GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL EXAMINATION

JUNE 2023

GRADE 10

PHYSICAL SCIENCES (PHYSICS)

PAPER 1

TIME: 2 hours

MARKS: 100

9 pages and 1 data sheet

INSTRUCTIONS AND INFORMATION

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

SECTION A: MULTIPLE-CHOICE QUESTIONS

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 to 1.8) in the ANSWER BOOK, e.g. 1.9 E.

1.1 Constructive interference takes place when …

A the wavelengths of the combined pulses are smaller than the individual amplitudes.
B the amplitudes of the combined pulses are smaller than the individual amplitudes.
C the combined amplitudes of two pulses are in phase with each other.
D the amplitudes of the combined pulses are greater than the individual amplitudes. (2)

1.2 A longitudinal wave is a wave where the particles in the medium …

A move perpendicular to the direction of propagation of the wave.
B move parallel to the direction of propagation of the wave.
C move diagonal to the direction of propagation of the wave.
D move adjacent to the direction of propagation of the wave. (2)

1.3 The amplitude and frequency of a sound wave are both DECREASED. How do these changes affect the loudness and the pitch of the sound?

	Loudness	**Pitch**
A	Increased	Raised
B	Increased	Unchanged
C	Decreased	Lowered
D	Decreased	Raised

(2)

1.4 The frequency of an electromagnetic wave with a wavelength of 2,1 x10^{-6} m is …

A 1,43 x 10^{14} Hz.
B 1,43 x 10^{12} Hz.
C 2,6 x 10 Hz.
D 2,50 x 10^{12} Hz. (2)

1.5 John wants to decrease the resistance of an electrical circuit and has the following options:

(i) Increase the length of the nichrome conductor
(ii) Increase the thickness of the nichrome conductor
(iii) Use a copper conductor instead of a nichrome conductor

Which combination of his options would best reduce the resistance of the circuit?

A (i), (ii) and (iii)
B (i) and (ii)
C (i) and (iii)
D (ii) and (iii) (2)

1.6 The maximum work done per unit charge by a battery is the ...

A emf.
B current.
C resistance.
D terminal potential difference. (2)

1.7 A positively charged rod is brought near the following objects:

(i) Small uncharged pieces of paper
(ii) A thin stream of water
(iii) A positive charged balloon
(iv) A negatively charged cloth

Which of these objects will not be attracted to the rod?

A (i), (ii) and (iii)
B (i) and (ii)
C (ii) and (iii)
D (iii) (2)

1.8 A rubber balloon obtains a negative charge when rubbed against a rabbit's fur.

Which of the statements below best explains why this happens?

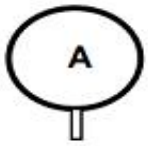
A Negative charges are transferred from the rabbit's fur to the rubber balloon.
B Positive charges are transferred from the rubber balloon to the rabbit's fur.
C Negative charges are transferred from the rubber balloon to the rabbit's fur.
D Positive charges are transferred from the rabbit's fur to the rubber balloon. (2)

[16]

SECTION B: ELECTROSTATICS AND ELECTRICITY

QUESTION 2 (Start on a new page.)

A small, metal sphere **A** carrying a charge of – 4nC is placed on an insulated stand.



2.1 Were electrons added or removed from sphere **A**? (1)

2.2 How does the number of protons compare with the number of electrons on sphere **A**? Write down only LESS THAN, GREATER THAN or EQUAL TO. Give a reason for your answer. (3)

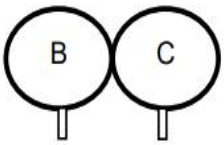
2.3 10^{13} electrons are now added to sphere **A**.

Calculate the new charge on sphere **A**. (4)
[8]

QUESTION 3 (Start on a new page.)

Two identical metal spheres **B** and **C** placed on an insulated stand, carry charges of $+4 \times 10^{-6}$ C and -6×10^{-6} C respectively as shown in the diagram below.

The spheres are allowed to touch each other.



