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PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2021

MARKS: 150

TIME: 3 HOURS

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 10 questions. Answer ALL questions in the ANSWER BOOK.
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. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1

Various options are provided as possible answers to the following questions. Choose the answer and write down only the letter (A – D) next to the question number (1.1–1.10) in your ANSWER BOOK, e.g. 1.11 E.

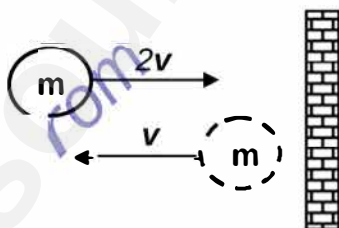
1.1 A car is moving at a **CONSTANT** velocity on an incline.

Which **ONE** of the following statements about the forces acting on the car is **CORRECT**?

- A There are no forces acting on the car.
- B The net force acting on the car is zero.
- C There is a non-zero net force acting on the car.
- D The weight of the car is equal to the normal force. (2)

1.2 A ball of mass **m** strikes a wall perpendicularly at a speed **2v**. Immediately after the collision the ball moves in the opposite direction at a speed **v**, as shown in the diagram below.

The magnitude of the impulse of the ball is ...



- A 0
- B **mv**
- C **$2mv$**
- D $3mv$ (2)

1.3 A stone is dropped from a certain height above the ground. Which **ONE** of the following combinations is **TRUE** while the stone is moving downwards? Ignore the effects of air resistance.

	NET FORCE ACTING ON THE STONE	MECHANICAL ENERGY OF THE STONE
A	Remain the same	Increases
B	Decreases	Remains the same
C	Remain the same	Remain the same
D	Increases	Decreases

(2)

1.4 Which ONE of the following forces is an example for *conservative* force?

- A Gravitational force.
- B Tension in a chord.
- C Frictional force.
- D Normal force.

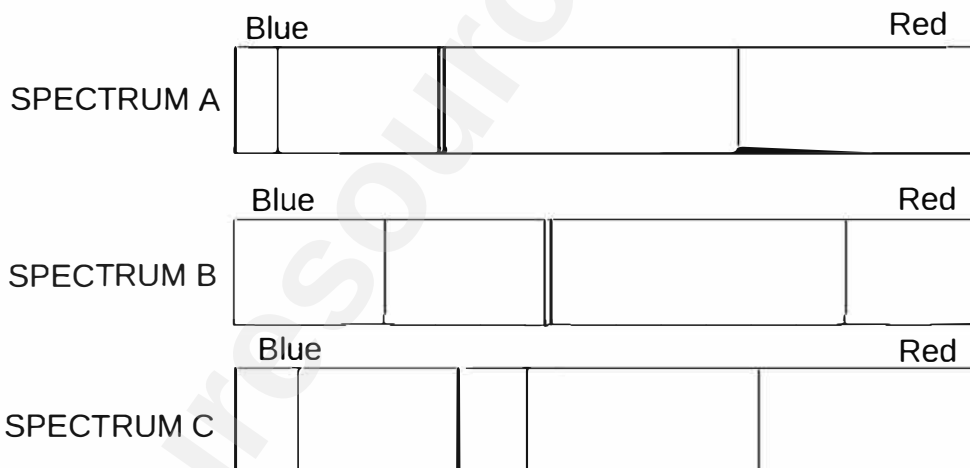
(2)

1.5 Which ONE of the following combinations is TRUE for an elastic collision?

	TOTAL LINEAR MOMENTUM	TOTAL KINETIC ENERGY
A	Conserved	Conserved
B	Not conserved	Not conserved
C	Conserved	Not conserved
D	Not conserved	Conserved

(2)

1.6 SPECTRUM A represents the visible light spectrum recorded on earth. SPECTRA B and C are recorded from two stars Y and Z respectively

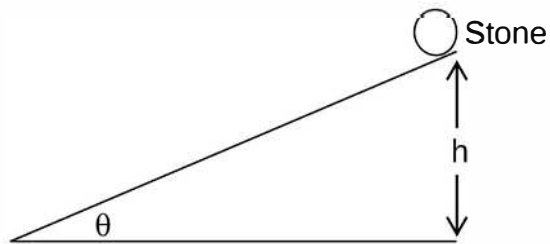


Which ONE of the following combinations most correctly describes the movement of the stars relative to earth?

- A Star Y is moving away from the earth and star Z is moving towards the earth.
- B Star Y is moving towards the earth and star Z is moving away from the earth.
- C Both Star Y and star Z are moving towards the earth.
- D Both Star Y and star Z are moving away from the earth.

(2)

- 1.7 A stone starting from rest and rolls down a frictionless track, reaches the bottom of the track with a speed v . What change must be effected on the track for the stone to reach a speed of $2v$ at the bottom of the track?

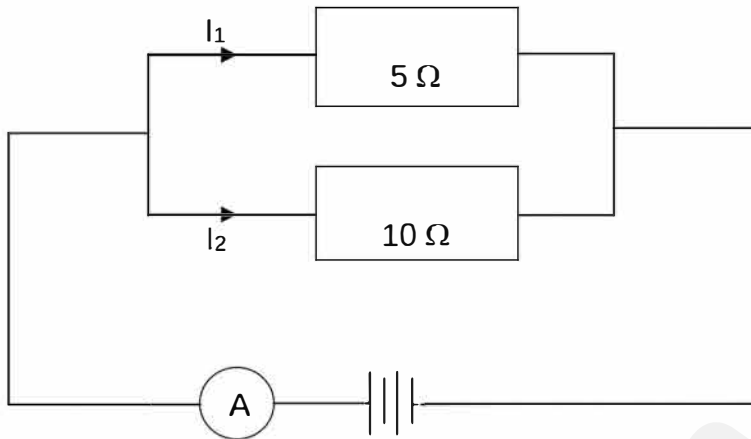


- A Double the height of the track.
- B Increase the height by a factor $\sqrt{2}$.
- C Increase the height by four times.
- D keep the height the same, but make the track twice steeper. (2)

- 1.8 Two identical charged spheres kept at a distance d apart. The force exerted on one charge by the other is F . What is the new force, when the charge on one sphere is DOUBLED?

- A $2F$
- B F
- C $\frac{1}{2} F$
- D $\frac{1}{4} F$ (2)

1.9 5 Ω and 10 Ω resistors are connected in parallel as shown in the diagram.



