LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

TRIAL EXAM

2026

MARKS: 150 **TIME: 3 HRS**

This exam paper consists of 17 pages & 3 Information Sheets

INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 10 questions. Answer ALL the 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, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable 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.
11. Give brief motivations, discussions, etc. where required.
12. 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 the letter (A-D) next to the question numbers (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 A learner sits on a chair and exerts a force downwards on the chair. The chair exerts a normal force upwards on the learner. The two forces…

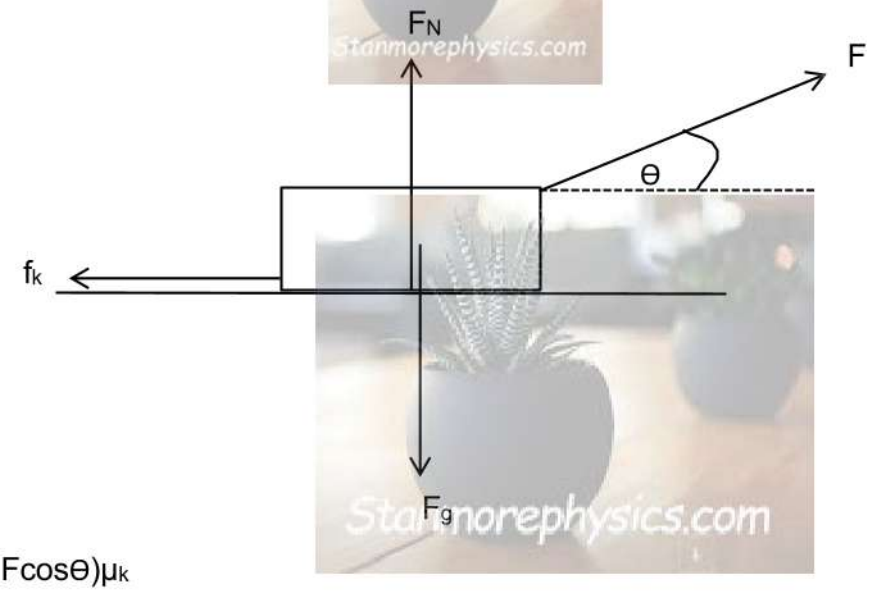
A act simultaneously on the bodies

B act in the same direction

C are unequal in magnitude

D do not act along the same line (2)

1.2 The following force diagram shows the forces that are present on a moving object. Which expression can be used to calculate the frictional force on the object?



A $(F_g - F\cos\theta)\mu_k$

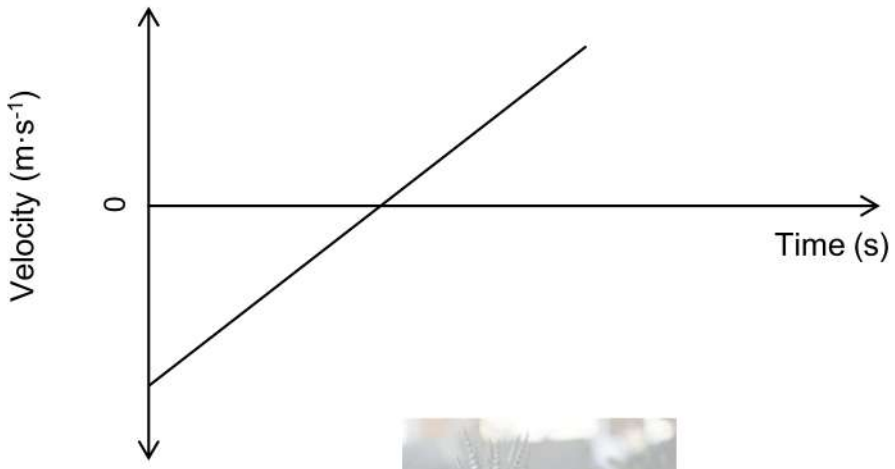
B $(F_g - F\sin\theta)\mu_k$

C $(F_g + F\sin\theta)\mu_k$

D $(F_g + F\cos\theta)\mu_k$

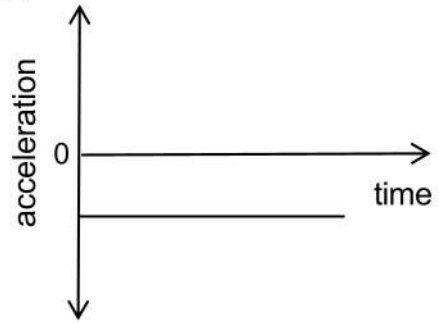
(2)

1.3 A sketch of the velocity-vs-time graph for an object that is thrown vertically upwards, and which falls back to its original position, is shown below:

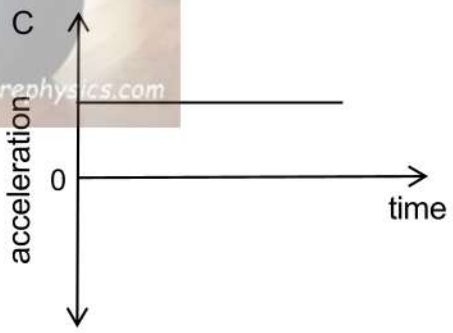


Neglect the effects if air resistance. Which ONE of the following sketch graphs for acceleration-vs-time BEST represents the motion of the object?

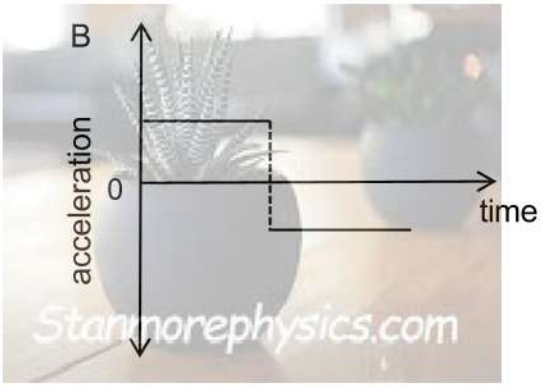
A



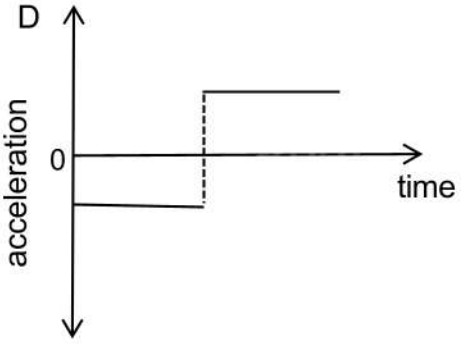
C



B



D



(2)

1.4 A ball of mass m with initial speed v_1 collides with another ball of mass M, initially at rest on a frictionless surface. After the collision, the two balls stick together and move with speed v_2.

The RATIO of the final speed v_2 to the initial speed v_1, is, $v_2:v_1$ = …

A M : M + m.

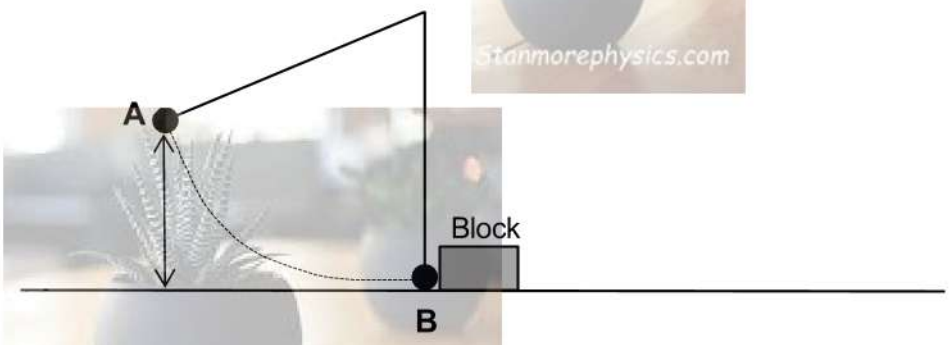
B M + m : M.

C m : M + m.

D M + m : m.

(2)

1.5 A pendulum bob is released from REST from point **A** above a surface. At its lowest point, **B**, it collides with a stationary block resting on a frictionless surface, as shown in the diagram below.



Ignore the effects of friction.

Which ONE of the following combinations of physics *conservation principles* can be used to calculate the speed of the pendulum bob JUST BEFORE and JUST AFTER the collision with the block?

