education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name 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 subquestions, 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. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 A man pushes a wall with a constant force **F** but the wall does not move.

Which of the following Newton's laws of motion applies to this scenario?

(i) First law
(ii) Second law
(iii) Third law

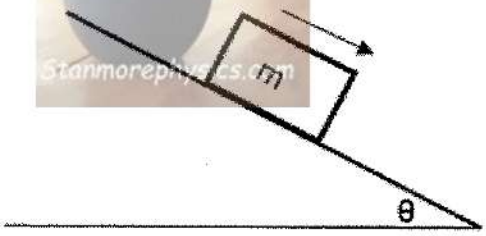
A (i) only

B (i) and (ii) only

C (i) and (iii) only

D (i), (ii) and (iii) (2)

1.2 A crate of mass **m** is sliding down a rough incline at a constant velocity.



Which ONE of the following statements regarding the magnitude of the normal force acting on the crate is correct?

The magnitude of the normal force acting on the crate is …

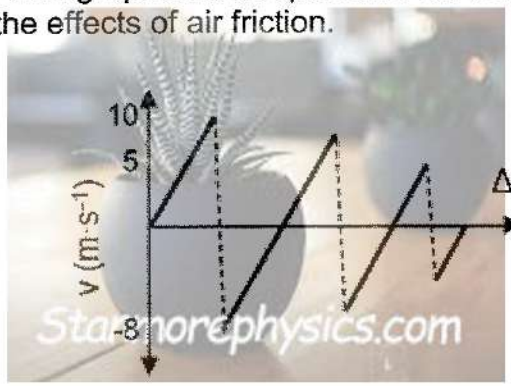
A equal to the component of the weight of the crate which is perpendicular to the slope.

B equal to the component of the weight of the crate which is parallel to the slope.

C greater than the component of the weight of the crate which is perpendicular to the slope.

D greater than the component of the weight of the crate which is parallel to the slope. (2)

1.3 The velocity-time graph below represents the bouncing movement of a ball. Ignore the effects of air friction.



Which ONE of the following statements about the motion of the ball is INCORRECT?

A The ball was dropped from a certain height.

B The ball lost some of its kinetic energy to heat and sound each time it is in contact with the ground.

C The ball experiences a constant acceleration each time it is in the air.

D The ball reaches maximum height 4 times after it was dropped. (2)

1.4 The net force **F** acts on an object of mass **m** to produce a change in momentum of **p** per second. If the net force **F** is DOUBLED, the new change in momentum will be …

A $\Delta \mathbf{p}$

B $2\,\Delta \mathbf{p}$

C $\frac{1}{2}\Delta \mathbf{p}$

D $4\,\Delta \mathbf{p}$ (2)

1.5 A block slides across a rough horizontal surface until it stops.

Which ONE of the following statements regarding the movement of the block is CORRECT?

A The net work done on the block is negative.

B The net force acting on the block is equal to ZERO.

C The change in kinetic energy of the block is positive.

D Mechanical energy during the motion of the block is conserved. (2)

1.6 An astronaut studies a star that is moving away from the earth.

Which ONE of the following combinations of frequency and wavelength is CORRECT about the star?

	FREQUENCY	WAVELENGTH
A	Increases	Decreases
B	Increases	Increases
C	Decreases	Increases
D	Decreases	Decreases

(2)

1.7 The electric field strength from a charged sphere **q** is **E** at a point that is a distance **r** away from the sphere.

The electric field strength will be ... at a point that is **3 r** from the same charged sphere.

A $\frac{1}{3}$ **E**

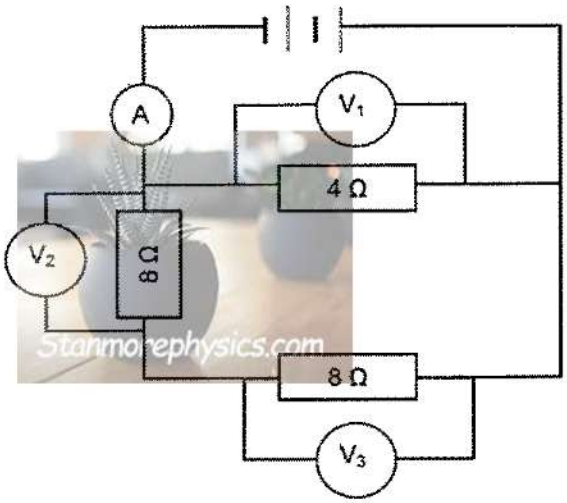
B $\frac{1}{9}$ **E**

C 3 **E**

D 9 **E**

(2)

1.8 In the circuit diagram below, the battery has negligible internal resistance. The resistance of the ammeter and the wires may also be ignored.



The reading on voltmeter V_3 is equal to …

A $V_1 \times V_2$

B $V_1 + V_2$

C $2\,V_1$

D $\frac{1}{2}V_1$

(2)

1.9 A DC motor has all these components except …

A a cell or battery.

B carbon brushes.

C split ring commutator.

D slip rings commutator. (2)

1.10 The line absorption spectrum, in terms of the energy transitions of atoms, will be from …

A zero to high energy level.

B high energy level to zero.

C low to high energy level.

D high to low energy level. (2)

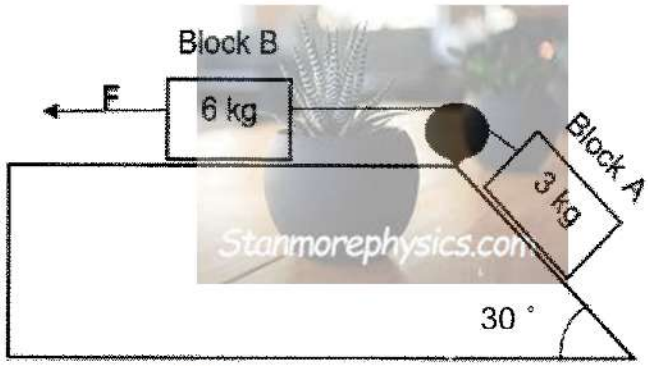
[20]

QUESTION 2 (Start on a new page.)

Block **A** of mass 3 kg is connected to block **B** of mass 6 kg by a light inextensible string passing through a frictionless pulley.

