



GAUTENG PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

**JUNE EXAMINATION
GRADE 12**

2026

**PHYSICAL SCIENCES (PHYSICS)
(PAPER 1)**

PHYSICAL SCIENCES P1



C2841E

TIME: **3 hours**

MARKS: 150

18 pages + 3 data sheets

X05



INSTRUCTIONS AND INFORMATION

1. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line open between two subsections, e.g. between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
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. 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 Two objects of equal mass move towards each other at the same speed. Object **A** moves to the right and collides with object **B** which is moving to the left. Both objects stop immediately after the collision. Ignore the effects of friction.

Which of the following statements is INCORRECT during the collision?

- A The force exerted by object **A** is equal to the force exerted by object **B**.
- B The total linear momentum is conserved.
- C The collision is inelastic.
- D The magnitude of the impulse of object **A** is equal to the magnitude of the impulse of object **B**.

(2)

- 1.2 Two objects, object **X** and object **Y**, of equal mass move towards each other due to their gravitational force of attraction.

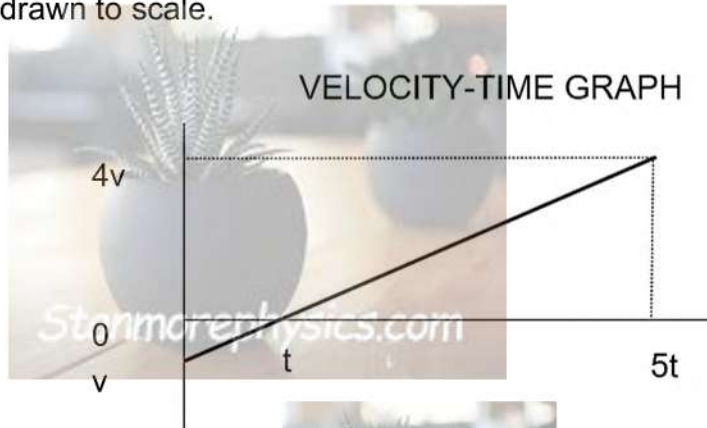


Which of the combinations below is CORRECT for the acceleration of the objects towards each other and the gravitational force between them?

	ACCELERATION	GRAVITATIONAL FORCE
A	Decreases	Remains the same
B	Increases	Remains the same
C	Remains the same	Increases
D	Increases	Increases

(2)

- 1.3 The velocity-time graph below represents the movement of an object starting with an initial velocity v and moving under the influence of gravitational force only. The graph is not drawn to scale.



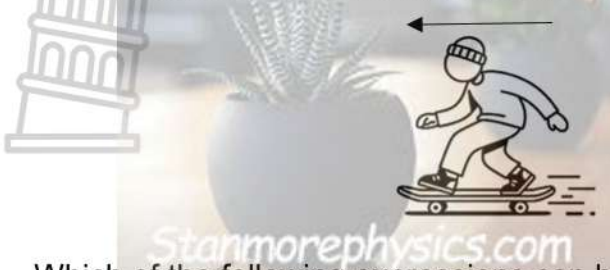
The distance that the object travels in the time $5t$ is:

- A $v t$
- B $\frac{15}{2} v t$
- C $\frac{17}{2} v t$
- D $\frac{21}{2} v t$



(2)

- 1.4 A person of mass M is moving to the left on a skateboard of mass m . The initial velocity of the person and the skateboard is v . The person then jumps off the skateboard and is stationary while the skateboard continues to move to the left.



Which of the following expressions can be used to CORRECTLY calculate the speed of the skateboard after the person jumps off?

A $(M+m)v - m$

B $\frac{Mv + mv}{m}$

C $\frac{mv}{M + m}$

D $\frac{(M - m)v}{m}$



(2)

- 1.5 An apple falls from a tree. Which of the following statements about the falling apple is TRUE? Ignore all effects of air friction.

A Total momentum is conserved.

B Total kinetic energy is conserved.

C The total mechanical energy is conserved.

D The gravitational potential energy is conserved.

(2)

- 1.6 An ambulance moves towards a stationary listener at a constant speed while emitting soundwaves with a wavelength of 0,72 m.

The wavelength of a soundwave observed by the listener becomes ...

A larger than 0,72 m.

B smaller than 0,72 m.

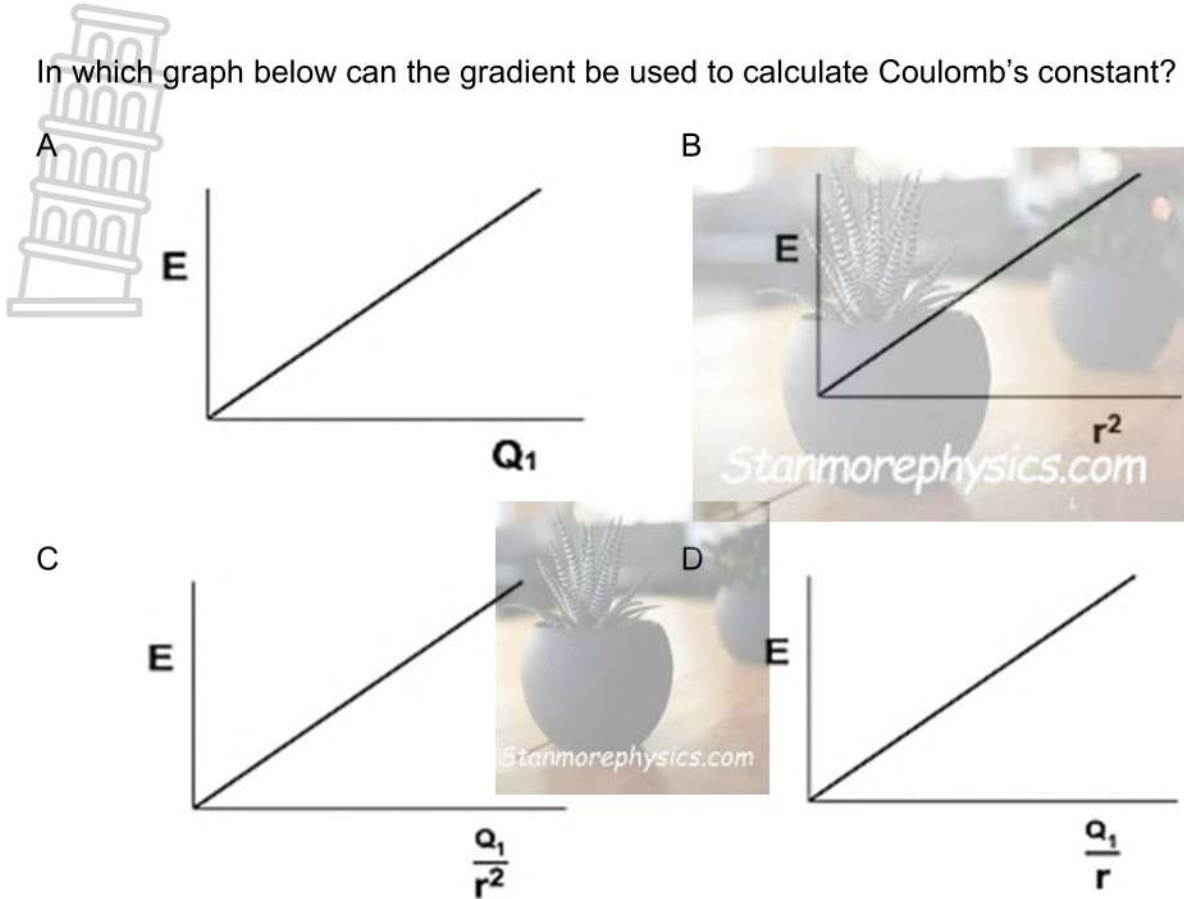
C equal to 0,72 m.

D larger and then zero.

(2)

Stanmorephysics.com

1.7 In which graph below can the gradient be used to calculate Coulomb's constant?



(2)

1.8 Two charges of +2 nC and -2 nC are placed on a straight line. **S** and **T** are two points that are on the same straight line as shown in the diagram below.

