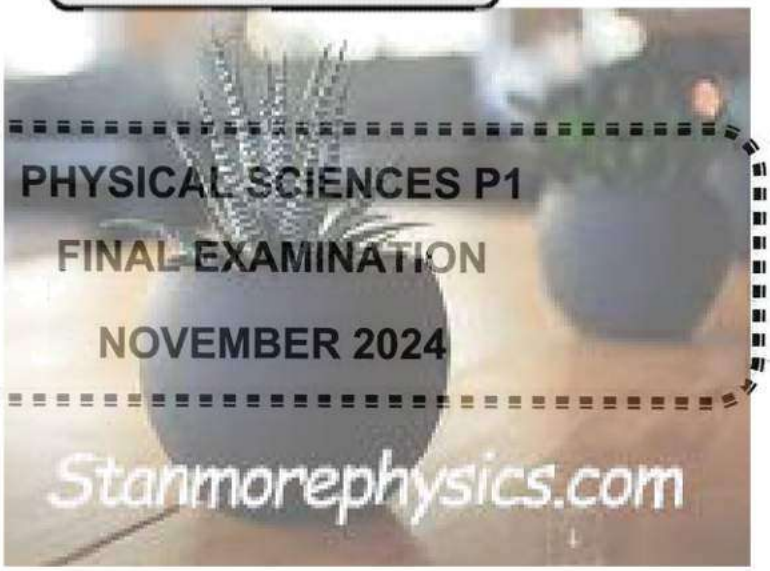
KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10



PHYSICAL SCIENCES P1

FINAL EXAMINATION

NOVEMBER 2024

MARKS: 100

DURATION: 2 hours

This question paper consists of 11 pages and a data sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT 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

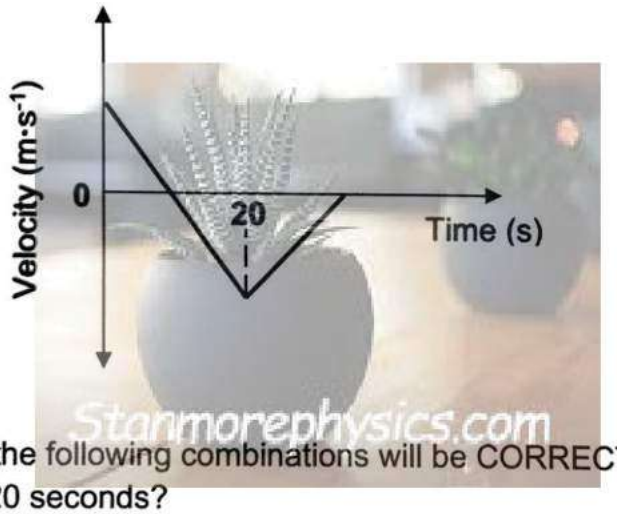
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

1.1 Which of the following indicates the number of wave pulses per second?

A Wave speed
B Period
C Frequency
D Wavelength

(2)

1.2 The velocity-time graph for a car travelling along a straight horizontal surface is shown below. North is taken as positive.



Which of the following combinations will be CORRECT for the motion of the car after 20 seconds?

	Acceleration	Direction of motion
A	Positive	North
B	Positive	South
C	Negative	North
D	Negative	South

(2)

