KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES P1

COMMON TEST

JUNE 2025

MARKS: 75

DURATION: 1,5 hours

This question paper consists of 10 pages and a data sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEET.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. 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. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

1.1 Which one of the following statements is CORRECT for a longitudinal wave?

A The period of the wave is the time between two consecutive crests.

B The frequency of the wave is the time between two consecutive crests.

C The period of the wave is the time between two consecutive compressions.

D The frequency of the wave is the time between two consecutive compressions. (2)

1.2 Consider the following statements regarding sound waves:

(i) Sound waves are longitudinal waves.
(ii) Sound waves travel faster in air than water.
(iii) The pitch of a sound wave depends on the frequency of the wave.
(iv) The loudness of a sound wave depends on the period of the wave.

Which of the above statements is/are TRUE?

A (i), (ii) and (iii) only.

B (i) and (iii) only.

C (i), (ii) and (iv) only.

D (i) only. (2)

1.3 The energy of a photon of light is **E**.
What will be the energy of the photon if the wavelength is halved?

A 2 E

B $\frac{1}{4}$ E

C $\frac{1}{2}$ E

D 4 E (2)

1.4 Two identical metal spheres, each carrying an equal charge **Q**, are brought into contact and then separated.
What will be the charge on each sphere once separated?

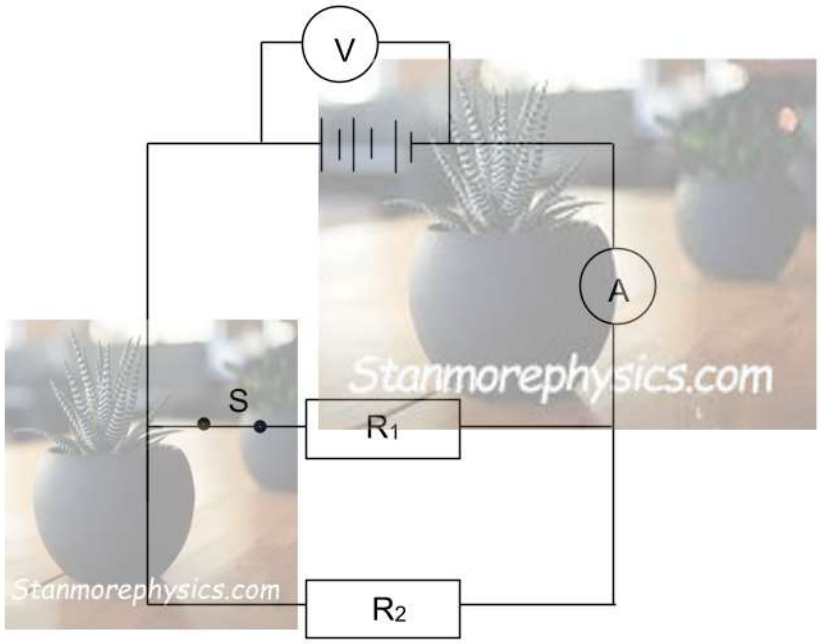
A Zero

B $\frac{1}{2}$ Q

C 2Q

D Q (2)

1.5 Consider the circuit diagram below, with switch **S** closed. The resistance of the battery is neglected.



Which one of the following combinations correctly describes the changes in the ammeter and voltmeter readings when the switch is opened?

	Ammeter Reading	**Voltmeter Reading**
A	Increase	Increase
B	Decrease	Decrease
C	Decrease	Remains the same
D	Increase	Remains the same

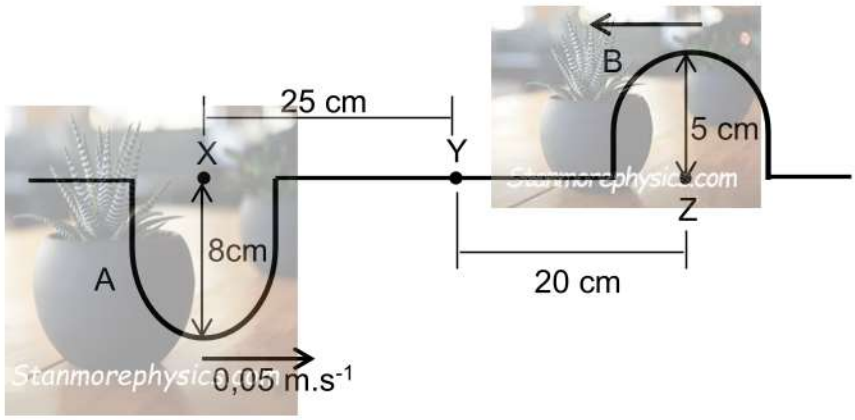
(2)

[5 X 2 = 10]

QUESTION 2 (Start on a new page.)