	SPEED JUST BEFORE	SPEED JUST AFTER
A	Mechanical energy	Linear momentum
B	Linear momentum	Mechanical energy
C	Mechanical energy	Mechanical energy
D	Linear momentum	Linear momentum

(2)

1.6 Which ONE of the following equations CORRECTLY describes the vehicle, if A relates to the vehicle approaching the listener and B relates to the vehicle moving away from the listener.

A $\frac{f_{LA}}{f_{LB}} = \frac{v+v_s}{v-v_s}$

B $\frac{f_{LA}}{f_{LB}} = \frac{v-v_s}{v+v_s}$

C $\frac{f_{LB}}{f_{LA}} = \frac{v-v_L}{v-v_L}$

D $\frac{f_{LA}}{f_{LB}} = \frac{v+v_L}{v-v_L}$ (2)

1.7 Two small metal spheres on isolated stands carry EQUAL and OPPOSITE charges and are placed a distance, **d**, apart. Each sphere experiences an electrostatic force of magnitude ***F***. The spheres are allowed to touch and are placed back at a distance **2d**.

The magnitude of the electrostatic force that they experience NOW, is…

A 0 F.

B $\frac{1}{2}$ F.

C F.

D 2 F. (2)

1.8 An electric heater **X** has a resistance **R**. The power of heater **Y** is DOUBLE that of heater **X**.

If the potential difference in BOTH cases is the SAME, then the resistance of **Y** is…

A 4 R.

B 2 R.

C $\frac{1}{2}$ R.

D $\frac{1}{4}$ R.

(2)

1.9 Which combination of energy conversions in motors and generators is correct?

	MOTOR	GENERATOR
A	Mechanical to Electrical	Electrical to Mechanical
B	Electrical to Mechanical	Electrical to Mechanical
C	Electrical to Mechanical	Mechanical to Electrical
D	Mechanical to Electrical	Mechanical to Electrical

(2)

1.10 A Listener is moving towards a stationary ambulance. The frequency of sound produced by the siren of the ambulance is 550 Hz. When the listener approaches the ambulance, the observed wavelength of the sound…

A increases.

B stays constant.

C decreases.

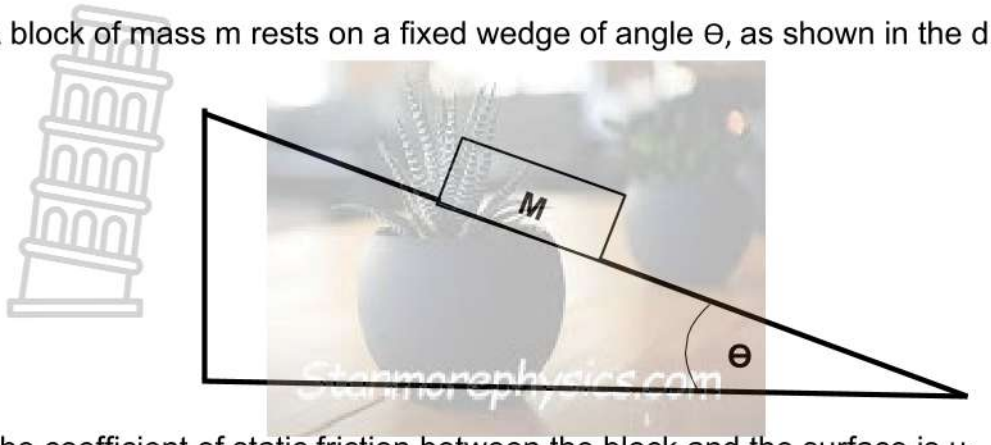
D becomes zero.

(2)

[20]

QUESTION 2 (Start on a new page)

A block of mass m rests on a fixed wedge of angle Θ, as shown in the diagram below.



The coefficient of static friction between the block and the surface is μ_s.

2.1 State *Newton's First Law of Motion* in words. (2)

2.2 Draw a labelled free-body diagram for the block. (3)

2.3 Show that the value of Θ at which the block *starts to slide*, is given by $\theta_{max} = \tan^{-1}\mu_s$. (Show all your workings) (5)

2.4 The block starts accelerating down the wedge.
Using an appropriate calculation, prove that the acceleration is given by:
$a = g(\sin\theta - \mu_k \cos\theta)$. (3)

[13]

QUESTION 3 (Start on a new page)

An object, **A**, is dropped from a certain height **h** above the ground. At EXACTLY THE SAME TIME, object **B** is thrown upwards from the ground. They pass each other after exactly 1,5 seconds. Object **B** hits the ground 3,5 seconds after being projected upwards.

3.1 Define the term *freefall.* (2)

3.2 Calculate the:

3.2.1 Speed with which **B** is thrown (3)

3.2.2 Height above the ground at which they pass each other (3)

3.2.3 Height **h** above the ground from which **A** is dropped (4)

3.2.4 Maximum height that **B** reaches above the ground (3)

3.3 Draw position-versus-time sketch graphs for BOTH objects on the same set of axes, from the time that they are released, to the time that **B** hits the ground.

TAKE THE GROUND AS THE REFERENCE POINT (ZERO POSITION)

Clearly show the values of the following on the graphs:

- Initial height of **A** above the ground
- Maximum height above the ground that **B** reaches
- Height above the ground when they pass each other
- Time when they pass each other
- Time when **B** hits the ground

(4)

[19]

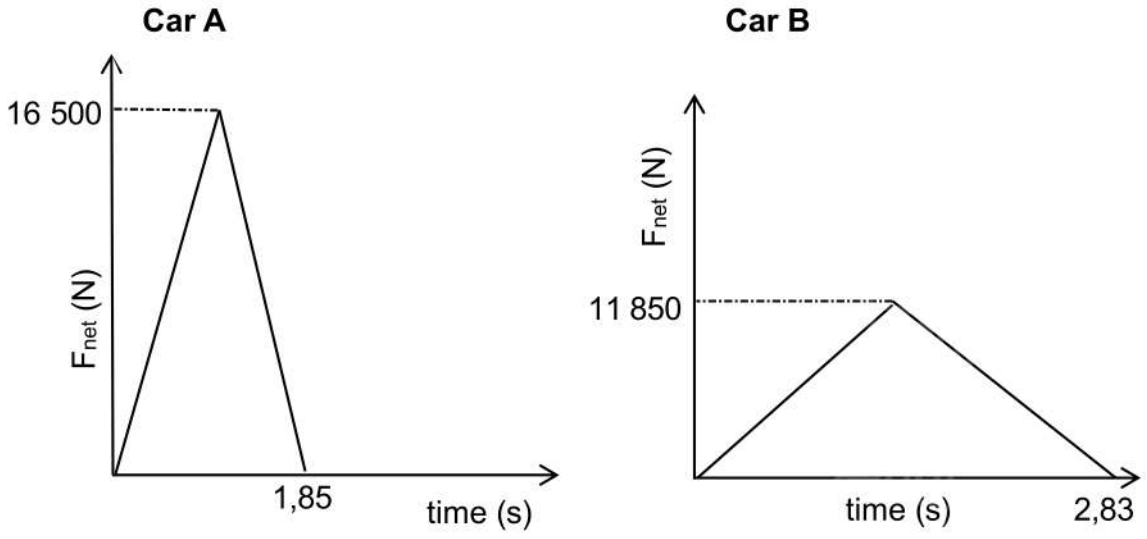
QUESTION 4 (Start on a new page)

The following diagrams show two cars that are used for crash tests by manufacturing companies. **Car A** has no crumple zone, and **car B** has a designed crumple zone.