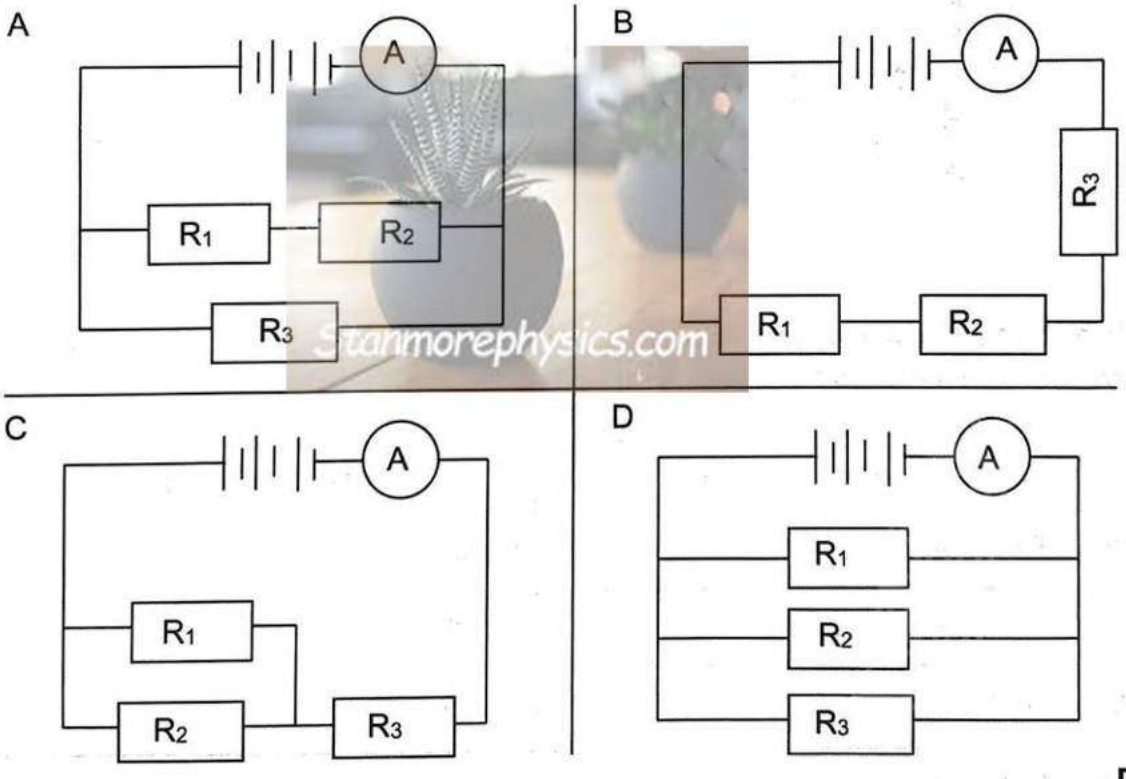
1.3 Which statement explains why a glass rod becomes positively charged when rubbed with a woollen cloth?

A Protons are transferred from the glass rod to the woollen cloth.
B Protons are transferred from the woollen cloth to the glass rod.
C Electrons are transferred from the glass rod to the woollen cloth.
D Electrons are transferred from the woollen cloth to the glass rod. (2)

1.4 An object is thrown from the top of a building with velocity V and kinetic energy E. It reaches the ground with a velocity of 2V. Which ONE of the following is the objects kinetic energy just before it strikes the ground?

A 2E
B 4E
C 0,5E
D E (2)

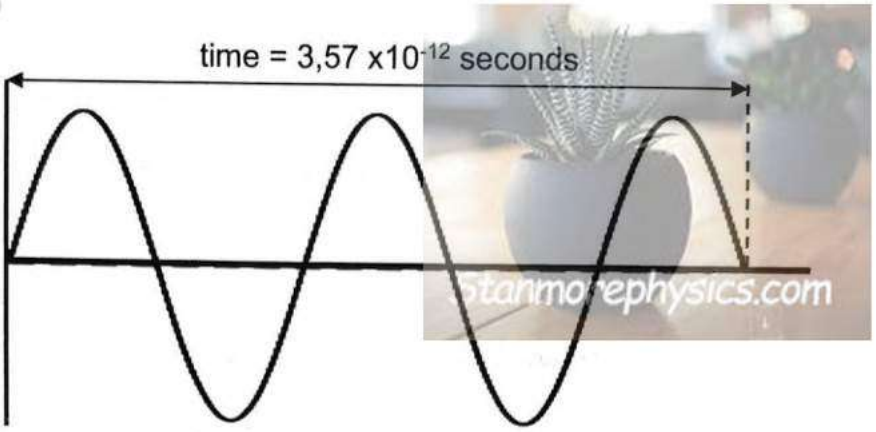
1.5 A battery is connected to three identical resistors in different combinations. Which combination, represented in the circuit diagrams below, will result in the ammeter having the largest reading?



(2)
[2 X 5 = 10]

QUESTION 2 (Start on a new page.)

The propagation of Radiation X in air is represented by the transverse wave pattern below.



