



Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMundo
Provinsie van die Oos Kaap: Departement van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

PHYSICAL SCIENCES P1

MARKS: 150

TIME: 3 hours

This question paper consists of 20 pages, including 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 10 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. You may use a non-programmable calculator.
5. Leave ONE line between TWO sub-questions, for example QUESTION 2.1 and QUESTION 2.2.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. All diagrams are NOT necessarily drawn according to scale.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. question Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

- 1.1 A student throws a basketball vertically upwards into the air. She catches the ball 10 s later at the same height from which she threw it.

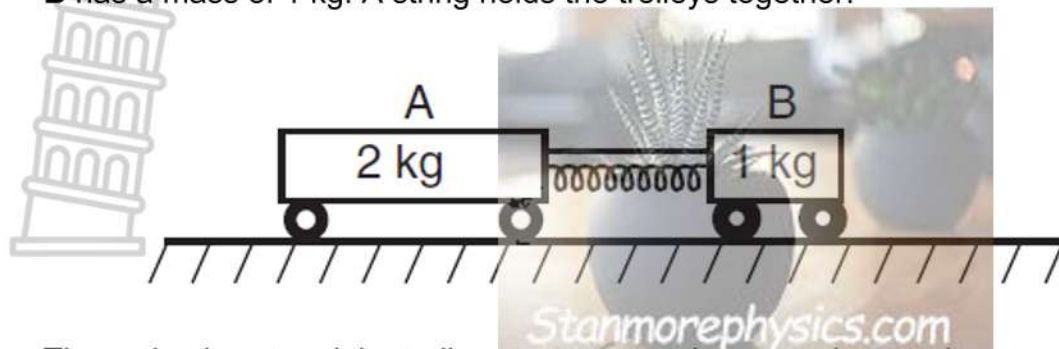
Which ONE of the following statements is INCORRECT with regards to the above situation?

- A The velocity of the ball decreases as it moves upwards.
- B The velocity of the ball is zero when it reaches its maximum height.
- C The ball returns to the student's hands with the same speed with which she threw the ball upwards.
- D The acceleration of the ball as it goes upwards is equal to the acceleration of the ball as it falls downwards but in the opposite direction. (2)

- 1.2 When a car moves at a constant velocity, it means that the net force acting on the car is zero. This phenomenon is best explained by ...

- A Newton's 1st law of motion.
- B Newton's 2nd law of motion.
- C Newton's 3rd law of motion.
- D Newton's law of Universal Gravitation. (2)

- 1.3 The diagram below shows a compressed spring between two trolleys, initially at rest, on a horizontal, frictionless surface. Trolley **A** has a mass of 2 kg and trolley **B** has a mass of 1 kg. A string holds the trolleys together.

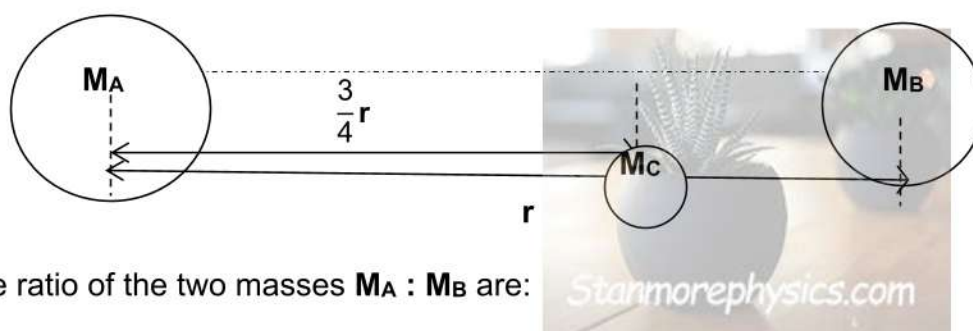


The spring is cut and the trolleys move apart. In comparison to the magnitude of the force the spring exerts on trolley **A**, the magnitude of the force the spring exerts on trolley **B** is ...

- A half as great.
- B twice as great.
- C the same.
- D four times as great.

(2)

- 1.4 Two masses M_A and M_B are placed at a distance r apart. A third mass M_C experiences a ZERO resultant horizontal gravitational force when it is placed $\frac{3}{4}r$ from M_A on the line between M_A and M_B .



The ratio of the two masses $M_A : M_B$ are:

- A 16 : 1
- B 4 : 3
- C 3 : 1
- D 9 : 1

(2)

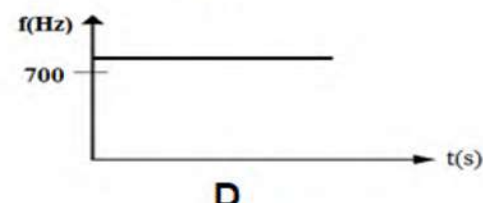
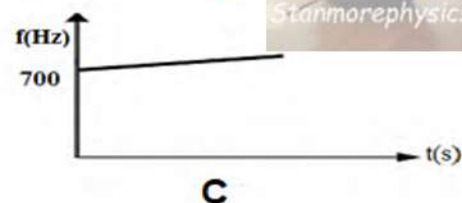
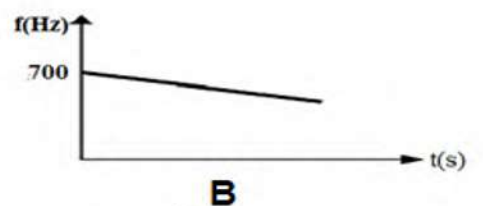
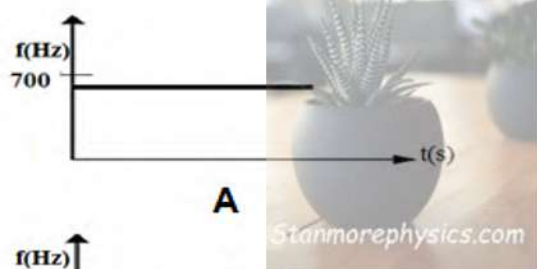
- 1.5 An object moves in a straight line on a ROUGH horizontal surface. If the net work done on the object is ZERO, then ...

A the object moves at constant speed.
B the object has ZERO kinetic energy.
C the object moves with constant acceleration.
D there is no frictional force acting on the object.

(2)

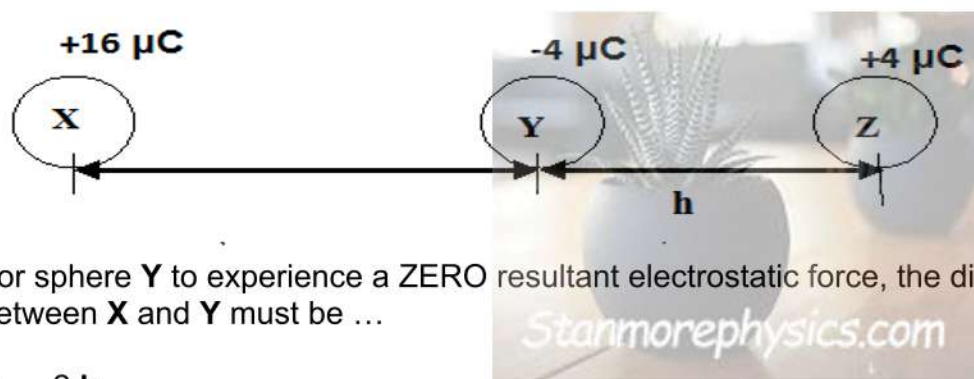
- 1.6 The siren of an ambulance travelling down a straight road at constant speed emits sound waves of frequency 700 Hz. A man sitting next to the road notices that the frequency (pitch) of the sound changes as the ambulance moves towards him.

Which ONE of the following frequency vs time graphs best shows the frequency of the sound observed (heard) by the man?



(2)

- 1.7 Three small identical spheres, **X**, **Y** and **Z** are charged as shown in the diagram below. The distance between sphere **Y** and **Z** is **h**.

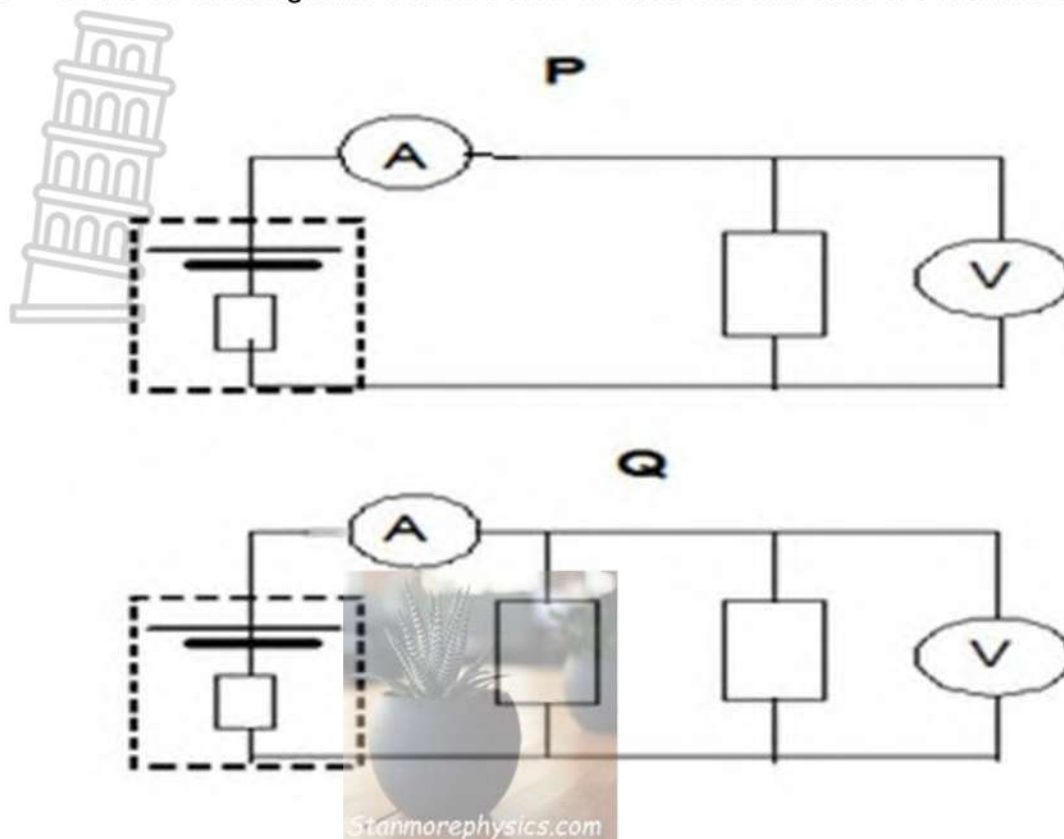


For sphere **Y** to experience a ZERO resultant electrostatic force, the distance between **X** and **Y** must be ...