The relationship between current I_1 and current I_2 can be expressed as:

- A $I_2 = I_1$
- B $I_2 = \frac{1}{2} I_1$
- C $I_2 = \frac{1}{3} I_1$
- D $I_2 = \frac{3}{2} I_1$ (2)

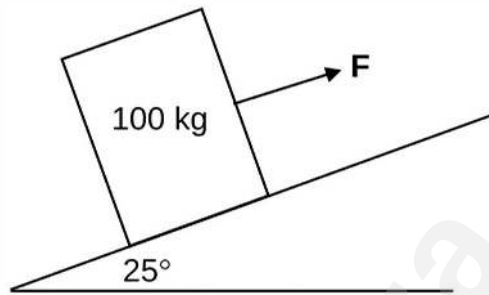
1.10 When an electron moves from a higher energy level to a lower energy level a specific ...

- A emission line in an emission spectrum is observed.
 - B absorption line in an emission spectrum is observed.
 - C emission line in an absorption spectrum is observed.
 - D absorption line in an absorption spectrum is observed. (2)
- [20]

QUESTION 2

A block of mass 100 kg is sliding **down** a rough inclined surface at a **CONSTANT** speed when a force **F** is applied parallel to the inclined plane as indicated in the diagram below.

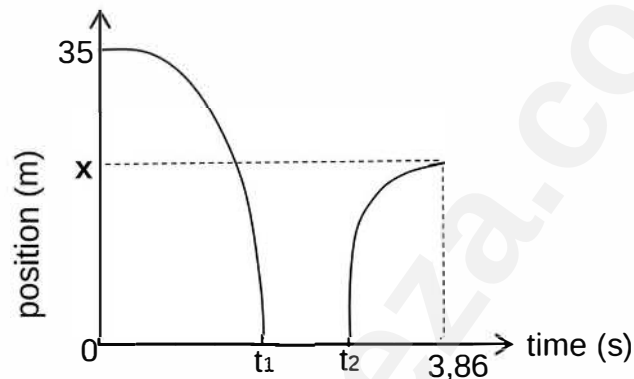
The coefficient of kinetic friction for the surfaces is 0,29.



- 2.1 Define the term *normal* force in words. (2)
 - 2.2 Draw a labelled free-body diagram for the block. (4)
 - 2.3 Calculate the magnitude of the applied force, **F**. (5)
 - 2.4 Name the force that will form an action-reaction pair with the normal force in this case. (1)
- [12]**

QUESTION 3

The position – time graph below, not according to scale, represents the motion of a ball thrown vertically downwards with a speed of $3,28 \text{ m}\cdot\text{s}^{-1}$ from the edge of the roof of a 35 m high building. The ball hits the ground and is in contact with the ground for 0,1 s. The ball then bounces off to a maximum height x above the ground. Ignore the effects of air resistance.



3.1 Explain the term *projectile*. (2)

3.2 Calculate the:

3.2.1 Speed of the ball at time t_1 (3)

3.2.2 Time, t_1 , it takes the ball to hit the ground (3)

3.2.3 Height, x , reached by the ball after it bounces off the ground (7)

3.3 Draw the velocity-time graph for the ball from the moment it is thrown until it reaches the maximum height x after the first bounce.

Indicate:

(i) The values of time t_1 and t_2

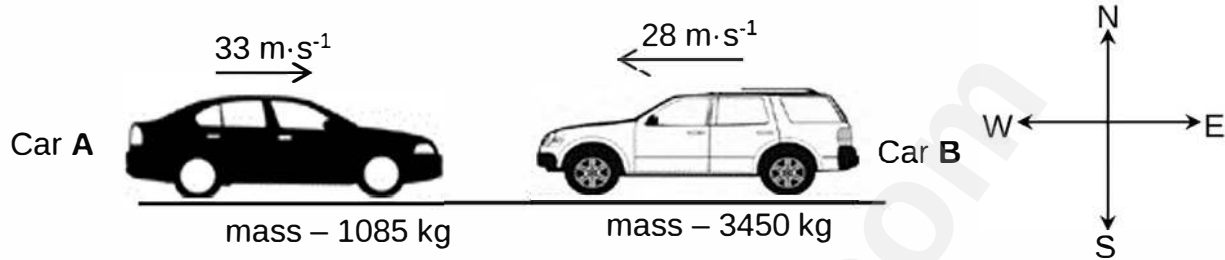
(ii) The velocities of the ball at time t_1 and t_2

(3)

[18]

QUESTION 4

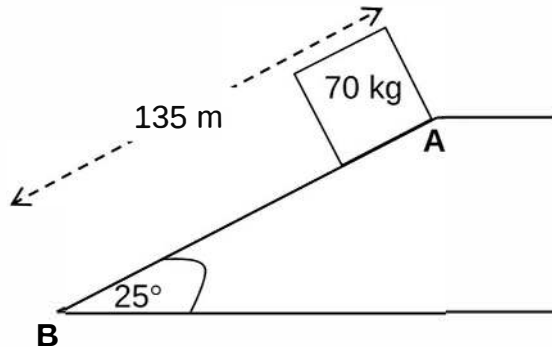
Car **A** of mass 1 085 kg travelling east at a speed of $33 \text{ m}\cdot\text{s}^{-1}$, collides head on with car **B** of mass 3 450 kg travelling west at a speed of $28 \text{ m}\cdot\text{s}^{-1}$. Immediately after the collision, car **A** moves west at a speed of $5 \text{ m}\cdot\text{s}^{-1}$. Ignore friction.



- 4.1 State *Newton's second law of motion* in terms of momentum in words. (2)
- 4.2 Calculate the:
- 4.2.1 Velocity of car **B** after collision (5)
- 4.2.2 Magnitude of the impulse on car **B** during the collision (3)
- 4.3 Airbags serves as a safety feature during collision.
- 4.3.1 Use the relevant laws of physics to explain the purpose of air bags in cars. (3)
- 4.3.2 Which driver sustains more injuries during above collision?
Choose from CAR A or CAR B (1)
- [14]**

QUESTION 5

A 70 kg crate, starts from rest at point **A** (top of slope) and slides down a slope inclined at 25° to the horizontal. The distance from point **A** to point **B** is 135 m.



The total kinetic friction between the crate and the surface is 150 N.

- 5.1 Define the term *non-conservative force* in words. (2)
 - 5.2 Calculate the net work done on the crate, as it slides from point **A** to point **B**. (4)
 - 5.3 Calculate the time it takes the crate to slide from point **A** to point **B**. (6)
- [12]**

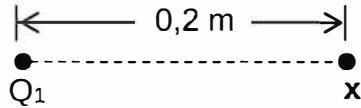
QUESTION 6

An ambulance moving at a constant speed along a straight horizontal road, emits sound with a constant frequency. When the ambulance **approaches** a detector mounted next to the road a frequency of f is recorded. After **passing** the detector, a frequency of $0,55 f$ is recorded.