The 3 kg block lies on an incline that makes an angle of 30° with the horizontal.

Block **B** is pulled by a constant force **F** to the left, as shown in the diagram below. The blocks have an acceleration of 2 $m \cdot s^{-2}$ to the left.



2.1 Define the term *kinetic frictional force.* (2)

The kinetic frictional forces acting on blocks **A** and **B** are 4,3 N and 7,2 N respectively.

2.2 Draw a labelled free-body diagram showing ALL the forces acting on block **A**. (4)

2.3 Calculate the magnitude of:

2.3.1 The tension in the string (4)

2.3.2 Force **F** (3)

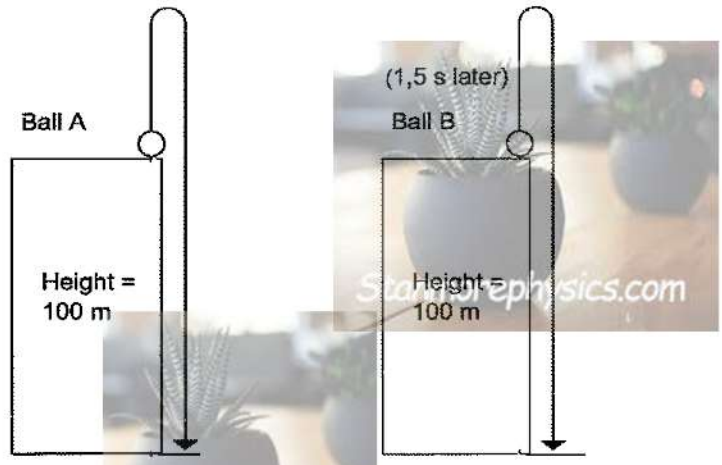
2.4 How will the acceleration of block **B** change if the string breaks? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)
[14]

QUESTION 3 (Start on a new page.)

Ball **A** is thrown vertically upwards from the top edge of a building which is 100 m high and reaches its maximum height after 1,5 seconds. Ball **A** strikes the ground at time **t**.

An identical ball **B** is thrown vertically upwards from the same roof top when ball **A** is at maximum height.

Both balls **A** and **B** strike the ground with the SAME VELOCITY.



Ignore the effects of air friction.

3.1 Explain what is meant by a *projectile*. (2)

3.2 Using EQUATIONS OF MOTION ONLY, calculate the:

3.2.1 Maximum height reached by ball **A** above the ground (4)

3.2.2 Velocity at which ball **B** hits the ground (4)

3.2.3 Time it takes for both balls to hit the ground from the moment they were thrown (3)

3.3 Draw a labelled velocity versus time graphs, on the same set of axes for the motion of the two balls from the moment they were thrown until they strike the ground.

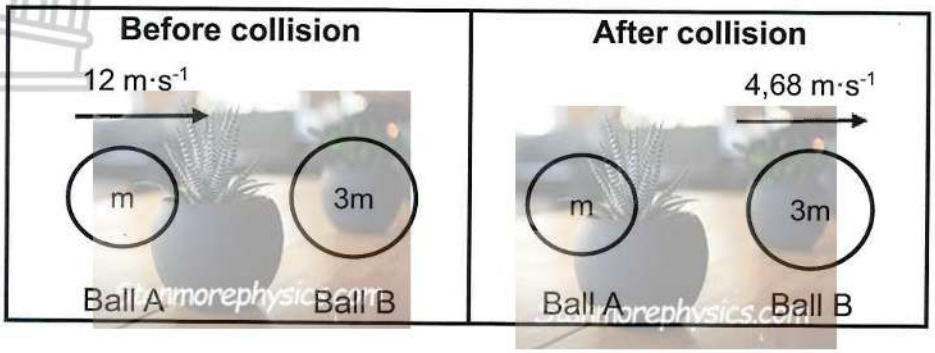
Clearly indicate the following on the graphs:

- The velocities with which each ball was thrown
- The time at which ball **B** was thrown
- The velocities with which the balls strike the ground
- The time at which ball **B** strike the ground (5)

[18]

QUESTION 4 (Start on a new page.)

Ball **A** of mass **m** moving to the right with a speed of 12 $m \cdot s^{-1}$ collides with a stationary ball **B** of mass **3m**. After collision, ball **B** moves to the right at 4,68 $m \cdot s^{-1}$.



Ignore all frictional and rotational effects.

4.1 Calculate the velocity of ball **A** after the collision. (4)

4.2 Prove, showing ALL calculations, that the collision of the two balls is INELASTIC. (4)

If the value of **m** is 0,05 kg and the balls are in contact with each other for 0,03 s during the collision.

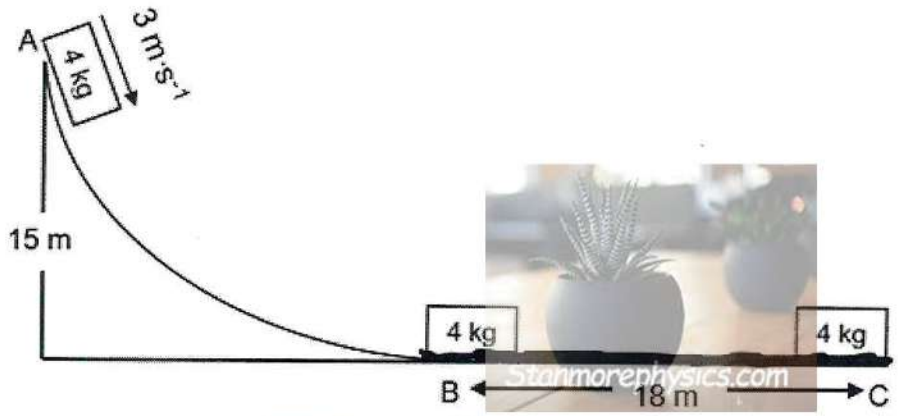
4.3 Define the term *impulse*. (2)

4.4 Determine the force that ball **A** exerts on ball **B** during the collision. (3)
[13]

QUESTION 5 (Start on a new page.)

A 4 kg block slides down a slope. As it passes point **A**, which is 15 m above the ground, its velocity is 3 m·s^{-1}. It slides down a smooth slope **AB**.