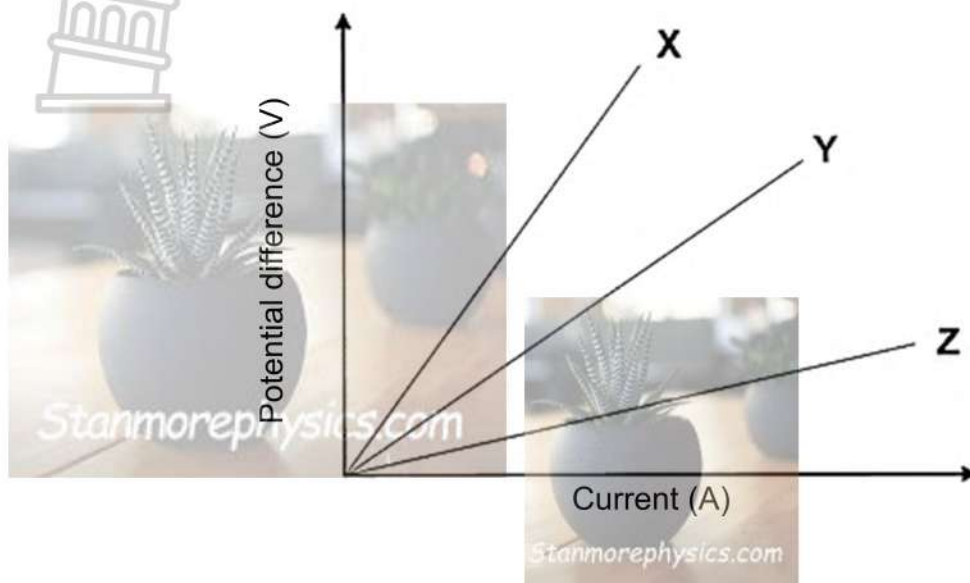


Which of the following represents the directions of the resultant electric field at **S** and **T** CORRECTLY?

	Direction of the resultant electric field at point S	Direction of the resultant electric field at point T
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

- 1.9 A learner conducts an experiment by measuring the potential difference and current that flows through three different copper wires, representing the results on graphs **X**, **Y** and **Z** as shown below.



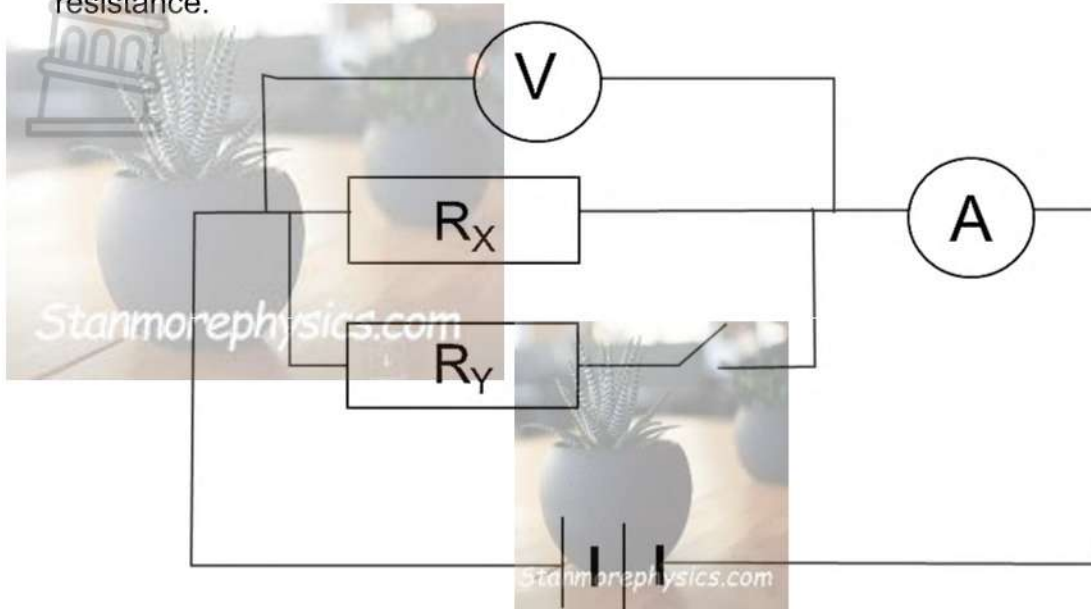
Which of the following is TRUE?

Resistance of:

- A $X > Y > Z$
- B $X = Y = Z$
- C $Y > X > Z$
- D $Z > Y > X$

(2)

- 1.10 In the circuit diagram below, R_x and R_y are identical ohmic resistors that are connected in parallel. When the switch is open, the ammeter reading is 0,1 A and the voltmeter reading is 3 V. The battery has an unknown emf and internal resistance.



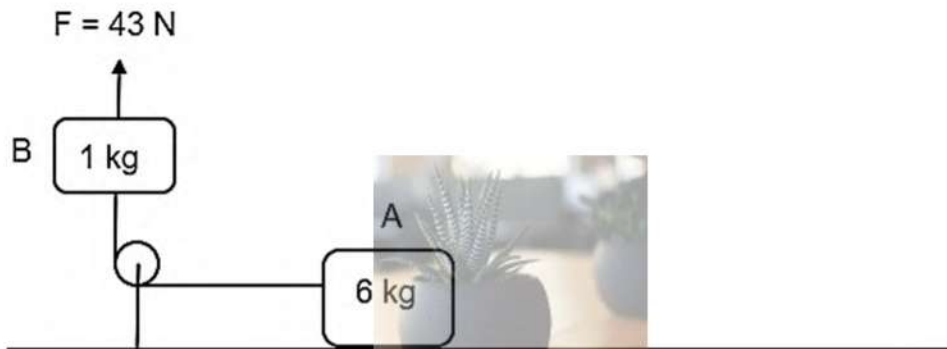
What is the reading on the AMMETER and the VOLTMETER when the switch is closed?

	READING ON AMMETER	READING ON VOLTMETER
A	Equal to 0,1 A	Equal to 3 V
B	Larger than 0,1 A	Equal to 3 V
C	Smaller than 0,1 A	Larger than 3 V
D	Larger than 0,1 A	Smaller than 3 V

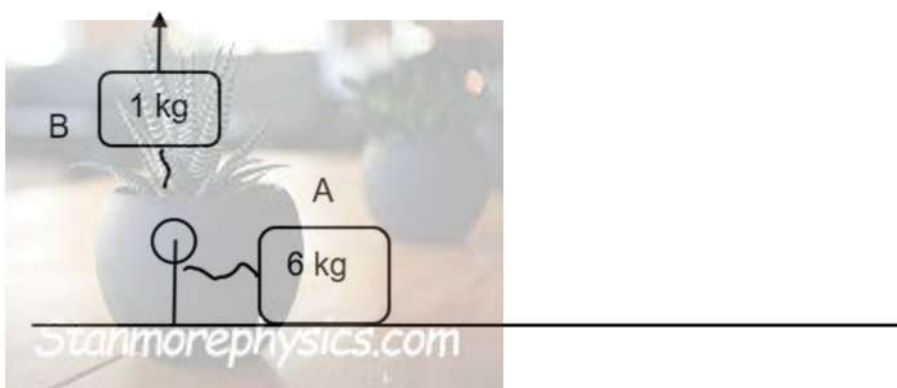
(2)
[20]

QUESTION 2 (Start on a new page.)

Block **A** of mass 6 kg is connected to block **B** with a mass of 1 kg by means of a light, inextensible rope over a frictionless pulley. Initially, both blocks are stationary. Block **B** is pulled vertically up with a force of 43 N. Block **A** accelerates to the left with a constant acceleration of $2 \text{ m}\cdot\text{s}^{-2}$ over a rough horizontal surface, as shown in the diagram below. Ignore the effects of air resistance.



- 2.1 State *Newton's Second Law of Motion* in words. (2)
- 2.2 Draw a labelled free-body diagram, showing ALL the forces acting on block **B**. (3)
- 2.3 Calculate the magnitude of the:
- 2.3.1 Tension in the rope (4)
- 2.3.2 Coefficient of kinetic friction between block **A** and the surface (4)
- 2.4 The rope connecting the two blocks breaks and the 6 kg block slows down and stops after a certain time.