- 6.1 State the *Doppler effect* in words. (2)
 - 6.2 Calculate the speed of the ambulance. Take the speed of sound in air as $340 \text{ m} \cdot \text{s}^{-1}$. (6)
 - 6.3 State TWO applications of the Doppler effect. (2)
- [10]**

QUESTION 7

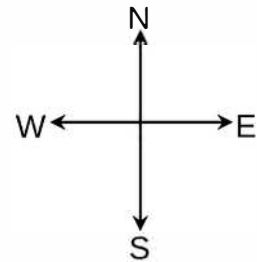
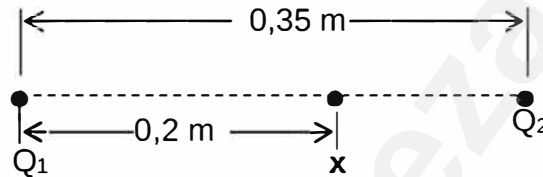
x is a point 0,2 m from point charge, Q_1 , carrying charge $-3 \times 10^{-5} \text{ C}$.



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

7.2 Draw the electric field pattern due to the charge Q_1 . (2)

Now another point charge Q_2 , carrying a charge of $+12 \times 10^{-5} \text{ C}$ is placed at a distance of 0,35 m from Q_1 as shown below.



7.3 Calculate the net electric field at point **x** due to the two charges. (6)

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

7.5 Calculate the magnitude of the electrostatic force exerted by charge Q_2 on charge Q_1 . (3)

7.6 Charge Q_2 is moved further west. How will this change affect the net electrostatic force at this new distance?

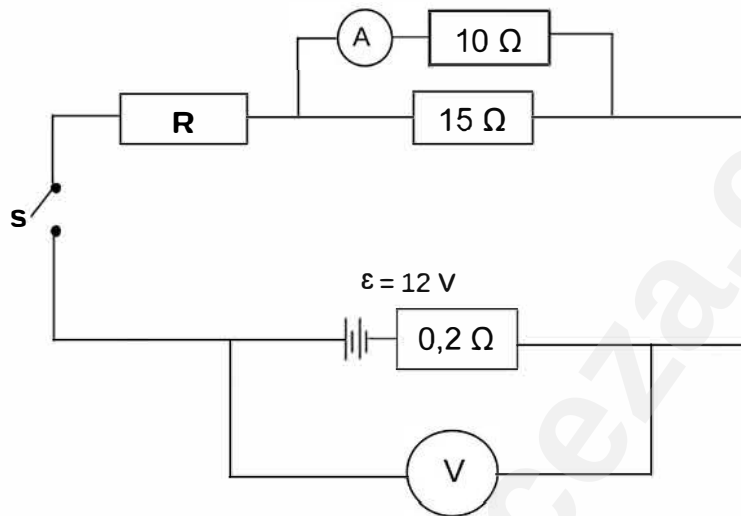
Choose from INCREASE, DECREASE or REMAIN THE SAME.

(1)

[16]

QUESTION 8

A battery has an emf (ϵ) of 12 V and an internal resistance of 0,2 Ω . The resistances of the connecting wires are negligible, as shown in the circuit below.



8.1 What is the meaning of the underlined words? (2)

When switch **S** is CLOSED, the voltmeter reading decreases from 12 V and the ammeter reading is 0,9 A.

8.2 Explain why the voltmeter reading decreases. (2)

Calculate the:

8.3 Total current in the circuit (4)

8.4 Resistance of resistor **R** (5)

8.5 The total power dissipated by the battery (3)

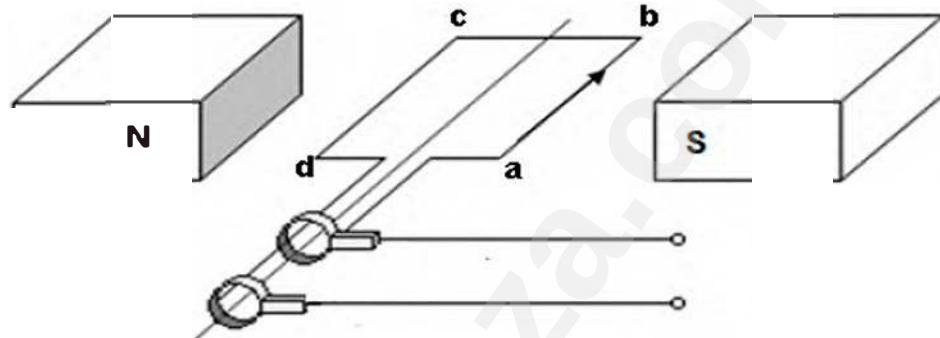
8.6 Will the ammeter reading INCREASE, DECREASE or REMAIN THE SAME if the 15 Ω resistor is removed? Give a reason for the answer. (2)

[18]

QUESTION 9

- 9.1 The diagram below represents a simplified electric machine. The coil **abcd** rotates at 20 cycles per second.

The direction of the current in the coil is from **a** to **b**.



- 9.1.1 What type of electric machine is represented by the above diagram? (1)
- 9.1.2 Name the principle on which the machine operates. (1)
- 9.1.3 In which direction is the coil rotating?
Choose from CLOCKWISE or ANTICLOCKWISE. (1)
- 9.1.4 How long does it take for the coil **abcd** to complete one rotation? (3)
- 9.1.5 State ONE way in which this machine can produce a lower output voltage without changing its construction. (1)
- 9.2 An electrical device is rated 220 V, 1850 W.
- 9.2.1 Define the term *rms voltage* in words. (2)
- Calculate the:
- 9.2.2 Rms current passing through the appliance when it is operating. (3)
- 9.2.3 Resistance of the device. (3)

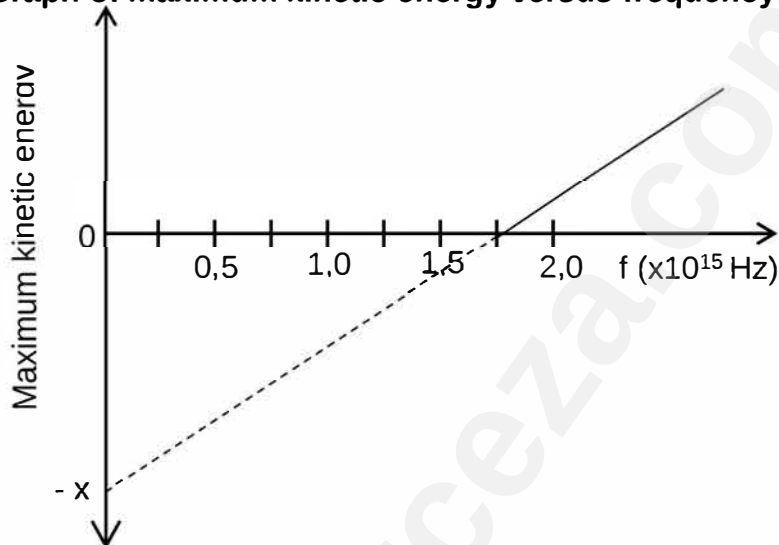
[15]

QUESTION 10

An experiment is conducted to investigate the relationship between the frequency of light incident on a metal cathode and the maximum kinetic energy of the emitted electrons from the surface of a metal cathode of a photocell.