It then moves a distance of 18 m on a horizontal surface **BC** which applies a constant, non-conservative force, on the block until it stops at point **C**.



5.1 Name the non-conservative force acting on the block from point **B** to point **C**. (1)

5.2 Using ENERGY PRINCIPLES ONLY, calculate the:

5.2.1 Speed of the block at point **B** (3)

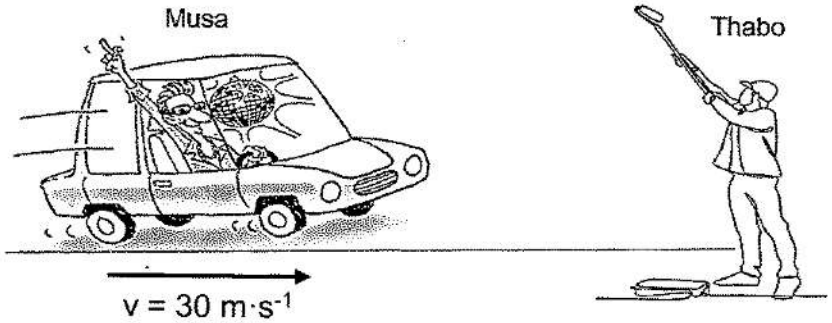
5.2.2 Magnitude of the non-conservative force acting on the block from point **B** to point **C** (4)

5.2.3 Coefficient of kinetic frictional force (3)
[11]

QUESTION 6 (Start on a new page.)

Musa is playing loud music from his car as he approaches Thabo who is standing on the sidewalk. Thabo has a wavelength detector which registers a wavelength of 350 mm coming from Musa's car.

Take the speed of sound in air to be 343 $m \cdot s^{-1}$.



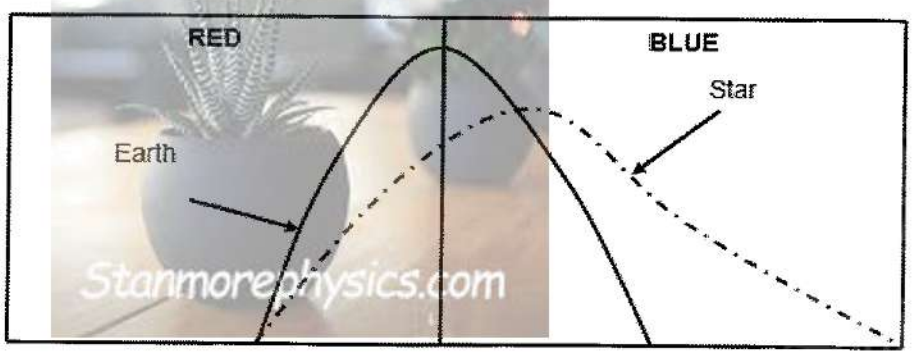
6.1 State the Doppler effect in words. (2)

6.2 Calculate the:

6.2.1 Frequency of the detected wavelength by Thabo's detector (3)

6.2.2 Wavelength of the sound produced by Musa's car radio if the car is moving at a constant speed of 30 $m \cdot s^{-1}$ (5)

6.3 Information of a distant star from earth is recorded in a laboratory and the results are shown in the diagram below.



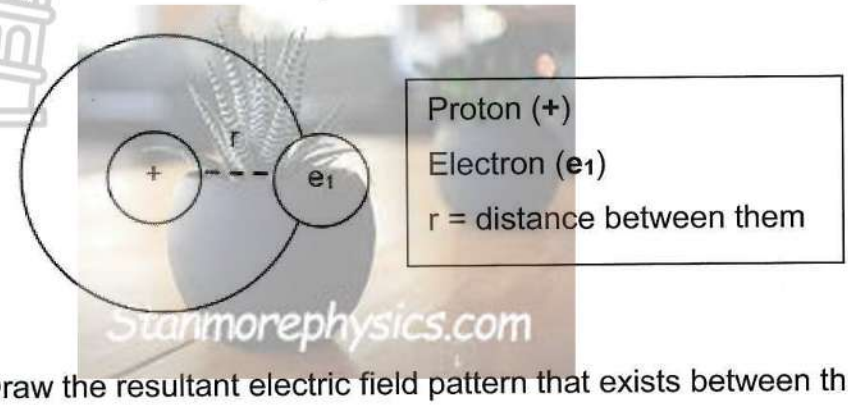
6.3.1 Is the star moving TOWARDS or AWAY FROM the earth? Choose from TOWARDS or AWAY FROM. (1)

6.3.2 Explain the answer to QUESTION 6.3.1 (2)

[13]

QUESTION 7 (Start on a new page.)

In an atom, the proton, in the nucleus is 3×10^{-12} m away from an electron in the orbital, as shown in the diagram below.



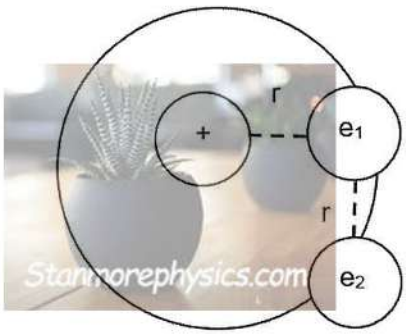
7.1 Draw the resultant electric field pattern that exists between the proton and the electron. (3)

7.2 State Coulomb's Law in words. (2)

7.3 Calculate the electrostatic force between the proton and the electron. (3)

The atom now gains an electron which is placed in such a way that the three particles make a right angle, as shown in the diagram below.

The distance between electrons e_1 and e_2 is equal to the distance between the proton and electron e_1. Assume that both electrons and the proton remain stationary at those positions.