A $2h$.
B $\frac{1}{2}h$.
C $\frac{1}{4}h$.
D $4h$.

(2)

1.8 In the circuit diagrams shown below all resistors and cells are identical.

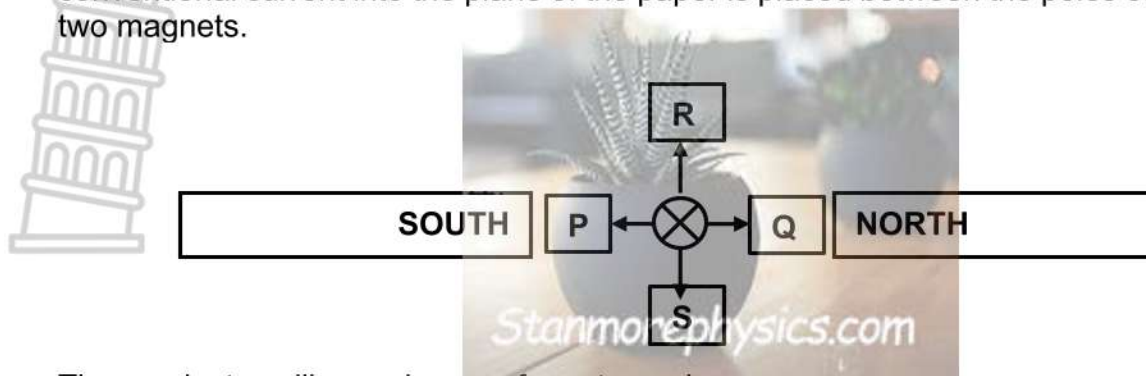


Which ONE of the following gives the correct comparison between the voltmeter and ammeter readings in the circuit diagrams P and Q above?

	VOLTMETER READING	AMMETER READING
A	$V_P > V_Q$	$A_P > A_Q$
B	$V_P > V_Q$	$A_P < A_Q$
C	$V_P < V_Q$	$A_P = A_Q$
D	$V_P = V_Q$	$A_P < A_Q$

(2)

- 1.9 Two strong magnet bars are arranged with the north and south poles facing each other as shown in the diagram below. A current-carrying conductor carries conventional current into the plane of the paper is placed between the poles of the two magnets.

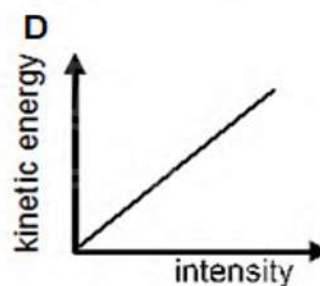
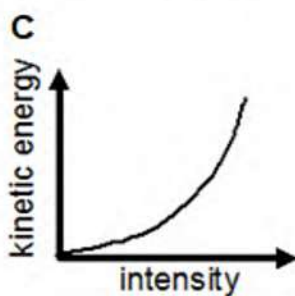
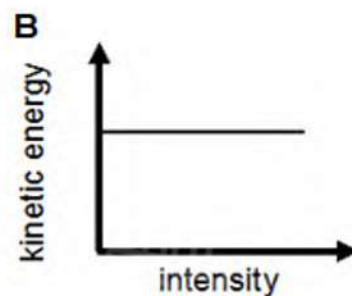
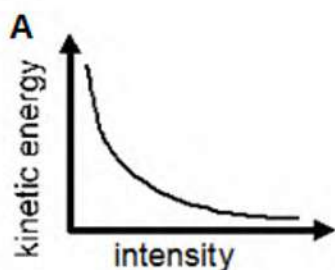


The conductor will experience a force towards ...

- A P.
- B Q.
- C R.
- D S.



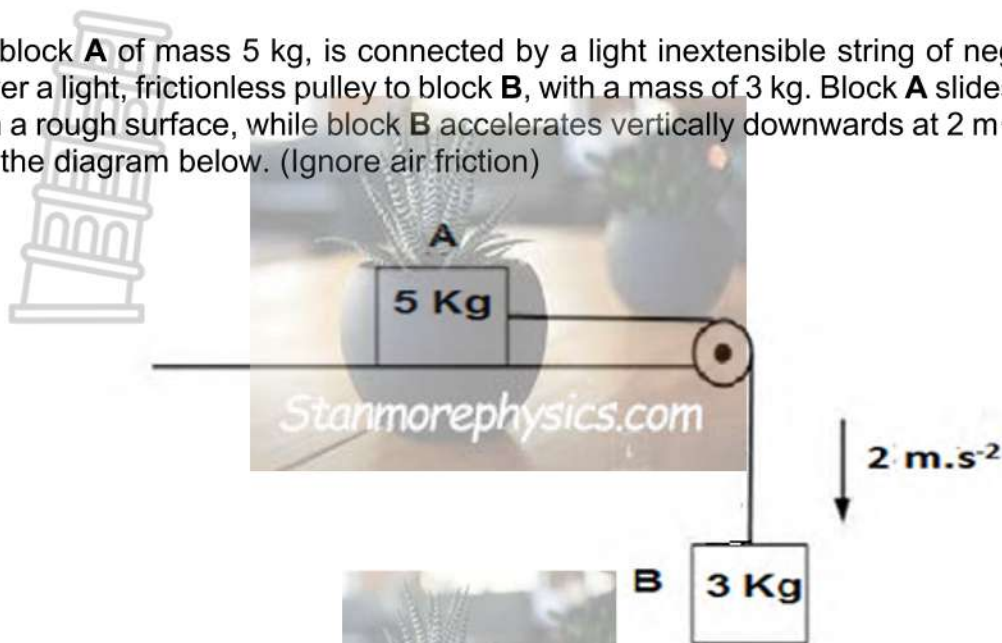
- 1.10 Which ONE of the following graphs best represents the relationship between the maximum kinetic energy of the emitted photo-electrons and the intensity of the incident radiation?



(2)
[20]

QUESTION 2 (Start on a NEW page.)

A block **A** of mass 5 kg, is connected by a light inextensible string of negligible mass over a light, frictionless pulley to block **B**, with a mass of 3 kg. Block **A** slides horizontally on a rough surface, while block **B** accelerates vertically downwards at $2 \text{ m}\cdot\text{s}^{-2}$ as shown in the diagram below. (Ignore air friction)