- 2.4.1 In which direction will the acceleration of the 6 kg block be? Choose between TO THE LEFT or TO THE RIGHT. (1)
- 2.4.2 Explain the answer to QUESTION 2.4.1 (2)

[16]

QUESTION 3 (Start on a new page.)

The planet Omega has a mass $6,4 \times 10^{23}$ kg. The diameter of planet Omega is equal to the radius of the Earth.

3.1 Describe the term *weight of an object*. (2)

3.2 A 90 kg object is dropped from a height of 2 m above the surface of Omega.

3.2.1 Calculate the magnitude of the gravitational acceleration on the surface of Omega. (4)

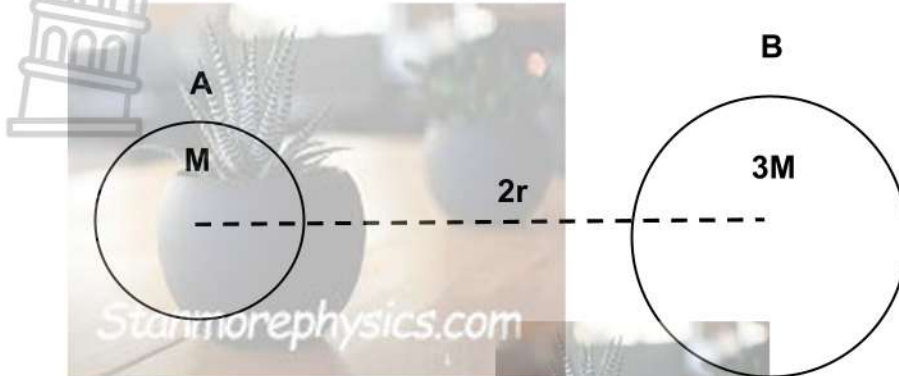
3.2.2 How long will it take the object to reach the surface of Omega compared to the time it would take on Earth? Write only SAME TIME, LESS TIME or MORE TIME. Give a reason for the answer. (2)

3.3 The 90 kg object was projected upwards so that the distance between the surface of Omega and the centre of the object is 2 360 000 m as shown in the diagram below.



Calculate the gravitational force between Omega and the object at this distance. (5)

- 3.4 Two isolated bodies, **A** and **B**, with masses **M** and **3M** respectively, are placed a distance **2r** from each other's centres. The gravitational force between them is **F**. The diagram is not drawn to scale.

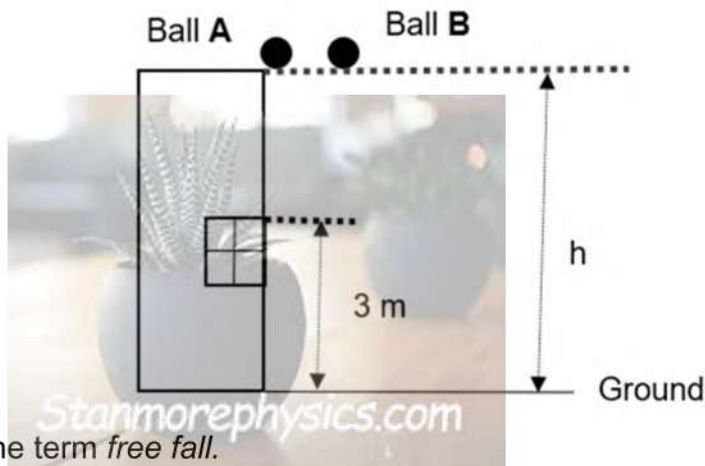


Determine the gravitational force between **A** and **B** in terms of **F** if the distance is increased to **6r**.

(2)
[15]

QUESTION 4 (Start on a new page.)

Ball **A** is dropped vertically downwards from the top of a high building with an unknown height **h**. ONE second later, another ball, **B**, is thrown vertically downwards from the same height with a speed of $20 \text{ m}\cdot\text{s}^{-1}$. Ball **B** passes ball **A** when the balls reach the top of the window. The top of the window is 3 m above the ground as shown in the diagram below. The diagram is not drawn to scale. Ignore the effects of friction.



- 4.1 Define the term *free fall*. (2)
- 4.2 Use only equations of motion and calculate:
- 4.2.1 The velocity of ball **A** after falling for 2 seconds (3)
- 4.2.2 How long after ball **A** was dropped will ball **B** pass it (5)
- 4.2.3 The height of the building (4)

- 4.3 On the same set of axes, sketch the velocity-time graphs of the motion of ball **A** and ball **B** until they reach the ground. Label the graphs **A** and **B** respectively.

Clearly indicate the following on your graph:

- The initial velocities of both balls
- The times at which the balls reach the ground as t_1 for ball **A** and t_2 for ball **B** (4)

- 4.4 Ball **A** bounces and reaches a certain height above the window. The collision of the ball and the ground is elastic.

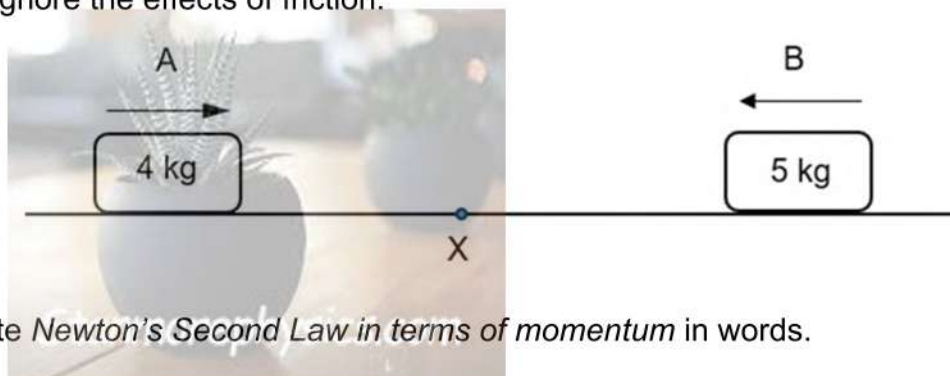
Sketch the position-time graph for ball **A** from the moment it was dropped until it reaches the top of the window AFTER the ball bounced from the ground. Take the ground as zero reference.

Clearly indicate the initial and final height of the ball on your graph:

(3)
[21]

QUESTION 5 (Start on a new page.)

A 4 kg metal object slides to the right at a constant speed of $7 \text{ m}\cdot\text{s}^{-1}$ and it collides with a 5 kg metal object moving towards it at the same speed. They collide at point **X**. The collision lasts 0,03 seconds after which they stick together and move in the same direction. Ignore the effects of friction.



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

- 5.2 Calculate the:

5.2.1 Velocity of the combined system after the collision (4)

5.2.2 Average net force that the 4 kg object exerts on the 5 kg object (4)

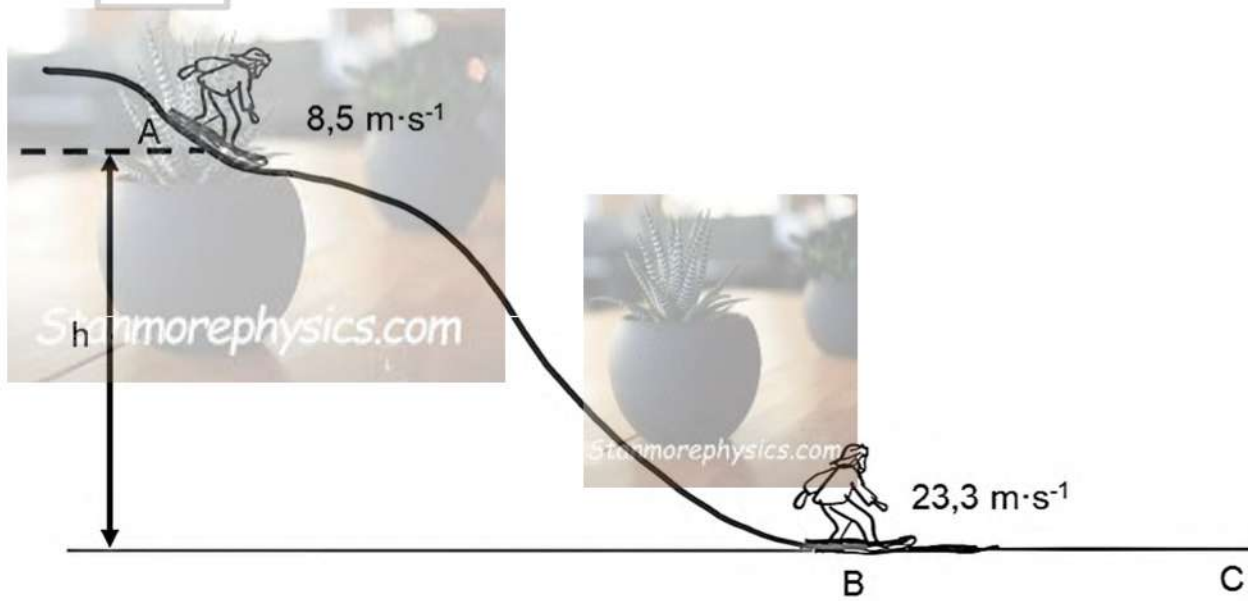
- 5.3 What would happen to the magnitude of the impulse if softer objects were used and the net force remains the same? Write only **INCREASES**, **DECREASES** or **REMAINS THE SAME**.

