Province of the
EASTERN CAPE
EDUCATION

BUFFALO CITY METRO DISTRICT

GRADE 10

PHYSICAL SCIENCES

MARCH 2024

MARKS: 100

TIME: 2 HOURS

THIS QUESTION PAPER CONSISTS OF 10 PAGES INCLUDING THE COVER PAGE.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 6 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 SHEETS that are 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.

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 numbers (1.1 to 1.8) in the ANSWER BOOK, e.g. 1.9 E.

1.1 The phenomenon where the crest of one pulse overlaps with the crest of another to produce a pulse of increased amplitude is ….

A. Destructive interference
B. Interference
C. Trough
D. Constructive interference (2)

1.2 The distance between TWO successive points in phase…

A. wave speed
B. trough
C. crest
D. wavelength

1.3 Which one of the following will increase if the wavelength of a wave increases and the speed of the wave remains constant?

A. Amplitude
B. Frequency
C. Period
D. Velocity (2)

1.4 The angle between the vibrations and direction of propagation of particles of a longitudinal wave is:

A. 0°
B. 45°
C. 60°
D. 90° (2)

1.5 The amount of energies of two different photons moving through a vacuum is different from each other because their ..... differ from each other.

A. Amplitudes
B. Intensities
C. Speeds
D. Frequencies

(2)

1.6 Which of the following is correct regarding ultraviolet rays?

	Type of wave	Medium required?
A	Longitudinal	No
B	Longitudinal	Yes
C	Transverse	No
D	Transverse	Yes

(2)

1.7 A rod acquires a negative charge after it has been rubbed with wool. Which ONE of the following best explains why this happens?

A. Positive charges are transferred from the rod to the wool.
B. Negative charges are transferred from the rod to the wool.
C. Positive charges are transferred from the wool to the rod.
D. Negative charges are transferred from the wool to the rod.

(2)

1.8 An object which is positively charged has…

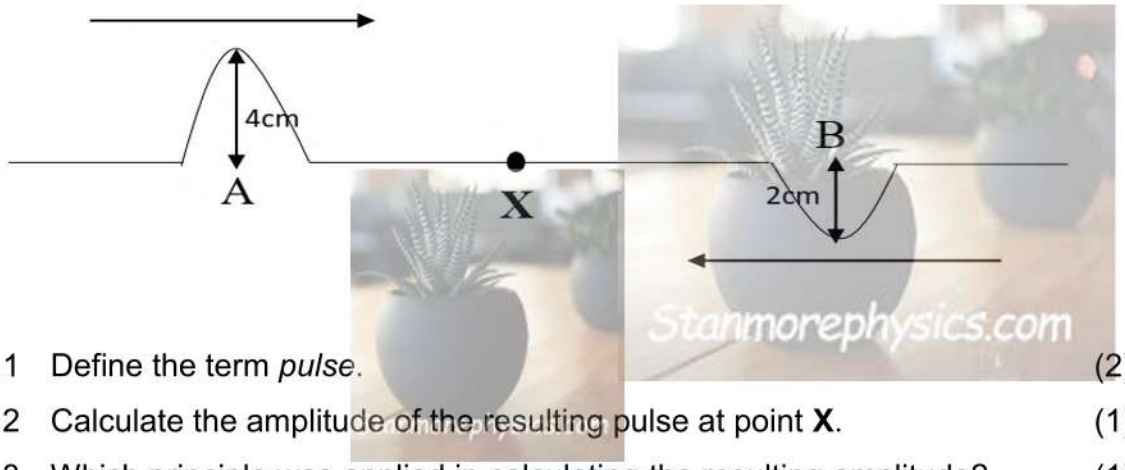
A. lost protons
B. lost electrons
C. gained protons
D. gained protons.

(2)

[16]

QUESTION 2 (Start on a new page)

Two pulses A and B move together in opposite directions in a rope. The amplitudes of the pulses are 4 cm and 2 cm respectively. The pulses meet at point **X** as shown in the diagram below (not drawn to scale). Assume there is no loss of energy.



2.1 Define the term *pulse*. (2)

2.2 Calculate the amplitude of the resulting pulse at point **X**. (1)

2.3 Which principle was applied in calculating the resulting amplitude? (1)

2.4 Draw an accurate sketch of the resulting pulse and indicate the new amplitude when the two pulses meet at point **X**. (2)