4.1 State *Newton's Second Law of Motion in terms of momentum* in words. (2)

4.2 Explain, using an appropriate physics theorem and its accompanying formula, how a crumple zone will aid in preventing injuries during collisions. (3)

Both car **A** and car **B** travel at the same velocity of 15 $m \cdot s^{-1}$ toward a wall during a crash test. Note that the cars are not identical. Use the following graphs to answer the questions that follow:



4.3 USE THE GRAPH to calculate the following:

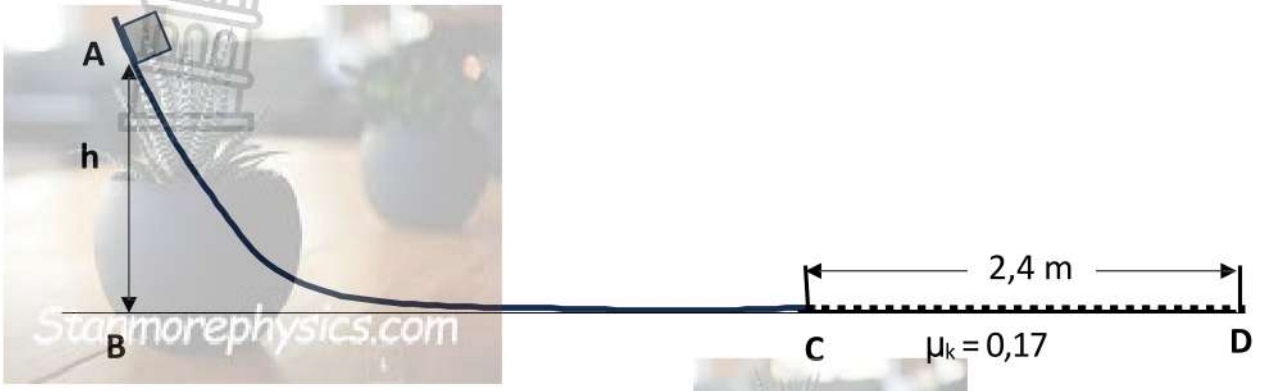
4.3.1 The impulse that will be exerted on Car **A** (2)

4.3.2 The mass of Car **B** (4)

[11]

QUESTION 5 (Start on a new page)

A block of mass 5,9 kg is released from rest at point **A**, which is *h* meters above point **B.** The block moves past point **C** and comes to a complete stop at point **D**. The track AC is frictionless and CD is ROUGH.



The distance from point C to point D is **2,4 m** and this part of the track is a straight line. The coefficient of kinetic friction between the block and the track is **μ_k = 0,17.**

5.1 Define the term *non-conservative force.* (2)

5.2 Using energy principles, calculate the:

5.2.1 Work done by friction on the object as it slides from point **C** to point **D** (4)

5.2.2 Height *h* from which the object is released (6)

[12]

QUESTION 6 (Start on a new page)

A racing car in a race is approaching a spectator. The spectator hears a frequency of 1 800 Hz and when the racing car moves away from him, the spectator observes a frequency that is 360 Hz **lower**.

6.1 State the *Doppler effect* in words (2)

6.2 Use an appropriate diagram to illustrate the change in pitch when a sound source moves TOWARD and AWAY from a listener. (2)

6.3 Assuming the speed of sound in air to be 340 $m \cdot s^{-1}$, calculate the:

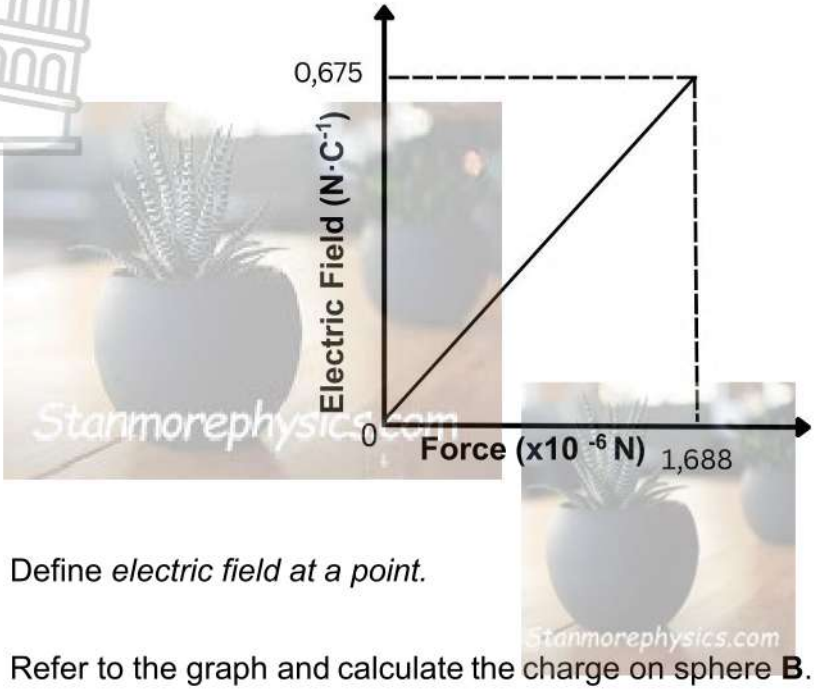
6.3.1 Speed with which the racing car is moving (5)

6.3.2 Frequency of the sound emitted by the racing car (2)

[11]

QUESTION 7 (Start on a new page)

The following graph shows the relationship between the electric field of a charged sphere **(A)** and the force that it exerts on another charged sphere **(B)** at a specific distance.



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

7.2 Refer to the graph and calculate the charge on sphere **B**. (4)

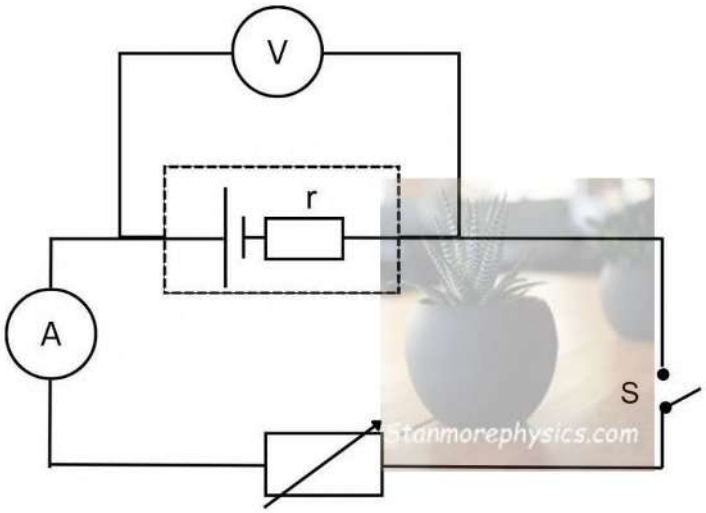
7.3 Draw a sketch graph to show the relationship between the force exerted by one charge **(Q_1)** on another charge **(Q_2)** and the square of the distance between their centres. (2)

[08]

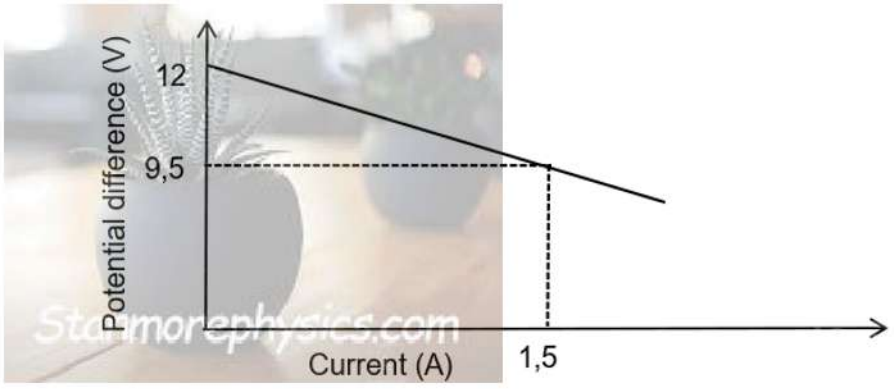
QUESTION 8 (Start on a new page)

A group of learners conduct an experiment to determine the internal resistance of a cell by setting up the circuit shown in the diagram below. They measure the potential difference across the cell and current in the circuit at regular intervals. A variable resistor is used to change the total resistance of the circuit.

During the experiment, the learners ensure that the switch is opened after every reading is taken.



The results obtained are shown in the sketch graph below.



8.1 Write down the:

8.1.1 Magnitude of the *emf* of the cell (1)

8.1.2 Name of the quantity represented by the slope of the graph (1)

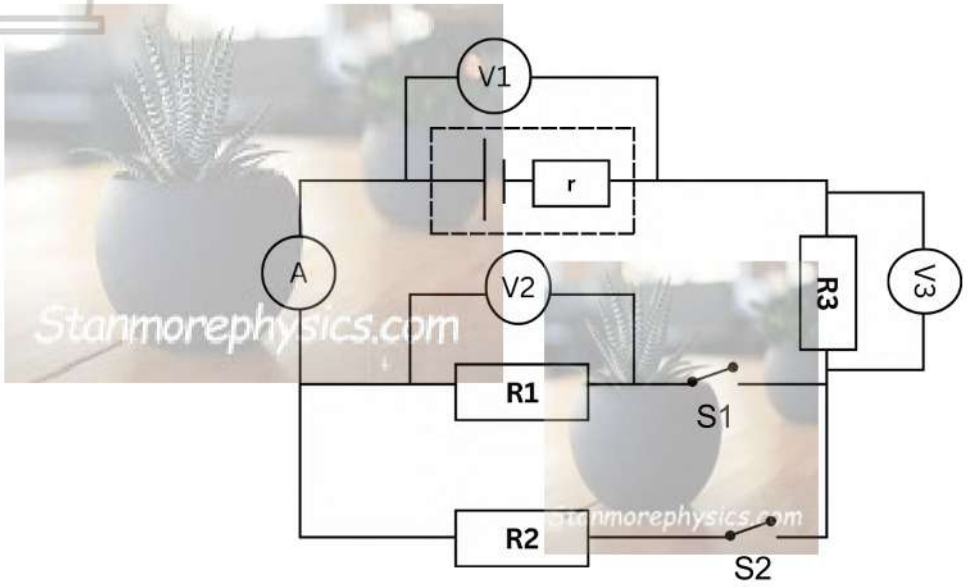
8.2 Calculate the:

8.2.1 Internal resistance of the cell (2)

8.2.2 Resistance of the variable resistor when the current is 1,2 A (4)

The following circuit diagram shows the circuit that is used by learners during an investigation. The switches are OPEN at the start of the investigation.
The reading on V_1 is 12 V. The resistance of resistors R_1 and R_2 are IDNETICAL, while the resistance of R_3 is DOUBLE that of R_1.