2.1 Two pulses, A and B, travelling in the same string approach each other. Pulse A has an amplitude of 8 cm at point X and travels at 0,05 m.s^{-1} right. Pulse B, with and amplitude of 5 cm at point Z is moving to the left.

The distances between points X and Y is 25 cm and between points Y and Z is 20 cm. Both pulses overlap at point Y.



2.1.1 Identify the type of interference that occurs when the pulses meet. (1)

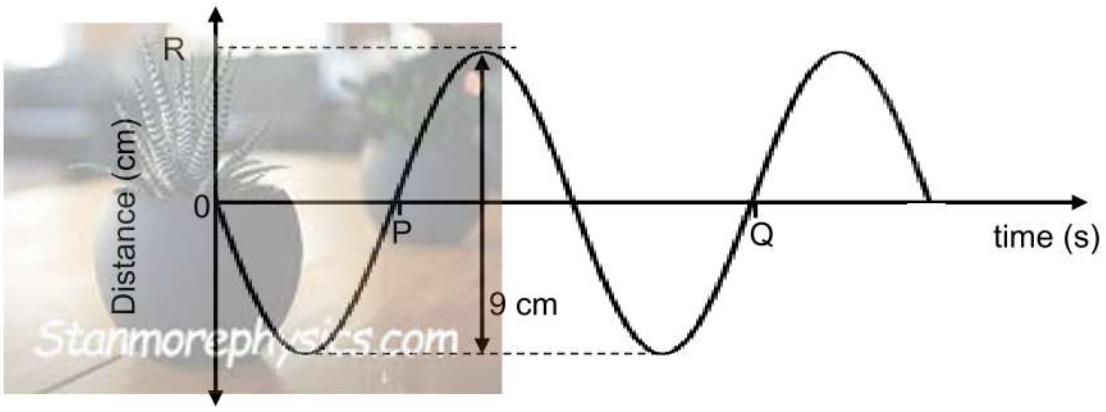
2.1.2 Write down the amplitude of the pulse formed when pulses A and B meet at point Y. (1)

2.1.3 Draw the resultant pulse formed when pulses A and B meet at point Y. Indicate the amplitude of the pulse on the diagram (2)

Pulse A passes point X at the same time that pulse B passes point Z.

2.1.4 Determine the speed of pulse B. (5)

2.2 The transverse wave below, with a period of 0,1seconds travels at 0,5 m.s^{-1} right.



2.2.1 Write down the values of :

a) P (1)

b) Q (1)

c) R (1)

2.2.2 Determine the distance between three consecutive troughs in the wave above. (4)

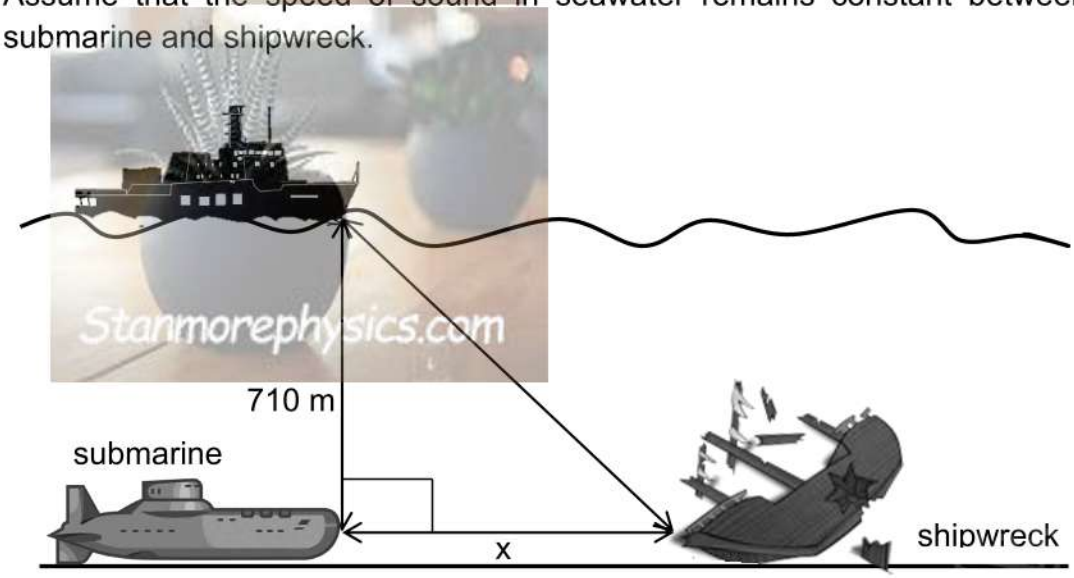
[16]

QUESTION 3 (Start on a new page.)

