculate the reading on A_2. (3)

5.3 Determine the:

5.3.1 Effective resistance of the parallel connection. (3)

5.3.2 Reading on V_1. (2)

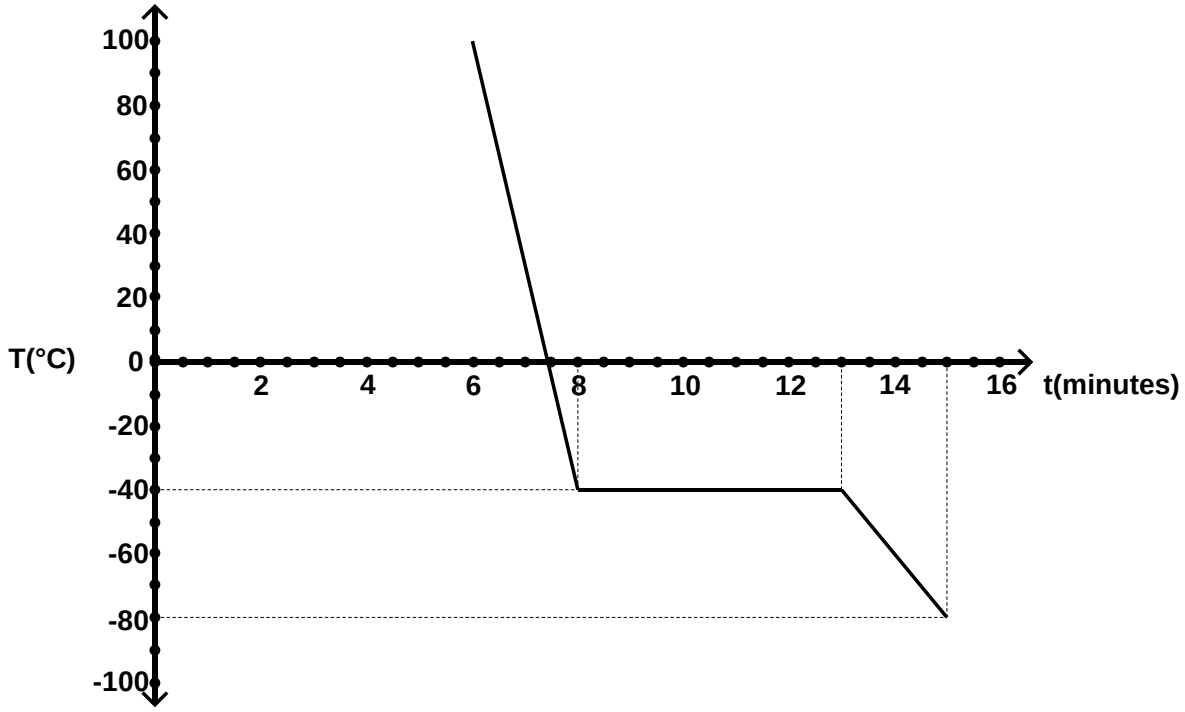
5.3.3 Energy transferred to the 2 Ω resistor in 1,5 minutes. (4)

5.4 A wire with negligible resistance is connected from point **X** to point **Y**.
Will the reading on A_1 INCREASE, DECREASE or REMAIN THE SAME?
Explain the answer. (3)

[17]

QUESTION 6

An unknown liquid is COOLED from 100 °C to – 80 °C.



6.1 What happens to the substance at t = 8 minutes to t = 12 minutes? (1)

6.2 Is the kinetic energy of the substance INCREASING, DECREASING or REMAINING CONSTANT from t = 8 minutes to t = 12 minutes? (1)

6.3 Which measuring instrument can be used to get an indication of the kinetic energy? (1)

6.4 Determine the melting point of the substance. (1)

6.5 Do the particles of the dust move more freely at 0 °C or at – 80 °C? (1)

6.6 Give a reason for your answer in QUESTION 6.5. (2)

6.7 Use the following table with melting points and boiling points to identify the substance that is being cooled. (1)

Substance	**Melting point (°C)**	**Boiling point (°C)**
Water	0	100
Lead	327	1613
Mercury	– 39	357

6.8 Define the term *boiling point*. (2)

6.9 To what temperature should the substance be heated for it to boil? (1)

[11]

QUESTION 7

A specific atom of an element has the following ($^{A}_{Z}E$) notation:

$$^{35}_{17}X$$

7.1 Define *atomic number*. (2)

7.2 What is the mass number of this element? (1)

7.3 How many protons does this element have? (1)

7.4 Give the name of this element. (1)

Consider the elements phosphorus and potassium.

