GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL EXAMINATION

NOVEMBER 2023

GRADE 10

PHYSICAL SCIENCES: PHYSICS

PAPER 1

TIME: 2 hours

MARKS: 100

10 pages + 2 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions.
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. Write neatly and legibly.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the DATA SHEETS that are attached.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question numbers (1.1 to 1.7) in the ANSWERBOOK, e.g. 1.8 E.

1.1 The maximum displacement of a particle from its equilibrium position is …

A period.
B amplitude.
C wavelength.
D frequency. (2)

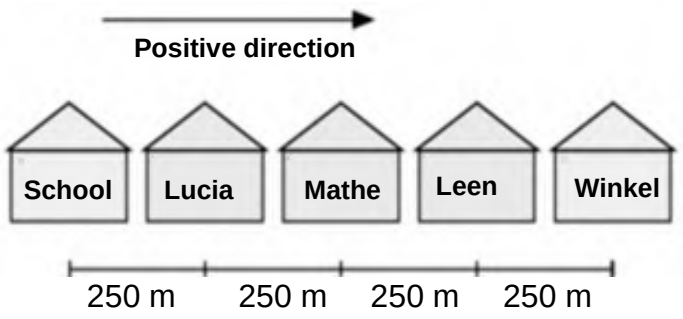
1.2 If the velocity of the wave remains constant, the … increases when the wavelength decreases.

A frequency
B amplitude
C speed
D period (2)

1.3 Which of the following sentences describes a vector?

A The food in the lunch box contains 3 300J.
B The charge on the pith ball is –145 C.
C The electric field is 120 $N.C^{-1}$ North.
D The container occupies 250 dm^3. (2)

1.4 In the diagram below, Mathe's house is the reference point and the positive direction is to the right.



What is the position of the school relative to Mathe's house?

A +250 m
B –250 m
C –500 m
D +500 m (2)

1.5 A negatively charged plastic ruler is brought close to small pieces of paper but does not touch them. If the ruler and the papers are now attracted to each other, the original charge(s) on the papers is/are …

A positive only.
B negative only.
C neutral only.
D both positive and neutral. (2)

1.6 The potential difference between two points in an electric circuit is 17 400 V. A power source transfers 400 000 J of energy when moving a certain amount of charge between these two points. What is the amount of charge that moved between the two points?

A 0,044 C
B 22,99 C
C $6{,}96 \times 10^{9}$ C
D 11,49 C (2)

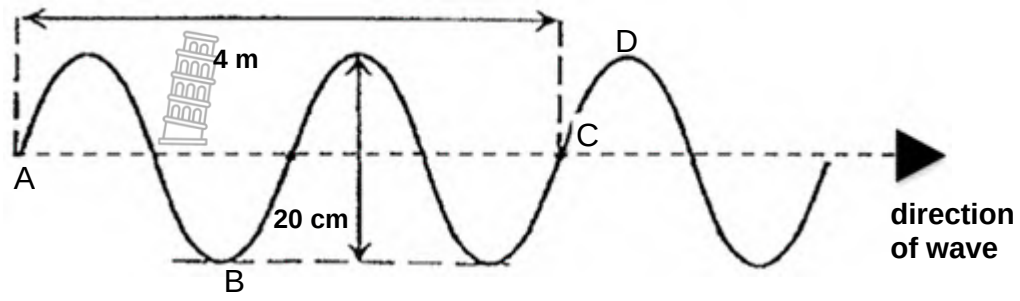
1.7 An object of mass m, is dropped from the top of the building and strikes the ground with kinetic energy **E**. Another object of mass 2 m is dropped FROM THE SAME HEIGHT and strikes the ground. Its kinetic energy will be equal to …

A $\frac{1}{4}$ E.
B $\frac{1}{2}$ E.
C E.
D 2E. (2)

[14]

QUESTION 2 (Start on a new page)

The diagram below represents a transverse wave with the frequency of 1,5 Hz moving from left to right.