The graph represents the results obtained.

Graph of maximum kinetic energy versus frequency of light



10.1 For this investigation, write down the following:

10.1.1 Controlled variable (1)

10.1.2 Dependent variable (1)

10.2 Name the phenomenon on which this experiment is based. (1)

10.3 Define the term *work function* in words. (2)

10.4 Calculate the:

10.4.1 Value of x as shown on the graph (3)

10.4.2 Frequency of the incident light that will emit electrons from the surface with a maximum speed of $5,23 \times 10^5 \text{ m} \cdot \text{s}^{-1}$ (4)

10.5 The intensity of the light is now increased. State how this change affects the current in the photocell .
Choose from INCREASES, DECREASES or REMAINS THE SAME.

Explain your answer. (3)
[15]

GRAND 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	$9,8 \text{ m}\cdot\text{s}^{-1}$
Universal gravitational constant <i>Universele gravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
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	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$
Mass of the Earth <i>Massa van die Aarde</i>	M	$5,98 \times 10^{24} \text{ kg}$
Radius of the Earth <i>Radius van die Aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$

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

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = m v_f - m v_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or/of $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or/of $g = G \frac{M}{r^2}$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = F \Delta x \cos \theta$	$U = mgh$ or/of $E_p = mgh$
$K = \frac{1}{2} m v^2$ or/of $E_k = \frac{1}{2} m v^2$	$W_{\text{net}} = \Delta K$ 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 $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{av}} = F v_{\text{av}}$ / $P_{\text{gemid}} = F v_{\text{gemid}}$	

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 $E = h \frac{c}{\lambda}$
$E = W_o + E_{k(\text{max})}$ or/of $E = W_o + K_{\text{max}}$ where/waar	
$E = hf$ and/en $W_o = hf_o$ and/en $E_{k(\text{max})} = \frac{1}{2} m v_{\text{max}}^2$ or/of $K_{\text{max}} = \frac{1}{2} m v_{\text{max}}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e} \quad \text{or/of} \quad n = \frac{Q}{q_e}$	

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

$I_{rms} = \frac{I_{max}}{\sqrt{2}} \quad / \quad I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}} \quad / \quad V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms} I_{rms} \quad / \quad P_{gemiddeld} = V_{wgk} I_{wgk}$ $P_{ave} = I_{rms}^2 R \quad / \quad P_{gemiddeld} = I_{wgk}^2 R$ $P_{ave} = \frac{V_{rms}^2}{R} \quad / \quad P_{gemiddeld} = \frac{V_{wgk}^2}{R}$
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**PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

SEPTEMBER 2021

MARKS/PUNTE: 150

**MARKING GUIDELINES
NASIENRIGLYNE**

This marking guidelines consists of 17 pages.
Hierdie nasienriglyne bestaan uit 17 bladsye.

Marking Guidelines/Nasienriglyne

QUESTION/VRAAG 1

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

QUESTION/VRAAG 2

Marking criteria/Nasienkriteria:

If any of the underlined key words/phrases in the correct context are omitted:

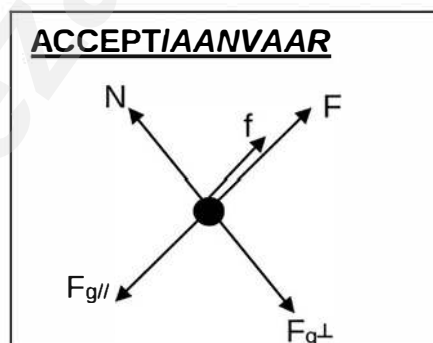
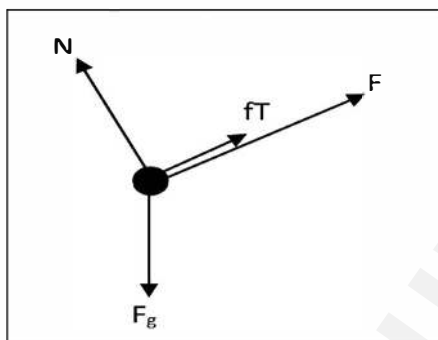
- 1 mark per word/phrase

As een van die onderstreepte sleutelwoorde/frases in die regte konteks weggelaat word:

- 1 punt per woord/frase

- 2.1 The force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface. ✓✓
 Die krag of die komponent van 'n krag wat 'n oppervlak op 'n voorwerp uitoefen waarmee dit in kontak is, en wat loodreg op die oppervlak is. (2)

2.2

**Accept the following symbols/Aanvaar die volgende simbole**

F	F_{applied} / Force applied / F_A F_{toegepas} / Krag toegepas / F_A	✓
F_g	w / F_w / weight / gewig	✓
N	F_N / Normal / Normal force F_N / Normaal / Normaalkrag	✓
f	F_f / f_k / friction / frictional force/kinetic frictional force F_f / f_k / wrywing / wrywingskrag / kinetiese wrywingskrag	✓

NOTE/LET WEL:

- Mark awarded for label and arrow/Punt toegeken vir byskrif en pyl
- Do not penalise for length of arrow since drawing is not to scale. Moenie penaliseer vir die lengte van die pyl nie, want die tekening is nie volgens skaal nie. $\frac{3}{4}$
- Any additional force(s)/Enige bykomende krag(te) $\frac{3}{4}$
- If force(s) do not make contact with body/As krag(te) nie kontak met liggaam maak nie $\frac{3}{4}$
- No labels/Geen byskrifte $\frac{0}{4}$

Marking Guidelines/Nasienriglyne

2.3

Marking criteria / Nasienkriteria:

- Showing $F_{\text{net/netto}} = 0$ ✓
-
- Substitution of first term ✓
- Substitution of second term
- Final answer of / *Finale antwoord van* 157,48 N ✓
Range (152,98N to/tot 157,45N)