7.5 Draw the Aufbau diagram (orbital box diagram) of a phosphorus ion. (3)

7.6 Give the electron configuration (sp-notation) of a potassium ion. (3)

7.7 Show the formation of the bond between phosphorus and potassium using Lewis diagrams. (3)

Nitrogen is a diatomic element (N_2) that occurs naturally in the atmosphere.
70% of the air we breathe is made up of nitrogen. Nitrogen has only two isotopes, and has a natural abundance of 99,6% N-14. The rest is N-15

7.8 Draw a Lewis diagram (electron diagram) of a nitrogen atom. (2)

7.9 Define the term, isotope. (2)

7.10 Calculate the relative atomic mass of nitrogen. Do not round your final answer. (4)

[22]

TOTAL: 100

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•s^{-2}
Universal gravitational constant / *Universelegravitasiekonstant*	G	6,67 × 10^{-11} N•m^{2}•kg^{-2}
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	3,0 × 10^{8} m•s^{-1}
Planck's constant / *Planck se konstante*	h	6,63 × 10^{-34} J•s
Coulomb's constant / *Coulomb se konstante*	k	9,0 × 10^{9} N•m^{2}•C^{-2}
Charge on electron / *Lading op elektron*	e	-1,6 × 10^{-19} C
Electron mass / *Elektronmassa*	m_e	9,11 × 10^{-31} kg
Mass of earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 10^{3} km

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ 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*

$F_{net} = ma$	$w = mg$
$\mu_k = \frac{f_k}{N}$	$\mu_s = \frac{f_s^{max}}{N}$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	p = mv
$F = \frac{Gm_1m_2}{d^2}$ or/of $F = \frac{Gm_1m_2}{r^2}$	$g = \frac{GM}{d^2}$ or/of $g = \frac{GM}{r^2}$

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/of $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or/of $E = W_0 + E_{k(maks)}$	$W_0 = hf_0$
$E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/of $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$	$n = \frac{Q}{q_e}$ or/of $n = \frac{Q}{e}$
$V = \frac{W}{q}$	

ELECTROMAGNETISM/ *ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$R_s = R_1 + R_2 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$
emf (ε) = I(R + r) or/of emk (ε) = I(R + r)	

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

W = F$\Delta x cos\theta$	U = mgh or/of E_p = mgh
K = ½mv^2 or/of E_k = ½mv^2	$W_{net} = \Delta K$ or/of $W_{net} = \Delta E_k$
$W_{nc} = \Delta K + \Delta U$ or/of $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
P_{ave} = Fv_{ave} or/of P_{gem} = Fv_{gem}	

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$	or/of $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ or/of $P_{gem} = V_{wgk}I_{wgk}$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$	or/of $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = I_{rms}^2 R$ or/of $P_{gem} = I_{wgk}^2 R$
		$P_{ave} = \frac{V_{rms}^2}{R}$ or/of $P_{gem} = \frac{V_{gem}^2}{R}$

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)
DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)