The internal resistance of the cell is 1,14 Ω.



When switch S_2 is CLOSED, the reading on V_3 is 7 V.

8.3 Calculate the:

8.3.1 Reading on **A** (4)

8.3.2 Resistance of R_3 (3)

Switch S_1 is now also CLOSED.

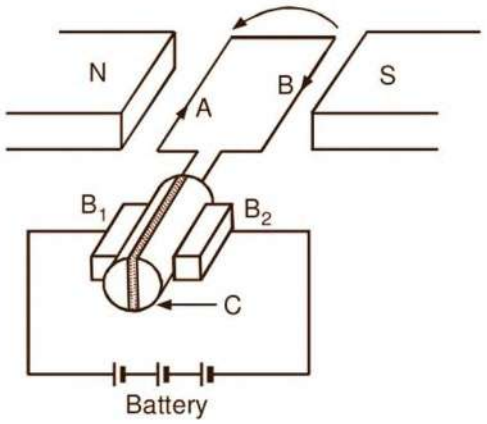
8.4 What is the effect on the reading of **A**?
Only write INCREASES, DECREASES or REMAINS THE SAME.
Explain the answer. (3)

8.5 Calculate the power dissipated in resistor R_2. (6)

[24]

QUESTION 9 (Start on a new page)

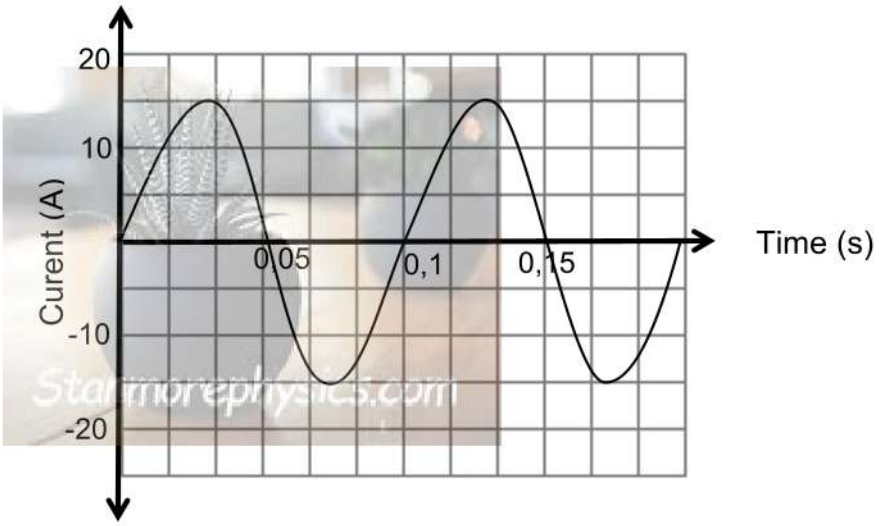
Examine the diagram of an electrical device that follows.



9.1 Fully identify the electrical device. (2)

9.2 State the energy conversion that takes place in this device. (2)

9.3 The following graph shows information regarding a generator that is providing power to a 4,5 Ω resistor.



9.3.1 Define the term *rms current*. (2)

Calculate the:

9.3.2 Average power dissipated in the resistor (5)

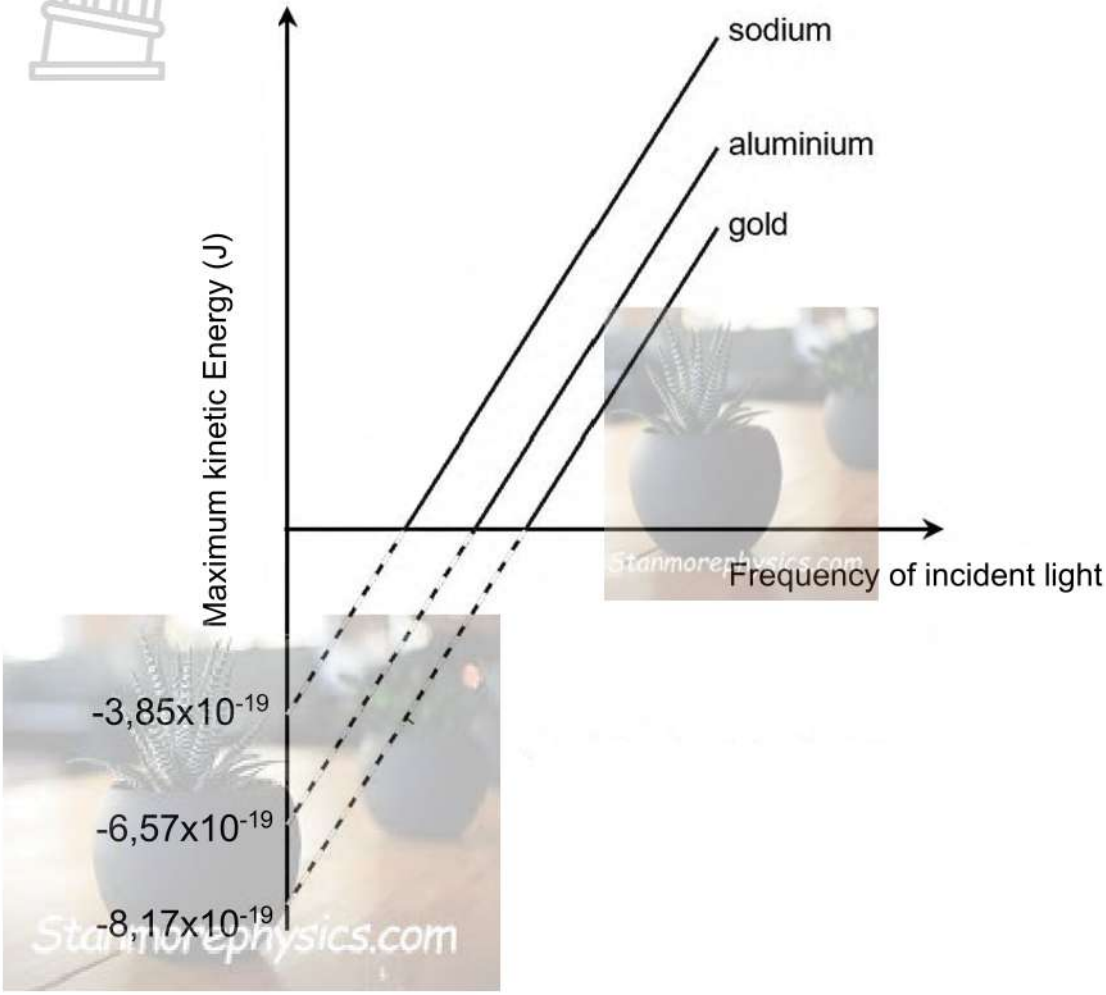
9.3.3 Root mean square potential difference for the generator (3)

9.3.4 Frequency of the generator (3)

[17]

QUESTION 10 (Start on a new page)

The following sketch graphs show the results obtained during an investigation testing the photoelectric effect on three different metals: *sodium*, *aluminium* and *gold*.