2.1 Define a *transverse wave*. (2)

2.2 Name the following:

2.2.1 Two points that are in phase (1)

2.2.2 Point **B** (1)

2.2.3 Point **D** (1)

2.3 Determine the:

2.3.1 Amplitude of the wave in meter (3)

2.3.2 Wavelength (2)

2.4 Calculate:

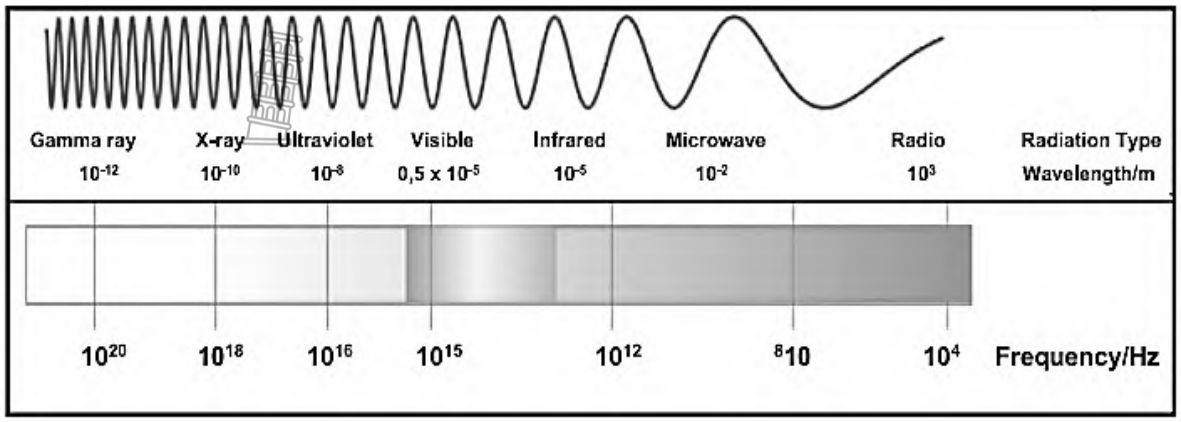
2.4.1 The period of the wave (3)

2.4.2 The speed of the wave (3)

[16]

QUESTION 3 (Start on a new page)

The diagram below shows the wavelengths of frequencies of different types of electromagnetic radiation. Consider the diagram and answer the questions that follow.



3.1 How is an electromagnetic wave created? (1)

3.2 Name THREE other types of electromagnetic waves that have a frequency lower than that of ultraviolet light. Arrange this frequency in order of INCREASING frequency. (3)

3.3 A photon has a wavelength of 700 nm. Calculate the:

3.3.1 Energy of the photon. (4)

3.3.2 Frequency of the photon. (3)

[11]

QUESTION 4 (Start on a new page)

A man applies a force of 5 N on a trolley full of crates on a horizontal plane. The trolley experiences a friction force of 2 N in the opposite direction.

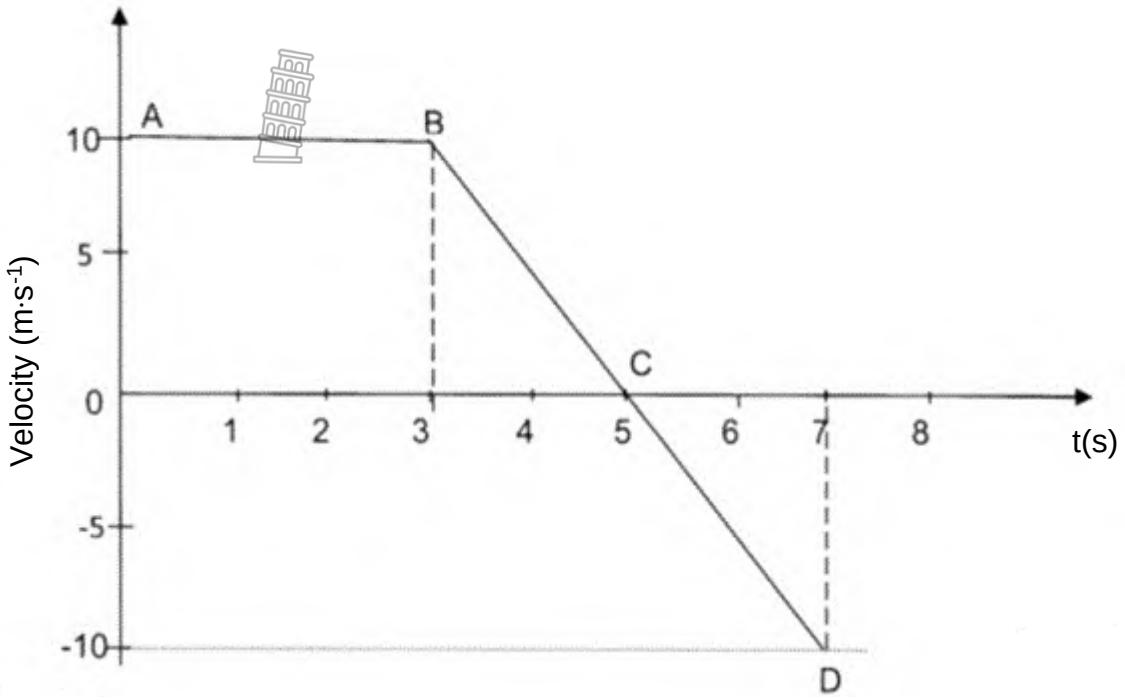
4.1 Define the term *resultant vector.* (2)