Explain the answer.

(3)
[13]

QUESTION 6 (Start on a new page.)

A person on a sandboard, with a combined mass of 62 kg, goes sandboarding down a sand dune in Boksburg, Mount Mayhem, South Africa. The person's velocity increases from $8,5 \text{ m}\cdot\text{s}^{-1}$ to $23,3 \text{ m}\cdot\text{s}^{-1}$ from point **A** to point **B**. The work done by friction from point **A** to point **B** is 8 700 J.



- 6.1 Define the term *non-conservative force*. (2)
- 6.2 Calculate the height at which the person starts, at point **A**, using ENERGY PRINCIPLES ONLY. (4)
- 6.3 Define the term *power*. (2)
- 6.4 Draw a free-body diagram of all the horizontal forces acting on the person while moving from point **B** to point **C**. (2)
- 6.5 The average power dissipated by the person until he stops, is 4 593,83 W. Calculate the average force experienced by the person during this motion. (3)
- [13]

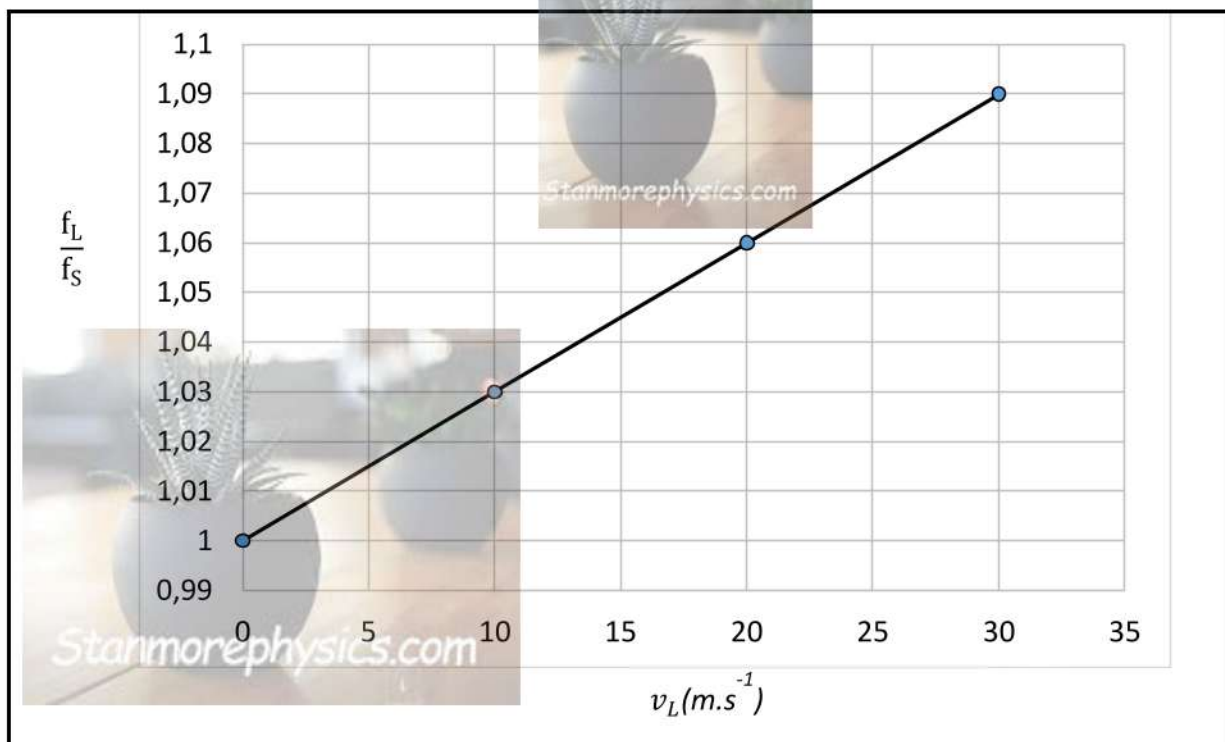
QUESTION 7 (Start on a new page.)

A group of grade 12 learners investigates the relationship between the RATIO of the observed frequency to the frequency of the source ($\frac{f_L}{f_S}$), and the velocity at which the listener moves relative to a stationary source.

The experiment is repeated by increasing the constant velocity at which the listener moves towards the same sound source.

The observed frequency (f_L) is recorded and the RATIO ($\frac{f_L}{f_S}$) for each experiment is calculated.

The graph below shows the results that were acquired.



7.1 State the *Doppler effect* in words. (2)

Use the graph to answer the following questions.

7.2 Is the listener moving AWAY or TOWARDS the stationary source?
Give a reason for the answer. (2)

7.3 What physical quantity is represented by the gradient of this graph? (2)

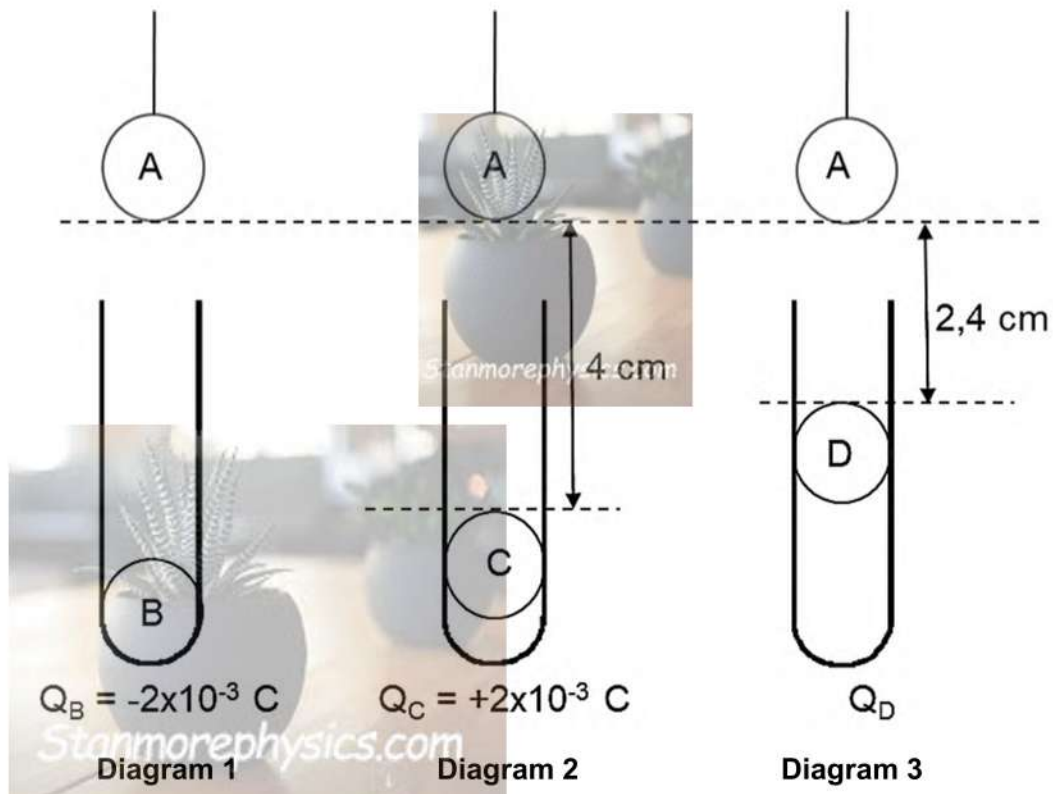
7.4 Calculate the speed of sound in air. (4)

[10]

QUESTION 8 (Start on a new page.)