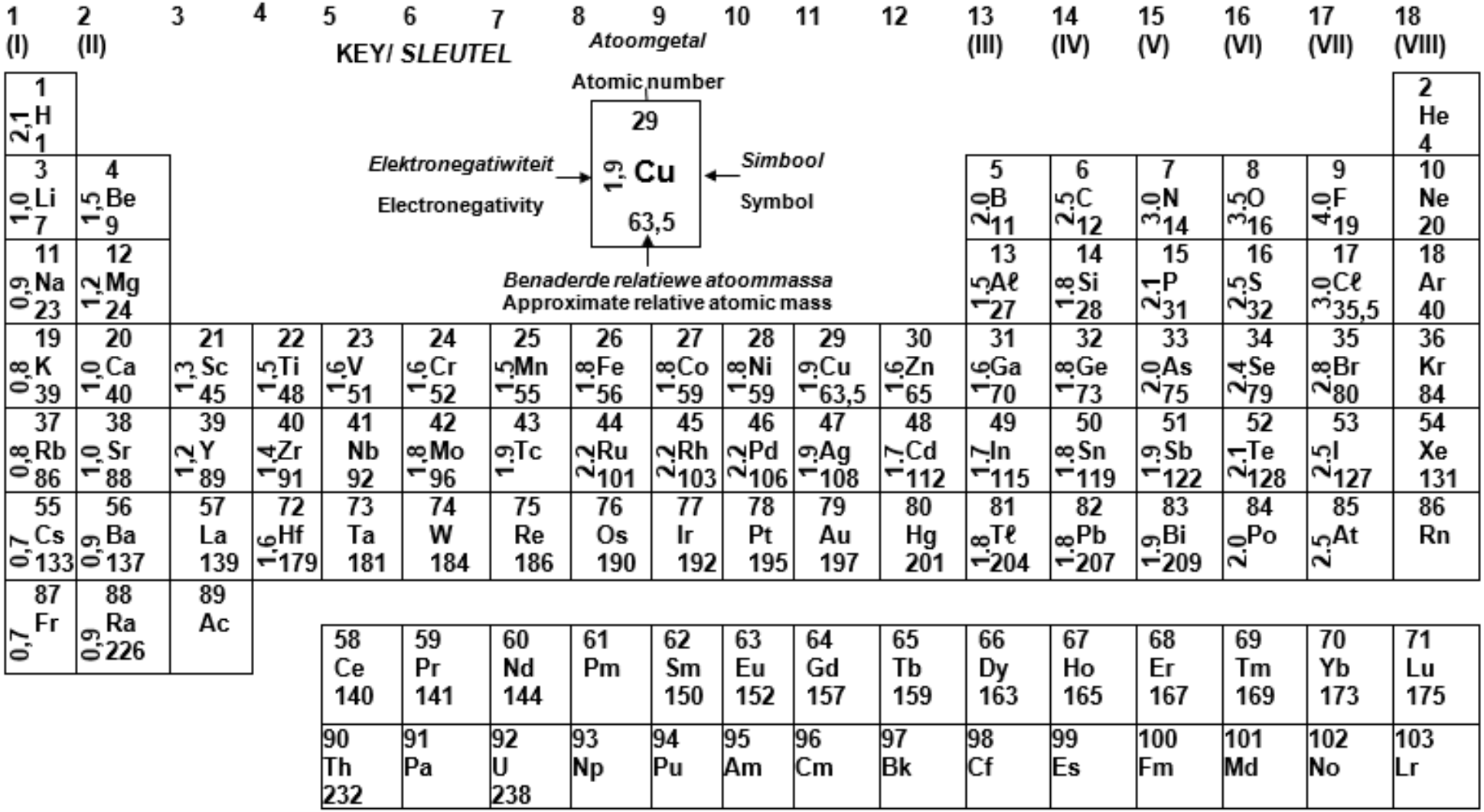
TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}$ kg
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 dm^3·mol^{-1}
Standard pressure *Standaarddruk*	$p^\ominus$	$1{,}013 \times 10^5$ Pa
Standard temperature *Standaardtemperatuur*	$T^\ominus$	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$K_W = [H_3O^+][OH^-] = 1 \times 10^{-14}$ *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* $E^\theta_{cell} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{redusing agent}}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	