After touching, the spheres are then separated and brought back to their original positions as shown in the diagram below.

3.1 State the *principle of conservation of charge*. (2)

3.2 Explain what occurred as the spheres touched each other. Explain why this reaction occurred after touching each other. (3)

3.3 Calculate the number of electrons transferred between the two spheres during contact. (4)
[9]

QUESTION 4 (Start on a new page.)

The grade 10 learners want to investigate the relationship between current and potential difference. Their teacher gives them the following apparatus:

- voltmeter
- ammeter
- connecting wires
- 5 cells

The table below shows the results obtained during the investigation:

Voltmeter (V)	Ammeter (A)
1,5	0,7
3,0	1,4
4,5	2,0
6,0	2,7
7,5	3,4

4.1 Write down a possible investigative question. (2)

4.2 Name the dependent variable for this investigation. (2)

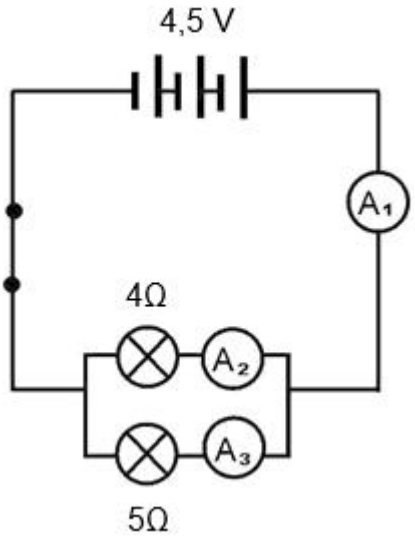
4.3 What is the control variable? (1)

4.4 Draw a graph of potential difference versus current difference. Plot the points and connect them with a best fit straight line. (7)

4.5 From the graph drawn, deduce a relationship that exists between the current difference and the potential difference in a circuit. (2)
[14]

QUESTION 5 (Start on a new page.)

The circuit below shows two light bulbs 4Ω and 5Ω respectively, connected in PARALLEL to a 4,5 V battery.



5.1 Calculate the effective resistance of the circuit. (2)

5.2 Calculate the total current of the circuit. (3)

5.3 Calculate the amount of charge passing through the ammeter A_2 in 10 s. (3)

5.4 Another resistor is connected in series next to ammeter A_1. How will this change affect the total current of the circuit? Write down only DECREASES, INCREASES or REMAIN THE SAME. Give a reason for your answer. (3)

[11]

SECTION C: WAVES, SOUNDS AND LIGHTS

QUESTION 6 (Start on a new page.)

6.1 Two or more pulses can pass through the same medium at the same time in the same place. When they do, they interact with each other to form a different disturbance at that point. The resulting pulse is obtained by using the principle of superposition.

State the *principle of superposition of pulses*. (2)