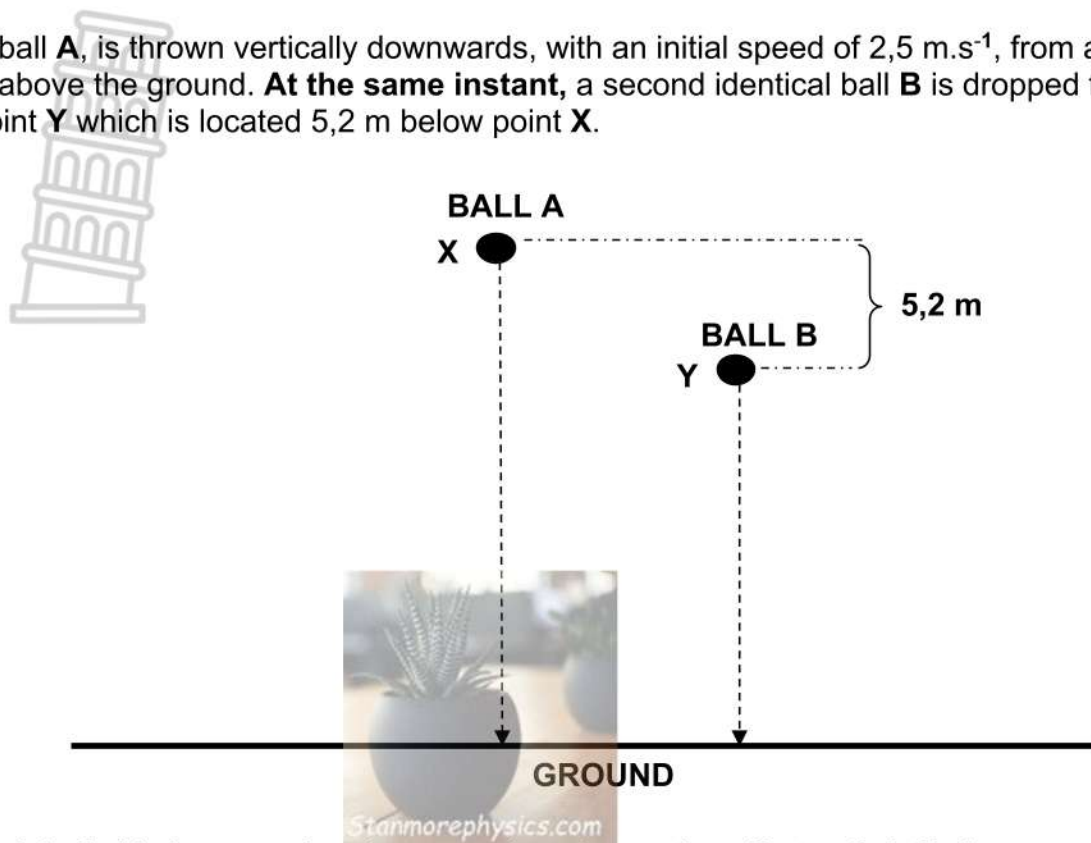


- 2.1 State Newton's First Law of motion in words. (2)
- 2.2 Draw a free-body diagram showing ALL the forces acting on block **B**. (2)
- 2.3 Give a reason why block **B** is accelerating downward. (1)
- 2.4 Calculate the:
- 2.4.1 Magnitude of the frictional force acting on object **A** (5)
- 2.4.2 Coefficient of kinetic friction between block **A** and the surface (3)
- 2.5 Identify ONE, Newton's Third Law, action-reaction force pair that is acting on block **B**. (2)

[15]

QUESTION 3 (Start on a NEW page.)

A ball **A**, is thrown vertically downwards, with an initial speed of $2,5 \text{ m}\cdot\text{s}^{-1}$, from a point **X** above the ground. **At the same instant**, a second identical ball **B** is dropped from a point **Y** which is located $5,2 \text{ m}$ below point **X**.



Both balls hit the ground at the same time. Ignore the effects of air friction.

- 3.1 Define the term *free fall*. (2)
- 3.2 Calculate the:
- 3.2.1 Time taken by the balls to hit the ground (5)
- 3.2.2 Velocity with which ball **A** strikes the ground (3)
- 3.2.3 Height of point **Y** above the ground (3)
- 3.3 On the same system of axes, sketch the relevant velocity-time graphs for the entire motion of both balls **A** and **B**.
• Indicate on your graph the corresponding velocity and time values.
• Label your graphs. (4)

[17]

QUESTION 4 (Start on a NEW page.)

A truck of mass 4 000 kg is travelling at $32,17 \text{ m}\cdot\text{s}^{-1}$ to the right on a straight horizontal road. At the same time a car of mass 2 000 kg is travelling at $25 \text{ m}\cdot\text{s}^{-1}$ in the same direction ahead of the truck as shown in the diagram below.



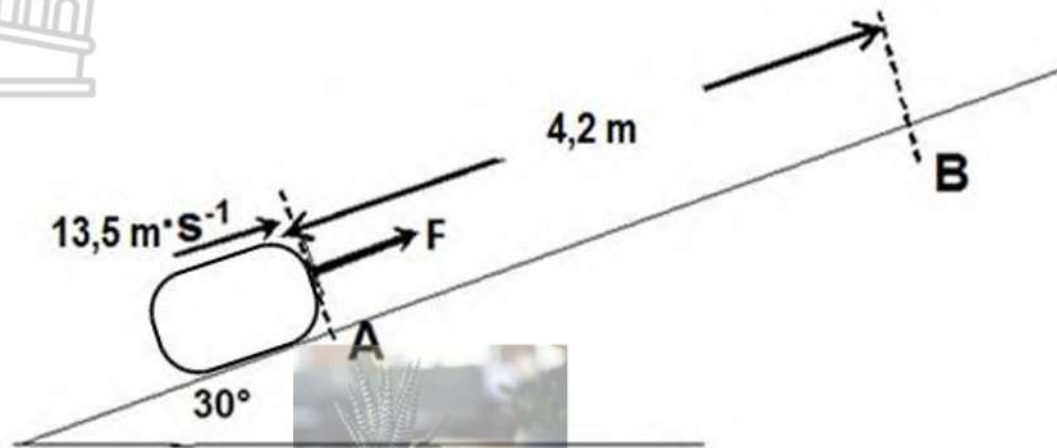
The truck collided with the car and the two vehicles stick together and move as one unit. Ignore the effects of friction.

- 4.1 State the principle of conservation of linear momentum in words. (2)
- 4.2 Calculate the velocity of the truck-car-system immediately after the collision. (4)
- 4.3 Is the collision between the truck and the car ELASTIC or INELASTIC? (1)
- 4.4 On impact the truck exerts a force of magnitude **F** on the car.
 - 4.4.1 Will the magnitude of the force that the car exerts on the truck, on impact, be GREATER THAN, LESS THAN or EQUAL TO, **F**? (1)
 - 4.4.2 Name and state a relevant physics law that explains the answer to QUESTION 4.4.1. (3)

[11]

QUESTION 5 (Start on a NEW page.)

A constant force **F** is applied to a crate of mass 20 kg to move it upwards along a frictionless inclined plane. The speed of the crate at point **A** and point **B** is $13,5 \text{ m}\cdot\text{s}^{-1}$ and $12,2 \text{ m}\cdot\text{s}^{-1}$ respectively. The distance between point **A** and point **B** is 4,2 m as shown in the diagram below.

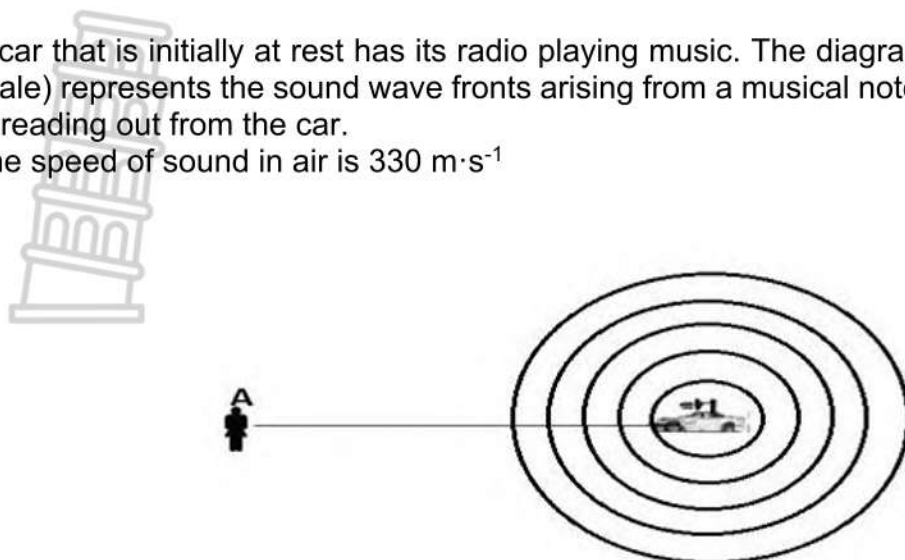


- 5.1 Draw a labelled free-body diagram showing ALL the forces acting on the crate while it is moving up the incline. (3)
- 5.2 Is mechanical energy conserved during this motion? Write down YES or NO and briefly explain the answer. (2)
- 5.3 Write down the name of the conservative force that acts on the crate. (1)
- 5.4 Give a reason why the normal force does no work on the crate during its movement up the incline. (1)
- 5.5 In which direction does the net force act on the crate as it moves up the incline? Write only FROM A TO B or FROM B TO A. (1)
- 5.6 Use energy principles to calculate the magnitude of the force **F**. (5)
- [13]**

QUESTION 6 (Start on a NEW page.)

A car that is initially at rest has its radio playing music. The diagram below (not drawn to scale) represents the sound wave fronts arising from a musical note of frequency 440 Hz, spreading out from the car.

The speed of sound in air is $330 \text{ m}\cdot\text{s}^{-1}$

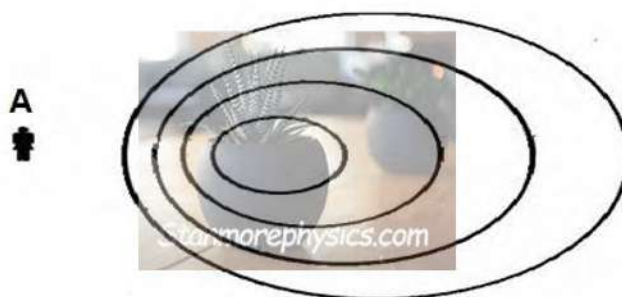


Stationary source

6.1 Calculate the wavelength of the sound wave. (3)

6.2 What is the frequency of the note as heard by an observer at point **A**? (1)

The car now moves at a constant speed of $8 \text{ m}\cdot\text{s}^{-1}$. The wave fronts reach the stationary observer at **A** as shown in the diagram below.