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



PHYSICAL SCIENCE
GRADE 10
2025 JUNE
Mid-year exam - MARKS: 100 - MARKING GUIDELINE

QUESTION 1

1.1 A ✓✓ (2)
1.2 C ✓✓ (2)
1.3 D ✓✓ (2)
1.4 C ✓✓ (2)
1.5 D ✓✓ (2)
[10]

QUESTION 2

2.1 The distance between two successive points in phase. ✓✓ (2)

2.2 Two ✓ (1)

2.3 T = 0,5 x 10^{-3} s ✓ = 5 x 10^{-4} s = 0,0005 s (1)

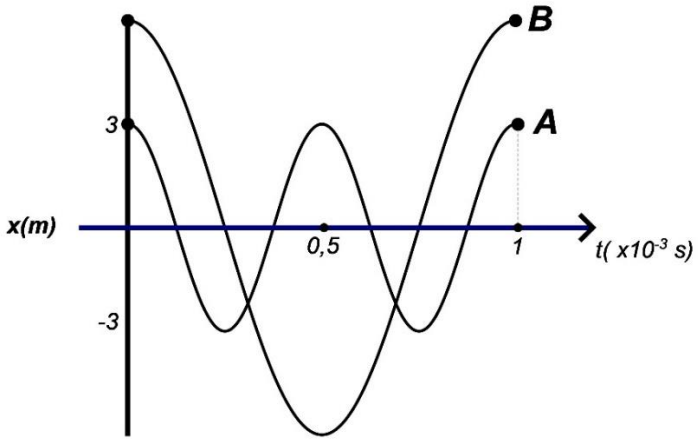
2.4 UP ✓ (1)

2.5.1 $f = \frac{1}{T}$ ✓
$= \frac{1}{0,0005}$ ✓
$= 2000\ Hz$ ✓ (3)

2.5.2 $v = f\lambda$ ✓
$340 = 2000\lambda$ ✓
$\lambda = 0,17\ m$ ✓ (3)

2.6.1

Marking criteria for wave B.	
Amplitude of B: 6 m / - 6m	✓
One complete cycle of B.	✓
Time indicated at 0,5 (x 10^{-3}) or 0,0005 s or 1 (x 10^{-3}) or 0,0001 s	✓
Labelled axes	✓



(4)

2.6.2 LONGER THAN ✓ (1)
[16]

QUESTION 3

3.1 Electromagnetic ✓ (1)

3.2 Possesses particle and wave properties. ✓
Moving at the speed of light (3 x 10^8 m.s^{-1}). ✓
Are transverse waves.
Can transplant in a vacuum. (2)

3.3 Infrared ✓ (1)

3.4 A quantum (packet) of energy. ✓ (1)

3.5 $E = h\frac{c}{\lambda}$ ✓

$1{,}989 \times 10^{-16} = 6{,}63 \times 10^{-34}\left(\frac{3\times10^{8}}{\lambda}\right)$ ✓

$\lambda = 1 \times 10^{-9}\ m$ ✓ (3)

3.6 LOWER ✓ (1)

[9]

QUESTION 4

4.1 Negative✓ because it has excess negative electrons. ✓ (2)

4.2 $n = \frac{Q}{q_e}$ ✓

$3{,}75 \times 10^{13} = \frac{Q}{-1{,}6\times10^{-19}}$ ✓

$Q = -6 \times 10^{-6}\ C$✓ (3)

4.3 Positive ✓, opposite charges attract each other.✓ (2)

4.4 FROM Q_1 TO Q_2 ✓ (1)

4.5 The nett charge of an isolated system remains constant during any physical process. ✓✓ (2)

4.6 When the two spheres touch they share the charge equally between them/ they get the same charge ✓ and like charges repel ✓. (2)

4.7 *Positive marking from QUESTION 4.2*

$Q = \frac{Q_1+Q_2}{2}$✓

$+2 \times 10^{-6} = \frac{-6\times10^{-6}+Q_2}{2}$✓

$Q_2 = +1 \times 10^{-5}C$ ✓ (3)

[15]

QUESTION 5

5.1 The charge transferred in a conductor in one second if the current is one ampere. ✓✓ (2)

5.2 $I = \frac{Q}{\Delta t}$ ✓

$= \frac{180}{90}$ ✓

$= 2\ A$ ✓ (3)

5.3.1 $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓
$= \frac{1}{3} + \frac{1}{6}$ ✓
$R_p = 2\ \Omega$ ✓ (3)

5.3.2 $V_1 = \frac{2}{6} \times 18$ ✓
$= 6\ V$ ✓

OR

$V_1 = IR$
$= 2 \times 3$
$= 6\ V$ (2)

5.3.3 $V_{2\Omega} = \frac{2}{3} \times 6$ ✓
$= 4\ V$

$W = VQ$ ✓
$= 4(180)$ ✓
$= 720\ J$ ✓

OR

$V_{2\Omega} = IR$
$= 2(2)$
$= 4\ V$

$W = VQ$
$= 4(180)$
$= 720\ J$ (4)

5.4 INCREASE ✓
The total resistance decreases. ✓
Current is inversely proportional to resistance. ✓ (3)

[17]