10.1 Describe the *photoelectric effect.* (2)

10.2 Which ONE of the metals have the HIGHEST work function? (2)

10.3 Write down the numerical value of the slope of the graphs? (2)

10.4 Define the term *work function* of a metal. (2)

10.5 Write down the work function of aluminium. (2)

10.6 Calculate the maximum speed of photo electrons from sodium, if the incident light (photon) energy is equivalent to that of aluminium's work function. (5)

[15]

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS/*FISIESE KONSTANTES*

NAME/*NAAM*	**SYMBOL/*SIMBOOL***	**VALUE/*WAARDE***
Acceleration due to gravity *Gravitasieversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op 'n elektron*	e	1,6 x 10^{-19} C
Electron mass *Massa van elektron*	m_e	9,11 x 10^{-31} kg
Mass of the Earth *Massa van die Aarde*	M	5,98 x 10^{24} kg
Radius of the Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Speed of sound in air *Spoed van klank in lug*	v	340 $m \cdot s^{-1}$

TABLE 2: FORMULAE/*FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$ OR $F = \frac{Gm_1m_2}{r^2}$	$g = \frac{GM}{d^2}$ OR $g = \frac{GM}{r^2}$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ OR $E_P = mgh$
$K = \frac{1}{2}mv^2$ OR $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ OR $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ OR $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ OR $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

WAVES, SOUND AND LIGHT/*GOLWE, LIG EN KLANK*

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ OR $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ of $E = W_o + K_{max}$	$E = W_0 + E_{k(maks)}$ of $E = W_0 + K_{maks}$
$E = hf$ and/en $W_0 = hf_0$ & $E_{k(max)} = \frac{1}{2}mv_{max}^2$ of/or $K_{max} = \frac{1}{2}mv_{max}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F=\frac{kQ_1Q_2}{r^2}$	$E=\frac{kQ}{r^2}$
$V=\frac{W}{q}$	$E=\frac{F}{q}$
$n=\frac{Q}{e}$ OR $n=\frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms}=\frac{I_{max}}{\sqrt{2}}$	$I_{wgk}=\frac{I_{maks}}{\sqrt{2}}$	$P_{ave}=V_{rms}I_{rms}$	$P_{gem}=V_{wgk}I_{wgk}$
$V_{rms}=\frac{V_{max}}{\sqrt{2}}$	$V_{wgk}=\frac{V_{maks}}{\sqrt{2}}$	$P_{ave}=I_{rms}^2R$	$P_{gem}=I_{wgk}^2R$
		$P_{ave}=\frac{V_{rms}^2}{R}$	$P_{gem}=\frac{V_{wgk}^2}{R}$

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NATIONAL SENIOR CERTIFICATE

GRADE 12

ERRATA MARKING GUIDELINES/*ERRATA NASIENRIGLYNE*

PHYSICAL SCIENCES: PHYSICS (P1)

TRIAL 2026

MARKING GUIDELINE/ *NASIEN RIGLYNE*

MARKS: 150

These marking guidelines consist of 18 pages

 please turn over

QUESTION/VRAAG 1

1.1 A✓✓

1.2 B✓✓

1.3 C✓✓

1.4 C✓✓

1.5 A ✓✓

1.6 A ✓✓

1.7 A ✓✓

1.8 C ✓✓

1.9 C ✓✓

1.10 C ✓✓

(2 x 10 =20)

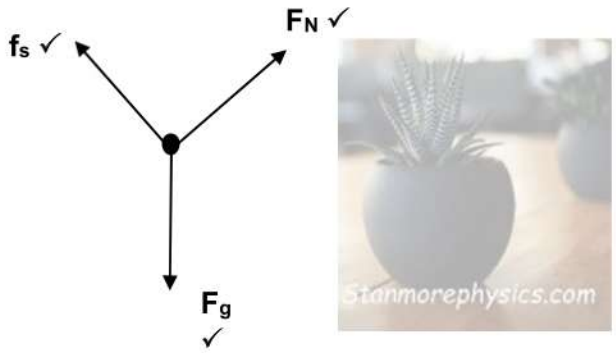
QUESTION/VRAAG 2

2.1 An object will remain in its state of rest or motion at constant velocity/ uniform motion in a straight line, unless a non-zero net/resultant force acts on it ✓✓

'n Voorwerp sal in 'n toestand van rus of konstante snelheid volhard tensy 'n nie-nul netto/resultante krag daarop inwerk. ✓✓

(2)

2.2



(3)

NOTE: DO NOT ALLOW f_k since object is stationary.

ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
f_s	Friction/ Static friction/F_f	*Wrywing*
F_g	w, weight/Gravitational force/ $F_{Earth\ on\ A}$	*Gewig/Gravitasiekrag/ $F_{Aarde\ op\ A}$*
F_N	Normal force/ N	*Normaalkrag*
Notes: • Mark awarded for label and arrow • Do not penalize for length of arrows • Any additional force/s: -1 • If force(s) do not make contact with the body: -1 mark • -1 mark if all arrowheads are omitted but correctly labelled.		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *Addisionele krag/te:-1* • *As kragte nie kontak maak met kol nie: -1* • *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.*
		(3)

2.3

$F_{net\parallel} = 0$

$W_{\parallel} + (-f)_s = 0$

$mgsin\theta - f_s = 0$

$\therefore f_s = mgsin\theta$

$F_{net\perp} = 0$

✓ Any one

$F_N + (-F_{g_\perp}) = 0$

$F_N = F_{g_\perp}$

$F_N = mgcos\theta$

BUT: $f_{smax} = \mu_s F_N$✓

$f_{smax} = \mu_s(mgcos\theta)$

$f_{smax} = mgsin\theta_{max}$

$F_N = mgcos\theta_{max}$

$F_{g\parallel} = f_{smax}$

$mgsin\theta_{max}$✓ $= \mu_s(mgcos\theta_{max})$✓

$sin\theta_{max} = \mu_s cos\theta_{max}$

$\mu_s = \frac{sin\theta_{max}}{co_{max}}$

$\mu_s = tan\theta_{max}$ ✓

$\theta_{max} = tan^{-1}\mu_s$

(5)

Marking criteria:

- Newton's first law (Fnet = 0)
- Formula for f_{smax} (Lose formula mark if max is omitted)
- Expanding for f_{smax}
- Expanding for $F_{g\parallel}$
- Substituting tanθ for $\frac{sin\theta}{cos\theta}$

OPTION 2

$F_{net}=ma$ ✓ Any one

$F_{g\parallel}-f_s^{max}=0$

$f_s^{max} = \mu_s F_N$✓

$mg\sin\theta_{max}$✓$=\mu_s(mg\cos\theta_{max})$✓

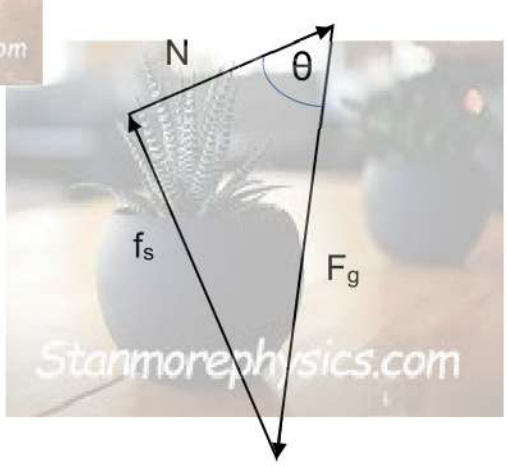
$\sin\theta_{max}=\mu_s\cos\theta_{max}$

$\mu_s=\frac{\sin\theta_{max}}{\cos\theta_{max}}$

$\mu_s=\tan\theta_{max}$✓

$\theta_{max}=\tan^{-1}\mu_s$

OPTION 3: Using force diagram



$\tan\theta_{max}=\frac{f_s^{max}}{F_N}$✓✓

$f_s^{max} = \mu_s F_N$✓

$\tan\theta_{max}=\frac{\mu_s F_N}{F_N}$ ✓

$\mu_s=\tan\theta_{max}$✓

$\theta_{max}=\tan^{-1}\mu_s$

2.4 Once the block is sliding, its acceleration is given by:

$F_{netx} = ma$

$F_{g\parallel} + (-f_k) = ma$

$mg\sin\theta - f_k = ma$

$mg\sin\theta - \mu_k F_N = ma$

$mg\sin\theta - \mu_k(mg\cos\theta)$✓ $= ma$

✓ ANY ONE

$g\sin\theta - \mu_k g\cos\theta = a$ ✓

$a = g\sin\theta - \mu_k g\cos\theta$

$a = g(\sin\theta - \mu_k \cos\theta)$ (3)

[13]

QUESTION/ VRAAG 3

3.1 Motion of an object under the influence of gravitatonal force only. ✓ ✓

Beweging waartydens die enigste krag wat op 'n voorwerp inwerk, die gravitasiekrag is.✓✓ (2)