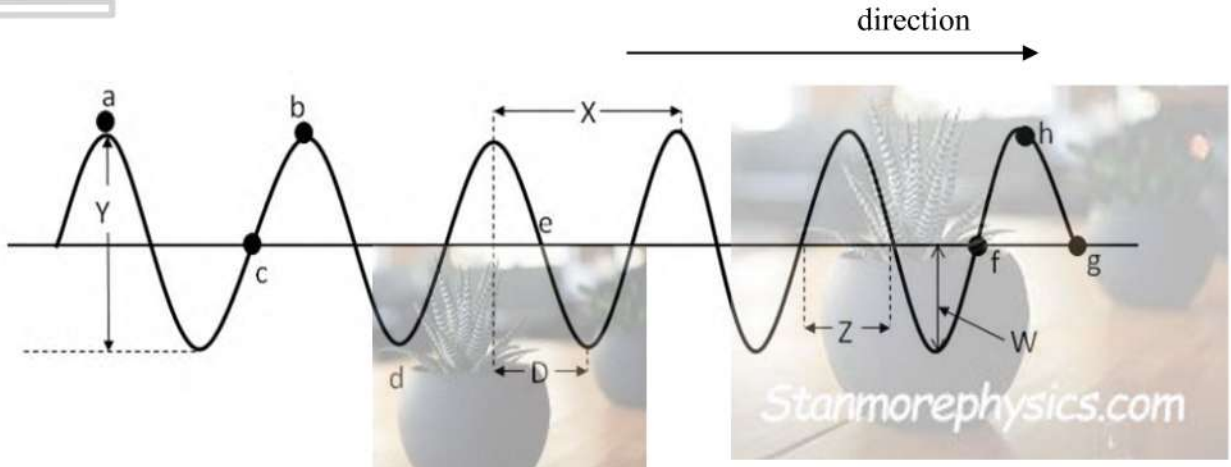
2.5 What type of interference leads to the sketch drawn in QUESTION 2.4? Explain your answer. (3)

2.6 In which direction does pulse B move after the two pulses meet at point **X**? Write down: TO THE LEFT; TO THE RIGHT or REMAINS IN THE SAME position. (1)

[10]

QUESTION 3 (Start on a new page)

Water waves crash against the wall of a dam. 10 crests crash against the wall in 2 seconds. A section of the waves is shown in the diagram below. The distance between consecutive crests (X) is 6m and the height of the wave from the crest to the trough (Y) is 3m.



3.1 What type of waves are water waves? (1)

3.2 Write down the letter(s)that represent:

3.2.1 any two points that are in phase. (1)

3.2.2 any two points that are out of phase. (1)

3.2.3 one wavelength. (1)

3.3 Define the term *amplitude* of a wave. (2)

3.4 Write down the amplitude of the water waves above. (2)

3.5 Define the term *frequency* of a wave. (2)

3.6 Determine the frequency of the water waves. (2)

3.7 Hence, determine the period of the water waves. (3)

3.8 Calculate the speed of the water waves. (3)

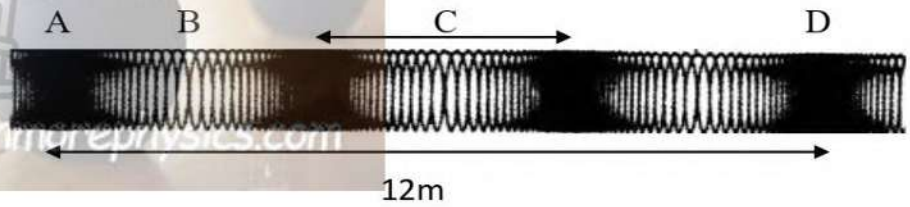
3.9 In which direction is a water particle at point C about to move? (2)

[20]

QUESTION 4 (Start on a new page)

4.1 A longitudinal wave moves along a slinky spring as shown in the diagram below.

The distance from A to D is 12m.



4.1.1 Define a *longitudinal* wave. (2)

4.1.2 Write down the names of the points labelled **A; B** and **C**. (3)

4.1.3 Define the term *wavelength* of a wave. (2)

4.1.4 Determine the wavelength of the wave. (2)

4.2 Bats use echolocation to navigate and find their prey. In one of such use, a bat sends out sound waves with a wavelength of 5mm. If the speed of sound in air is 340m.s^{-1}.

4.2 Determine whether the frequency of sound produced by the bat is ultrasound. (5)

The speed of sound in water is 1500m.s^{-1}. A dolphin sends out sound waves and receives the reflected waves off a small fish after 1,2s. (3)

4.3 How far is the dolphin from the small fish?

4.4 Write down TWO uses of ultrasound. (2)

[19]

QUESTION 5 (Start on a new page)

Some electromagnetic radiations are given below:

Infrared rays; X-rays; Microwaves; Radiowaves; Gamma rays.