2.1 Calculate the frequency of the wave. (3)

2.2 Write down the speed of the wave. (1)

2.3 The table below shows the data for different types of radiation in order of decreasing wavelength.

TYPE OF RADIATION	WAVELENGTH RANGE (m)
Radio waves	Greater than 0,1 m
Microwaves	0,1 to 10^{-3}
Infrared (IR)	10^{-3} to 7×10^{-7}
Visible light	7×10^{-7} to 4×10^{-7}
Ultraviolet (UV) light	4×10^{-7} to 10^{-9}
X-rays	10^{-9} to 10^{-11}
Gamma rays	10^{-11} to 10^{-15}

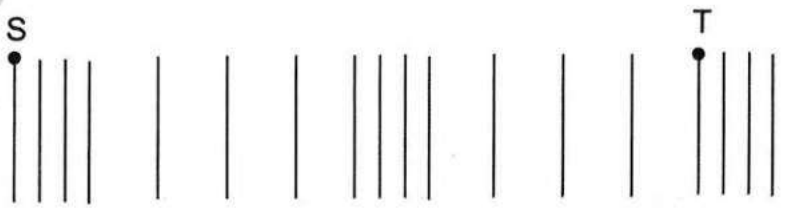
2.3.1 By means of a suitable calculation, identify the type of radiation represented by Radiation X. (4)

2.3.2 Determine the energy of a photon of Radiation X. (3)

[11]

QUESTION 3 (Start on a new page.)

3.1 **S** and **T** are two points on a longitudinal wave pattern travelling at 2 m·s^{-1} east.



The distance between FOUR consecutive compressions is 1,2 m.

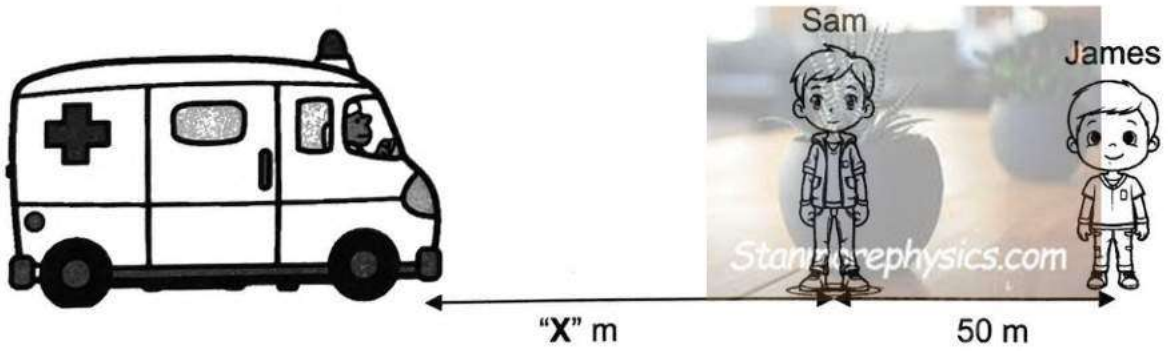
3.1.1 Define the term *longitudinal wave* in words. (2)

3.1.2 Calculate the frequency of the wave. (4)

3.1.3 Determine the time taken for the wave to move from point S to point T. (3)

3.2 The alarm of a stationary ambulance emits a sound wave which is detected by both Sam and James.

Sam stands at an unknown distance, **X** metres, due east of the ambulance and hears the sound after 0,6 seconds. James stands 50 m due east of Sam and hears the sound after 0,75 seconds.



3.2.1 Calculate the speed of the sound wave. (4)

3.2.2 Determine **X**, the distance between Sam and the ambulance. (2)

[15]

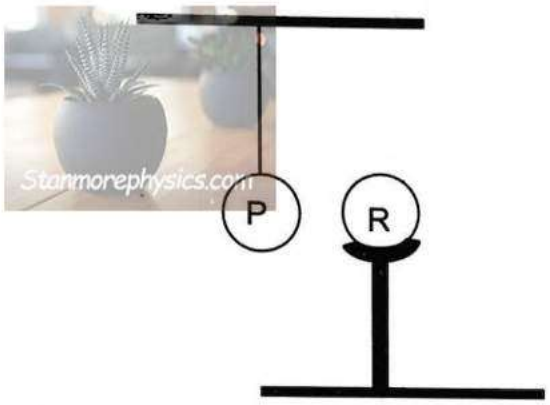
QUESTION 4 (Start on a new page.)