4.2 Calculate the resultant of the two horizontal forces acting on the trolley. (4)

[6]

QUESTION 5 (Start on a new page)

5.1 The velocity versus time graph below illustrates the motion of an object that is initially travelling east. At t = 0 s, the position of the object is zero.



5.1.1 What is the velocity of the object at t = 0 s? (1)

5.1.2 Describe the motion of the object between interval **A – B**. (2)

5.1.3 Calculate the acceleration of the object for interval **B – D**. (4)

5.2 A learner has to walk to the shops to buy bread, after walking 200 m, he realises that he does not have enough money and goes back home. It took him 4 minutes from the time he began walking until he returned to the house.

Calculate the following:

5.2.1 Determine the learner's displacement. (1)

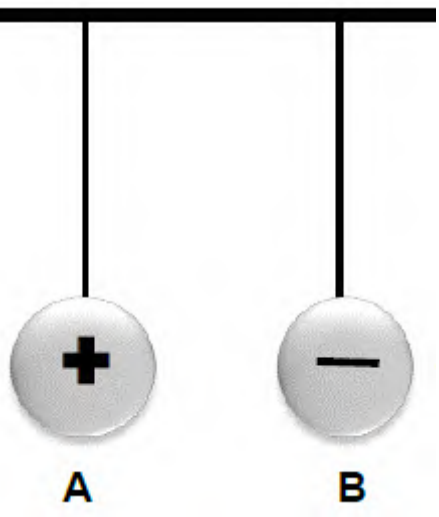
5.2.2 Differentiate between average speed and average velocity. (4)

5.2.3 Calculate the learner's average speed. (3)

[15]

QUESTION 6 (Start on a new page)

Two small, identical spheres **A** and **B** are suspended on long strings, as shown in the diagram below. The spheres carry charges of +5 x10^{-9} C and -2 x10^{-9} C respectively.



6.1 State the *Principle of Conservation of Charge*. (2)

The two spheres are brought into contact and then separated again.

6.2 Which sphere, **A** or **B**, will gain electrons? Motivate the answer. (2)

6.3 Calculate the:

6.3.1 Net charge of the two spheres during contact (2)

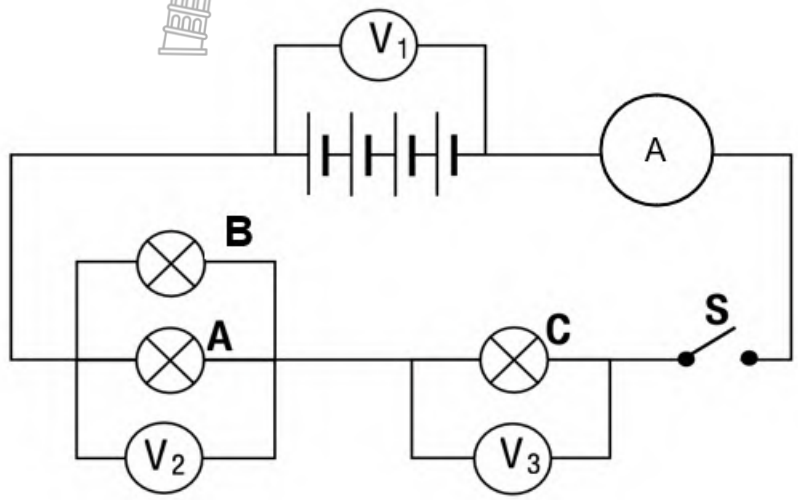
6.3.2 Charge on each sphere after the spheres have separated again (3)