Moving source

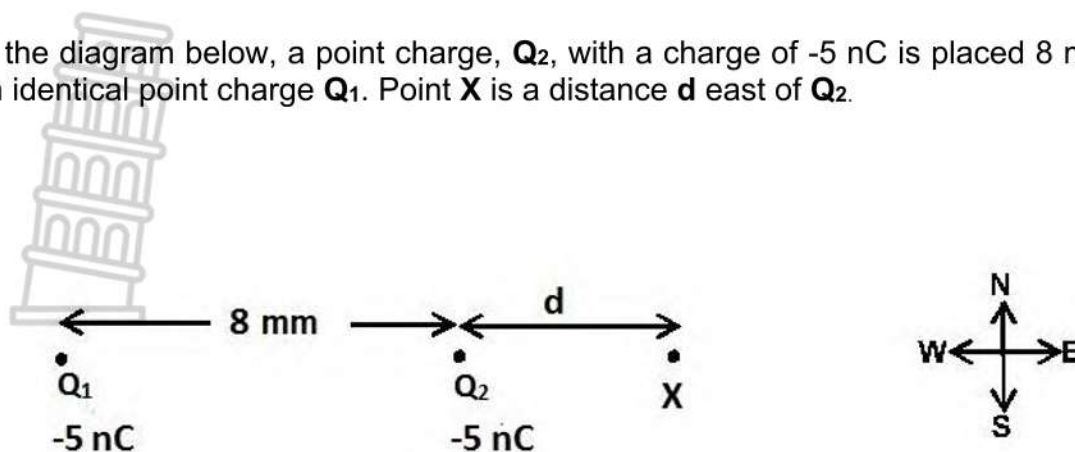
6.3 State the Doppler effect in words. (2)

6.4 At what speed are the wave fronts progressing towards the observer? (1)

6.5 Calculate the frequency of the note as heard by the observer at point **A**. (5)
[12]

QUESTION 7 (Start on a NEW page.)

In the diagram below, a point charge, Q_2 , with a charge of -5 nC is placed 8 mm east of an identical point charge Q_1 . Point X is a distance d east of Q_2 .

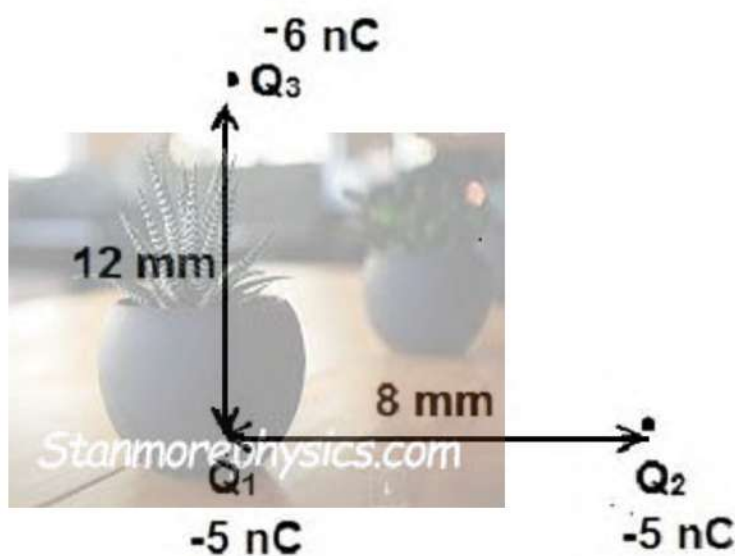


7.1 Define the term *electric field at a point* in words. (2)

7.2 Draw an electric field pattern between Q_1 and Q_2 . (3)

7.3 The electric field at point X , due to ONLY Q_1 , is $5,22 \times 10^5 \text{ N} \cdot \text{C}^{-1}$ west. Calculate the distance d . (4)

A third charge Q_3 of -6 nC is now placed 12 mm due north of charge Q_1 as shown in the diagram below.



7.4 State *Coulomb's law* in words. (2)

7.5 Calculate the magnitude of the net electrostatic force experienced by charge, Q_1 due to the presence of the other two charges Q_2 and Q_3 . (6)
[17]

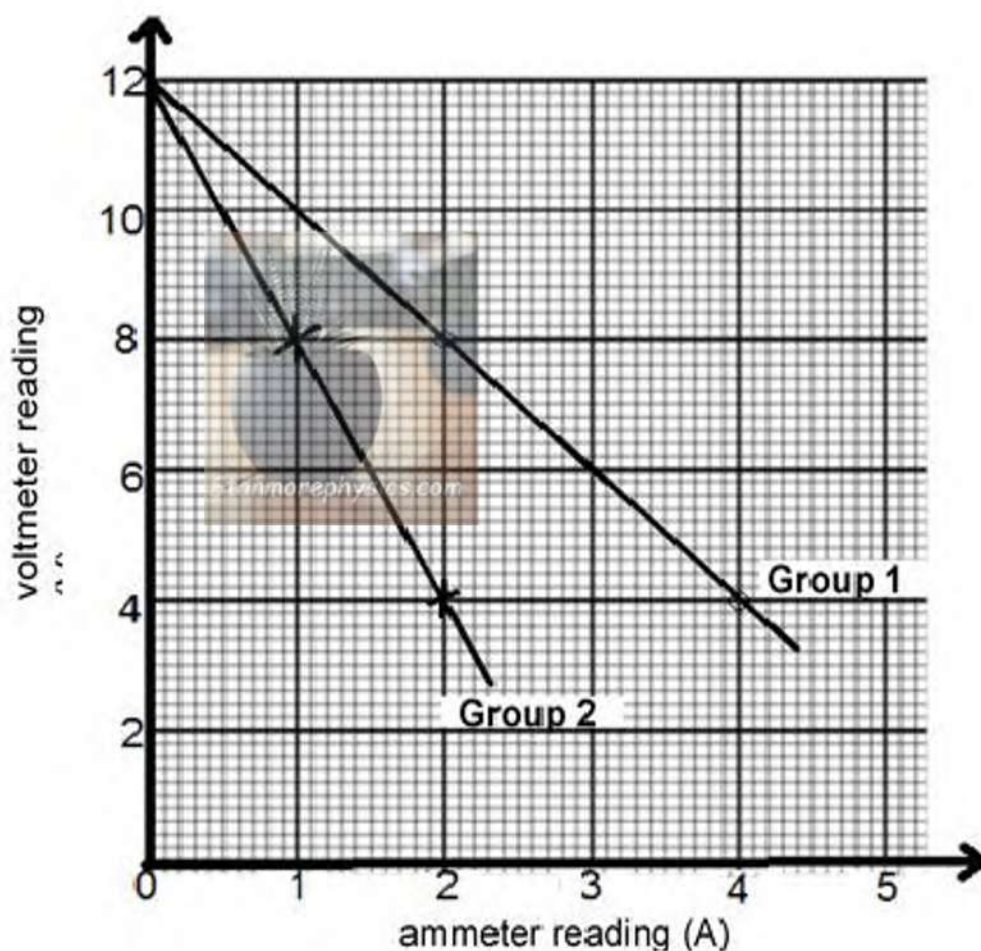
QUESTION 8 (Start on a NEW page.)

Grade 12 learners conducted an experiment to determine the INTERNAL RESISTANCE of a battery. The learners were divided into two groups:

Group 1 used battery 1 with an internal resistance r_1 .

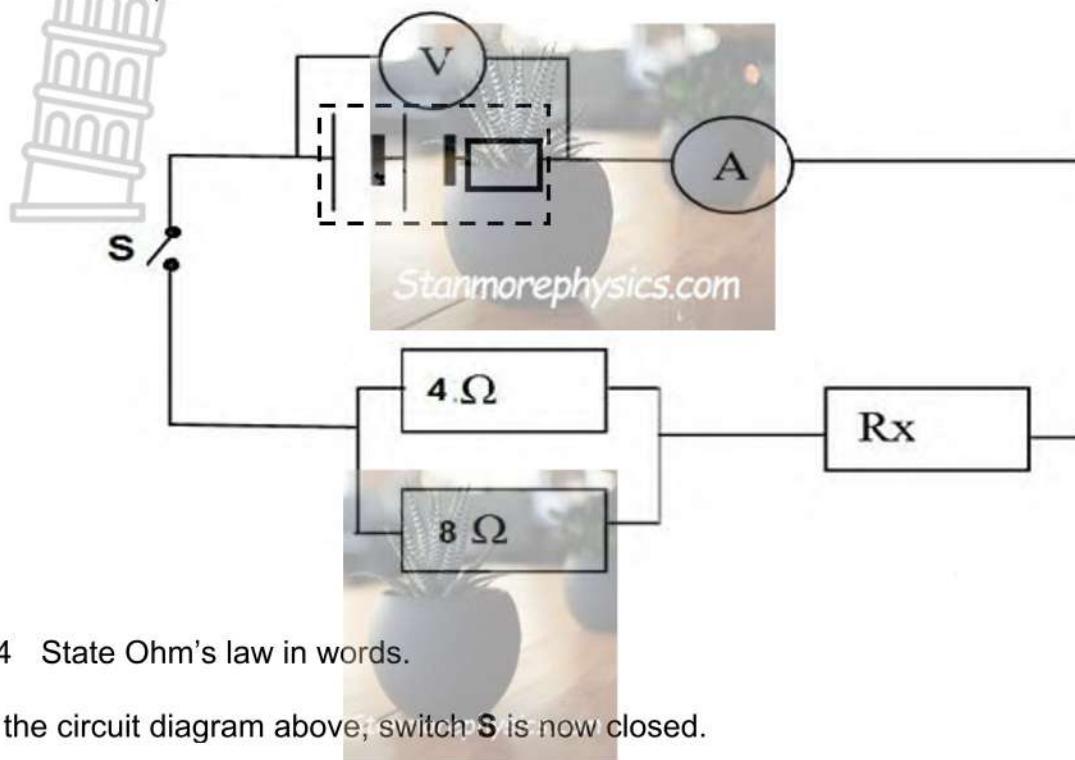
Group 2 used battery 2 with an internal resistance r_2 .