A metal sphere, P, which was initially neutral, is given a charge of 8×10^{-9} C

4.1 Were electrons ADDED TO or REMOVED FROM sphere P? (1)

4.2 Determine the number of electrons that were added or removed. (4)

Sphere P is now suspended from a wooden beam by means of a light insulated string. An identical sphere, R, carrying an initial charge of -12×10^{-9} C is first brought into contact with sphere P and then placed on an insulated stand next to Sphere P, as shown in the diagram below.

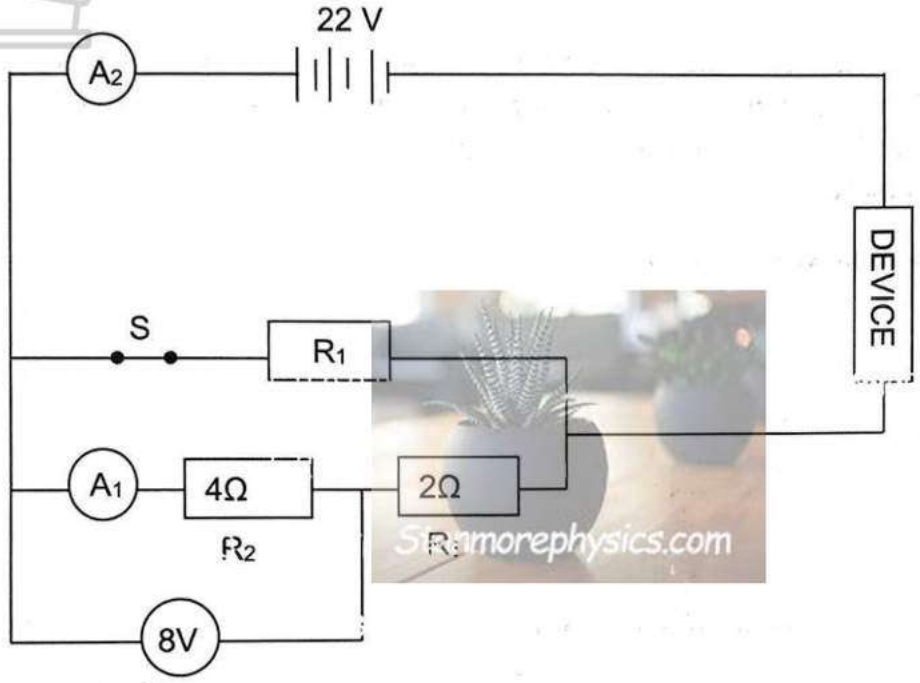


4.3 Determine the charge on sphere R after it touches and separates from sphere P. (3)

4.4 Will the spheres ATTRACT or REPEL each other when they are placed as shown in the diagram?
Give a reason for the answer. (2)
[10]

QUESTION 5 (Start on a new page)

A battery with an EMF of 22 V is connected to three resistors and an electrical device, as shown in the circuit diagram below. The connecting wires and the battery have negligible resistance.



The voltmeter reads 8 V.