7.4 Calculate the:

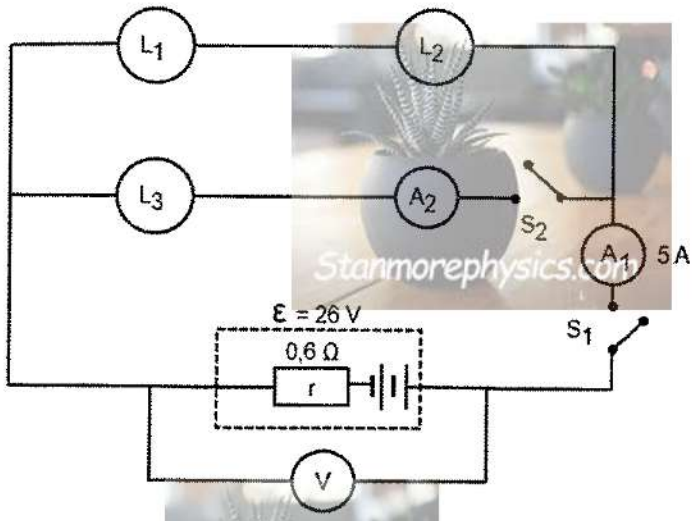
7.4.1 Net electrostatic force on the electron e_1 from the proton and electron e_2 (4)

7.4.2 Magnitude of the net electric field strength at electron e_1 from the proton and electron e_2 (3)
[15]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows three light bulbs, a voltmeter, a battery and two ammeters of negligible resistance.

L_1, L_2 and L_3 are IDENTICAL light bulbs, each with a resistance R.



The battery has an EMF of 26 V and an internal resistance of 0,6 Ω.

8.1 What is the function of the ammeter A_1 in this circuit? (1)

8.2 When both switches are closed, A_1 reads 5A.

Calculate the:

8.2.1 Reading on ammeter A_2 (3)

8.2.2 Value of R (5)

8.2.3 Voltmeter reading (3)

8.2.4 Energy dissipated by the light bulb that is in series with ammeter A_2 in 2 minutes (3)

8.3 Switch S_2 is now OPENED and S_1 remains closed.

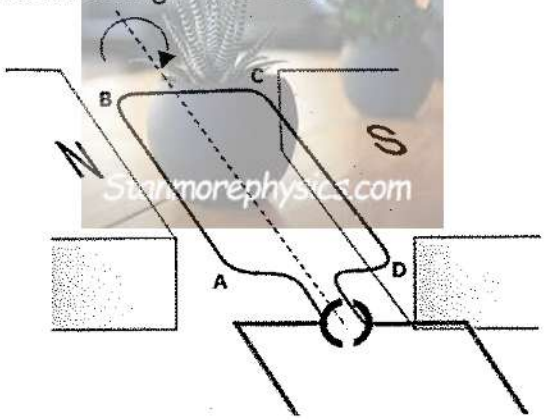
8.3.1 How will this change affect the value of the lost volts? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

8.3.2 Explain the answer to QUESTION 8.3.1. (3)

[19]

QUESTION 9 (Start on a new page.)

The simplified diagram below represents a DC generator with a coil rotating clockwise and current flowing in the coil.

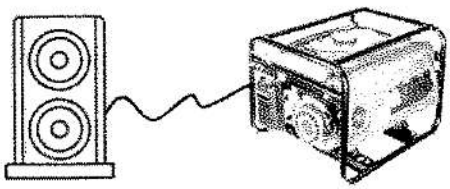


9.1 State the energy conversion that takes place in the generator. (2)

9.2 What is the direction of the current in the coil? Write **A to B** or **B to A**. (2)

9.3 State TWO changes that can be made to the generator to increase the EMF. (2)

A speaker is now connected to the device above, as shown in the diagram below.



The peak value of current of the speaker is 23 A and the speaker has a resistance of 13 Ω.

9.4 Define the *root mean square current*. (2)

9.5 Calculate the:

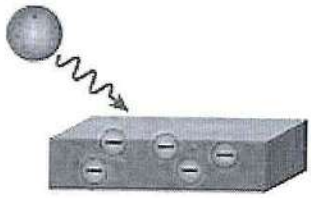
9.5.1 Root mean square current of the speaker (3)

9.5.2 Peak value of the voltage (3)

[14]

QUESTION 10 (Start on a new page.)

During a photoelectric investigation, a packet of light energy, **A**, of $4,8 \times 10^{-19}$ J is shone onto a metal surface, as shown in the diagram below.



The metal surface has a threshold frequency of $8,1 \times 10^{14}$ Hz.

10.1 Give the term for the underlined phrase above. (1)

10.2 Define the term *threshold frequency*. (2)

10.3 Will this packet of light energy be able to eject an electron from the surface of this metal? Choose from YES or NO.
Support the answer with a suitable calculation. (4)

The packet of light energy, **A**, is now replaced by another one, **B**.

B with $7,68 \times 10^{-19}$ J is allowed to shine on the same metal surface.

10.4 Calculate the maximum speed of the ejected photoelectrons when the packet of light energy, **B**, is shone onto the metal surface. (4)

10.5 How will the maximum speed of the ejected photoelectrons change if the intensity of the light energy, **B**, is decreased?
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

10.6 Explain the answer to QUESTION 10.5. (1)
[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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

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

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ 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* $E_p = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max/maks)}$ or/*of* $E = W_0 + K_{(max/maks)}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max/maks)} = \frac{1}{2}mv^2_{max/maks}$ or/*of* $K_{max/maks} = \frac{1}{2}mv^2_{max/maks}$	

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/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

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

education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

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

SEPTEMBER 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 15 pages.
Hierdie nasienriglyne bestaan uit 15 bladsye.

QUESTION/*VRAAG 1*

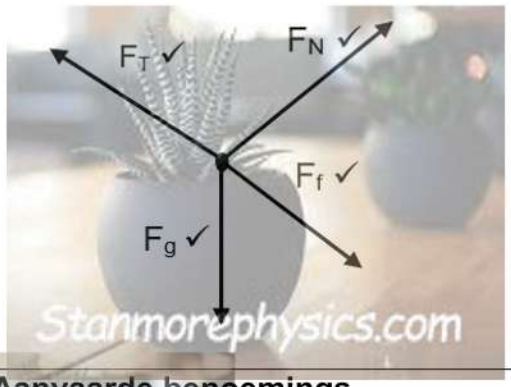
1.1	C	✓✓	(2)
1.2	A	✓✓	(2)
1.3	D	✓✓	(2)
1.4	B	✓✓	(2)
1.5	A	✓✓	(2)
1.6	C	✓✓	(2)
1.7	B	✓✓	(2)
1.8	D	✓✓	(2)
1.9	D	✓✓	(2)
1.10	C	✓✓	(2)