The results of each group are shown in the graph below:



- 8.1 Explain why the voltmeter reading across the battery decreases as the current increases. Use appropriate equation(s) in Physics in your explanation. (4)
- 8.2. Which group, 1 or 2, used a battery with greater internal resistance? (1)
- 8.3 Use the graph to determine the internal resistance of the battery used by learners in **group 1**. (3)

Three resistors, $4\ \Omega$, $8\ \Omega$ and R_x are connected to a battery as shown in the circuit diagram below. When switch S is open the reading on the voltmeter is 12 V . When switch S is closed the reading on the voltmeter is 10 V and the reading on the ammeter is $1,5\text{ A}$.



8.4 State Ohm's law in words.

(2)

In the circuit diagram above, switch S is now closed.

8.5 Calculate the resistance of the unknown resistor R_x .

(6)

8.6 Calculate the internal resistance of the battery.

After a while, the $4\ \Omega$ resistor gets hotter than the $8\ \Omega$ resistor.

(3)

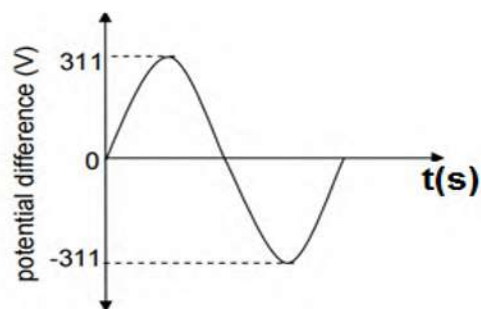
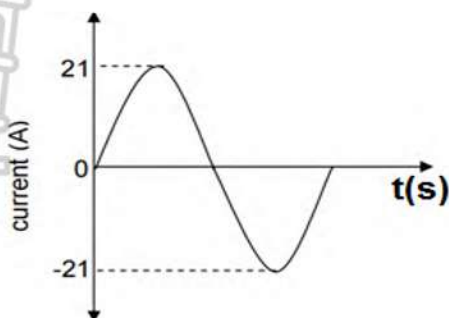
8.7 Fully explain this observation.

(3)

[22]

QUESTION 9 (Start on a NEW page.)

Graphs of the current and potential difference outputs of an AC generator are shown below.



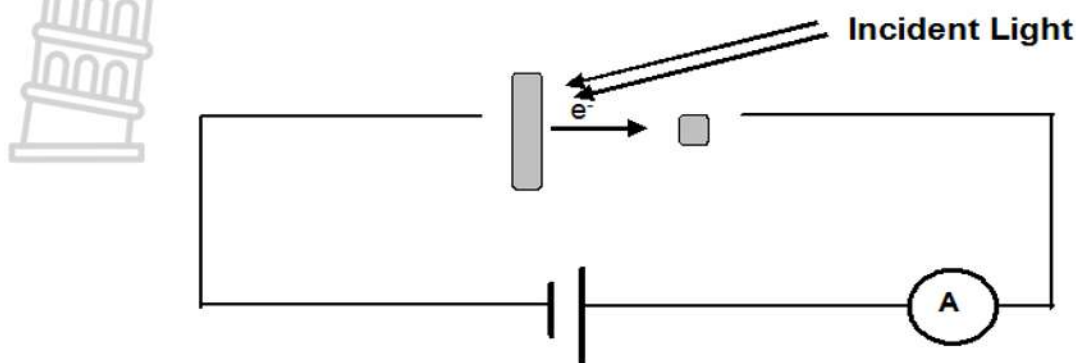
- 9.1 Define the term *root mean square value (rms)* of an AC voltage. (2)
- 9.2 Write down the energy conversion that takes place in an AC generator. (1)
- 9.3 Give ONE reason why AC voltage is preferred to DC voltage for everyday use. (1)
- 9.4 Calculate the average power output of this generator. (6)

Stanmorephysics.com

[10]

QUESTION 10 (Start on a NEW page.)

The diagram below shows a circuit in which a photocell is irradiated alternately with red and blue light to demonstrate the photo-electric effect.



- 10.1 An ammeter reading is recorded when the photocell is irradiated with red light. Give an explanation for this observation. (2)

Blue light with the same intensity as the red light is now used to irradiate the metal in the photocell. How will this affect the following?

- 10.2 The kinetic energy of the photo-electrons (Write down only INCREASE, DECREASE or STAYS THE SAME.) (1)

- 10.3 The ammeter reading. (Write down only INCREASE, DECREASE or STAYS THE SAME.)

Fully explain your answer. (4)

- 10.4 The wavelength of the blue light used in the demonstration is $4,5 \times 10^{-7} \text{ m}$. Calculate the threshold frequency (cut-off frequency) of the metal used in the photo cell if the average speed of an emitted photo-electron is equal to $4,78 \times 10^5 \text{ m} \cdot \text{s}^{-1}$. (6)

[13]

TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAME/NAAM	SYMBOL/ SIMBOOL	VALUE/WAARDE
Acceleration due to gravity / <i>Swaartekragversnelling</i>	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant / <i>Universelegravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Mass of earth / <i>Massa op aarde</i>	M	$5,98 \times 10^{24} \text{ kg}$
Radius of earth / <i>Radius van aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$
Speed of light in a vacuum / <i>Spoed van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant / <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant / <i>Coulomb se konstante</i>	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Charge on electron / <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass / <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

MOTION/BEWEGING

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

FORCE/KRAG

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{d^2}$	$g = G \frac{M}{d^2}$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = F \Delta x \cos \theta$	$U = mgh$ or/of $E_p = mgh$
$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{av}} = Fv$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_o + E_{k(\text{max})}$ where/waar $E = hf$ and/en $W_o = hf_o$ and/en $E_{k(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$ or/of $K_{\text{max}} = \frac{1}{2} mv_{\text{max}}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1 Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

$R = \frac{V}{I}$	emf ($\mathcal{E}$) = $I(R + r)$ emk ($\mathcal{E}$) = $I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/WISSELSTROOM

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{average} = V_{rms} I_{rms}$ / $P_{gemiddeld} = V_{wgk} I_{wgk}$ $P_{average} = I_{rms}^2 R$ / $P_{gemiddeld} = I_{wgk}^2 R$ $P_{average} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	



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Porafensie Ya Kapa Botjhabela: Lefapha la Thuto

**NATIONAL SENIOR
CERTIFICATE/
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

SEPTEMBER 2025

**AMENDED PHYSICAL
SCIENCES P1 MARKING
GUIDELINE/ FISIIESE
WETENSKAPPE V1
NASIENRIGLYN**

MARKS/PUNTE: 150

This marking guideline consists of 15 pages./
Hierdie nasienriglyn bestaan uit 15 bladsye.

QUESTION/VRAAG 1

- 1.1 D ✓✓ (2)
- 1.2 A ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 A ✓✓ (2)
- 1.6 D ✓✓ (2)
- 1.7 A ✓✓ (2)
- 1.8 B ✓✓ (2)
- 1.9 C ✓✓ (2)
- 1.10 B ✓✓ (2)
- [20]**



QUESTION/VRAAG 2

- 2.1 A body will remain at rest or motion at constant velocity unless a non-zero net/resultant force acts on it. ✓✓

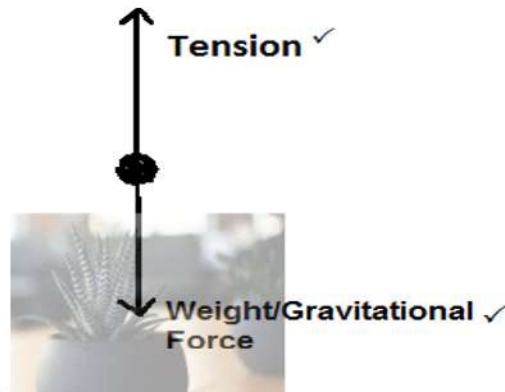
1 underlined word omitted 1 mark

(2)

2 underlined words omitted 0 mark

'n Liggaam sal in rus bly of aanhou beweeg teen konstante snelheid tensy 'n netto/resultante krag op die liggaam inwerk.

2.2



Accepted labels/Aanvaarde benoeming

W	F_g/F_w /weight/gravitational force/ gewig/gravitasiekrag /29,4 N	✓
T	F_T /Tension/Force in string/ Spanning/ Krag in die tou	✓

(2)

2.3

Gravitational force > Tension force ✓/ $F_g > T$

accept Force of gravity

Gravitasiekrag > Spanningskrag

(1)

2.4.1

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ F_{\text{net}} &= T - f \\ F_{\text{net}} &= F_g - T \end{aligned} \right\} \text{Any one/Enige een } \checkmark$$

3 kg block / 3 kg blok

$$\frac{3 \times 9,8 - T}{N} \checkmark = 3 \times 2 \quad \therefore T = 23,4 \text{ N}$$

5 kg block / 5 kg blok

$$T - f_k = 5 \times 2$$

$$f_k = 23,4 - 10 \checkmark$$

$$\therefore f_k = 13,4 \text{ N} \checkmark$$

Any one/Enige een (3 x 2 or/of 5 x 2)✓

(5)

2.4.2

$$f_k = \mu_k N \checkmark$$

$$= \mu_k F_g = \mu_k mg$$

$$13,4 = \mu_k (5)(9,8) \checkmark$$

$$\therefore \mu_k = 0,27 \checkmark$$

Positive marking from Q 2.4.1

(3)

- 2.5 The force that the rope exerts on the box and the force that the box exerts on the rope. ✓✓ $F_{rb} = F_{br}$

Die krag wat die tou op die houer uitoefen en die krag wat die houer op die tou uitoefen.