A stationary ship uses SONAR (Sound Navigation and Ranging) to detect the location of a stationary submarine stranded on the seabed. The sound wave emitted is in the ultrasound range.

When the first sound wave is emitted it detects the submarine 710 metres directly beneath the ship. The sound wave reflected off the submarine returns to the ship after 0,94 seconds.

Assume that the speed of sound in seawater remains constant between the ship, submarine and shipwreck.



3.1 Define the term *ultrasound* in words. (2)

3.2 Calculate the speed of sound in seawater. (3)

Another sound wave emitted from the ship detects a shipwreck, on the seabed, "x" metres due east of the submarine. The sound wave takes 0,52 seconds to reach the shipwreck.

3.3 Determine the distance, "x", between the submarine and the shipwreck. (4)

The frequency of the sound wave emitted by the ships SONAR system is 30 kHz.

3.4 Calculate the wavelength of the emitted sound wave. (3)

[12]

QUESTION 4 (Start on a new page.)

4.1 Arrange the following types of electromagnetic radiation in order of increasing wavelength:
X-ray; Gamma ray; Visible light; Radiowave; Microwave. (2)

4.2 The frequency and energy for different types of electromagnetic radiation is presented in the table below:

Electromagnetic Radiation	Frequency (Hz)	Energy (J)
Radiation A	$6{,}03 \times 10^{11}$	4×10^{-22}
Radiation B	$3{,}02 \times 10^{19}$	**X**
Radiation C	**Y**	3×10^{-17}

4.2.1 Calculate the energy of a photon of Radiation B. (3)

4.2.2 Determine the wavelength of Radiation C. (4)

4.2.3 Which type of radiation, A, B or C, will have the greatest penetrating ability? (1)

[10]

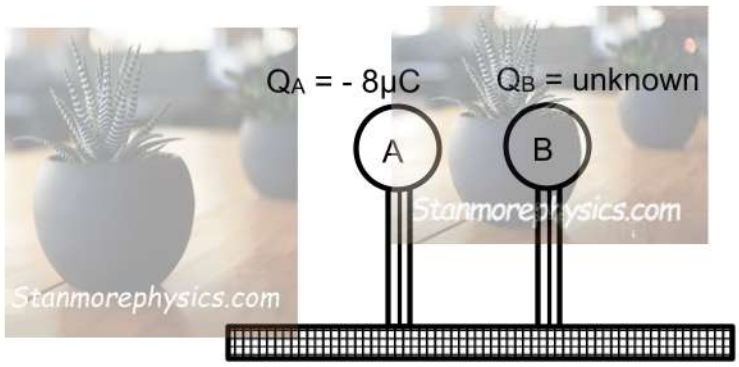
QUESTION 5 (Start on a new page.)

5.1 A rubber rod with a charge of - 2 x 10^{-9} C is rubbed with a woollen cloth and gains 1,88 x 10^{10} electrons in this process.

5.1.1 Describe the process of *tribo-electric charging*. (2)

5.1.2 Determine the new charge on the rod after gaining the electrons. (4)

5.2 Two identical conducting spheres, A and B, are placed on insulating stands. The charge on sphere A is – 8 µC and the charge on sphere B is unknown.



The spheres are brought into contact and thereafter separated.
After separation each sphere carries a charge of – 1 µC.