5.1 Define the term *current* in words. (2)

5.2 Calculate the reading on ammeter A_1. (3)

3000 J of energy is transferred in the electrical device in 1 minute

5.3 Determine the:

5.3.1 Charge travelling through the electrical device in 1 minute (5)

5.3.2 Reading on Ammeter A_2 (3)

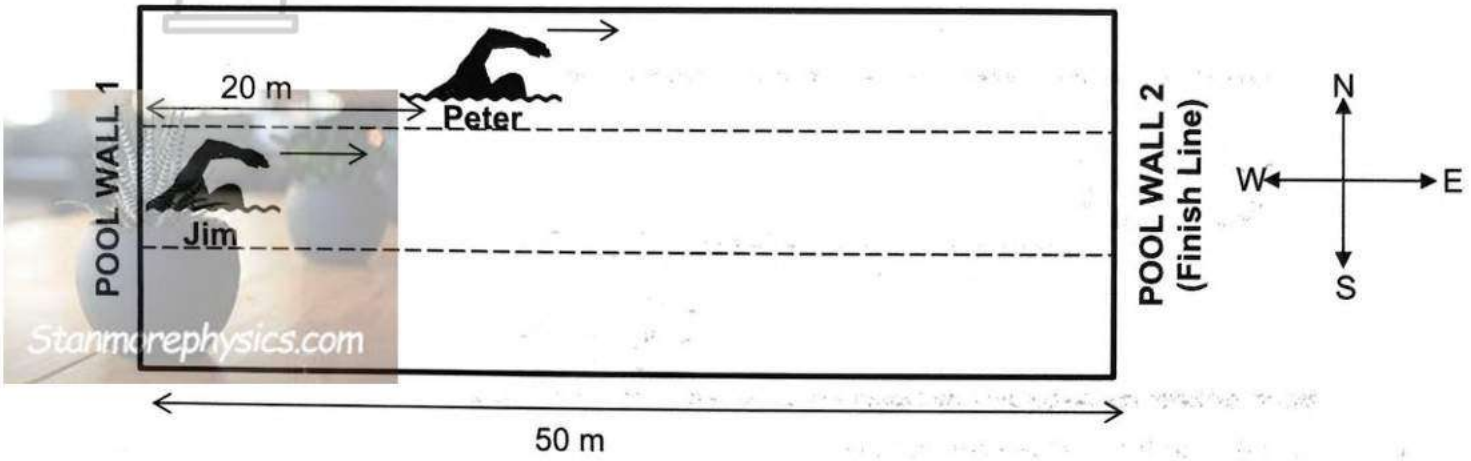
The switch is now opened.

5.4 Will the current through the device INCREASE, DECREASE or REMAIN THE SAME? (2)
Give a reason for the answer.

[15]

QUESTION 6 (Start on a new page)

Peter and Jim are both on the final lap of an 800 m race, in a swimming pool of length 50 metres. When Jim is at pool wall 1, Peter is 20 metres ahead of him.
Both swimmers are moving eastwards to finish the race at pool wall 2.



6.1 Write down the position of Peter relative to the finish line, when Jim is at pool wall 1. (2)

Peter swims at an average velocity of 1,2 $m \cdot s^{-1}$ east.

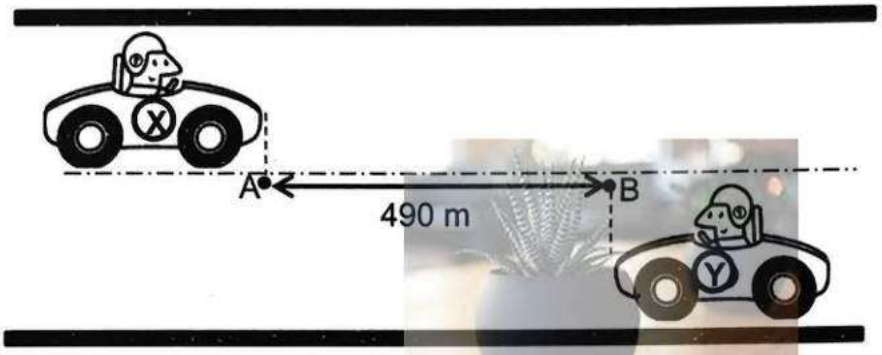
6.2 Calculate the time taken for Peter to reach the finish line from his current position. (3)

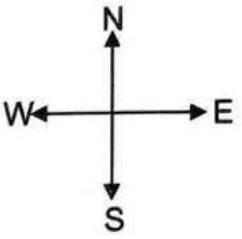
6.3 Calculate the average speed at which Jim needs to swim in order to finish the race 0,5s ahead of Peter. (4)

[9]

QUESTION 7 (Start on a new page)

Car X, starting from rest at Point A, accelerates at 4 $m \cdot s^{-2}$ for 5 seconds along a straight horizontal road, travelling eastwards. After 5 seconds it continues further at a constant velocity.
At the same instant that Car X starts to move, Car Y moves past Point B on the same road in a westerly direction at an unknown CONSTANT velocity.
Points A and B are 490 metres apart.





7.1 Define the term *acceleration* in words. (2)

7.2 Calculate the velocity that Car X reaches after 5 seconds. (4)

Both cars pass each other after 12 seconds.