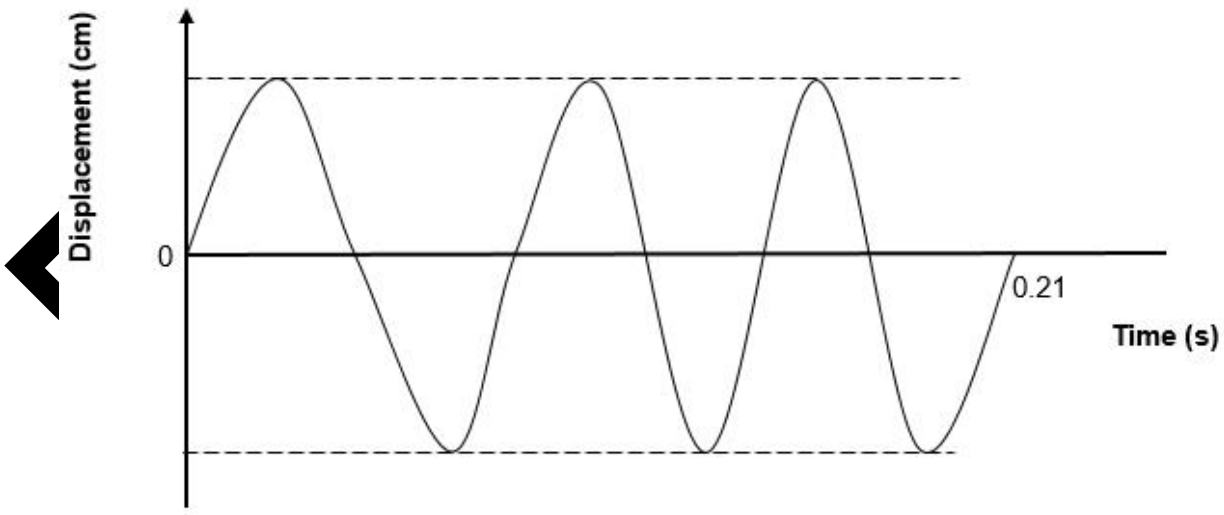
6.2 Destructive interference takes place when two pulses meet and result in a smaller amplitude disturbance. The amplitude of the resulting pulse is the sum of amplitudes of the two initial pulses, but the one amplitude will be a negative number.

Use the theory of destructive interference to draw TWO pulses of different amplitudes meeting from different directions to demonstrate the theory. (3)

6.3 A pulse covers 37,5 cm in 1,25 s on a heavy rope. Calculate the pulse speed in ($m \cdot s^{-1}$). (4)
[9]

QUESTION 7 (Start on a new page.)

A transverse wave is travelling along a string. A point on the medium carrying the wave is observed. A graph of displacement versus time of the point is shown below. The vertical distance between a crest and trough is 3,0 cm.



7.1 Define a *transverse wave*. (2)

7.2 How many full waves are there between t = 0 s and t = 0,21 s? (2)

7.3 From the information given, write down the amplitude of the wave. (2)

7.4 Calculate the period of the wave. (2)

7.5 If the wavelength of the wave is 0,4 m, calculate the speed of the wave. (4)
[12]

QUESTION 8 (Start on a new page.)

8.1 Grade 10 learners studied the relationship between the frequency and wavelength of different types of EM radiations.

8.1.1 Define the term *electromagnetic radiation*. (2)

8.1.2 Arrange the following types of EM radiation in order of increasing wavelength:

infra-red; X-rays; ultraviolet; visible light; gamma rays (5)

8.1.3 Ultraviolet radiation is dangerous and can cause skin cancer. Explain how this radiation causes cancer when your skin is overexposed. (2)

8.2 Give ONE use for each of the following types of EM radiation:

8.2.1 X-rays (1)

8.2.2 Microwaves (1)

8.3 Calculate the wavelength of a radio wave with a frequency of $2,1 \times 10^8$ Hz. (4)
[15]

QUESTION 9 (Start on a new page.)

The particle nature of light can be demonstrated by the interaction of photons with matter. One way in which light interacts with matter is via the photoelectric effect.

9.1 Define a *photon*. (2)

9.2 The infrared beam emitted by a projector remote has a wavelength of 1,3 μm. Calculate the energy of a photon of this infrared radiation. (4)
[6]

TOTAL: 100

END

DATA FOR PHYSICAL SCIENCES GRADE 10

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

Acceleration due to gravity	*g*	9,8 m·s^{-2}
Planck's constant	h	6,63 x 10 – 34
Speed of light in a vacuum	c	3,0 × 1 m·s^{-1}
Charge on electron	e	–1, 6x 10

TABLE 2: FORMULAE

ELECTROSTATICS

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

ELECTRICITY

$I = \frac{Q}{\Delta t}$	$R_S = r_1 + r_2 + \ldots$
$R = \frac{V}{I}$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R} + \frac{1}{R_3} + \ldots$

WAVES, SOUND AND LIGHT

v = f λ	T = $\frac{1}{f}$
E = h or E = h $\frac{c}{\lambda}$	