3.2.1 Downwards as positive

$v_f = v_i + a\Delta t$ ✓

$v_i = -(v_i) + (9{,}8)(3{,}5)$ ✓

$v_i = 17{,}15\ m \cdot s^{-1}$

:. The speed is 17,15 m·s^{-1}✓

Upwards as positive

$v_f = v_i + a\Delta t$ ✓

$-v_i = (v_i) + (-9{,}8)(3{,}5)$ ✓

$v_i = -17{,}15\ m \cdot s^{-1}$

:. The speed is 17,15 m·s^{-1}✓

OPTION 2

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

$0 = v_i(3{,}5) + \frac{1}{2}(9{,}8)(3{,}5)^2$ ✓

v_i = -17,15

= 17,15 m·s^{-1}✓

OPTION 3

$v_f = v_i + a\Delta t$ ✓

0 = v_i + 9,8(1,75) ✓

v_i = -17,15 m·s^{-1}✓

OPTION 3

$v_f = v_i + a\Delta t$ ✓

v_f = 0 + 9,8(1,75) ✓

v_i = 17,15 m·s^{-1}✓

(3)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1**

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

$\Delta y = (-17,15)(1,5) + \frac{1}{2}(9,8)(1,5)^2$ ✓

$\Delta y = -14,7$

Height at which they pass is 14,7 m above the ground.✓ (3)

3.2.3 **POSITIVE MARKING FROM QUESTION 3.2.2**

Calculate the distance that **A** travelled from rest in 1,5 seconds.

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

$= 0 + \frac{1}{2}(9,8)(1,5)^2$ ✓

= 11,025 m

Add to the height at which they passed each other:

Total height = 11,025 + 14,7 ✓ (14,7 is answer as obtained in Q 3.2.2)

= 25,725 m ✓ (25,73 m)

(4)

3.2.4 **POSITIVE MARKING FROM QUESTION 3.2.1**

OPTION 1

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = (-17,15)^2 + 2(9,8)(\Delta y)$ ✓

Δy = -15,00625

Max height = 15,01 m ✓

OPTION 2

$\Delta y = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$ ✓

$\Delta y = (-17,15)(1,75) + \frac{1}{2}(9,8)(1,75)^2$ ✓

= -15,00625m

Max height = 15,00625m✓

OPTION 3

$\Delta y = v_f \Delta t - \frac{1}{2} a (\Delta t)^2$ ✓

$\Delta y = (0)(1,75) - \frac{1}{2}(9,8)(1,75)^2$ ✓

= -15,00625 m

Max height is 15,00625 m✓ (15,01 m)

OPTION 4

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

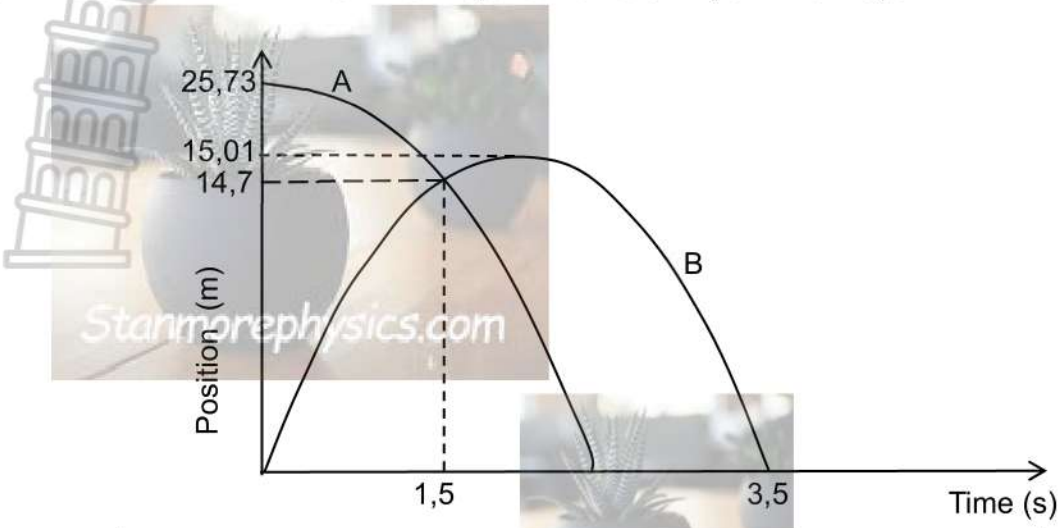
$\Delta y = \left(\frac{-17,15+0}{2}\right)(1,75)$ ✓

=-15,00625 m

Max height is 15,00625 m✓ (15,01 m)

(3)

3.3 **POSITIVE MARKING FROM QUESTIONS 3.2.1, 3.2.2. 3.2.3, 3.2.4**



Marking Criteria

* A: starting point and shape✓
* B shape and final time ✓
* time and height that A and B pass - before max height of B ✓
* B max height ✓

NOTE: If graphs are not labelled: 0/4

If drawn on two axis: max 3/4

(4)

QUESTION 4/ VRAAG 4

4.1 The net/resultant force acting on an object is equal to the rate of change of momentum of the object in the direction of the net force.✓✓

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

(2)

4.2. From/van $F_{net} = \frac{\Delta p}{\Delta t}$ ✓, accept Fnet Δt= Δp,

$F_{net} \alpha \frac{1}{\Delta t}$ for a constant change in momentum. ✓

Crumple zone increases the contact time and thus reduces the net force.✓

$F_{net} \alpha \frac{1}{\Delta t}$ *vir 'n konstante verandering in momentum..* ✓

Frommel zone verhoog die kontaktyd en daarom gaan netto krag afneem. ✓

OR

From/Van $F_{net} = \frac{\Delta p}{\Delta t}$ ✓,

Net force is inversely proportional to contact time if change in momentum is constant. ✓

Therefore, as the crumple zone increases the time for the vehicle to change momentum, the net force will decrease.✓

Netto krag is omgekeerd eweredig aan kontaktyd as verandering in momentum constant is.✓

Die frommelzone verhoog die kontaktyd en daarom gaan die netto krag afneem✓.

OR

$F_{net} = \frac{m\Delta v}{\Delta t}$ ✓

Net force is inversely proportional to contact time if change in velocity is constant ✓

Therefore as time increase, net force decrease.✓ (3)

4.3.1 Impulse = area under the graph

$= \frac{1}{2}bh$

$= \frac{1}{2}(1{,}85)(16500)$ ✓

Impulse = 15 262,5 N·s ✓ (2)

4.3.2

$\text{Impulse} = \Delta p$
$\text{Area} = m(v_f - v_i)$ ✓ any one

$\frac{1}{2}(2{,}83)(-11850)$✓ $= m(0 - 15)$✓

m = 1117,85 kg✓ (4)

QUESTION/VRAAG 5

5.1 A force for which the work done in moving an object between two points depends on the path taken. ✓✓**OR** A force for which the work done in moving an object around a closed path is non-zero.✓✓

'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg afhanklik is van die roete wat gevolg word.✓✓ (2)

5.2.1 **CD**

$W = f_k \Delta x \cos\theta$ ✓

$W = \underline{9,8294(2,4)(\cos 180)}$ ✓

$W = -23,59056\ J$ ✓

$f_k = \mu_k N$

$= \underline{(5,9)(9,8)(0,17)}$ ✓

$f_k = 9,8294$

Carry over

(4)

5.2.2 **POSITIVE MARKING FROM QUESTION 5.2.1**

OPTION 1

C TO D

$W_{net} = \Delta E_k$ (no formula mark)

$-23,59$ ✓ $= \frac{1}{2}m(v_f^2 - v_i^2)$

$= \frac{1}{2}(5,9)(0 - v_i^2)$ ✓

$v_i = 2,8278$

Carry over

A - C

$E_{MA} = E_{MC}$ ✓ (formula mark)

$mgh + \frac{1}{2}mv^2 = mgh + \frac{1}{2}mv^2$

$\underline{(5,9)(9,8)h + \frac{1}{2}(5,9)(0)^2}$ ✓ $= \underline{(5,9)(9,8)(0) + \frac{1}{2}(5,9)(2,8278)^2}$ ✓

h =0,41 m ✓ (Range: 0,40799)

OPTION 2

$W_{net} = \Delta E_k$ (no formula mark)