OR/OF

The force that the Earth exerts on the box and the force that the box exerts on the Earth. ✓✓ $F_{eb} = F_{be}$

Die krag wat die Aarde op die houer uitoefen en die krag wat die houer op die Aarde uitoefen.

(2)
[15]

QUESTION/VRAAG 3

- 3.1 The motion of an object where the only force acting on the object is the gravitational force. ✓✓ (2 or 0)
Die beweging van 'n voorwerp waar die enigste krag wat op die voorwerp inwerk die gravitasiekrag is.

(2)

OR/OF

Motion under the influence of gravitational force only ✓✓ (2 or 0)

Beweging slegs onder die invloed van gravitasiekrag/swaartekrag

NOTE: If projectile is defined 0/2

NOTA: Indien projecktiel gedefineer is 0/2

- 3.2.1 **Upwards as positive/Opwaarts as positief**

Ball/Bal A:

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

$$-\Delta y = (-2,5) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

Ball/Bal B:

$$-(\Delta y - 5,2) = 0 + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$-\Delta y = -5,2 + \frac{1}{2} (-9,8) \Delta t^2$$

$$(-2,5) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 = -5,2 + \frac{1}{2} (-9,8) \Delta t^2 \checkmark \text{ (equating/gelykstelling } \Delta y_A \text{ to/na } \Delta y_B)$$

$$\Delta t = 2,08 \text{ s } \checkmark$$

Upwards as negative/Opwaarts as negatief

Ball/Bal A:

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

$$\Delta y = (2,5) \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

Ball/Bal B:

$$(\Delta y - 5,2) = 0 + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta y = 5,2 + \frac{1}{2} (9,8) \Delta t^2$$

$$(2,5) \Delta t + \frac{1}{2} (9,8) \Delta t^2 = 5,2 + \frac{1}{2} (9,8) \Delta t^2 \checkmark \text{ (equating/gelykstelling } \Delta y_A \text{ to } \Delta y_B)$$

$$\Delta t = 2,08 \text{ s } \checkmark$$

(5)

3.2.2 POSITIVE MARKING FROM 3.2.1/POSITIEWE NASIEN VANAF VRAAG 3.2.1

Upwards as positive/Opwaarts as positief

$$v_f = v_i + a \Delta t \checkmark$$

$$v_f = -2,5 + (-9,8)(2,08) \checkmark$$

$$v_f = -22,884$$

$$v_f = 22,884 \text{ m} \cdot \text{s}^{-1}, \text{ downwards/afwaarts} \checkmark$$

Upwards as negative/Opwaarts as negatief

$$v_f = v_i + a \Delta t \checkmark$$

$$v_f = 2,5 + (9,8)(2,08) \checkmark$$

$$v_f = 22,884 \text{ m} \cdot \text{s}^{-1},$$

$$\text{downwards/afwaarts} \checkmark$$

(3)

3.2.3 POSITIVE MARKING FROM 3.2.2/ POSITIEWE NASIEN VANAF VRAAG 3.2.2
OPTION/OPSIE 1

Upwards as positive/Opwaarts as positief

Ball/Bal A:

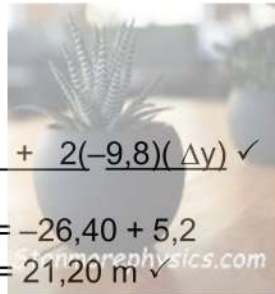
$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$-22,884^2 = -2,5^2 + 2(-9,8)(\Delta y) \checkmark$$

$$\Delta y = -26,40 \text{ m}$$

$$\text{Height/Hoogte } Y = -26,40 + 5,2$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m} \checkmark$$



Upwards as negative/Opwaarts as negatief

Ball/Bal A:

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$22,884^2 = 2,5^2 + 2(9,8)(\Delta y) \checkmark$$

$$\Delta y = 26,40 \text{ m}$$

$$\text{Height/Hoogte } Y = 26,40 - 5,2$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m} \checkmark$$

**POSITIVE MARKING FROM 3.2.1/ POSITIEWE NASIEN VANAF VRAAG 3.2.1
OPTION/OPSIE 2**

Upwards is positive/Opwaarts as positief

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

$$\Delta y = (-2,5) \times 2,08 + \frac{1}{2}(-9,8) 2,08^2 \checkmark$$

$$\Delta y = -26,40$$

$$\text{Height/Hoogte } Y = -26,40 + 5,2$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m } \checkmark$$

Upwards is negative/Opwaarts as negatief

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

$$\Delta y = (2,5) 2,08 + \frac{1}{2}(9,8) 2,08^2 \checkmark$$

$$\Delta y = 26,40$$

$$\text{Height/Hoogte } Y = 26,40 - 5,2$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m } \checkmark$$

OPTION/OPSIE 3

Ball/Bal B

POSITIVE MARKING FROM 3.2.1/ POSITIEWE NASIEN VANAF VRAAG 3.2.1

Upwards is positive / Opwaarts as positief

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

$$\Delta y = 0 \times 2,08 + \frac{1}{2}(-9,8) 2,08^2 \checkmark$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m } \checkmark$$

Upwards is negative/ Opwaarts as negatief

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

$$\Delta y = 0 2,08 + \frac{1}{2}(9,8) 2,08^2 \checkmark$$

$$\text{Height/Hoogte } Y = 21,20 \text{ m } \checkmark$$

(3)

Option 4

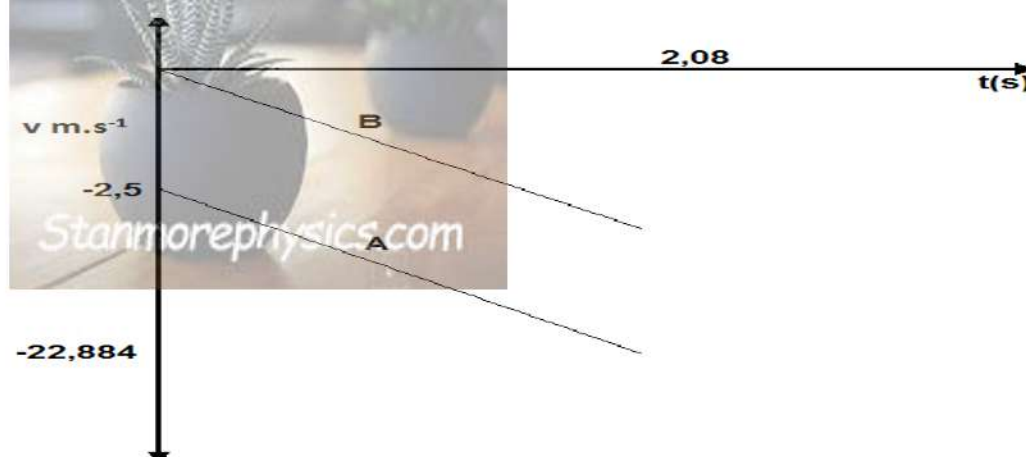
$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

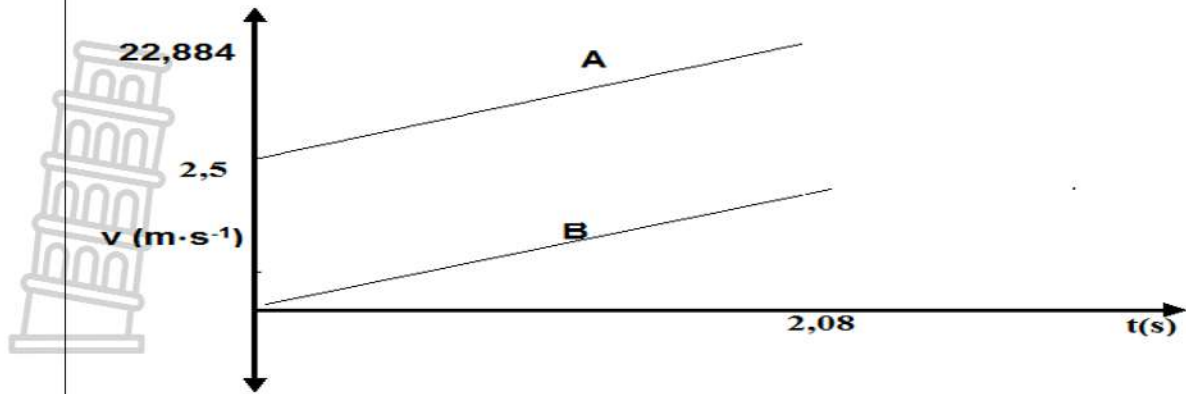
$$= \left(\frac{2,5 + 22,88}{2} \right) 2,08 \checkmark$$

$$= 26,4 \text{ m}$$

$$Y = 26,4 - 5,2 = 21,20 \text{ m } \checkmark$$

3.3





Criteria for graph/Kriteria vir grafiek	Marks/ Punte
Shape parallel lines/Beide lyne parallel.	✓✓
B starts on $(0,0)$ and A from 2,5/ B begin by $(0,0)$ en vanaf 2,5	✓
2,08 s and /en $22,884 \text{ m}\cdot\text{s}^{-1}$ indicated / aangedui $(2,08, 22,884)$	✓