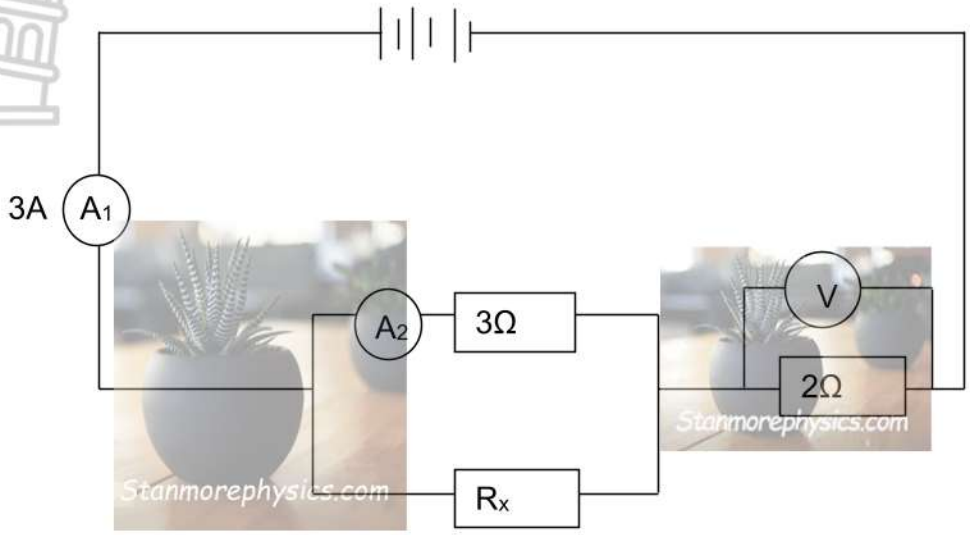
5.2.1 Explain why the conducting spheres are placed on insulating stands. (1)

5.2.2 Determine the initial charge of Sphere B. (4)

[11]

QUESTION 6 (Start on a new page)

A battery, consisting of three identical cells, is connected to three resistors as shown in the circuit diagram below. The connecting wire and battery has negligible resistance



The ammeter A_1 reads 3A.

6.1 Define the *emf of a battery* in words. (2)

6.2 Calculate the reading on the voltmeter. (3)

240 coulomb of charge passes through the 3Ω resistor in 2 minutes.

6.3 Determine the :

6.3.1 Reading on ammeter A_2. (4)

6.3.2 Resistance of resistor R_x. (4)

6.3.3 EMF of each cell in the battery, (3)

[16]

TOTAL: 75

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

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 x 10^{8} $m{\cdot}s^{-1}$
Planck's constant	h	6,63 x 10^{-34} J·s
Charge on electron	q_e	-1,6 x 10^{-19} C
Electron mass	m_e	9,11 x 10^{-31} kg

TABLE 2: FORMULAE

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WAVES, SOUND AND LIGHT

$v = f\lambda$ or $c = f\lambda$	$T = \frac{1}{f}$
E = hf	$E = \frac{hc}{\lambda}$
□□□□□ = □□□□□□□□ / □□□□	

ELECTROSTATICS

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

ELECTRIC CIRCUITS

$Q = I \times \Delta t$	$\frac{1}{Rp} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots.$
$R_s = R_1 + R_2 + \cdots$	$V = \frac{W}{Q}$
V = I x R	

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MARKING MEMORANDUM
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QUESTION 1:

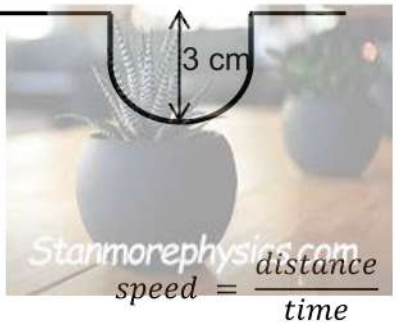
1.1 C ✓✓ (2)
1.2 B ✓✓ (2)
1.3 A ✓✓ (2)
1.4 D ✓✓ (2)
1.5 C ✓✓ (2)
[10]

QUESTION 2

2.1
2.1.1 Destructive (interference) ✓ (1)

2.1.2 3 cm (Accept: - 3 cm) ✓ (1)

2.1.3 Criteria
Shape: Pulse drawn as trough ✓
Amplitude of pulse = 3 cm ✓ (2)



2.1.4 Pulse A:

$$speed = \frac{distance}{time}$$

$$0,05 = \frac{0,25}{time}$$

time = 5 s

Pulse B:

$$speed = \frac{distance}{time}$$

$$speed = \frac{0,2}{5}$$

= 0,04 m.s^{-1}✓ (5)

2.2
2.2.1 a) 0,05 ✓ (1)
b) 0,15 ✓ (1)
c) 4,5 ✓ (1)

2.2.2 OPTION 1 OPTION 2

Distance (1 wave) = speed x time

= 0,5 ✓ x 0,1✓

= 0,05 m

Distance (2 waves) = 0,05 x 2 ✓

= 0,1 m ✓

$$f = \frac{1}{T}$$

$$f = \frac{1}{0,1}$$

= 10 Hz

$$v = f \times \lambda$$

$$0,5 = 10 \times \lambda$$

λ = 0,05 m

Distance (2 waves) = 0,05 x 2 ✓

= 0,1 m ✓ (4)