$-23,59$ ✓ $= \frac{1}{2}m(v_f^2 - v_i^2)$

$= \frac{1}{2}(5,9)(0 - v_i^2)$ ✓

$v_i = 2,8278$

$W_{nc} = \Delta E_k + \Delta E_P = 0$ ✓

$((½)(5,9)(2,8278)^2 - 0)$ ✓ $= -(0 - (5,9)(9,8)h)$ ✓

h = 0,407 m ✓

OPTION 3

$W_{net} = \Delta E_k$ (no formula mark)

-23,59056 ✓ = ½ (5,9)(0^2 - v_i^2)

$$-23{,}59056 = -2{,}95\ v^2$$

$$v_i = 2{,}85214\ m.s^{-1}$$

$$E_{M(A)} = E_{M(C)}$$

$$(E_p + E_k) = (E_p + E_k)$$

$$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_c$$ ✓

(5,9)(9,8)h + 0✓ = 0 + ½ (5,9)(2,85214)^2 ✓ (6)

h= 0,415 m ✓

[12]

QUESTION 6/ VRAAG 6

6.1 The (apparent) change in frequency (Pitch) of the wave (or sound) detected by a listener, because the sound and the listener have different velocities relative to the medium of sound propagation.✓✓

OR

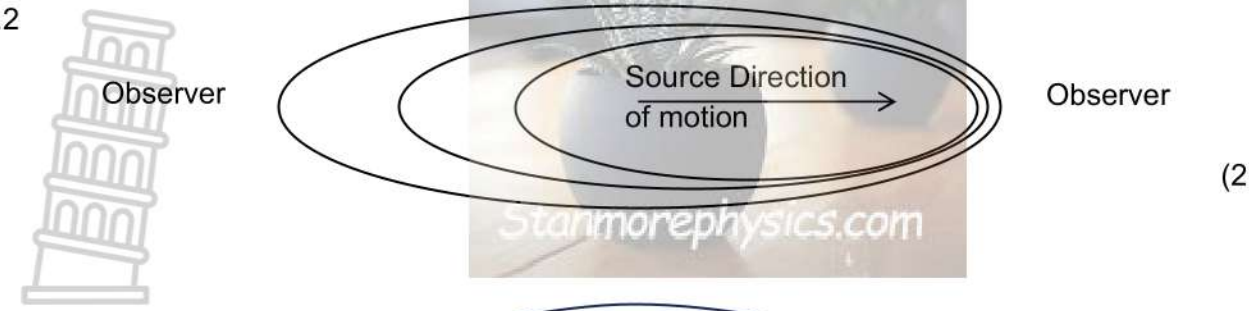
The apparent change in the observed frequency (pitch) of a wave (or sound) when there is relative motion between the source of the wave and an observer (listener).✓✓

Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.✓✓

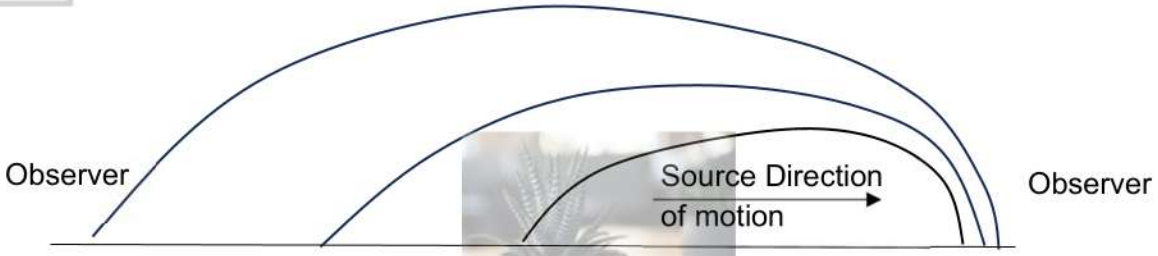
OF

Die skeinbare verandering in die waargenome frekwensie (toonhoogte) wanneer daar relatiewe beweging tussen die bron en luisteraar is.✓✓ (2)

6.2



(2)



Marking Criteria

* Show compressions in front of source ✓
* Show depressions behind source ✓

NOTE: if direction of motion is not indicated, then 0/2

6.3.1 **OPTION 1**

$$f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right) f_S$$

TOWARDS

$$f_L = \left(\frac{v}{v - v_S}\right) f_S$$

$$f_S = \left(\frac{v - v_S}{v}\right) f_L$$

$$= \frac{1800(340 - v_S)}{340} \checkmark \ldots(1)$$

AWAY

$$f_L = \left(\frac{v}{v + v_S}\right) f_S$$

$$f_S = \left(\frac{v + v_S}{v}\right) f_L$$

$$= \frac{1440\ (340 + v_S)}{340} \checkmark \ldots(2)$$

✓ **Any formula**

Note that f_s is made the object of equation.

(1)= (2) ✓(equating the two derived formulae)

$$\left(\frac{v - v_S}{v}\right) f_L = \left(\frac{v + v_S}{v}\right) f_L$$

$$1800(340 - v_S) = 1440\ (340 + v_S)$$

$$v_S = 37{,}78\ \text{m} \cdot \text{s}^{-1} \quad \checkmark \qquad (37{,}777\ \text{m} \cdot \text{s}^{-1})$$

OPTION 2

$f_L = (\frac{v \pm v_L}{v \pm v_s})\ f_S$ ✓

TOWARDS

$f_L = (\frac{340}{340 - v_s})\ f_S$

$f_S = (\frac{340 - v_s}{340})\ f_L$

$340f_s = 1800(340 - v_S)$ ✓ ...(1

AWAY

$f_L = (\frac{340}{340 + v_s})\ f_S$

$f_S = (\frac{340 + v_s}{340})\ f_L$

$340f_s = 1440\ (340 + v_S)$ ✓

(1)= (2)✓

$1800(340 - v_S) = 1440\ (340 + v_S)$

$v_S = 37{,}78\ m \cdot s^{-1}$ ✓ $(37{,}777\ m \cdot s^{-1})$ (5)

6.3.2 **POSITIVE MARKING FROM QUESTION 6.3.1**

OPTION 1

$f_s = 1800\ (\frac{340 - 37{,}777}{340})$ ✓

$= 1600{,}00$ Hz ✓

OPTION 2

$f_s = 1440\ (\frac{340 + 37{,}777}{340})$ ✓

$= 1600{,}00$ Hz ✓ (Range: 1599,9967 $m.s^{-1}$) (2)

[11]

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 elektriese veld by 'n punt is die elektrostatiese krag wat per eenheid positiewe lading uitgeoefen word. ✓✓ (2)

7.2 From: $E_A = \frac{F_{A\ on\ B}}{q_B}$

Slope, $m = \frac{\Delta E}{\Delta F} = \frac{1}{q_B}$

$$\text{slope} = \frac{0{,}675 - 0\checkmark}{1{,}688 \times 10^{-6} - 0\checkmark}$$

$= 3{,}9988 \times 10^{5}\checkmark$

$\therefore$ $q = 2{,}50 \times 10^{-6}$ C (range = $2{,}50074 \times 10^{-6}$ C)✓

OPTION 2

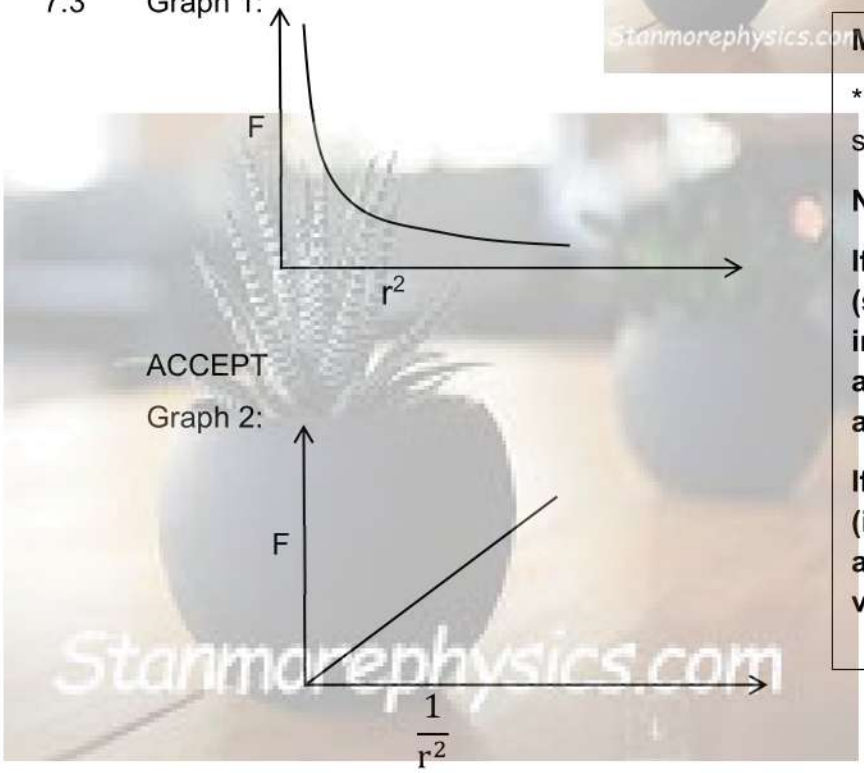
$$E = \frac{F}{q}\checkmark$$

$$q = \frac{1{,}688 \times 10^{-6}\checkmark}{0{,}675\checkmark}$$

$q = 2{,}50 \times 10^{-6}$ C✓

(4)