[20]

QUESTION/*VRAAG 2*

2.1 The force that opposes the motion of a moving object relative to the surface.✓✓/*Die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenwerk.* **(2 or/*of* 0)** (2)

2.2



Accepted labels/Aanvaarde benoemings	
F_N	N/Normal force/*Normaalkrag*
F_T	T/Tension force/*Spanningskrag*
F_g	Fw/w/gravitational force/weight/*gravitasiekrag/gewig*
F_f	f/f_k/(kinetic) friction/*(kinetiese) wrywing*

***Notes/Aantekeninge*:**

- Mark awarded for label and arrow./*Punt toegeken vir benoeming en pyltjie.*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*
- Any other additional force(s)/*Enige ander addisionele krag(te)*: Max/*Maks* 3/4
- If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* 3/4
- If force(s) do not make contact with the dot /*Indien krag(te) nie met die kolletjie kontak maak nie*: Max/*Maks* 3/4
- If components drawn for F_g/*Indien komponente van F_g geteken*: Max/*Maks* 3/4

(4)

2.3.1
Fnet = ma
$T - f_f - F_{g//} = ma$ } Any one✓/*Enige een*
$\underline{T - 4,3 - (3 \times 9,8 \sin 30°)}$ ✓= $\underline{3 \times 2}$✓
T = 25 N ✓ (4)

POSITIVE MARKING FROM 2.3.1/*POSITIEWE NASIEN VANAF 2.3.1*

2.3.2
Fnet = ma
$F - T - f_f = ma$ } Any one✓/*Enige een*
F – 25 – 7,2 = 6 x 2 ✓
F = 44,2 N ✓ (3)

2.4 Increase✓/*Toeneem* (1)
[14]

QUESTION/*VRAAG 3*

3.1
Marking criteria/*Nasienkriteria*:
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/ *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

If gravity/gravitation without force is used 1/2
Indien gravitasie sonder krag gebruik word 1/2

An object which has been given an initial velocity✓ and then moves under the influence of the gravitational force only.✓/*'n Voorwerp waaraan 'n beginsnelheid gegee word, wat daarna slegs onder die invloed van gravitasiekrag beweeg.* (2)

3.2.1 **Upwards as positive (note: v_f and v_i can be switched except for OPTION 1)/*Opwaarts as positief (nota: v_f en v_i kan omgeruil word behalwe vir OPSIE 1)***

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***	**OPTION/*OPSIE 3***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= 0 + \frac{1}{2}(-9,8)(1,5)^2$ ✓ $= 11,025$ m $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7$ m·s^{-2} $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = 14,7^2 + (-9,8)\Delta y$ ✓ $\Delta y = 11,025$ $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7$ m·s^{-2} $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= 14,7(1,5) + \frac{1}{2}(9,8)(1,5)^2$ ✓ $\Delta y = 11,025$ m $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓
OPTION/*OPSIE 4*		
$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7$ m·s^{-2} $\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓ $\Delta y = \frac{0 + 14,7}{2} 1,5$ ✓ $\Delta y = 11,025$ $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓		

Downwards as positive (note: v_f and v_i can be switched except for OPTION 5)/Af*waarts as positief (nota: v_f en v_i kan omgeruil word behalwe vir OPSIE 5)*

OPTION/*OPSIE 5*	**OPTION/*OPSIE 6***	**OPTION/*OPSIE 7***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= 0 + \frac{1}{2}(9,8)(1,5)^2$ ✓ $= 11,025$ m $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (9,8)(1,5)$ $v_i = -14,7$ m·s^{-2} $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = -14,7^2 + (9,8)\Delta y$ ✓ $\Delta y = -11,025$ $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (9,8)(1,5)$ $v_i = -14,7$ m·s^{-2} $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= -14,7(1,5) + \frac{1}{2}(9,8)(1,5)^2$ ✓ $\Delta y = 11,025$ m $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓
OPTION/*OPSIE 8*		
$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7$ m·s^{-2} $\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓ $\Delta y = \frac{0 + 14,7}{2} 1,5$ ✓ $\Delta y = 11,025$ $h = 11,025 + 100$ ✓ $h = 111,03$ m ✓		

(4)

3.2.2 **Upwards as positive/*Opwaarts as positief***

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 14,7^2 + 2(-9,8)(-100)$ ✓ $v_f = 46,65\ m\cdot s^{-1}$ ✓downwards✓/ *afwaarts*	**POSITIVE MARKING FROM 3.2.1/ *POSITIEWE NASIEN VANAF 3.2.1*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0^2 + 2(-9,8)(-111,03)$ ✓ $v_f = 46,65\ m\cdot s^{-1}$ ✓ downwards✓/ *afwaarts*

Downwards as positive/Af*waarts as positief*

OPTION/*OPSIE 3*	**OPTION/*OPSIE 4***
$v_f = v_i + a\Delta t$ $0 = v_i + (9,8)(1,5)$ $v_i = -14,7\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= -14,7^2 + 2(9,8)(100)$ ✓ $v_f = 46,65\ m\cdot s^{-1}$ ✓ downwards✓/ *afwaarts*	**POSITIVE MARKING FROM 3.2.1** ***POSITIEWE NASIEN VANAF 3.2.1*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0^2 + 2(9,8)(111,03)$ ✓ $v_f = 46,65\ m\cdot s^{-1}$ ✓ downwards✓/ *afwaarts*

(4)

3.2.3 **Positive marking from/*Positiewe nasien vanaf* 3.2.1 and/*en* 3.2.2**
Upwards as positive/*Opwaarts as positief*

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7\ m\cdot s^{-1}$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓ $-100 = 14,7\Delta t + ½\ (-9,8)(\Delta t)^2$ ✓ $\Delta t = 6,26\ s$ ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (-9,8)(1,5)$ $v_i = 14,7\ m\cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $46,65 = 14,7 + (-9,8)\Delta t$ ✓ $\Delta t = 6,26\ s$ ✓
OPTION/*OPSIE 3*	
$v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = 14,7^2 + 2(-9,8)(-100)$ $v_f = 46,65\ m\cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $-46,65 = 14,7 + (-9,8)\Delta t$ ✓ $\Delta t = 6,26\ s$ ✓	