QUESTION 6

6.1 The substance undergoes a phase change. ✓
(The substance is in the process of freezing.) (1)

6.2 REMAINING CONSTANT ✓ (1)

6.3 Thermometer ✓ (1)

6.4 – 40°C ✓ (1)

6.5 0 °C ✓ (1)

6.6 0 °C is warmer than – 80 °C. ✓ The warmer the particles of a substance are, the higher is
the kinetic energy ✓ (energy of motion). (2)

6.7 Mercury ✓ (1)

6.8 The specific temperature at which the vapor pressure of a substance is equal to atmospheric pressure. ✓✓ (2)

6.9 357°C ✓ (1)

[11]

QUESTION 7

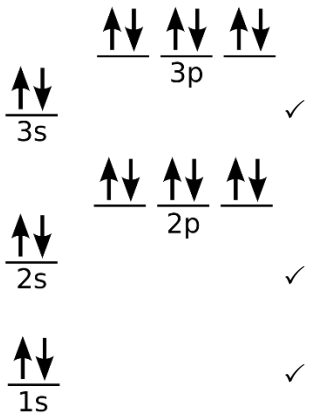
7.1 The number of protons in an atom of an element.✓✓ (2)

7.2 35 ✓ (1)

7.3 17 ✓ (1)

7.4 Chlorine ✓ (1)

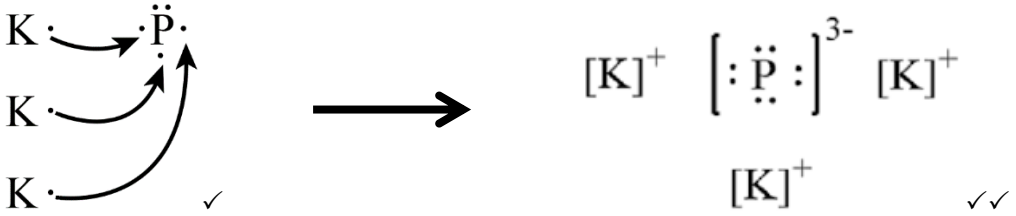
7.5 (3)



✓
✓
✓

7.6 $1s^2$ ✓$2s^2$ $2p^6$ ✓$3s^2$ $3p^6$ ✓ (3)

7.7



✓ ✓✓ (3)

7.8

✓✓ (2)

7.9 Atoms of the same element that have the same number of protons but different numbers of neutrons.✓✓ (2)

7.10 $A_r = \frac{(14\times99,6\checkmark)+(15\times0,4\checkmark)}{100\checkmark} = 14,004$ ✓ (4)

[22]

TOTAL: 100

TAXONOMY LEVELS					
GRADE 10					
PHYSICAL SCIENCES					
Mid-year exam- TERM 2 - 2025					
MARKS: 100					
QUESTION	**RECALL**	**COMPREHENSION**	**ANALYSIS APPLICATION**	**EVALUATION SYNTHESIS**	**TOTAAL**
DESIRED %	**15%**	**35%**	**40%**	**10%**	**100%**
1.1		2			2
1.2	2				2
1.3		2			2
1.4		2			2
1.5	2				2
2.1	2				2
2.2			1		1
2.3			1		1
2.4				1	1
2.5.1			3		3
2.5.2			3		3
2.6.1				4	4
2.6.2		1			1
3.1		1			1
3.2		2			2
3.3		1			1
3.4	1				1
3.5			3		3
3.6		1			1
4.1		2			2
4.2			3		3
4.3		2			2
4.4		1			1
4.5		2			2
4.6	2				2
4.7			3		3
5.1	2				2
5.2			3		3
5.3.1			3		3
5.3.2			2		2
5.3.3			4		4
5.4				3	3

6.1		1			
6.2		1			
6.3	1				
6.4		1			
6.5		1			
6.6		2			
6.7		1			
6.8	2				
6.9		1			
7.1	2				
7.2		1			
7.3		1			
7.4		1			
7.5				3	
7.6		3			
7.7			3		
7.8			2		
7.9	2				
7.10			4		
Total	**18**	**33**	**38**	**11**	**100**
Actual %	**18**	**33**	**38**	**11**	**100**
Desired %	**15%**	**35%**	**40%**	**10%**	**100**