OPTION / OPSIE 1:**Downwards as positive/Afwaarts positief:**

$$F_{\text{net}} = ma \text{ or } F_{\text{net}} = 0$$

$$-F - f_k + F_{g//} = 0$$

$$-F - \mu_k mg \cos \theta + mg \sin \theta = 0 \quad \left. \vphantom{\begin{matrix} -F - f_k + F_{g//} = 0 \\ -F - \mu_k mg \cos \theta + mg \sin \theta = 0 \end{matrix}} \right\} \text{Any } \checkmark$$

$$-F - 0,289 \times (100 \times 9,8 \cos 25^\circ) \checkmark + (100 \times 9,8) \sin 25^\circ \checkmark = 0 \checkmark$$

$$F = 157,48 \text{ N} \checkmark$$

Downwards as negative / Afwaarts positief

$$F_{\text{net}} = ma \text{ or } F_{\text{net}} = 0$$

$$F + f_k - F_{g//} = 0$$

$$F + \mu_k mg \cos \theta - mg \sin \theta = 0 \quad \left. \vphantom{\begin{matrix} F + f_k - F_{g//} = 0 \\ F + \mu_k mg \cos \theta - mg \sin \theta = 0 \end{matrix}} \right\}$$

$$F + 0,289 \times (100 \times 9,8 \cos 25^\circ) \checkmark - (100 \times 9,8) \sin 25^\circ \checkmark = 0 \checkmark$$

$$F = 157,48 \text{ N} \checkmark$$

(5)

2.4 Perpendicular force tha the water tank exerts on the surface. ✓

Loodreg krag wat die watertenk op die oppervlak uitgeoefen.**ACCEPT/AANVAAR**

mgcosθ

(1)

[12]

QUESTION/VRAAG 3

- 3.1 An object upon which the only force acting is the force of gravity (2 or 0) ✓✓
'n Voorwerp waarop die enigste krag wat daarop inwerk, swaartekrag is. (2)

3.2.1

Marking criteria / Nasinkriteria:

Appropriate formula / Toepaslike formule ✓

Substitution of / Vervanging van 3,28 & 35 ✓

Final answer of / Finale antwoord van 26,396 m·s⁻¹ ✓

Range (26,397 to 26,41)

Downwards as positive /
Afwaarts positief

Upwards as positive /
Opwaarts positiief

<u>OPTION 1/ OPSIE 1</u> $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= (3,28)^2 + 2(9,8)(35) \checkmark$ $v_f = 26,396 \text{ m} \cdot \text{s}^{-1} \checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= (3,28)^2 + 2(9,8)(35) \checkmark$ $v_f = 26,396 \text{ m} \cdot \text{s}^{-1} \checkmark$
<u>OPTION 2/ OPSIE 2</u> $v_f = v_i + a\Delta t \checkmark$ $= 3,28 + (9,8)(2,359) \checkmark$ $v_f = 26,398 \text{ m} \cdot \text{s}^{-1} \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $= -3,28 + (-9,8)(2,359) \checkmark$ $v_f = 26,398 \text{ m} \cdot \text{s}^{-1} \checkmark$
<u>OPTION 3/ OPSIE 3</u> $\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$ $35 = \left(\frac{v_f + 3,28}{2} \right) (2,359) \checkmark$ $v_f = 26,398 \text{ m} \cdot \text{s}^{-1} \checkmark$	$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$ $35 = \left(\frac{v_f + 3,28}{2} \right) (2,359) \checkmark$ $v_f = 26,398 \text{ m} \cdot \text{s}^{-1} \checkmark$

(3)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1 / POSITIEWE NASIEN ANAF 3.2.1**

Downwards as positive/ Afwaarts positief	Upwards as positive/ Opwaarts positiief
<u>OPTION 1/OPSIE 1</u> $v_f = v_i + a\Delta t \checkmark$ $26,396 = 3,28 + (9,8)\Delta t \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $-26,396 = 3,28 + (-9,8)\Delta t \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$
<u>OPTION 2/OPSIE 2</u> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $35 = 3,28\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $-35 = -3,28\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$
<u>OPTION 3/OPSIE 3</u> $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t \checkmark$ $35 = \left(\frac{26,396 + 3,28}{2}\right)\Delta t \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$	<u>OPTION 3/OPSIE 3</u> $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t \checkmark$ $35 = \left(\frac{-26,396 + (-3,28)}{2}\right)\Delta t \checkmark$ $\Delta t = 2,359 \text{ s} \checkmark$

(3)

Marking Guidelines/Nasienriglyne

3.2.3 Calculate velocity at t_2 / Bereken snelheid by t_2

$$t_2 = \frac{2,359 + 0,1}{1} \checkmark$$

$$= 2,459 \text{ s}$$

$$\text{Time to max(x)} = \frac{3,86 - 2,459}{1} \checkmark$$

$$= 1,40 \text{ s}$$

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

$$0 = v_i + 9,8(1,40) \checkmark$$

$$v_i = -13,73 \text{ m} \cdot \text{s}^{-1}$$

Downward as positive /
Afwaarts positief

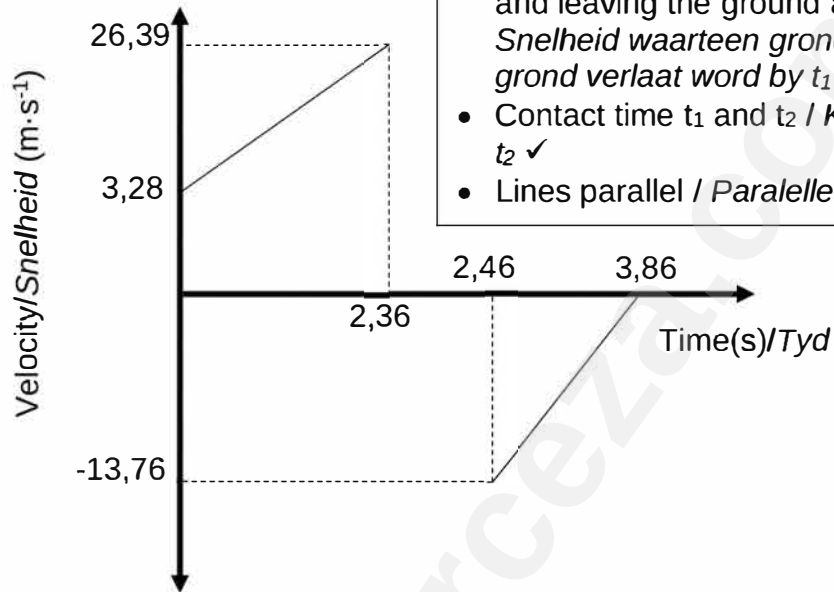
Upward as positive /
Opwaarts positief

OPTION 1/ OPSIE 1 $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0 = (-13,73)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = -9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0 = (13,73)^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$
OPTION 2/ OPSIE 2 $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (-13,73)(1,4) + \frac{1}{2}(9,8)(1,4)^2 \checkmark$ $\Delta y = -9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (13,73)(1,4) + \frac{1}{2}(-9,8)(1,4)^2 \checkmark$ $\Delta y = 9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$
OPTION 3/ OPSIE 3 $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $= \left(\frac{0 + (-13,73)}{2} \right) (1,4) \checkmark$ $\Delta y = -9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$	$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $= \left(\frac{0 + (-13,73)}{2} \right) (1,4) \checkmark$ $\Delta y = -9,62 \text{ m}$ $\therefore \text{Height / Hoogte} = 9,62 \text{ m} \checkmark$