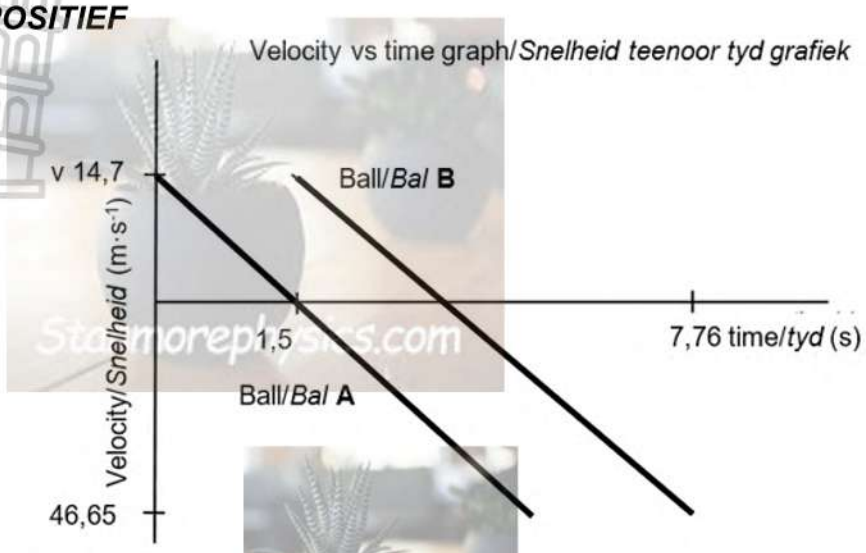
Downwards as positive/Afwaarts as positief

OPTION/*OPSIE 4*	**OPTION/*OPSIE 5***
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓ $100 = -14,7\Delta t + ½\ (9,8)(\Delta t)^2$ ✓ $\Delta t = 6,26\ s$ ✓	$v_f = v_i + a\Delta t$ $0 = v_i + (9,8)(1,5)$ $v_i = 14,7\ m\cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $46,65 = -14,7 + 9,8\Delta t$ ✓ $\Delta t = 6,26\ s$ ✓
OPTION/*OPSIE 6*	
$v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = -14,7^2 + 2(9,8)(100)$ $v_f = 46,65\ m\cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $46,65 = -14,7 + (9,8)\Delta t$ ✓ $\Delta t = 6,26\ s$ ✓	

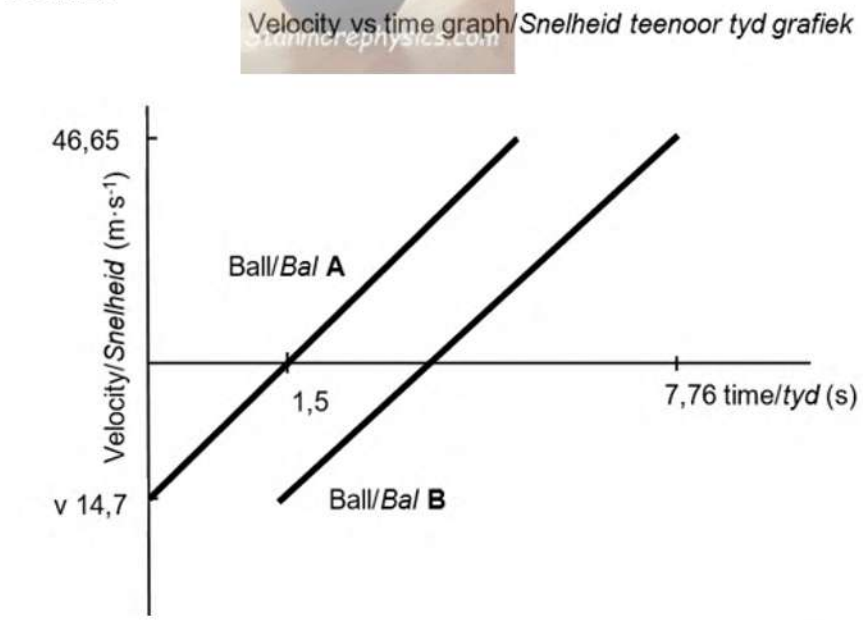
(3)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.1 AND QUESTION 3.2.3/** ***POSITIEWE NASIEN VANAF VRAE 3.2.1 EN 3.2.3***

OPTION 1: UPWARDS AS POSITIVE/*OPSIE 1: OPWAARTS AS POSITIEF*



OPTION 2: DOWNWARDS AS POSITIVE/*OPSIE 2: AFWAARTS AS POSITIEF*



Criteria/*Kriteria*:

- Same initial velocity for both ball A and B.✓/*Dieselfde aanvanklike snelheid vir beide bal A en bal B.*
- Graph of ball B starts at 1,5 s.✓/*Grafiek van bal B begin by 1,5 s.*
- Both graphs end with the same final velocity.✓/*Beide grafieke eindig met dieselfde eindsnelheid.*
- Graph of ball B stops at 7,76 s.✓/*Grafiek van bal B eindig by 7,76 s.*
- Correct shape and equal sizes for both graphs.✓/*Korrekte vorm en gelyke groottes vir beide grafieke.*

(5)
[18]

QUESTION/*VRAAG 4*

4.1

$mv_A + mv_B = mv_A + mv_B$ ✓
$(m \times 12) + (3m \times 0)$ ✓ $= mv_A + (3m \times 4{,}68)$ ✓
$v = -0{,}86\ m\cdot s^{-1}$
$v = 0{,}86\ m\cdot s^{-1}$ left✓/*links* (4)

4.2

$E_k = ½\ mv^2$ ✓
Before collision/*Voor botsing*
$E_k = ½(m)(12)^2 + ½(3m)(0)^2$ ✓
$E_k = 72m$ J

After collision/*Na botsing*
$E_k = ½(m)(0{,}86)^2 + ½(3m)(4{,}68)^2$ ✓
$E_k = 14{,}83m$ J
$E_{k\ before}$ is not equal to $E_{k\ after}$✓/$E_{k\ voor}$ *is nie gelyk aan* $E_{k\ na}$
Thus, an inelastic collision./*Dus 'n onelastiese botsing.* (4)