7.3 Determine the:

7.3.1 Distance covered by Car X in 12 seconds. (5)

7.3.2 Velocity of Car Y. (4)

7.4 <u>On the same set of axis</u> sketch the Velocity – Time graph for BOTH Car X and Car Y until they pass each other. Label each graph.

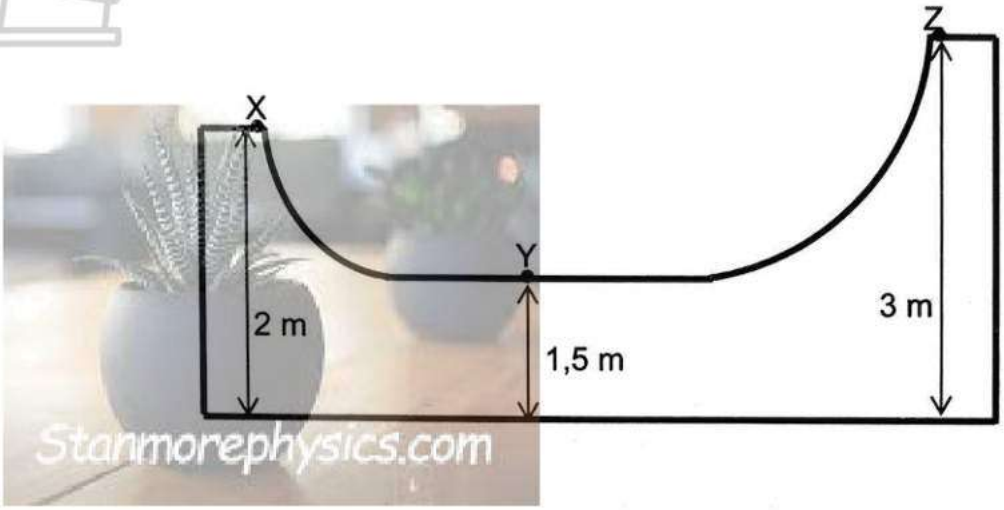
Show the following on the graph:

- The maximum velocity reached by Car X
- The velocity of Car Y
- The time they pass each other

(5)
[20]

QUESTION 8 (Start on a new page)

A boy skates along the frictionless ramp shown below. The boy starts at Point X, 2 metres above the ground, at a velocity of 1 m·s^{-1}.
The combined mass of the boy and skateboard is 60 kg.



8.1 Calculate the mechanical energy of the boy and his skateboard at Point X. (4)

8.2 Determine the speed of the boy and his skateboard at Point Y. (3)

8.3 Use relevant calculations to show that the skateboard will not be able to reach Point Z, when starting at 1 m·s^{-1} at Point X. (3)

[10]

TOTAL: 100

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	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}$ $J \cdot s$
Charge on electron	q_e	$-1,6 \times 10^{-19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE

WAVES, SOUND AND LIGHT

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

ELECTROSTATICS

$Q = n \times q_e$	$Q = \frac{Q1 + Q2}{2}$

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 = IR	

MOTION

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

WORK, ENERGY AND POWER

$U = mgh$ or $E_p = mgh$	$K = {}^1/_2\, mv^2$ or $E_k = {}^1/_2\, mv^2$

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PHYSICAL SCIENCES P1

FINAL EXAMINATION MARKING MEMORANDUM

NOVEMBER 2024

MARKS: 100

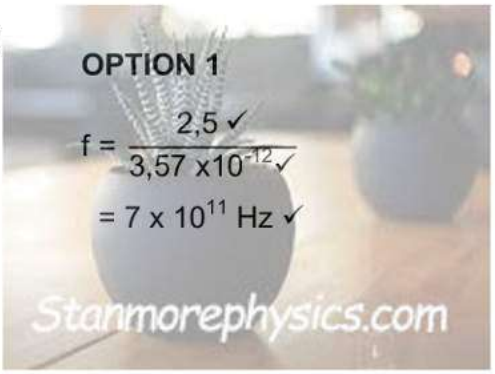
DURATION: 2 hours

QUESTION 1:

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

QUESTION 2

2.1



OPTION 2

$T = \frac{3,57 \times 10^{-12}}{2,5}$ ✓

$= 1,428 \times 10^{-12}$ s

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

$1,428 \times 10^{-12} = \frac{1}{f}$ ✓

$f = 7 \times 10^{11}$ Hz ✓ (3)

2.2 3×10^8 m·s^{-1} ✓ (1)

2.3.1 **POSITIVE MARKING FROM QUESTION 2.1**

$c = f \times \lambda$ ✓

$3 \times 10^8 = 7 \times 10^{11} \times \lambda$ ✓

$\lambda = 4,29 \times 10^{-4}$ m ✓

Radiation X is Infrared ✓ (4)

2.3.2

OPTION 1 (POSITIVE MARKING FROM QUESTION 2.1)

E = h x f ✓.