5.1 List TWO properties of electromagnetic waves. (2)

5.2 What angle do the electric and magnetic fields generated by electromagnetic radiation form when they propagate? (1)

5.3 Consider the given electromagnetic radiation above:

5.3.1 Arrange them in order of ***decreasing*** frequencies. (2)

5.3.2 Which radiation helps us to get television signals? (1)

5.3.3 Which radiation helps medical practitioners to obtain images of human bones for diagnosis? (1)

5.3.4 Which radiation will have the highest penetrating ability? (1)

5.4 A photon of the Gamma rays above has an energy of $1,4 \times 10^{-13}$ J.

5.4.1 Define a photon. (2)

5.4.2 Determine the wavelength of the Gamma rays above. (3)

5.4.3 How many visible light photons with a wavelength of 459 nm will you need to match the energy of this photon of Gamma rays mentioned in QUESTION 5.4.2? (3)

5.5 Electromagnetic radiation has a ***dual nature***. What does the underlined phrase mean? (2)

[18]

QUESTION 6 (Start on a new page)

Two charges, A and B with magnitudes of 2×10^{-6} C and -7×10^{-6} C respectively are placed on an insulated stand as shown in the diagram below:

6.1 Why are the charges placed on insulated stands? (1)

The charges are brought close together. They then attract, touch each other and after a short while, they move apart.

6.2 Explain why the charges move apart after they touch each other for a while. (3)

6.3 Calculate the new charge on sphere B after they separate. (3)

6.4 Which principle was used to solve the question in QUESTION 6.3? (1)

6.5 State the principle mentioned in QUESTION 6.4. (2)

6.6 Calculate the number of excess electrons on charge B after the charges separated. (3)

6.7 Charge B is now brought close to an identical sphere which is neutral. The neutral sphere shows some movement. Will the movement be towards B or away from B?

Explain your answer. (4)

[17]

TOTAL [100]

DATA FOR PHYSICAL SCIENCES GRADE 10

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	G	9,8 $m.s^{-2}$
Speed of light in a vacuum	C	$3,0\times10^{8}$ $m.s^{-1}$
Planck's Constant	H	$6,63\times10^{-34}$J.s
Charge of electron	e	$-1,6\times10^{-19}$C

TABLE 2: FORMULAE

WAVES, SOUND AND LIGHT

$v = f\lambda$	$f = \frac{1}{T}$ or $T = \frac{1}{f}$
$E = hf$ or $E = h\frac{c}{\lambda}$	$f = \frac{c}{\lambda}$
$v = \frac{\Delta x}{\Delta t}$	

ELECTROSTATICS

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

Province of the
EASTERN CAPE
EDUCATION

BUFFALO CITY METRO DISTRICT

GRADE 10

PHYSICAL SCIENCES

MARCH 2024

MEMORANDUM

MARKS: 100

THIS MEMORANDUM CONSISTS OF 6 PAGES INCLUDING THE COVER PAGE.

QUESTION 1

1.1	D	✓✓	(2)
1.2	D	✓✓	(2)
1.3	C	✓✓	(2)
1.4	A	✓✓	(2)
1.5	D	✓✓	(2)
1.6	C	✓✓	(2)
1.7	D	✓✓	(2)
1.8	B	✓✓	(2)

[16]

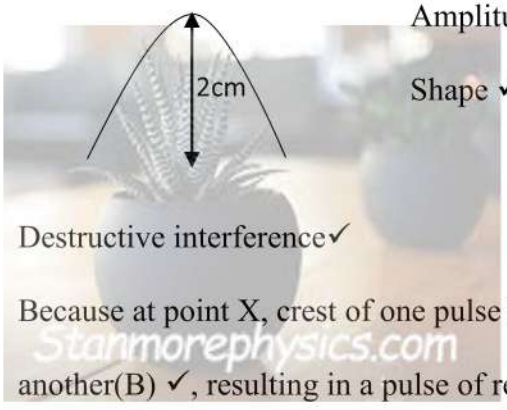
QUESTION 2

2.1 A single disturbance in a medium. ✓✓ (2)

2.2 2 cm✓ (1)

2.3 Principle of superposition✓ (1)

2.4



Amplitude ✓

Shape ✓ (2)

2.5 Destructive interference✓

Because at point X, crest of one pulse (A) overlaps with the trough of another(B) ✓, resulting in a pulse of reduced amplitude✓. (3)

OR

Because at point X, the algebraic sum of the amplitudes of the two pulses (A and B) ✓ leads to a pulse with decreased amplitude✓.