4.3

Marking criteria/*Nasienkriteria*:
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/ *Indien enige van die onderstreepte sleutelwoorde/frases in die* ***korrekte konteks*** *uitgelaat is, trek 1 punt af.*

The product of the resultant/net force acting on an object ✓and the time the net force acts on the object.✓/*Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk.* (2)

4.4

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
$F_{net}\Delta t = m(v_f - v_i)$ } Any one✓/Enige een $F_{net}\Delta t = \Delta p$	$F_{net}\Delta t = m(v_f - v_i)$ $F_{net}\Delta t = \Delta p$
$F_{net} \times 0{,}03 = 0{,}05\ (-0{,}86 - 12)$ ✓	$F_{net} \times 0{,}03 = 0{,}15(4{,}68 - 0)$ ✓
$F_{net} = 21{,}43$ N ✓	$F_{net} = 23{,}4$ N ✓

(3)
[13]

QUESTION/*VRAAG 5*

5.1 (Kinetic) frictional force.✓/*(Kinetiese) wrywingskrag* (1)

5.2.1
$mgh_f + \frac{1}{2}mv_f^2 = mgh_i + \frac{1}{2}mv_i^2$ ✓
$0 + \frac{1}{2}4(v_f^2) = (4 \times 9,8 \times 15) + \frac{1}{2}4(3^2)$ ✓
$v_f = 17,41\ m\cdot s^{-1}$ ✓ (3)

5.2.2
$F_{net}\Delta x = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓
$f_k \times 18\cos 180° = 0 - \frac{1}{2}4(17,41^2)$ ✓
$f_k = 33,68\ N$ ✓ (4)

5.3 **POSITIVE MARKING FROM 5.2.1/*POSITIEWE NASIEN VANAF 5.2.1***
$f_k = \mu_k mg$ ✓
$33,68 = \mu_k \times 4 \times 9,8$ ✓
$\mu_k = 0,86$ ✓ (3)
[11]

QUESTION/*VRAAG 6*

6.1 **Marking criteria/*Nasienkriteria*:**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/ *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The change in frequency (or pitch) of the sound detected by the listener✓, because the sound source and the listener have different velocities relative to the medium of sound propagation.✓/*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.*

OR/OF

An (apparent) change in (observed/detected) frequency (pitch),✓ as a result of the relative motion between a source and an observer ✓ (listener).
'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer (luisteraar). (2)

6.2.1
$v = \lambda f$ ✓
$343 = 350 \times 10^{-3} f$ ✓
$f = 980\ Hz$ ✓ (3)

6.2.2 **POSITVE MARKING FROM 6.2.1/*POSITIEWE NASIEN VANAF 6.2.1***

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

$$980 ✓ = \frac{343}{343-30} f_s ✓$$

$$f_s = 894{,}29 \text{ Hz}$$

$$v = \lambda f$$

$$343 = \lambda \times 894{,}29 ✓$$

$$\lambda = 0{,}39 \text{ m} ✓$$

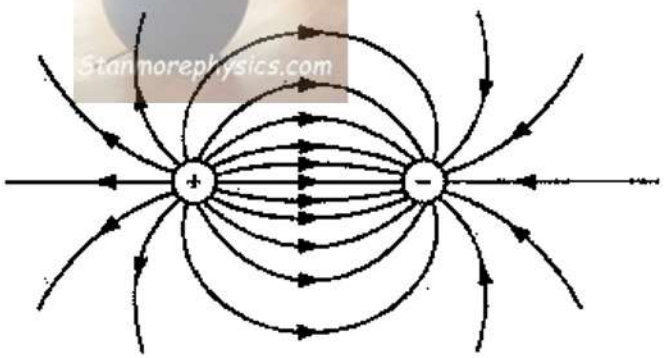
(5)

6.3.1 TOWARDS✓/*NA* (1)

6.3.2 The curve shows a blue shift✓/*Die kurwe toon 'n blou verskuiwing* , the star moves towards the side of a higher frequency/lower wavelength.✓/*die ster beweeg na die kant met 'n hoër frekwensie/korter golflengte*. (2)
[13]

QUESTION/*VRAAG 7*

7.1



Criteria for sketch/*Kriteria vir skets*	Marks/ *Punte*
Correct direction of field lines./*Korrekte rigting van veldlyne.*	✓
Correct shape of te electric field lines between the charges and on the outside of the charges./*Korrekte vorm van elektriese veldlyne tussen ladings en aan die buitekant van die ladings.*	✓
No field lines crossing each other. Field lines must touch the charge, but not go inside the charge./*Geen veldlyne wat mekaar kruis nie. Veldlyne moet die lading raak, maar nie die lading binnegaan nie.*	✓
Note: If learner draws field pattern of two like charges: 0/3 If only one charge is drawn: 0/3 *Nota: Indien leerder elektriese veld van twee gelyke ladings teken:* 0/3 *Indien slegs een lading geteken is:* 0/3	

(3)

7.2

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
If mass is used/*Indien massa gebruik is:* 0/2
If force is ommited/*Indien krag weggelaat is:* 0/2

The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitudes of the charges✓ and inversely proportional to the square of the distance between them✓
Die grootte van die elektrostatiese krag wat een puntlading op 'n ander puntlading uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

7.3

$F = \frac{KQq}{r^2}$ ✓

$F = \frac{9 \times 10^{9} \times 1,6 \times 10^{-19} \times 1,6 \times 10^{-19}}{(3 \times 10^{-12})^{2}}$ ✓

$F = 2,56 \times 10^{-5}$ N ✓ (3)

7.4.1

$r^2 = x^2 + y^2$ ✓ (or any suitable equation/*of enige geskikte formule*)
$r^2 = (2,56 \times 10^{-5})^2 + (2,56 \times 10^{-5})^2$ ✓
$F_{net} = 3,62 \times 10^{-5}$ N ✓

45° north west/west of north/north of west✓/*noordwes/wes van noord/noord van wes* **OR/OF** 315° (4)