Four pith balls are charged. Ball **A** and ball **D** have unknown charges. Ball **B** has a charge of $-2 \times 10^{-3} \text{ C}$ and ball **C** has a charge of $+2 \times 10^{-3} \text{ C}$. The effect of ball **A** when held above each of the isolated test tubes with each of the other charged pith balls, is shown in the diagram below.

- Ball **B** remains at the bottom of the test tube.
- Ball **C** moves up until it is 4 cm from ball **A**.
- Ball **D** moves up so that it is 2,4 cm from ball **A**.

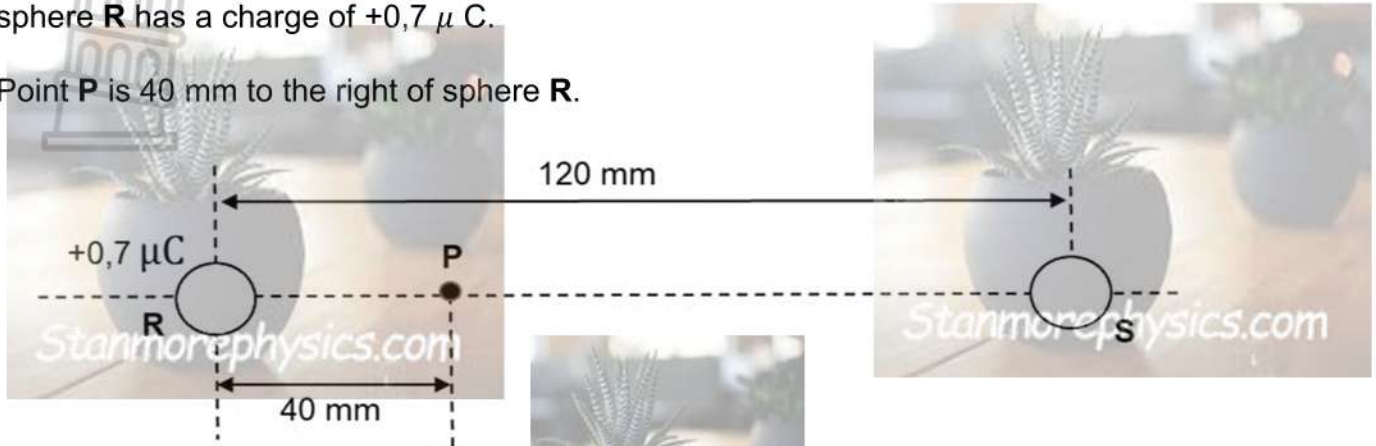


- 8.1 State *Coulomb's Law* in words. (2)
- 8.2 Identify the charge on ball **A** as POSITIVE or NEGATIVE. Explain the answer. (3)
- 8.3 Draw a free-body diagram of ALL the forces that are exerted on ball **A** in diagram 2. (3)
- 8.4 The net electrostatic force between ball **A** and ball **C** is F_{AC} . Calculate the charge on ball **D** if the force between **A** and **D** is the same as the force between **A** and **C**. (4)
- [12]

QUESTION 9 (Start on a new page.)

Two small, charged spheres, **R** and **S**, are placed 120 mm apart in a vacuum, as shown in the diagram below. Sphere **S** has $7,5 \times 10^{12}$ electrons in excess and sphere **R** has a charge of $+0,7 \mu\text{C}$.

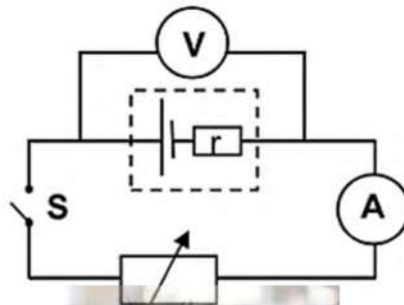
Point **P** is 40 mm to the right of sphere **R**.



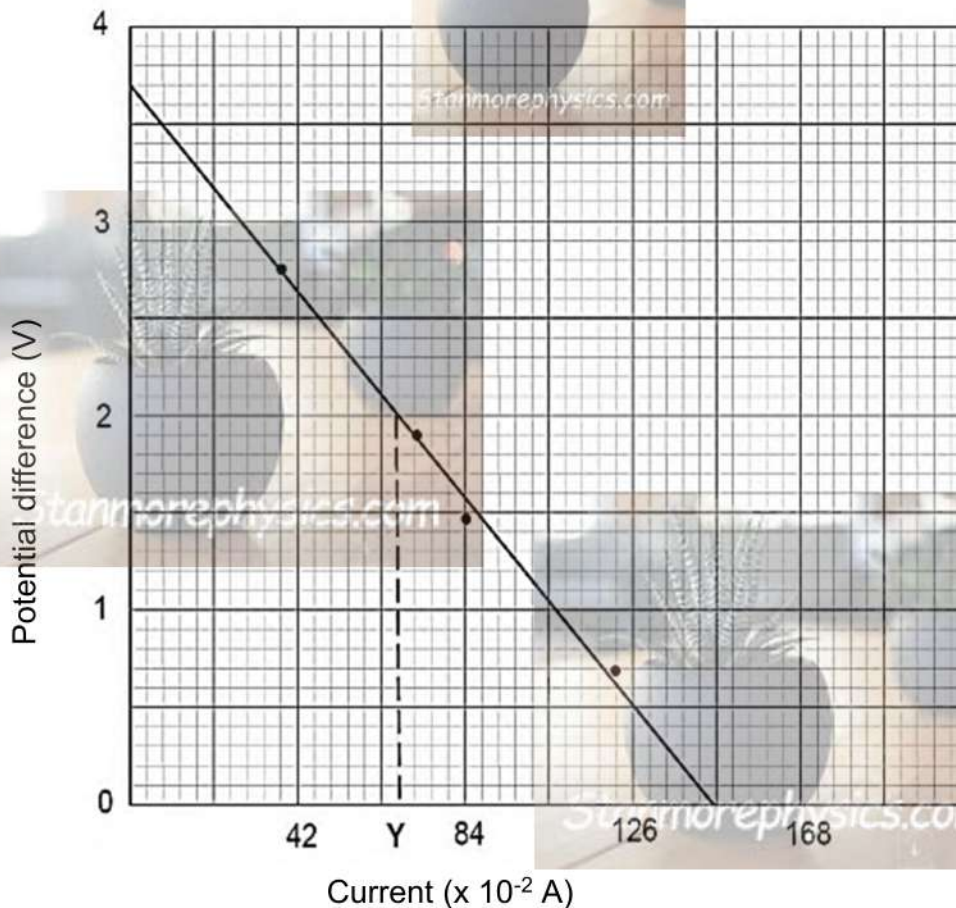
- 9.1 Define the term *electric field at a point*. (2)
- 9.2 Draw a diagram to show the net electric field pattern around the two spheres if they had the same magnitudes of charges. (3)
- 9.3 Calculate the:
- 9.3.1 Charge on sphere **S** (3)
- 9.3.2 Net electric field at point **P** (4)
- [12]

QUESTION 10 (Start on a new page.)

- 10.1 A group of learners conduct an experiment to determine the emf and internal resistance of a battery by using the circuit below.