2.6 To the left. ✓ (1)

[10]

QUESTION 3

3.1 Transverse waves✓ (1)

3.2.1 a and b; c and f; a and h; b and h; e and g. Any one ✓ (1)

3.2.2 a and c; b and c; c and e; e and f; h and f; h and g; f and g. Any one✓ (1)

3.2.3 ab /x ✓ (1)

3.3 The maximum displacement of a particle from its equilibrium (rest) position. ✓✓ (2)

3.4 1,5 m. ✓✓ (2)

3.5 The number of wave pulses per second. ✓✓ (2)

3.6 $f = \frac{10}{2}\checkmark = 5\ Hz.\checkmark$ Answer only: 2 marks (2)

3.7 Positive marking from 3.6

$$T = \frac{1}{f}\checkmark = \frac{1}{5}\checkmark = 0{,}2s\checkmark$$ (3)

3.8 Positive marking from 3.6

$v = f\lambda$ ✓

$= 5 \times 6$ ✓

$= 30m.s^{-1}$ ✓ (3)

3.9 Downwards ✓✓ (2)

[20]

QUESTION 4

4.1.1 A wave in which the particles of the medium vibrate parallel to the direction of motion of the wave. ✓✓ (2)

4.1.2 A – compression. ✓
B – rarefaction. ✓
C – wavelength. ✓ (3)

4.1.3 The distance between two successive points that are in phase. ✓✓ (2)

4.1.4 $\lambda = \frac{12}{3}$ ✓ $= 4\ m$✓. Answer only: full marks (2)

4.2 $v = f\lambda$ ✓

$340 = (f)(5 \times 10^{-3})$ ✓

$f = 68\,000\ Hz$ $(68\ kHz)$ ✓

: $68\,000Hz > 20\,000Hz$✓

Accept: 68 000 $(68\ kHz)$ (is greater than 20 000$(20\ kHz)$

Accept: $20\,000Hz < 68\,000Hz < 100\,000Hz$ (5)

OR

$68\ kHz > 20\ kHz$

Accept: $20\ kHz < 68\ kHz < 100\ kHz$

Hence, the sound produced by the bat is **ultrasound**. ✓

4.3 $v = \frac{\Delta x}{\Delta t}$ ✓ or $s = \frac{d}{t}$

$1\,500 = \frac{\Delta x}{0{,}6}$✓

$\Delta x = 900\ m.$ ✓ (3)

4.4
- Monitor the growth and development of a foetus.
- Imaging of the heart and other organs for easy diagnosis.
- Monitor the speed of blood vessels (to indicate if one is at risk of a heart condition).
- To destroy tumors and other cancerous cells.

Any two. ✓✓ (2)

[19]

QUESTION 5

5.1
- They have a constant speed.
- They travel through a vacuum.
- They are transverse waves.
- They are generated by accelerating charges.
- They are propagated by electric and magnetic fields oscillating at right angles to each other.

Any two✓✓ (2)

5.2 90° ✓ (1)

5.3.1 Gamma rays > X-rays > Infrared rays > microwaves > radiowaves. ✓✓ (2)

5.3.2 Radiowaves✓ (1)

5.3.3 X-rays✓ (1)

5.3.4 Gamma rays✓ (1)

5.4.1 A photon is a packet of energy found in light. ✓✓ (2)

5.4.2 $E = \frac{hc}{\lambda}$ ✓

$1{,}4 \times 10^{-13} = \frac{6{,}63\times10^{-34}\times3{,}0\times10^{8}}{\lambda}$ ✓

$\lambda = 1{,}42 \times 10^{-12} m.$ ✓ (3)

5.4.3 $E = \frac{hc}{\lambda}$

$= \frac{6{,}63\times10^{-34}\times3{,}0\times10^{8}}{459\times10^{-9}}$ ✓

$= 4{,}33 \times 10^{-19} J$

Number of visible light photons $= \frac{1{,}4\times10^{-13}}{4{,}33\times10^{-19}}$✓

$= 323\ 326$ photons. ✓ (3)

5.5 Light can behave (act) as a particle ✓or a wave. ✓ (2)

[18]

QUESTION 6

6.1 To prevent the loss of charges (electrons). (1)

To ensure that charges do not leak to the ground.

(Any one ✓)

6.2
- When the charges touch, electrons are transferred ✓ (from B to A).
- Both charges attain the same number of electrons. ✓
- They then become like charges ✓and like charges repel. (3)

6.3 $Qnew = \frac{Q_1+Q_2}{2}$ ✓

$= \frac{2\times10^{-6}+(-7\times10^{-6})}{2}$ ✓

$= -2,5 \times 10^{-6}\ C$. ✓ (3)

6.4 Principle of conservation of charge. ✓ (1)

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

6.6 **Positive marking from 6.3**

$n = \frac{Q}{e}$ ✓

$= \frac{-2,5\times10^{-6}}{-1,6\times10^{-19}}$ ✓

$n = 1,56 \times 10^{13}\ electrons.$ ✓ (3)

6.7 Towards B. ✓
- Sphere B polarizes (causes a partial separation of charges in) the neutral sphere. ✓
- The positive charges in the neutral sphere align themselves at the end closest to sphere B. ✓
- The neutral sphere is then attracted to sphere B✓ (since their ends that are close have opposite signs). **(4)**

[17]

TOTAL [100]