7.4.2

OPTION/*OPSIE 1* **POSITIVE MARKING FROM 7.4.1/ *POSITIEWE NASIEN VANAF 7.4.1***	**ACCEPT/*AANVAAR:***
$E = \frac{F}{q_e}$ ✓	$E = \frac{KQ}{r^2}$ ✓
$= \frac{3,62 \times 10^{-5}}{1,6 \times 10^{-19}}$ ✓	$E = \frac{9 \times 10^{9} \times 1,6 \times 10^{-19}}{(3 \times 10^{-12})^{2}}$
$= 2,26 \times 10^{14}$ N·C^{-1} ✓	$E = 1,6 \times 10^{14}$ N·C^{-1}
	$E_{net}^2 = (1,6 \times 10^{14})^2 + (1,6 \times 10^{14})^2$ ✓
	$E_{net} = 2,26 \times 10^{14}$ N·C^{-1} ✓

(3)
[15]

QUESTION/*VRAAG 8*

8.1 To measure the total current of the circuit.✓/ *Om die totale stroomsterkte in die stroombaan te meet.*
(If only current: 0/1/*Indien slegs stroomsterkte: 0/1*) (1)

8.2.1 5 ✓ $\times \frac{2}{3}$ ✓ $= 3{,}33$ A ✓ (3)

8.2.2
Emf/*Emk* = I(R + r) ✓
26 = 5(R + 0,6) ✓
$R_E = 4{,}6\ \Omega$

$$\frac{1}{R_E} = \frac{1}{2R} + \frac{1}{R}$$

$$\frac{1}{4{,}6} \checkmark = \frac{1}{2R} + \frac{1}{R} \checkmark$$

$R = 6{,}9\ \Omega$ ✓ (5)

8.2.3

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
POSITIVE MARKING FROM 8.2.2/*POSITIEWE NASIEN VANAF 8.2.2*	V = Ir = 5 x 0,6 = 3 V
V = IR ✓ = 5 x 4,6✓ = 23 V ✓	Emf = V_{ext} + V_{Int}/*Emk* = $V_{ekstern}$ + V_{intern} ✓ 26 = V + 3 ✓ V = 23 V ✓

(3)

8.2.4 **POSITIVE MARKING FROM 8.2.1; 8.2.2 AND 8.2.3/**
POSITIEWE NASIEN VANAF 8.2.1; 8.2.2 EN 8.2.3

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***	**OPTION/*OPSIE 3***
W = $I^2R\Delta t$ ✓ = $3{,}33^2$ x 6,9 x 120 ✓ = 9181,61 J ✓	W = $V^2/R\Delta t$ ✓ = 23^2/6,9 x 120 ✓ = 9200 J ✓	W = $VI\Delta t$ ✓ = 23 x 3,33 x 120 ✓ = 9190,8 J ✓

(3)

8.3.1 DECREASE✓/AF*NEEM* (1)

8.3.2 Total external resistance increase, current decreases. ✓
V_{int} decreases as current decreases/V_{int} is directly proportional to current ✓
Emf remains constant ✓, thus V_{lost} decreases.
Totale eksterne weerstand vermeerder, stroom verminder.
V_{int} verminder soos stroom verminder/V_{int} is direk eweredig aan die stroom
Emk bly konstant, dus neem $V_{verlore}$ af. (3)
[19]

QUESTION/*VRAAG 9*

9.1 Mechanical to electrical energy✓✓/*Meganiese na elektriese energie.* (2)

9.2 B to A✓✓/B *na A* (2)

9.3
- Use stronger magnets./*Gebruik sterkter magnete.* ✓
- Increase frequency of the rotation✓/*Verhoog die frekwensie van die rotasie*
- Increase the number of coils/surface area/*Meer windings/vergroot oppervlak*

(any two/*enige twee*) (2)

9.4 **Marking criteria/*Nasienkriteria*:**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/ *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The AC current which dissipates/produces the same amount of energy/heat✓ as an equivalent direct current (DC).✓*Die wgk-stroom is die wisselstroom wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente gelykstroom (GS).* (2)

9.5.1
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$
$= \frac{23}{\sqrt{2}}$ ✓
= 16,26 A ✓ (3)

9.5.2

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
V = IR ✓ = 23 x 13 ✓ = 299 V ✓	**POSITIVE MARKING FROM 9.5.1/ *POSITIEWE NASIEN VANAF 9.5.1*** V = IR = 16,26 x 13 $V_{rms/wgk}$ = 211,38 V ✓ $V_{rms} = \frac{V_{max}}{\sqrt{2}} / V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$ $211,38 = \frac{V_{max/maks}}{\sqrt{2}}$ ✓ $V_{max/maks}$ = 298,94 V ✓

(3)
[14]

QUESTION 10/*VRAAG 10*

10.1 Photon✓/*Foton* (1)

10.2 **Marking criteria/*Nasienkriteria*:**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/ *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The minimum frequency required✓ to eject an electron from a metal surface.✓/*Die minimum frekwensie benodig om 'n elektron uit 'n metaaloppervlak vry te stel.* (2)

10.3

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
NO✓/*NEE*	NO✓/*NEE*
$W_0 = hf_0$ ✓	$E = hf$ ✓
$= 6,63 \times 10^{-34} \times 8,1 \times 10^{14}$ ✓	$4,8 \times 10^{-19} = 6,63 \times 10^{-34} f$ ✓
$= 5,37 \times 10^{-19}$ J ✓	$f = 7,24 \times 10^{14}$ Hz ✓
$W_0 > E$	$f_0 > f$

(4)

10.4 **POSITIVE MARKING FROM 10.3/*POSITIEWE NASIEN VANAF 10.3***

$E = W_0 + \frac{1}{2} mv_{max/maks}^2$ ✓
$7,68 \times 10^{-19} = 5,37 \times 10^{-19}$ ✓ $+ \frac{1}{2} 9,11 \times 10^{-31} v_{max/maks}^2$ ✓
$v_{max/maks} = 712\,134,13 \text{ m·s}^{-1}$ ✓ (4)

10.5 REMAIN THE SAME✓/*BLY DIESELFDE* (1)

10.6
- Intensity does not affect the maximum speed.✓
- Only a change in frequency affects the maximum speed.
- *Intensiteit het geen effek op die maksimum spoed nie.*
- *Slegs 'n verandering in die frekwensie sal die maksimum spoed beïnvloed.*

(any one/*enige een*) (1)
[13]

TOTAL/*TOTAAL*: 150