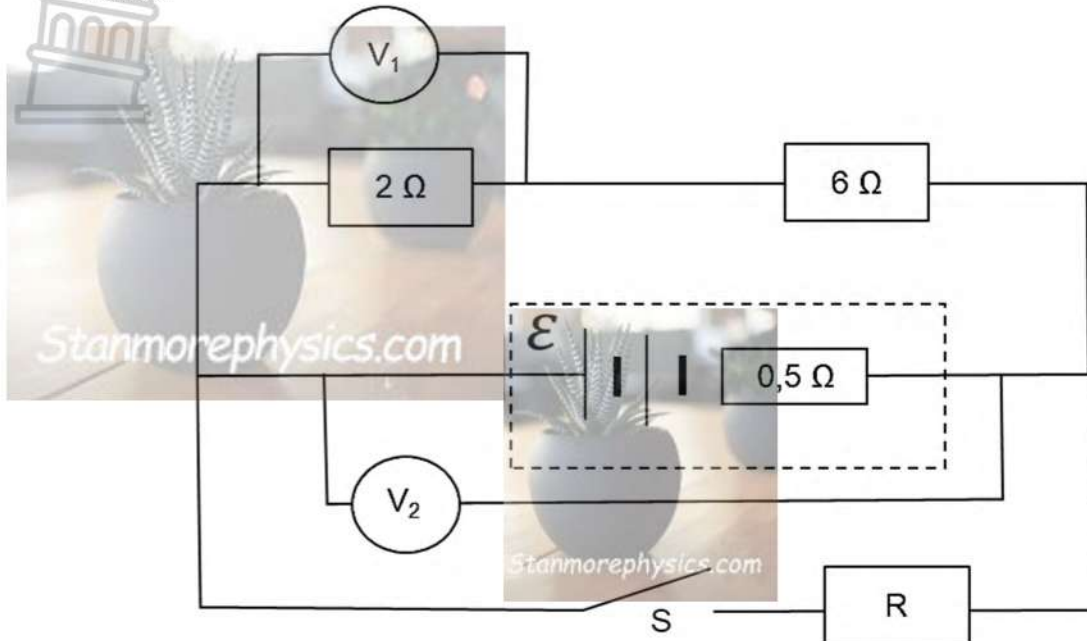


The learners draw the following potential difference versus current graph from the results acquired.



- 10.1.1 Give the value of the emf of the battery. (1)
- 10.1.2 Calculate the internal resistance of the battery. (3)
- 10.1.3 Determine the external resistance of the circuit when the ammeter reading is Y . (3)

- 10.2 In the circuit below there is a battery with UNKNOWN emf and an internal resistance of $0,5 \Omega$ connected to two resistors of 2Ω and 6Ω each as well as a resistor **R** with unknown resistance. Ignore the resistance of the connecting wires.



- 10.2.1 State *Ohm's Law* in words. (2)
- 10.2.2 Switch **S** is open. The reading on the voltmeter V_1 is 3 V. Calculate the emf of the battery. (4)
- 10.2.3 Switch **S** is closed. The reading on voltmeter V_2 is 10,25 V. Calculate the resistance of the resistor **R**. (5)

[18]**TOTAL: 150**



DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s ⁻²
Universal gravitational constant <i>Universele gravitasiekonstante</i>	G	6,67 x 10 ⁻¹¹ N·m ² ·kg ⁻²
Radius of the Earth <i>Radius van die Aarde</i>	R _E	6,38 x 10 ⁶ m
Mass of the Earth <i>Massa van die Aarde</i>	M _E	5,98 x 10 ²⁴ kg
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3 x 10 ⁸ m·s ⁻¹
Planck's constant <i>Planck se konstante</i>	h	6,63 x 10 ⁻³⁴ J·s
Coulomb's constant <i>Coulomb se konstante</i>	k	9 x 10 ⁹ N·m ² ·C ⁻²
Charge on electron <i>Lading op elektron</i>	e	1,6 x 10 ⁻¹⁹ C
Electron mass <i>Elektronmassa</i>	m _e	9,11 x 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

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ 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 $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ 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 $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{ave}} = F v_{\text{ave}}$ / $P_{\text{gemid}} = F v_{\text{gemid}}$	

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 $E = h \frac{c}{\lambda}$
$E = W_0 + E_{k(\text{max})}$ or/of $E = W_0 + K_{\text{max}}$ where/waar	
$E = hf$ and/en $W_0 = hf_0$ and/en $E_{k(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$ or/of $K_{\text{max}} = \frac{1}{2} mv_{\text{max}}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ 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)
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/WISSELSTROOM

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



GAUTENG PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

**JUNE EXAMINATION
JUNIE EKSAMEN**

GRADE/GRAAD 12

2026

**MARKING GUIDELINES/
NASIENRIGLYNE**

**PHYSICAL SCIENCES: PHYSICS/
FISIESE WETENSKAPPE: FISIKA**

(PAPER/VRAESTEL 1)

18 pages/bladsye

QUESTION/VRAAG 1

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

[20]

NOTE:

All diagrams, labels, graphs and answers should be done in blue pen.

NOTA:

Alle diagramme, byskrifte, grafieke en antwoorde moet in blou pen gedoen word.

QUESTION/VRAAG 2

2.1

Marking Criteria/Nasienkriteria:

If any of the underlined keywords/phrases in the **correct context** are omitted, deduct 1 mark. If the first sentence is omitted, penalize with one mark.

*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word, trek 1 punt af. Indien die eerste sin uitgelaat word, penaliseer met een punt.*

When a net/resultant force acts on an object, the object will accelerate in the direction of the force, and the acceleration is directly proportional to the force and inversely proportional to the mass of the object. ✓✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

Newton's law in terms of momentum: 2 or 0

Newton se wet in terme van momentum: 2 of 0

The net (or 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)

2.2



	Acceptable Labels/Aanvaarbare byskrifte
T ✓	F_T / $F_{\text{tension/spanning}}$ / Tension force / <i>Spanningskrag</i>
w ✓	Weight / <i>Gewig</i> / F_g/mg / $F_{\text{gravitation force/gravitasiekrag}}$ Do not accept gravity / <i>Moenie gravitasie aanvaar nie</i>
F ✓	F_{applied} / F_{toegepas} / Force applied / <i>Toegepaste krag</i> / 43 N

(3)

Note/LET WEL:

- Mark is awarded for label and arrow / *Punt word toegeken vir benoeming en pyltjie.*
- Do not penalise for the lengths of vectors
Moenie penaliseer vir die lengtes van vektore nie.
- If arrows do not touch the dot
As pyle nie aan die kolletjie raak nie: Max/Maks $\frac{2}{3}$
- Any additional force(s) / *Enige bykomende krag(te):*
Max/Maks $\frac{2}{3}$
- No labels / *geen benoemings* $\frac{0}{3}$

2.3.1

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

$$F - F_g - T = ma$$

$$F - (F_g + T) = ma$$

$$\frac{43 - ((1)(9,8) + T)}{1} = (1)(2)$$

$$T = 31,2 \text{ N}$$

} ✓ Any one / *Enige een*

(4)

2.3.2

Positive marking from QUESTION 2.3.1 / *Positiewe nasien van VRAAG 2.3.1*

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

$$T - f_k = ma$$

$$31,2 - f_k = (6)(2)$$

$$f_k = 19,2 \text{ N}$$

$$f_k = \mu_k N$$

$$19,2 = \mu_k (6)(9,8)$$

$$\mu_k = 0,33$$

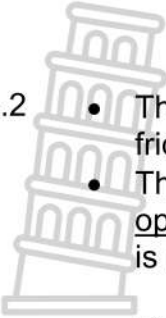
(4)

2.4.1

TO THE RIGHT ✓ / *NA REGS*

Do not accept East / *Moet nie Oos aanvaar nie*

(1)



- 2.4.2
- The net force is to the right ✓ The only force acting on the body is friction.
 - The 6 kg box experiences negative acceleration/ acceleration in the opposite direction ✓ The speed of the object decreases/the final velocity is less than the initial velocity

- Die netto krag is na regs / die enigste krag wat inwerk op die voorwerp is die wrywingskrag
- Die 6 kg blok ervaar 'n negatiewe versnelling/versnelling in die teenoorgestelde rigting/ Die spoed van die voorwerp neem af/die eindsnelheid is minder as die aanvanklike snelheid

ACCEPT deceleration in this question / AANVAAR vertraging in hierdie vraag



(2)
[16]

QUESTION/VRAAG 3

- 3.1 The gravitational force the Earth exerts on any object (on or near its surface). ✓✓
(2 or 0)
Die gravitasiekrag wat die Aarde uitoefen op enige voorwerp (op of naby sy oppervlak). (2)

3.2.1 **OPTION 1/OPSIE 1**

$$g = G \frac{M}{r^2} \quad \checkmark$$

$$= \frac{(6,67 \times 10^{-11})(6,4 \times 10^{23})}{(3,19 \times 10^6)^2} \checkmark$$

$$= 4,19 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

OPTION 2/OPSIE 2

$$F = G \frac{M_1 M_2}{r^2}$$

$$= \frac{(6,67 \times 10^{-11})(6,4 \times 10^{23})(90)}{(3,19 \times 10^6)^2} \checkmark$$

$$= 377,4 \text{ N}$$

$$w = mg$$

$$377,4 = 90g$$

$$g = 4,19 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

Both formulae for one mark/
Beide formules vir een punt

(4)

- 3.2.2 **MORE TIME** ✓
The acceleration on planet Omega is less than on earth. ✓

MEER TYD

Die versnelling op planeet Omega is minder as op aarde.