[16]

QUESTION 3

3.1 Sounds with frequencies higher than 20 kHz✓ up to about 100 kHz. ✓ (2)

3.2

$$speed = \frac{distance}{time}$$

$$= \frac{710}{0,47} \quad \text{OR} \quad = \frac{1420}{0,94}$$

= 1510,64 m.s^{-1}✓ (3)

3.3 **POSITIVE MARKING FROM QUESTION 3.2**

$$speed = \frac{distance}{time}$$

$$1510,64 = \frac{distance}{0,52}$$

distance = 785,53 m.s^{-1}

Distance (between the submarine and shipwreck) = $\sqrt[2]{785,53^2 - 710^2}$✓

= 336,09 m✓ (4)

3.4 **POSITIVE MARKING FROM QUESTION 3.2**

$v = f \times \lambda$ ✓

1510,64 = 30 000 x λ ✓

λ = 0,05 m ✓ (3)

[12]

QUESTION 4

4.1 Gamma ray, X-ray, Visible light, Microwave, Radiowave ✓✓ (2)

4.2.1 **OPTION 1**

E = h x f ✓

= 6,63 x10^{-34} x 3,02 x10^{19} ✓

= 2 x 10^{-14} J ✓

OPTION 2

c = f x λ

3 x 10^{8} = 3,02 x10^{19} x λ

λ = 9,93 x 10^{-12} m

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

$$= \frac{6{,}63 \times 10^{-34} \times 3 \times 10^{8}}{9.93 \times 10^{-12}}$$

= 2 x 10^{-14} J ✓ (3)

4.2.2 **OPTION 1**

$E = \frac{hc}{\lambda}$ ✓

$3 \times 10^{-17} = \frac{6{,}63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$

λ = 6,63 x 10^{-9} m ✓

OPTION 2

E = h x f ✓

3 x10^{-17} = 6,63 x10^{-34} x f ✓

f = 4,525 x10^{16} Hz

c = f x λ

3 x 10^{8} = 4,525 x10^{16} x λ ✓

λ = 6,63 x 10^{-9} m ✓ (4)

4.2.3 (Radiation) B ✓ (1)

[10]

QUESTION 5

5.1.1 A type of contact electrification in which certain materials become electrically charged after they come into contact with different materials and are then separated. ✓✓ (2)

5.1.2 $Q = n\,x\,q_e$ ✓

$= 1{,}88 \times 10^{10}\ x\ -1{,}6 \times 10^{-19}$ ✓

= - 3,01 x 10^{-9} C

Q_{new} = - 2 x 10^{-9} + (- 3,01 x 10^{-9}) ✓

= - 5,01 x 10^{-9} C ✓ (4)

5.2.1 To prevent the flow of electric charge between the sphere and the ground. ✓ (1)

5.2.2 $$Q = \frac{Q_1 + Q_2}{2}$$

$$-1 \times 10^{-6} = \frac{-8 \times 10^{-6} + Q_B}{2}$$

Q_B = 6 x 10^{-6} C (or 6μC) ✓ (4)

[11]

QUESTION 6

6.1 The work done per unit charge by the source (battery) ✓✓ (2)

6.2 $V = IR$ ✓
$= 3 \times 2$ ✓
$= 6\ V$ ✓ (3)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

6.3.1 $Q = I\Delta t$ ✓
240 ✓$= I \times 120$ ✓
$I = 2A$ ✓ (4)

6.3.2 **OPTION 1**
$V_{3\Omega} = IR$
$= 2 \times 3$ ✓
$= 6V$

$I_{Rx} = 3 - 2$ ✓
$= 1A$
$V = IR$
$6 = 1 \times R_x$ ✓
$R_x = 6\Omega$ ✓

OPTION 2
$I_{Rx} = 3 - 2$ ✓
$= 1A$

$$R_x = \frac{I_{3\Omega}}{I_{Rx}} \times R_{3\Omega}$$

$$R_x = \frac{2}{1} \times 3$$

$= 6\Omega$ ✓ (4)

6.3.3 $Emf = 6 + 6$ ✓
$= 12V$
$Emf\ (1cell) = 12 \div 3$ ✓
$= 4V$ ✓ (3)

[16]

TOTAL: 75