7.3 Graph 1:



Marking criteria:

* Correct axis **and** Correct shape ✓✓

NOTE:

If axis are reversed, 1/2 (since distance is the independent variable and r^2 should be on x-axis)

If graphs are mixed 0/2 (i.e shape of graph 2 on axis of graph 1 or vice versa)

(2)

[08]

QUESTION/VRAAG 8

8.1.1 12 V ✓ (1)

8.1.2 Internal resistance ✓ (1)

8.2.1 Using the following formula:

$$\varepsilon = I(R + r)$$

$$\varepsilon = V_{external} + Ir$$

$$V_{ext} = -rI + \varepsilon$$

$$\text{slope, m} = \frac{\Delta V}{\Delta I} = -r$$

$$= \frac{9,5 - 12}{1,5 - 0} \checkmark$$

r =-(-1,6667)

r = 1,6667 Ω✓ (2)

OPTION 2

$\varepsilon = V_{external} + V_{internal}$

$12 = 9,5 + V_{internal}$

$V_{internal} = 2,5$ V

V = Ir

2,5 = (1,5)r ✓

r = 1,67 Ω ✓

8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1**

$\varepsilon = I(R + r)$✓

12 ✓= 1,2(R + 1,6667)✓

R = 8,3333 Ω✓ (4)

8.3.1 $R_2 = R_1 = ½ R_3$

$\therefore V_{over\ R2} = \frac{7}{2} = 3,5V$✓

$V_{external} = \underline{7 + 3,5}$✓ = 10,5 V (Addition ✓)

$\varepsilon = V_{int} + V_{ext}$

$\varepsilon = I(R + r)$

$\varepsilon = Ir + V_{ext}$

$\underline{12 = I(1,14) + 10,5}$✓

I = 1,32 A✓ (Range: 1,315789 A)

OPTION 2

$\varepsilon = I(R + r)$

12✓ = I(3x + 1,14)✓

$I = \frac{12}{3x+1,14}$

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

$\frac{12}{3x+1,14} = \frac{7}{2x}$✓

x = 2,66

R_3 = 5,32 Ω

V= IR

$7 = I\ (5,32)$

$I = 1,32\ A$ ✓ (4)

8.3.2 **POSITIVE MARKING FROM QUESTION 8.3.1**

OPTION 1

$R_3 = \frac{V_3}{I}$ ✓

$= \frac{7}{1,315789}$ ✓

R_3 = 5,32 Ω✓ (range: 5,30 – 5,32)

OPTION 2

$\varepsilon = I(R + r)$✓

12 = (1,315789)(R +1,14)

R_T = 7,98

$R_3 = \frac{2}{3}(7,98)$ ✓

R_3= 5,32 Ω ✓

OPTION 3

$R_{ext} = \frac{V_{ext}}{I}$ ✓

$R_{ext} = \frac{10,5}{1,32}$

R_{ext} = 7,9545 Ω

$R_3 = \frac{2}{3}(7,95)$ ✓

R_3= 5,30 Ω ✓

(3)

8.4 INCREASE ✓

* Total resistance will decrease ✓

* Current is inversely proportional to resistance / $I \propto \frac{1}{R}$ ✓

OR

- Total resistance decrease ✓
- From the formula $R = \frac{V}{I}$ as total resistance decrease, current will increase ✓

TOENEEM ✓

- *Totale weerstand neem af* ✓
- *Stroom is omgekeerd eweredig aan weerstand* ✓

8.5 **POSITIVE MARKING FROM QUESTION 8.3.2 (Value of R_3)**

Calculation of R_T

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_p} = \frac{1}{2,66} + \frac{1}{2,66}$ ✓ (Substitution to calculate R_P)

R_p = 1,33

R_T = 1,33 + 5,32 ✓ (Adding answer to 5,32)

R_T = 6,64 Ω

$\varepsilon = I(R + r)$

12 = I (6,64 + 1,14)

I = 1,5424 A (Range: 1,54 A)

Current in $R_2 = \frac{1}{2}(1{,}54)$✓

= 0,7712 (Range: 0,77)

$P = I^2R$✓

$= (0{,}7712)^2(2{,}66)$ ✓

= 1,582 W ✓ (Range: 1,577 W)

(6)

[24]

QUESTION/VRAAG 9

9.1 DC/Direct current✓ Motor ✓

GS/Gelykstroom ✓ Motor ✓ (2)

9.2 From electrical✓ to mechanical energy ✓

Van elektriese ✓ energie na meganiese energie ✓ (2)

9.3.1 The alternating current which dissipates/produces the same amount of energy as an equivalent direct current (DC).✓✓

Die wisselstroom wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente gelykstroom.✓✓ (2)

9.3.2 **OPTION 1**

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

$I_{rms} = \frac{15}{\sqrt{2}}$✓

$= 10{,}6066$ (A)✓

$P_{ave} = I_{rms}^2 R$✓

$P = (10{,}6066)^2(4{,}5)$✓

$P = 506{,}249836$W ✓

OPTION 2

$P = I^2 R$ ✓

$= (15)^2(4{,}5)$✓

= 1012,5 (W)✓

$P_{ave} = \frac{0 + 1012{,}5}{2}$ ✓

P_{ave} = 506,25 W✓

OPTION 3:

$P_{ave} = I_{rms}^2 R$✓

$= \left(\frac{15}{\sqrt{2}}\text{ ✓✓}\right)^2 (4,5)$✓

= 506,25 W✓

OPTION 4 (answers 9.3.3 first)

$V_{rms} = I_{rms}R$

$= \frac{15}{\sqrt{2}}$✓✓ (4,5)

= 47,73 V

$P_{ave} = I_{rms}V_{rms}$✓

= (10,6066)(47,73) ✓

= 506,25 W ✓

(5)

9.3.3 **POSITIVE MARKING FROM 9.3.2**

OPTION 1:

$P_{ave} = I_{rms}V_{rms}$ ✓

506,249836 = 10,6066 V_{rms}✓

V_{rms} = 47,7297 V ✓

OPTION 2:

$P_{ave} = \frac{V_{rms}^2}{R}$✓

$506,249836 = \frac{V_{rms}^2}{4,5}$✓

V_{rms} = 47,7297 V✓

OPTION 3:

$V_{rms} = I_{rms}R$✓

$V_{rms} = (10,6066)(4,5)$✓

$V_{rms} = 47,7297\ V$✓

OPTION 4

$V_{max} = I_{max}R$✓ $= (15)(4,5)$✓ $= 67,50V$

$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{67,50}{\sqrt{2}} = 47,7297$ V✓

(3)

9.3.4 $f = \frac{1}{T}$ ✓ $= \frac{1}{0,1}$✓ $= 10$ Hz✓ (3)

[17]

QUESTION 10/ VRAAG 10

10.1 The process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface. ✓✓

Die proses waardeur elektrone uit 'n metaaloppervlak vrygestel word wanneer lig van geskikte frekwensie invallend op die oppervlak is. ✓✓ (2)

10.2 Gold ✓✓ (2)

10.3 6,63 x 10^{-34} (J·s)✓✓ (2)

10.4 The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel. ✓✓

(2)

10.5 $W_0 = 6,57 \times 10^{-19}$ J✓✓ (2)

10.6 **POSITIVE MARKING FROM QUESTION 10.5**

$$E_{light} = W_O + E_{K_{max}} \checkmark$$

$$(6,57 \times 10^{-19})\checkmark = (3,85 \times 10^{-19})\checkmark + \frac{1}{2}(9,11 \times 10^{-31})v_{max}^2\checkmark$$

$$v = 7,7275 \times 10^5 \ m \cdot s^{-1} \ \checkmark$$

(5)

[15]

GRAND TOTAL/GROOTTOTAAL: 150