6.3.3 Number of electrons transferred during contact (4)

[13]

QUESTION 7 (Start on a new page)

The circuit diagram below consists of four cells each with a voltage of 1,5 V.
The resistance of bulbs **A**, **B** and **C** are 3 Ω, 6 Ω and 8 Ω respectively. Use the circuit diagram to answer questions that follow:



When switch S is closed, the reading on the ammeter is 0,6 A.

7.1 Define the term *emf*. (2)

7.2 Write the emf of the battery. (2)

7.3 If the reading on V_3 is 4,8 V, calculate the:

7.3.1 Effective resistance of the circuit (4)

7.3.2 reading on voltmeter V_2 (2)

7.3.3 Amount of charge that is passing through resistor **C** in 20 s. (3)

7.4 If bulb **B** fuses, how will this affect the total current of the circuit?
Write down INCREASES, DECREASES or REMAINS THE SAME.
Give a reason for the answer. (2)
[16]

QUESTION 8 (Start on a new page)

A cricket ball of mass 180 g is travelling at 30 m·s^{-1}.

8.1 Define the term *kinetic energy.* (2)

8.2 Calculate the kinetic energy of the ball. (4)

8.3 Determine the speed of the ball if it had twice the kinetic energy calculated in QUESTION 8.2 above. (3)
[9]

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 $m \cdot s^{-2}$
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·s
Charge on electron *Lading op electron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/BEWEGING

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

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

U = mgh or/*of* E_p OR/*OF* $E_M = K + U$	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*

$n = \frac{Q}{e}$	$Q = \frac{Q_1 + Q_2}{2}$

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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GRADE 10

MARKING GUIDELINES

PHYSICAL SCIENCES: PHYSICS (PAPER 1)

5 pages

QUESTION 1

1.1 B ✓✓ (2)

1.2 A ✓✓ (2)

1.3 C ✓✓ (2)

1.4 C ✓✓ (2)

1.5 D ✓✓ (2)

1.6 B ✓✓ (2)

1.7 D ✓✓ (2)

[14]

QUESTION 2

2.1 A transverse wave is a wave in which the particles of the medium vibrate at right angles to the direction of the motion of the wave. ✓✓ (2)

2.2 2.2.1 A and C ✓ (1)

2.2.2 Trough ✓ (1)

2.2.3 Crest ✓ (1)

2.3 2.3.1 Amplitude = 0,5(20) ✓
= 10 cm ✓
= 0,1 m ✓ (3)

2.3.2 Wavelength = ½ (4) ✓
= 2 m ✓ (2)

2.4 2.4.1 T = 1/f ✓
= 1/1,5 ✓
= 0,67 s ✓ (3)

2.4.2 v = f.ƛ ✓
= (1,5)(2) ✓
= 3 m·s^{-1} ✓ (3)

[16]

QUESTION 3

3.1 Originates from accelerating electric charge/propagate as electric and magnetic fields that are perpendicular to each other. ✓ (1)

3.2 Microwave ✓ Infrared ✓ and Visible radiation ✓ (3)

3.3 3.3.1 $E = h\frac{c}{\lambda}$ ✓

$E = 6,63 \times 10^{-34}$ ✓ $\frac{3 \times 10^{8}}{700 \times 10^{-9}}$ ✓

$E = 2,84 \times 10^{-19}$ J ✓ (4)