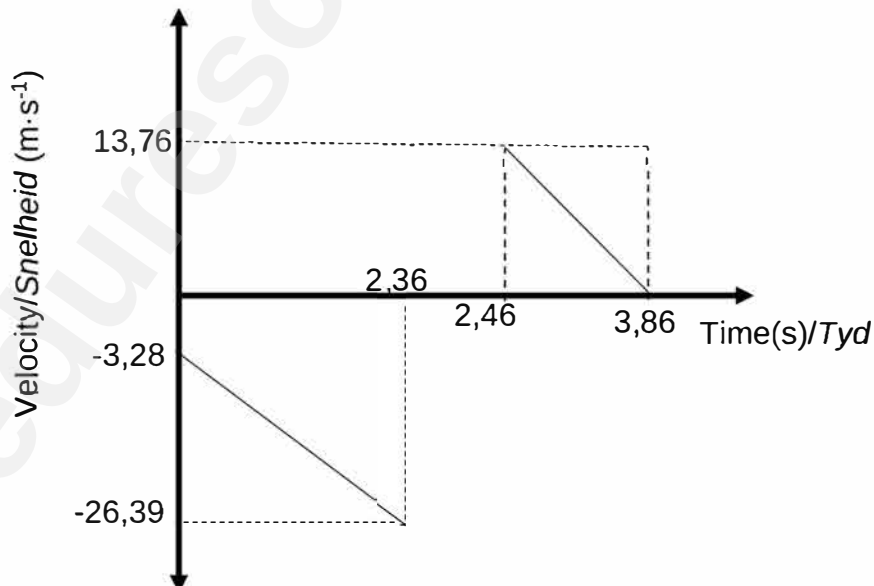
(7)

Marking Guidelines/Nasienriglyne

3.3 POSITIVE MARKING OF QUESTION 3.2.1 AND 3.3.2 / POSITIEWE NASIEN VAN 3.2.1 EN 3.2.2

OPTION 1: Downward Positive**OPSIE 1: Afwaarts Positief****Marking criteria / Nasienkriteria:**

- Velocity striking the ground and leaving the ground at t_1 and t_2 . ✓
Snelheid waarteen grond getref en grond verlaat word by t_1 en t_2
- Contact time t_1 and t_2 / Kontaktyd t_1 en t_2 ✓
- Lines parallel / Paralelle lyne ✓

OPTION 2: Upwards positive**OPSIE 2: Opwaarts positief**(3)
[18]

QUESTION/VRAAG 4

- 4.1 The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the net/resultant force. ✓✓
(2 or 0)

Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die netto/resulterende krag. (2 of 0)

(2)

4.2.1

OPTION 1 / OPSIE 1**Motion to the east (+) / Beweging na oos (+)**

$$\Sigma p_f = \Sigma p_i$$

Any/Enige ✓

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$1085(+33) + 3450(-28) = 1085(-5) + 3450v_{2f}$$

$$v_{2f} = -16,05$$

$$= 16,05 \text{ m} \cdot \text{s}^{-1}$$

✓ west / forward ✓
wes / voorwaarts

OPTION 2 / OPSIE 2**Motion to the east (-) / Beweging na oos (-)**

$$\Sigma p_f = \Sigma p_i$$

Any/Enige ✓

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$1085(-33) + 3450(+28) = 1085(+5) + 3450v_{2f}$$

$$v_{2f} = +16,05$$

$$= 16,05 \text{ m} \cdot \text{s}^{-1}$$

✓ west / forward ✓
wes / voorwaarts

(5)

4.2.2 POSITIVE MARKING FROM QUESTION 4.2.1/ POSITIEWE NASIEN VANAF 4,2,1

OPTION 1: CAR B Motion to the west (+) OPSIE 1: KAR B Beweging na wes (+) Impulse = $\Delta p = m\Delta v$ ✓ $= 3450(16,05 - 28)$ ✓ $= -41\,227,5$ $= 41\,227,5 \text{ N}\cdot\text{s}$ ✓	OPTION 2: CAR B Motion to the west (-) OPSIE 2: KAR B Beweging na wes (-) Impulse = $\Delta p = m\Delta v$ ✓ $= 3450(-16,05 - (-28))$ ✓ $= 41\,227,5 \text{ N}\cdot\text{s}$ ✓
OPTION 3: CAR A Motion to the west (+) OPSIE 3: KAR A Beweging na wes (+) Impulse = $\Delta p = m\Delta v$ ✓ $= 1085(5 - (-33))$ ✓ $= 41\,230 \text{ N}\cdot\text{s}$ ✓	OPTION 4: CAR A Motion to the west (-) OPSIE 4: KAR A Beweging na wes (-) Impulse = $\Delta p = m\Delta v$ ✓ $= 3450(-5 - (+33))$ ✓ $= -41\,230$ $= 41\,230 \text{ N}\cdot\text{s}$ ✓

(3)

4.3.1 According to Newton's second law✓ / $F_{\text{net}} = \frac{\Delta p}{\Delta t}$

Air bag causes an increase in collision time ✓ which results in a lesser / smaller force✓ (for the driver/passenger)

(3)

4.3.2 Car A / Kar A✓

(1)

[14]

QUESTION/VRAAG 5

5.1 A force for which the work done in moving an object between two points is dependent of the path taken.✓✓

'n Krag waarvan die werk wat verrig word om 'n voorwerp tussen twee punte te skuif, afhanklik is van die pad wat gevolg word.