(2)

3.3

Positive marking from QUESTION 3.2.1
Marking Criteria

- Correct formula for $F = G \frac{m_1 m_2}{r^2}$ ✓
- Correct substitution of G, m_1 and m_2 into the formula ✓
- Adding $2,36 \times 10^6$ to the radius of M_1 ✓
- Correct substitution of r into the formula ✓
- Correct final answer: 124,73 N ✓

Positiewe nasien vanaf VRAAG 3.2.1
Nasienkriteria

- Korrekte formule vir $F = G \frac{m_1 m_2}{r^2}$ ✓
- Korrekte vervanging van G, m_1 en m_2 in die formule ✓
- Bymekaartel van $2,36 \times 10^6$ en die radius van M_1 ✓
- Korrekte vervanging van r in die formule ✓
- Korrekte finale antwoord: 124,73 N ✓

$$F = G \frac{m_1 m_2}{r^2} \checkmark$$

$$= \frac{(6,67 \times 10^{-11})(6,4 \times 10^{23})(90)}{(3,19 \times 10^6 + 2,36 \times 10^6)^2} \checkmark$$

$$F = 124,73 \text{ N} \checkmark$$

(5)

3.4

$$F = \frac{GM_1 M_2}{(3r)^2}$$

$$\frac{1}{9} F \checkmark \checkmark$$

(2)

[15]

QUESTION/VRAAG 4

4.1 The motion during which the only force acting on an object is the gravitational force.
✓✓ **(2 or/of 0)**

Die beweging waartydens die enigste krag wat op 'n voorwerp inwerk, die gravitasiekrag is.

(2)

4.2.1 **OPTION 1/OPSIE 1**

OPTION 2/OPSIE 2

Downwards as positive/Afwaarts as positief

Upwards as positive/Opwaarts as positief

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

$$v_f = (0) + (9,8)(2) \checkmark$$

$$v_f = \underline{19,6 \text{ m}\cdot\text{s}^{-1} \text{ downwards/afwaarts}} \checkmark$$

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

$$v_f = (0) + (-9,8)(2) \checkmark$$

$$v_f = -19,6 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = \underline{19,6 \text{ m}\cdot\text{s}^{-1} \text{ downwards/afwaarts}} \checkmark \quad (3)$$

4.2.2 **Marking Criteria/Nasienkriteria:**

- Formula for $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ / Formule vir $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
- Correct substitution into formula for ball A ✓ / Korrekte vervanging in formule vir bal A
- Correct substitution into formula for ball B ✓ ✓ / Korrekte vervanging in formule vir bal B
- Correct final answer: 1,48 s ✓ / Korrekte finale antwoord

Downwards as positive/Afwaarts as positief:	Upwards as positive/Opwaarts as positief:
<p><u>Ball A/Bal A:</u> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\Delta y = 0 + \frac{1}{2}(9,8)(t_A)^2$ ✓ $\Delta y_A = 4,9 t_A^2$eq 1</p> <p><u>Ball B/Bal B:</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_B = (20)(t_A - 1) + \frac{1}{2}(9,8)(t_A - 1)^2$ ✓ $\Delta y_B = 4,9t_A^2 + 10,2t_A - 15,1$ eq 2</p> <p>$\Delta y_A = \Delta y_B$ $4,9t_A^2 = 4,9t_A^2 + 10,2t_A - 15,1$ $t_A = 1,48 \text{ s}$ ✓</p>	<p><u>Ball A/Bal A:</u> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\Delta y = 0 + \frac{1}{2}(-9,8)(t_A)^2$ ✓ $\Delta y_A = -4,9 t_A^2$eq 1</p> <p><u>Ball B/Bal B:</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_B = (-20)(t_A - 1) + \frac{1}{2}(-9,8)(t_A - 1)^2$ ✓ $\Delta y_B = -4,9t_A^2 - 10,2t_A - 15,1$ eq 2</p> <p>$\Delta y_A = \Delta y_B$ $4,9t_A^2 = 4,9t_A^2 - 10,2t_A + 15,1$ $t_A = 1,48 \text{ s}$ ✓</p>

(5)

4.2.3 **POSITIVE MARKING FROM 4.2.2/ POSITIEWE NASIEN VAN 4.2.2**

Marking Criteria/Nasienkriteria:

- Correct equation to calculate Δy ✓ / Korrekte bereken om Δy te bereken
- Correct substitution to calculate Δy ✓ / Korrekte vergelyking om Δy te bereken
- Adding 3 to Δy ✓ / Bymekaartel van 3 en Δy
- Correct final answer: 13,73 m ✓ / Korrekte finale antwoord: 13,73 m
Range/Gebied: 13,73 – 13,74 m

OPTION 1/OPSIE 1

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
 $\Delta y_A = 0 + \frac{1}{2}(9,8)(1,48)^2$ ✓
 $\Delta y_A = 10,73296 \text{ m}$
 $h = 10,73296 + 3$ ✓
 height of building = 13,73 m ✓
 hoogte van gebou = 13,73 m

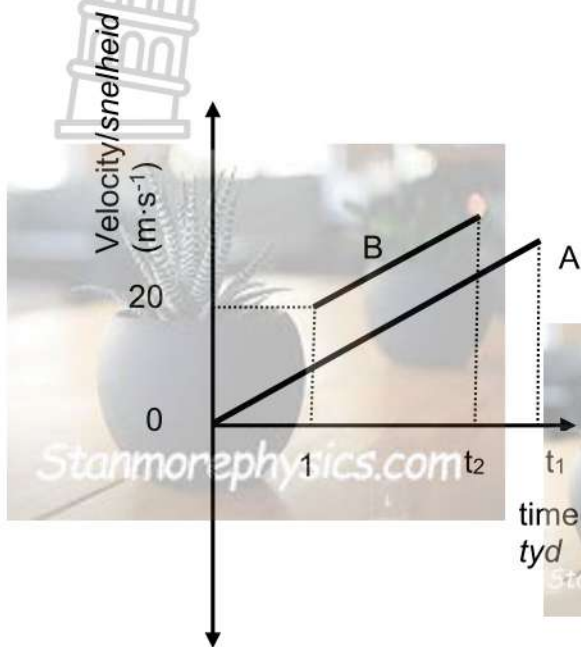
OPTION 2/OPSIE 2

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
 $\Delta y_B = (20)(1,48 - 1) + \frac{1}{2}(9,8)(1,48 - 1)^2$ ✓
 $\Delta y_B = 10,72896 \text{ m}$
 $\Delta y_B = 10,72896 + 3$ ✓
 height of building = 13,73 m ✓
 hoogte van gebou = 13,73 m