= 6,63 x 10^{-34} x 7 x 10^{11} ✓.

= 4,64 x 10^{-22} J ✓.

OPTION 2 (POSITIVE MARKING FROM QUESTION 2.3.1)

$E = \frac{hc}{\lambda}$ ✓

$= \frac{6,63 \times 10^{-34} \times 3 \times 10^8}{4,29 \times 10^{-4}}$ ✓

= 4,64 x 10^{-22} J ✓. (3)

[11]

QUESTION 3

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

3.1.2

$\lambda = \frac{1,2}{3}$ ✓

$= 0,4$ m

$v = f \times \lambda$ ✓

$2 = f \times 0,4$ ✓

$f = 5$ Hz ✓ (4)

3.1.3 **POSITIVE MARKING FROM QUESTION 3.1.2**

OPTION 1

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

$= \frac{1}{5}$ ✓

$= 0,2$ s

time = 0,2 x 2✓

$= 0,4$ s ✓

OPTION 2

5 waves → 1 second ✓

2 waves → x seconds

$x = \frac{2}{5}$ ✓

time = 0,4 s ✓ (3)

3.2.1

OPTION 1

$speed = \frac{distance}{time}$ ✓

$= \frac{50}{0,75 - 0,6}$ ✓

$= 333,33 \text{ m·s}^{-1}$ ✓

OPTION 2

$speed = \frac{distance}{time}$ ✓

Sam:

$speed = \frac{X}{0,6}$ ✓

X = speed x 0,6 (1)

James:

$speed = \frac{X + 50}{0,75}$ ✓

X + 50 = speed x 0,75 (2)

speed x 0,6 + 50 = speed x 0,75

speed = 333,33 m·s^{-1} ✓ (4)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1**

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

$333,33 = \frac{X}{0,6}$ ✓

X = 200 m ✓

POSITIVE MARKING FROM QUESTION 3.2.1

$333,33 = \frac{X}{0,6}$ ✓ OR $333,33 = \frac{X + 50}{0,75}$ ✓

X = 200 m ✓ (2)

[15]

QUESTION 4

4.1 Removed from ✓ (1)

4.2 $Q = n \times q_e$ ✓

8×10^{-9} ✓ $= n \times 1{,}6\times10^{-19}$ ✓

$n = 5 \times 10^{10}$ ✓ (4)

4.3 $Q = \frac{Q1 + Q2}{2}$ ✓

$Q = \frac{8\times10^{-9} + (-12\times10^{-9})}{2}$ ✓

$= -2 \times 10^{-9}$ C ✓ (3)

4.4 Repel✓. The spheres have the same charges after contact / Like charges repel ✓ (2)

[10]

QUESTION 5

5.1 The rate of flow of charge ✓✓ (2)

5.2 $V = IR$ ✓

$8 = I \times 4$ ✓

$I = 2$ A ✓ (3)

5.3.1 **POSITIVE MARKING FROM QUESTION 5.2**

$V_p = IR$

$= 2 \times 6$ ✓

$= 12$ V

OR $= 2 \times 4 + 2 \times 2$ ✓

$= 12$ V

$V_{Device} = 22 - 12$ ✓

$= 10$V

$V = \frac{W}{Q}$ ✓

$10 = \frac{3000}{Q}$ ✓

$Q = 300$ C ✓ (5)

5.3.2 **POSITIVE MARKING FROM QUESTION 5.3.1**

OPTION 1	**OPTION 2**
$Q = I\,\Delta t$ ✓	$W = VI\Delta t$ ✓
$300 = I \times 60$ ✓	$3000 = 10 \times I \times 60$ ✓
$I = 5$ A ✓	$I = 5$A ✓

(3)