(2)

5.2

$$\begin{aligned}
 W_{\text{net}} &= W_f + W_{Fg//} \\
 &= f\Delta x \cos\theta + mg \sin\theta \Delta x \cos\theta \quad \left. \vphantom{W_{\text{net}}} \right\} \checkmark \\
 &= \underline{150(135)\cos 180^\circ} \checkmark + \underline{70(9,8)\sin 25^\circ(135)\cos 0^\circ} \checkmark \\
 &= -20\,250 + 39\,138,677 \\
 &= 18\,888,677 \text{ J} \checkmark
 \end{aligned}$$

(4)

5.3 POSITIVE MARKING FROM QUESTION 5.2/ POSITIEWE NASIEN VANAF 5.2

OPTION 1/OPSIE 1

$$\begin{aligned}
 W_{\text{net}} &= \Delta K \\
 &= \frac{1}{2}m(v_f^2 - v_i^2) \quad \left. \vphantom{\begin{aligned} W_{\text{net}} &= \Delta K \\ &= \frac{1}{2}m(v_f^2 - v_i^2) \end{aligned}} \right\} \text{Any } \checkmark \\
 18\,888,677 \checkmark &= \frac{1}{2}(70)(v_f^2 - 0) \checkmark \\
 v_f &= 23,23 \text{ m} \cdot \text{s}^{-1} \\
 \Delta y &= \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark \\
 135 &= \left(\frac{23,23 + 0}{2} \right) \Delta t \checkmark \\
 \Delta t &= 11,625 \text{ s} \checkmark
 \end{aligned}$$

OPTION 2/ OPSIE 2

$$\begin{aligned}
 W_{\text{nc}} &= \Delta K + \Delta U \\
 f\Delta y \cos \theta &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \quad \left. \vphantom{\begin{aligned} W_{\text{nc}} &= \Delta K + \Delta U \\ f\Delta y \cos \theta &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \end{aligned}} \right\} \text{Any } \checkmark \\
 150(135) \cos 180^\circ \checkmark &= \frac{1}{2}(70)(v_f^2 - 0) + (70)(9,8)(0 - \sin 25^\circ \times 135) \checkmark \\
 v_f &= 23,23 \text{ m} \cdot \text{s}^{-1} \\
 \Delta y &= \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark \\
 135 &= \left(\frac{23,23 + 0}{2} \right) \Delta t \checkmark \\
 \Delta t &= 11,625 \text{ s} \checkmark
 \end{aligned}$$

Marking Guidelines/Nasienriglyne

OPTION 3/ OPSIE 3

$$W_{\text{net}} = F_{\text{net}} \Delta x \cos \theta \checkmark$$

$$18\,888,68 = F_{\text{net}} (135) \cos 0^\circ \checkmark$$

$$F_{\text{net}} = 139,92 \text{ N}$$

$$F_{\text{net}} = ma$$

$$139,92 = 70a \checkmark$$

$$a = 2 \text{ m} \cdot \text{s}^{-2}$$

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

$$135 = 0 + \frac{1}{2} (2) \Delta t^2 \checkmark$$

$$\Delta t = 11,625 \text{ s} \checkmark$$

(6)
[12]**QUESTION/VRAAG 6**

- 6.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓
Dit is die (skynbare) verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede het in verhouding tot die medium van klankverspreiding.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).
'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen 'n bron en 'n waarnemer (luisteraar).

(2)

6.2

$$f_L = \left(\frac{v \pm v_L}{v \pm v_s} \right) f_s \checkmark$$

$$\text{Towards : } f_L = \left(\frac{v}{v - v_s} \right) f_s$$

$$f \checkmark = \left(\frac{340}{340 - v_s} \right) f_s \checkmark \dots \text{equation 1}$$

$$\text{Away : } f_L = \left(\frac{v}{v + v_s} \right) f_s$$

$$0,55 f \checkmark = \left(\frac{340}{340 + v_s} \right) f_s \checkmark \dots \text{equation 2}$$

Equating – eqn 1 & eqn 2

$$153f = 1,55v_s f$$

$$v_s = 98,71 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(6)

6.3 **ANY TWO** ✓✓

Doppler /Blood flow meter

Measuring the heart beat of a foetus

Radar

Sonar

Use to determine whether stars are receding or approaching earth

(2)

[10]**QUESTION/VRAAG 7**

7.1 The electric field at a point is the electrostatic force ✓ experienced per unit positive charge (placed at that point). ✓

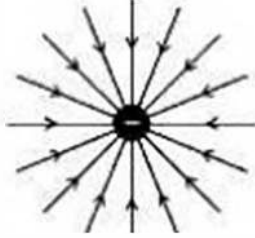
Die elektrieseveld by 'n punt is die elektrostatische krag ervaar per eenheid positiewe lading (op daardie punt geplaas).

(2)

Note: If electric field defined $\left(\frac{1}{2}\right)$ **Let wel:** As elektriese veld gedefinieer $\left(\frac{1}{2}\right)$

Marking Guidelines/Nasienriglyne

7.2

**Marking criteria/Nasienkriteria:**

Correct direction towards the sphere <i>Korrekte rigting na die sfeer</i>	✓
Field lines not crossing and radial <i>Veldlyne wat nie die radial kruis nie</i>	✓

(2)

7.3

$$\begin{aligned}
 E_{xQ1} &= \frac{kQ}{r^2} \checkmark \\
 &= \frac{9 \times 10^9 (3 \times 10^{-5})}{(0,2)^2} \checkmark \\
 &= 6,75 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ west}
 \end{aligned}$$

$$\begin{aligned}
 E_{xQ2} &= \frac{kQ}{r^2} \\
 &= \frac{9 \times 10^9 (12 \times 10^{-5})}{(0,15)^2} \checkmark \\
 &= 4,8 \times 10^7 \text{ N} \cdot \text{C}^{-1} \text{ west}
 \end{aligned}$$

$$\begin{aligned}
 E_{\text{net}} &= E_{xQ1} + E_{xQ2} \checkmark \\
 &= 6,75 \times 10^6 + 4,8 \times 10^7 \\
 &= 5,475 \times 10^7 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ west} \checkmark
 \end{aligned}$$

(6)

7.4 The electrostatic force(of attraction/repulsion) between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them. ✓✓ (2)

7.5

$$\begin{aligned}
 F &= \frac{kQ_1 Q_2}{r^2} \checkmark \\
 &= \frac{9 \times 10^9 (3 \times 10^{-5}) (12 \times 10^{-5})}{(0,35)^2} \checkmark \\
 &= 264,49 \text{ N} \checkmark
 \end{aligned}$$

(3)

7.6 Increase / Neem aan ✓

(1)
[16]

QUESTION/VRAAG 8

- 8.1 The battery supplies 12J ✓ of energy per coulomb of/per unit charge. ✓

Die battery voorsien 12J per coulomb van/per eenheidslading. (2)

- 8.2 Due to the internal resistance ✓ energy is dissipated (per coulomb of charge) in the battery. ✓

As gevolg van die interne weerstand, word energie per coulomb lading in die battery omgeskakel. (2)

- 8.3

Marking criteria / Nasienkriteria:

Appropriate formula / Toepaslike formule $V = IR$ ✓

Calculating current in/ Bereken stroom in $15\ \Omega$ ✓

Adding two currents / ✓

Final answer / Finale antwoord van $6\ \Omega$ ✓

$$V = IR \checkmark$$

$$V_{10\Omega} = V_{15\Omega}$$

$$I_{10\Omega} V_{10\Omega} = I_{15\Omega} V_{15\Omega}$$

$$\underline{0,9(10) = I_{15\Omega}(15)} \checkmark$$

$$I_{15\Omega} = 0,6\ \text{A}$$

$$\begin{aligned} I_{\text{TOT}} &= I_{10\Omega} + I_{15\Omega} \\ &= 0,9 + 0,6 \checkmark \\ &= 1,5\ \text{A} \checkmark \end{aligned}$$

ACCEPT

$$I_{10\Omega} : I_{15\Omega} = 15 : 10 \checkmark$$

$$0,9 \quad 0,6 \checkmark$$

$$\begin{aligned} I_{\text{TOT}} &= 0,9 + 0,6 \checkmark \\ &= 1,5\ \text{A} \checkmark \end{aligned}$$

(4)

8.4 POSITIVE MARKING FROM QUESTION 8.3 / POSITIEWE NASIEN VANAF 8.3

OPTION 1 / OPSIE 1 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $= \frac{1}{10} + \frac{1}{15} \quad \checkmark$ $\therefore R_p = 6\Omega$	OR/OF $R_p = \frac{R_1 \times R_2}{R_1 + R_2}$ $= \frac{10 \times 15}{10 + 15}$ $= 6\Omega$	OR/OF $R_p = \left(\frac{1}{R_1} + \frac{1}{R_2} \right)^{-1}$ $= \left(\frac{1}{10} + \frac{1}{15} \right)^{-1}$ $= 6\Omega$
$\varepsilon = I(R + R_p + r) \quad \checkmark$ $12 = 1,5 (R + 6 + 0,2) \quad \checkmark$ $\therefore R = 1,8\Omega \quad \checkmark$ OPTION 2 / OPSIE 2 $R_T = \frac{V_T}{I_T} \quad \checkmark$ $= \frac{12}{1,5}$ $= 8\Omega$ $R_T = R + R_p + r$ $8 = R + 6 + 0,2 \quad \checkmark$ $R = 1,8\Omega \quad \checkmark$		

(5)

8.5

OPTION 1 / OPSIE 1 $P = VI \quad \checkmark$ $= 12(1,5) \quad \checkmark$ $= 18 \text{ W} \quad \checkmark$	OPTION 2 / OPSIE 2 $P = I^2 R \quad \checkmark$ $= (1,5)^2 (8) \quad \checkmark$ $= 18 \text{ W} \quad \checkmark$	OPTION 3 / OPSIE 3 $P = \frac{V^2}{R} \quad \checkmark$ $= \frac{(12)^2}{8} \quad \checkmark$ $= 18 \text{ W} \quad \checkmark$
---	--	---

(3)

(2)

[18]

8.6 Decreases $\checkmark$ The total resistance increases. $\checkmark$

QUESTION/VRAAG 99.1.1 AC Generators / *WS-generators/opwekkers* ✓ (1)9.1.2 Electromagnetic induction / *Elektromagnetiese induksie* ✓ (1)9.1.3 Anticlockwise / *Antikloksgewys* (1)

9.1.4 $T = \frac{1}{20}$ ✓

$= \frac{1}{20}$ ✓

$= 0,05 \text{ s}$ ✓ (3)

9.1.5 Reduce rotation speed (to less than 20Hz). ✓
Verminder rotasiespoed (na minder as 20Hz). (1)

9.2.1 The rms value of AC is the DC potential difference which dissipates the same amount of energy as AC. ✓✓

Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie as WS versprei. (2)

9.2.2 $P_{ave} = V_{rms} I_{rms}$ ✓
 $1850 = (220) I_{rms}$ ✓
 $I_{rms} = 8,41 \text{ A}$ ✓ (3)

9.2.3 POSITIVE MARKING FROM 9.2.2 / POSITIEWE NASIEN VANAF 9.2.2

OPTION / OPSIE 1	OPTION / OPSIE 2	OPTION 3/OPSIE 3
$P_{ave} = I_{rms}^2 R$ ✓ $1850 = (8,41)^2 R$ ✓ $R = 26,16 \Omega$ ✓	$R = \frac{V_{rms}}{I_{rms}}$ ✓ $= \frac{220}{8,41}$ ✓ $= 26,16 \Omega$ ✓	$P_{ave} = \frac{(V_{rms})^2}{R}$ ✓ $1850 = \frac{(220)^2}{R}$ ✓ $\therefore R = 26,16 \Omega$ ✓

(3)
[15]

Marking Guidelines/Nasienriglyne

QUESTION/VRAAG 10

10.1.1 Metal (cathode) / Metaal (katode)/work function/threshold frequency / W_0 / f_0 ✓ (1)

10.1.2 (Maximum) Kinetic energy ✓ (1)

10.2 Photoelectric effect ✓ (1)

10.3 The minimum energy ✓ that an electron in the metal needs to be emitted from the metal surface ✓
Die minimum energie wat 'n elektron in die metaal vanaf die metaal-
oppervlak moet uitstraal (2)

10.4.1 $W_0 = hf_0$ ✓
 $= (6,63 \times 10^{-34})(1,75 \times 10^{15})$ ✓
 $= 1,16 \times 10^{-18} \text{ J}$ ✓ (3)

10.4.2 **POSITIVE MARKING FROM QUESTION 10.4.1 / POSITIEWE NASIEN VANAF 10.4.1**

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

$$hf = hf_0 + \frac{1}{2}mv_{\max}^2 \checkmark$$

$$(6,63 \times 10^{-34})f = 1,16 \times 10^{-18} + \frac{1}{2}(9,11 \times 10^{-31})(5,23 \times 10^5)^2 \checkmark$$

$$f = 1,94 \times 10^{15} \text{ Hz} \checkmark \quad (4)$$

10.5 Increases / Neem toe ✓
 The number of photons per unit time increases ✓ when the intensity of the light increase. Therefore, the number of photo-electrons per unit time increase. ✓ (Thus the current ($I = \frac{Q}{\Delta t}$) increases.)
 Die aantal fotone per eenheidstyd neem toe wanneer die intensiteit van die lig toeneem. Daarom sal die aantal foto-elektrone per eenheidstyd toeneem. (Dus neem die stroom ($I = \frac{Q}{\Delta t}$) toe.) (3)

[15]

TOTAL/TOTAAL: 150