3.3.2 $E = hf$ ✓

$2,84 \times 10^{-19} = 6,63 \times 10^{-34}\ f$ ✓

$f = 4,29 \times 10^{14}$ Hz ✓ (3)

[11]

QUESTION 4

4.1 A single vector that produces the same effect as is produced by a number of vectors collectively. ✓✓ (2)

4.2 $\overrightarrow{F_{net}} = \overrightarrow{F_1} + \overrightarrow{F_2}$ ✓

$F_{net} = 5 + (-2)$ ✓

$F_{net} = 3$ N regs ✓✓ (magnitude and direction) (4)

[6]

QUESTION 5

5.1 5.1.1 $10\ m \cdot s^{-1}$ ✓ (1)

5.1.2 The object moves at constant velocity ✓ of $10\ m \cdot s^{-1}$ east. ✓ (2)

5.1.3 $a = \frac{y_2 - y_1}{x_2 - x_1}$ ✓

$a = \frac{-10 - 10}{7 - 3}$ ✓

$a = -5\ m \cdot s^{-2}$

$a = 5\ m \cdot s^{-2}$ ✓ west ✓ (size and direction) (4)

5.2 5.2.1 200 m – 200 m = 0 m ✓ (1)

5.2.2 Average speed is the total distance travelled by an object per total time. ✓✓

Average velocity is the rate of the change in position or displacement divided by the time intervals in which displacement occurs.✓✓ (4)

5.2.3 $V_{speed} = \frac{\Delta x}{\Delta t}$

$= \frac{400}{240}$ ✓✓

$= 1,67 \text{ m·s}^{-1}$ ✓ (3)

[15]

QUESTION 6

6.1 The principle of conservation of charge states that the net charge of an isolated system remains constant during any physical process.✓✓ (2)

6.2 A ✓ Electrons move from the negative sphere to the positive sphere. ✓ or B has excess number of electrons or A has deficiet number of electrons. (2)

6.3 6.3.1 $Q_{net} = Q_1 + Q_2$ ✓

$= + 5 \times 10^{-9} + (-2 \times 10^{-9})$ ✓

$= + 3 \times 10^{-9}$ C ✓ (2

6.3.2 $Q = \frac{Q_1 + Q_2}{2}$ ✓

$= \frac{(5 \times 10^{-9}) + (-2 \times 10^{-9})}{2}$ ✓

$= + 1,5 \times 10^{-9}$ C ✓ (3)

6.3.3 $Q = n\,q_e$ ✓

$3,5 \times 10^{-9}$ ✓ $= n \times 1,6 \times 10^{-19}$ ✓

$n = 2,19 \times 10^{10}$ electrons ✓

or $n = \frac{Q}{e}$ ✓

$= \frac{3,5 \times 10^{-9}}{1,6 \times 10^{-19}}$ ✓

$= 2,19 \times 10^{10}$ electrons ✓ (4)

[13]

QUESTION 7

7.1 Work done per unit charge by the battery. ✓✓ (2)

7.2 1,5 x 4 = 6 V ✓✓ (2)

7.3 7.3.1 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{6}$ ✓

$R_p = 2\ \Omega$

$R_T = R_s + R_p$

$R_T = 8 + 2$ ✓

$R_t = 10\ \Omega$ ✓ (4)

7.3.2 Positive marking from 7,2.

$V_{Total} = V_2 + V_3$ ✓
$6 = V_2 + 4,8$ ✓
$V_2 = 1,2$ V ✓ (3)

7.3.3 $Q = I \Delta t$ ✓
$Q = (0,6)(20)$ ✓
$Q = 12$ C ✓ (3)

7.4 DECREASES ✓
The total effective resistance of the circuit increases. ✓ (2)
[16]

QUESTION 8

8.1 Kinetic energy is the energy an object possesses as a result of its motion. ✓✓ (2)

8.2 $E_k = ½ mv^2$ ✓
$= ½ (0,18) \times (30)^2$ ✓✓
$= 81$ J ✓ (4)

8.3 $E_K = ½ mv^2$
162 ✓ $= ½ (0,18).v^2$ ✓
$v = 42,43$ m·s^{-1} ✓ (3)
[9]

TOTAL: 100