Positive marking from 3.2.1 and 3.2.2
Graphs not labelled -1

(4)
[17]

QUESTION/VRAAG 4

- 4.1 The total linear momentum ✓ of an isolated system ✓ remains constant/is conserved.
Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant/behoue. (2)

- 4.2 **Right as positive/Regs as positief**
 $\Sigma p_i = \Sigma p_f$
 $(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ } Any one/Enige een ✓
 $(mv_i)_1 + (mv_i)_2 = (m_1 + m_2) v_f$ }

$$(4\,000 \times 32,17) + (2\,000 \times 25) \checkmark = (6\,000) v_f \checkmark$$

$$v_f = 29,78 \text{ m.s}^{-1} \text{ in the original direction/in die oorspronklike rigting } \checkmark \quad (4)$$

- 4.3 Inelastic/Onelasties ✓ (1)

- 4.4.1 equal to F/gelyk aan F ✓ (1)

- 4.4.2 Newton's Third Law of motion/Newton se derde Bewegingswet. ✓

When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓✓ (2 or 0)

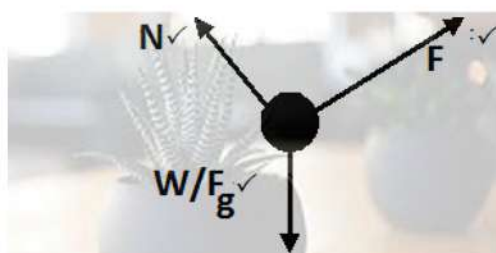
Newton se derde Bewegingswet

Wanneer voorwerp A 'n krag op voorwerp B uitoefen, oefen voorwerp B gelyktydig 'n krag van gelyke grootte en in die teenoorgestelde rigting op voorwerp A uit.

(3)
[11]

QUESTION/VRAAG 5

5.1

**Accepted labels/Aanvaarde benoeming**

w	F_g/F_w /weight/gravitational force gewig/gravitasiekrag	✓
F	F_A /Applied Force/ Toegepastekrag	✓
N	F_N/N /Normal force/ Normaalkrag	✓

(3)

- 5.2 No ✓, it is not an isolated system ✓
 Nee, dit is nie op geïsoleerde stelsel/sisteem nie



OR/OF

- No ✓, there is an external force (applied force) acting on the object ✓
 Nee, daar is 'n eksterne krag (toegepastekrag) wat op die voorwerp inwerk. (2)

Can accept: "non-conservative force on a crate as a reason"

- 5.3 Gravitational force/weight/Gravitasiekrag/gewig ✓ force of gravity (1)

- 5.4 The force is perpendicular to the displacement. ✓

Die krag is loodreg aan die verplasing.

Normal force acts at 90° to the motion ✓ / direction of motion



OR/OF

Therefore, $\cos \theta = 90^\circ$ / daarom is $\cos \theta = 90^\circ$ ✓ (1)

- 5.5 From B to A ✓

Van B tot A

(1)

- 5.6 **OPTION/OPSIE 1**

$$W_{\text{net}} = \Delta K$$

$$W_{\text{net}} = \Delta E_k$$

$$W_{\parallel} + W_F = \Delta K$$

$$F_{g\parallel} \cdot \Delta x \cdot \cos \theta + F \cdot \Delta x \cdot \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

Any one/Enige een ✓

$$(20 \times 9,8 \times \sin 30^\circ)(4,2) \cos 180^\circ \checkmark + F(4,2) \cos 0^\circ \checkmark = \frac{1}{2}(20)(12,2)^2 - \frac{1}{2}(20)(13,5)^2 \checkmark$$

$$411,6(-1) + F(4,2)(1) = 1488,4 - 1822,5$$

$$F = 18,45 \text{ N } \checkmark$$

OPTION/OPSIE 2

$$W_{\text{nc}} = \Delta E_k + \Delta E_p$$

$$F \cdot \Delta x \cdot \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$$

$$F(4,2) \cos 0^\circ \checkmark = [\frac{1}{2}(20)(12,2)^2 - \frac{1}{2}(20)(13,5)^2] \checkmark + [(20)(9,8)(4,2 \sin 30^\circ) \checkmark - 0$$

Any one/Enige een ✓

$$F(4,2)(1) = 1488,4 - 1822,5 + (196)(4,2)(0,5)$$

$$F = 18,45 \text{ N } \checkmark$$

(5)

[13]

QUESTION/VRAAG 6

6.1 $v = f\lambda$ ✓

$330 = (440) \lambda$ ✓

$\lambda = 0,75 \text{ m}$ ✓

(3)

6.2 440 Hz ✓

(1)

6.3 The (apparent) change in frequency/pitch ✓ of the sound detected by a listener because the listener and the sound source have different velocities relative to the medium of sound propagation. ✓ **underlined words cannot be omitted**

Die (skynbare) verandering in frekwensie/toonhoogte van die klank wat deur 'n luisteraar waargeneem word want die luisteraar en die klankbron het verskillende snelhede relatief aan die medium van klank voortplanting.

(2)

6.4 $330 \text{ m}\cdot\text{s}^{-1}$ ✓

(1)

6.5

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

$$= \frac{330}{330 - 8} \cdot 440 \quad \checkmark$$

$$f_L = 450,93 \text{ Hz} \quad \checkmark$$

(5)

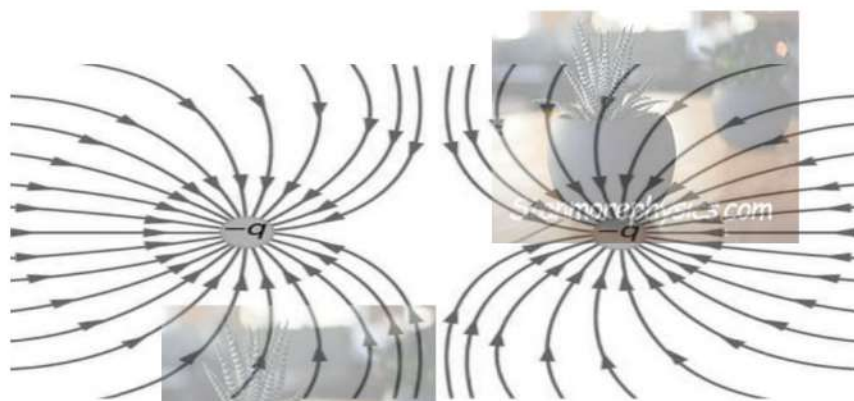
[12]

QUESTION/VRAAG 7

- 7.1 It is the electrostatic force experienced per unit positive placed at that point. ✓✓ **If key word omitted, deduct 1 mark**
 Dit is die elektrostatiese krag wat deur 'n eenheidpositiewe-lading wat by daardie punt geplaas is, ondervind word.

(2)

7.2

**Marking Criteria/Nasienkriteria**

Correct Shape/Korrektevorm ✓

Arrows pointing towards P and Q/Pyltjies wys na P en Q ✓

Field lines don't touch/cross and perpendicular on charge/Veldlyne raak nie/kruis en loodreg op lading ✓

7.3

$$E = \frac{kQ}{r_1^2} \checkmark$$

$$5,22 \times 10^5 = \frac{(9 \times 10^9)(5 \times 10^{-9})}{r^2} \checkmark$$

$$r = 9,285 \times 10^{-3}$$

$$\therefore d = 9,285 \times 10^{-3} = 8 \times 10^{-3} \text{ m} \checkmark$$

$$= 1,29 \times 10^{-3} \text{ m} \checkmark (\text{or } 1,29 \text{ mm})$$

$$d = 0,009 - 0,008$$

$$= 0,001 \text{ m (or 1mm)}$$

(4)

- 7.4 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓

If masses instead of charges 0/2

(2)

Die grootte van die elektrostatiese krag wat deur een puntlading op 'n ander puntlading uitgeoefen word, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

7.5 $F = \frac{kQ_1Q_2}{r^2} \checkmark$

$$F_1 = \frac{(9 \times 10^9)(5 \times 10^{-9})(5 \times 10^{-9})}{(0,008)^2} \checkmark$$

$$F_1 = 3,52 \times 10^{-3} \text{ N (west/wes OR/OF left/links)}$$

$$F_2 = \frac{(9 \times 10^9)(5 \times 10^{-9})(6 \times 10^{-9})}{(0,012)^2} \checkmark$$

$$F_2 = 1,88 \times 10^{-3} \text{ N (south/suid OR/OF down/aft)}$$

$$F_{\text{net}}^2 = (3,52 \times 10^{-3})^2 + (1,88 \times 10^{-3})^2 \checkmark$$

$$\therefore F_{\text{net}} = 3,98 \times 10^{-3} \text{ N} \checkmark$$

Range $(3,98 \times 10^{-3} \text{ N} - 3,99 \times 10^{-3} \text{ N})$



(6)
[17]

QUESTION/VRAAG 8

8.1 $\text{emf}(\mathcal{E}) = IR_{\text{ext}} + Ir$ ✓ / $\text{emf}(\mathcal{E}) = V + V_{\text{int}}$