5.4 Decrease. ✓ The total resistance increases. ✓ (2)

[15]

QUESTION 6

6.1 30 m ✓ west✓ (2)

6.2 $v = \frac{\Delta x}{\Delta t}$ ✓

$1,2 = \frac{30}{\Delta t}$ ✓

$\Delta t = 25$ s ✓ (3)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

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

$= \frac{50}{24,5}$ ✓

$= 2,04 \text{ m·s}^{-1}$ ✓ (4)

[9]

QUESTION 7

7.1 Rate of change of velocity ✓✓ (2 or 0) (2)

7.2 $v_f = v_i + a\Delta t$ ✓

$= 0 + 4\,(5)$ ✓

$= 20 \text{ m·s}^{-1}$ ✓ east ✓ (4)

7.3 **POSITIVE MARKING FROM QUESTION 7.2**

7.3.1 Start – 5 seconds:

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

$= (0)5 + \frac{1}{2}(4)(5^2)$ ✓

$= 50$ m

OR $v_f^2 = v_i^2 + 2a\Delta x$ ✓

$(20)^2 = 0^2 + 2(4)\Delta x$ ✓

$\Delta x = 50$ m

5 seconds – 12 seconds:

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

$= (20)7 + \frac{1}{2}(0)(7^2)$ ✓

$= 140$ m

OR $\Delta x = v\Delta t$

$= (20)7$ ✓

$= 140$ m

Distance $= 140 + 50$ ✓

$= 190$ m ✓ (5)

7.3.2 $\Delta x = 490 - 190$ ✓

$= 300$ m

$v = \frac{\Delta x}{\Delta t}$ ✓

$v = \frac{300}{12}$ ✓

$= 25 \text{ m·s}^{-1}$ west ✓

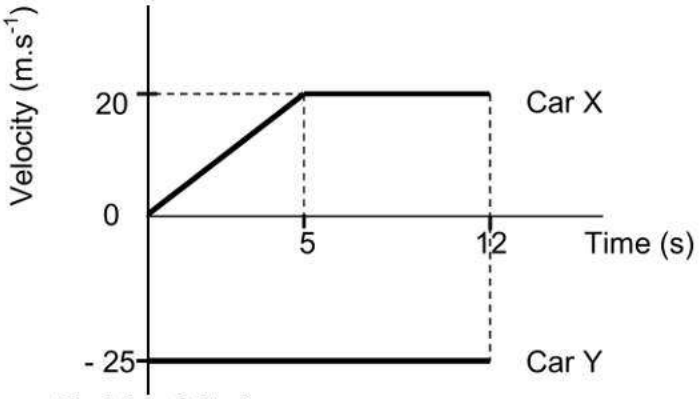
OR

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

$300 = v(12) + \frac{1}{2}(0)(12^2)$ ✓

$v = 25 \text{ m·s}^{-1}$ west ✓ (4)

7.4 **POSITIVE MARKING FROM QUESTION 7.2 AND 7.3**



Marking Criteria

1 Mark – Car X maximum velocity
1 Mark – Car Y velocity
1 Mark – Both graphs stop at time = 12 seconds
1 Mark – Car X Shape(straight line from t = 0 s to t = 5 s AND horizontal line from t = 5 s to t = 12 s) and labelled.
1 Mark – Car Y Shape (horizontal lines from t = 0 s to t = 12 s) and labelled. (5)

[20]

QUESTION 8

8.1 $E_T = mgh + \frac{1}{2}mv^2$ ✓
$= \underline{60 \times 9,8 \times 2}$ ✓ $+ \underline{\frac{1}{2} \times 60 \times (1)^2}$ ✓
$= 1206$ J ✓ (4)

8.2 **POSITIVE MARKING FROM 8.1**
$E_T = mgh + \frac{1}{2}mv^2$
1206 ✓ $= 60 \times 9,8 \times 1,5 + \frac{1}{2} \times 60 \times v^2$ ✓
$v = 3,29$ m·s^{-1} ✓ (3)

8.3 Point Z
$E_P = mgh$
$= 60 \times 9,8 \times 3$ ✓
$= 1764$ J ✓
(The skateboarder is unable to reach Point Z since), the gravitational potential energy at Z is greater than the total mechanical energy ✓. (3)

[10]

TOTAL: 100