When the current increases, Ir (lost volts) increases ✓ IV_{ext} (terminal voltage/pd)(voltage of the load) decreases ✓Since $\text{emf}(\mathcal{E})$ is the same/constant ✓Wanneer die stroom toeneem, neem Ir (verlore volts) toe IR_{ekst} (terminaal spanning/ spanning van die las) neem af $\text{emk}(\mathcal{E})$ is dieselfde/konstant

(4)

8.2 Group/Groep 2 ✓ [Accept/Aanvaar r_2]

(1)

8.3

$$\text{gradient} = \frac{\Delta y}{\Delta x}$$

$$= \frac{4-8}{4-2}$$

$$\text{gradient} = -2 \Omega$$

$$r = 2 \Omega$$
 ✓

Use any coordinate values

Gebruik enige koördinaatwaardes

OR/OF

$$V = -Ir + E$$
 ✓

$$4 = -4r + 12$$
 ✓

$$\frac{4r}{4} = \frac{8}{4}$$

$$r = 2 \Omega$$
 ✓

(3)

8.4 The potential difference across a conductor is directly proportional to the current ✓ in the conductor at constant temperature. ✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (2)

OPTION/OPSIE 1

8.5

$$R_{\text{ext}} = R_x + R_{\text{parallel}} \quad \text{OR/OF} \quad R_{\text{ext}} = R_x + \left(\frac{R_1 R_2}{R_2 + R_1} \right) \quad \text{OR/OF} \quad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \checkmark$$

Any one/Enige een

$$\frac{1}{R_{//}} = \frac{1}{4} + \frac{1}{8} \quad \therefore R_p = 2,67 \Omega$$

$$R_{\text{ext}} = \frac{V}{I}$$
 ✓

$$R_{\text{ext}} = \frac{10}{1,5}$$
 ✓

$$= 6,67 \Omega$$

$$6,67 = R_x + 2,67$$
 ✓

$$R_x = 6,67 - 2,67$$

$$= 4 \Omega$$
 ✓

OPTION/OPSIE 2

$$R_{\text{ext}} = R_x + R_{\text{parallel}} \quad \text{OR/OF} \quad R_{\text{ext}} = R_x + \left(\frac{R_1 R_2}{R_2 + R_1} \right) \quad \text{OR/OF} \quad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \checkmark$$

Any one/Enige een

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{8} \quad \checkmark \quad \therefore R = 2,67 \Omega$$

$$V_p = IR_p \quad \checkmark$$

$$= (1,5)(2,67) \quad \checkmark$$

$$= 4,00 \text{ V OR/OF } 4,01 \text{ V}$$

$$V_{R_x} = 10 - 4 \quad \text{OR/OF } 10 - 4,01$$

$$= 6 \text{ V OR/OF } 5,99 \text{ V}$$

$$V_{R_x} = IR_x$$

$$6 = (1,5)R_x \quad \checkmark \quad \text{OR/OF } 5,99 = (1,5)R_x \quad \checkmark$$

$$\therefore R_x = 4 \Omega \quad \checkmark \quad \text{OR/OF } 3,99 \Omega \quad \checkmark$$

(6)

8.6

OPTION/OPSIE 1**POSITIVE MARKING FROM 8.5/ POSITIEWE NASIEN VANAF VRAAG 8.5**

$$\text{Emf/emk} = I(R + r) \quad \checkmark$$

$$12 = (1,5)(2,67 + 4 + r) \quad \checkmark \quad \text{OR/OF } (1,5)(2,67 + 3,99 + r)$$

$$\therefore r = 1,33 \Omega \quad (1,33 \Omega - 1,34 \Omega) \quad \checkmark$$

OPTION/OPSIE 2

$$V_{\text{lost/verlore}} = Ir \quad \checkmark$$

$$2 = (1,5)r \quad \checkmark \quad \therefore r = 1,33 \Omega \quad \checkmark$$

(3)

8.7 $W = VI \Delta t \quad \checkmark$ For the same potential difference and time, internal $I_{4\Omega}$ is greater than $I_{8\Omega} \quad \checkmark$

$$W \propto I \quad \checkmark$$

Vir dieselfde potensiaal verskil en tyd, is $I_{4\Omega}$ groter as $I_{8\Omega}$

$$\text{Energy: } W = \frac{V^2}{R} \Delta t \quad \checkmark \quad \text{For the same potential difference and time } \checkmark \quad W \propto \frac{1}{R} \text{ is}$$

greater for the smaller resistance than for the larger resistance. $\checkmark$

$$\text{Energie: } W = \frac{V^2}{R} \Delta t \quad \text{Vir dieselfde potensiaalverskil en tyd } W \propto \frac{1}{R} \text{ is groter vir die}$$

kleiner weerstand as vir die groter weerstand

(3)

[22]

QUESTION/VRAAG 9

- 9.1 The rms voltage of AC is the AC potential difference which dissipates produces the same amount of energy as an equivalent DC potential difference ✓✓

Underlined word omitted deduct 1 mark. DC and AC swapped 0/2

Die wgk spanning van WS is die WS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente GS-potensiaalverskil.

(2)

- 9.2 Mechanical energy to electrical energy. ✓

Meganiese energie na elektriese energie

(1)

- 9.3 It can be stepped up or stepped down/is easier to transmit ✓ with less energy lost
AC can be converted to DC but DC cannot be converted to AC

Dit kan verhoog of verlaag word/is makliker om oor te dra met minder energie wat verlore raak WS kan na GS omgeskakel word maar kan nie na WS herlei word nie

(1)

9.4

OPTION/OPSIE 1

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$$

Any one/Enige een

$$V_{rms} = \frac{311}{\sqrt{2}} \checkmark$$

$$= 219,91 \text{ V}$$

$$P_{ave} = V_{rms} I_{rms} \checkmark$$

$$= (219,91)(14,85) \checkmark$$

$$= 3265,66 \text{ W} \checkmark$$



$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_{rms} = \frac{21}{\sqrt{2}} \checkmark$$

$$= 14,85 \text{ A}$$

OPTION/OPSIE 2

$$P_{ave} = \frac{V_{max} I_{max}}{2} \checkmark \checkmark$$

$$P_{ave} = \frac{311 \times 21}{2} \checkmark \checkmark \checkmark$$

$$P_{ave} = 3265,5 \text{ W} \checkmark$$

OPTION/OPSIE 3

$$R = \frac{V}{I}$$

$$R = \frac{311}{21} \checkmark$$

$$R = 14,81 \Omega$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$$

$$= \frac{21}{\sqrt{2}} \checkmark$$

$$= 14,85 \text{ A}$$

$$P_{ave} = I_{rms}^2 R \checkmark$$

$$= (14,85)^2 (14,81) \checkmark$$

$$P_{ave} = 3265,94 \checkmark$$

OPTION/OPSIE 4

$$R = \frac{V}{I}$$

$$R = \frac{311}{21} \checkmark$$

$$R = 14,81 \Omega$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$$

$$V_{rms} = \frac{311}{\sqrt{2}} \checkmark$$

$$V_{rms} = 219,91 \text{ V}$$

$$\text{Range } [3\,265,39 \text{ V} - 3\,265,94]$$

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark$$

$$= \frac{219,91^2}{14,81} \checkmark$$

$$P_{ave} = 3\,265,39 \text{ W} \checkmark$$

(6)
(10)



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QUESTION/VRAAG 10

- 10.1 The energy of the photons of red light is greater than the work function of the metal in the photocell. ✓ Photo electrons are ejected (from the metal surface) ✓ $E > W_0$

Die energie van die fotone van rooi lig is groter as die arbeidsfunksie van die metaal in die fotosel. Foto-elektrone word vrygestel (vanaf die metaal oppervlak)

OR/OF

The frequency of the red light is higher than the threshold/cut-off frequency of the metal in the photocell. ✓ Photo electrons are ejected (from the metal surface) ✓

Die frekwensie van die rooi lig is hoër as die drumpel/afsnijfrekwensie van die metaal in die fotosel. Foto-elektrone word vrygestel (vanaf die metaal oppervlak) (2)

- 10.2 Increase/Toeneem ✓ (1)

- 10.3 Stays the same ✓
The change in colour/frequency only affected the kinetic energy of the photo electrons. ✓

Only the intensity of the light affects the number of photo electrons emitted per time unit. ✓

The intensity of the light stays the same and therefore the number of photo electrons emitted per unit time / current stays the same. ✓

Bly dieselfde

Die verandering in kleur/frekwensie het slegs 'n invloed op die kinetiese energie van die foto-elektrone.

Slegs die intensiteit van die lig het 'n invloed op die aantal foto-elektrone wat per tydseenheid vrygestel word

Die intensiteit van die lig bly dieselfde en daarom bly die aantal foto-elektrone wat per eenheid tyd/stroom vrygestel word dieselfde (4)

10.4 $E = W_0 + E_{k(max)}$

$$h \frac{c}{\lambda} = hf_0 + \frac{1}{2}mv_{max}^2 \quad \left. \begin{array}{l} \\ \end{array} \right\} \text{✓ Any one/Enige een}$$

$$\frac{6,63 \times 10^{-34} \times 3 \times 10^8}{4,5 \times 10^{-7}} \quad \checkmark \quad 6,63 \times 10^{-34}(f_0) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})(4,78 \times 10^5)^2 \checkmark$$

$$f_0 = 5,10 \times 10^{14} \text{ Hz } \checkmark$$

(6)

[13]

TOTAL/TOTAAL: 150