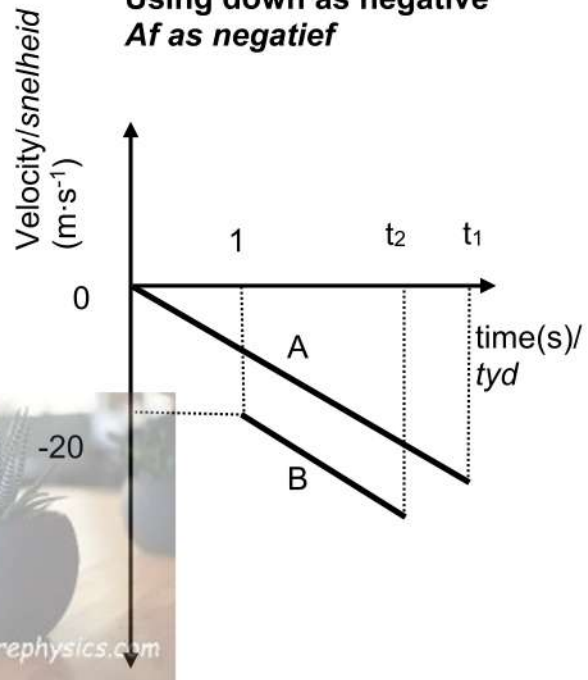
(4)

4.3

Using down as positive/
Af as positief

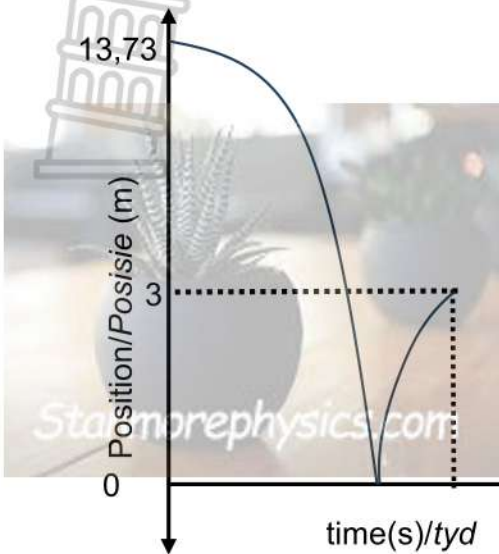


Using down as negative
Af as negatief

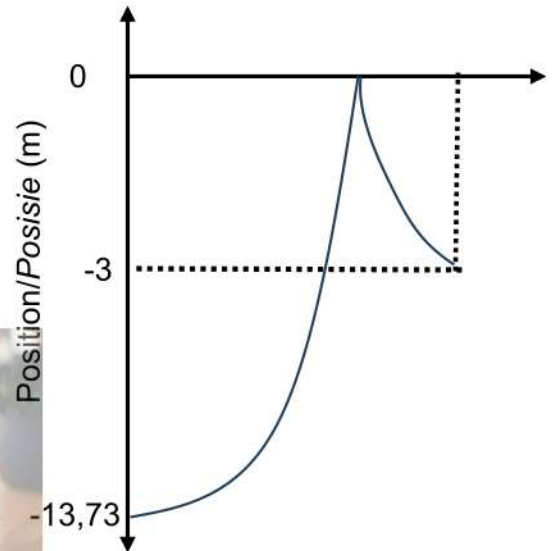


Marking Criteria/Nasienkriteria:		
<ul style="list-style-type: none"> Correct initial velocities of both ball A and B with correct shape (straight lines with both positive/both negative slopes). <i>Korrekte aanvanklike snelhede van beide bal A en B met korrekte vorm (reguit lyne met albei positiewe/albei negatiewe hellings).</i> 		✓
<ul style="list-style-type: none"> Correct initial times for ball A and B, B starting 1 s after the intercept of A. <i>Korrekte aanvanklike tye vir bal A en B, B begin 1 s na die afsnit van A.</i> 		✓
<ul style="list-style-type: none"> Correct final times for ball A and B as t_1 and t_2 respectively with t_1 to the right of t_2. (Note ball B will reach the ground before ball A; if t_1 is before t_2 then deduct 1 mark). <i>Korrekte finale tye vir bal A en B as t_1 en t_2 onderskeidelik met t_1 regs van t_2. (Let wel: Bal B sal die grond bereik voor bal A; indien t_1 voor t_2 is, trek 1 punt af).</i> 		✓
<ul style="list-style-type: none"> Graphs parallel to each other and B to the left of A. <i>Grafieke parallel aan mekaar en B links van A</i> 		✓
If graphs are not labelled maximum 2/4 Indien grafieke nie benoem is nie maksimum 2/4		
		(4)

4.4 Using up as positive/Op as positief



Using down as positive/Af as positief
time(s)/tyd



Marking Criteria/Nasienkriteria:		
• Correct initial position (13,73 m) as from QUESTION 4.2.3/Korrekte aanvanklike posisie (13,73 m) soos vanaf VRAAG 4.2.3		✓
• Final (3 m) height of ball A/Finale hoogte (3 m) van bal A		✓
• Correct shape/Regte vorm		✓
		(3)
		[21]

QUESTION/VRAAG 5

5.1 The net (or 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.
✓✓ (2 or/of 0)

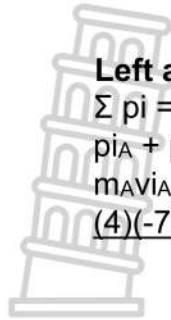
Die netto (of resulterende) krag wat op 'n voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die netto krag.

(2)

5.2.1 Right as positive/Regs as positief

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \\ p_{iA} + p_{iB} &= p_{f(A+B)} \\ m_A v_{iA} + m_B v_{iB} &= m_{(A+B)} v_{f(A+B)} \\ (4)(7) + (5)(-7) &\checkmark = (4+5) v_f \checkmark \\ v_f &= -0,78 \\ v_f &= \underline{0,78 \text{ m}\cdot\text{s}^{-1} \text{ left/links}} \checkmark \end{aligned}$$

} ✓ Any one/Enige een



Left as positive

$$\Sigma p_i = \Sigma p_f$$

$$p_{iA} + p_{iB} = p_{f(A+B)}$$

$$m_A v_{iA} + m_B v_{iB} = m_{(A+B)} v_{f(A+B)}$$

$$(4)(-7) + (5)(7) \checkmark = (4+5) v_f \checkmark$$

$$v_f = 0,78$$

$$v_f = \underline{0,78 \text{ m}\cdot\text{s}^{-1} \text{ left/links}} \checkmark$$

✓ Any one/Enige een

5.2.2 Positive marking from 5.2.1/Positiewe nasien vanaf 5.2.1

Range: 1036,67 - 1037,33

<p>Left as positive/Links as positief</p> $F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark$ $= \frac{(4)(-0,78 - 7)}{(0,03)} \checkmark$ $= -1037,33$ $F_{\text{net}} = 1037,33 \text{ N} \checkmark \text{ right/regs} \checkmark$	<p>Right as positive/Regs as positief</p> $F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark$ $= \frac{(4)(0,78 - (-7))}{(0,03)} \checkmark$ $F_{\text{net}} = 1037,33 \text{ N} \checkmark \text{ right/regs} \checkmark$
<p>Left as positive/Links as positief</p> $F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark$ $= \frac{(5)(-0,78 - (-7))}{(0,03)} \checkmark$ $= -1036,67$ $F_{\text{net}} = 1036,67 \text{ N right /regs}$	<p>Right as positive/Regs as positief</p> $F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark$ $= \frac{(5)(-0,78 - (-7))}{(0,03)} \checkmark$ $F_{\text{net}} = 1036,67 \text{ N right /regs}$

- 5.3 INCREASE ✓
Time of impact increased. ✓
Impulse is $F_{\text{net}}\Delta t$ ✓

VERHOOG

Kontaktyd vergroot.

Impuls is $F_{\text{net}}\Delta t$ (3)
[13]

QUESTION/VRAAG 6

6.1 A force for which the work done in moving an object between two points depends on the path taken. ✓✓ (2 or 0)
'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word. (2)

6.2 $W_{nc} = \Delta E_K + \Delta E_P$ ✓
 $-8700 = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$
 $-8700 \checkmark = \frac{1}{2}(62)(23,3)^2 - \frac{1}{2}(62)(8,5)^2 \checkmark + 0 - (62)(9,8)h_i \checkmark$
 $-8700 = 16829,59 - 2239,75 - 607,6h_i$
 $h_f = 38,33 \text{ m}$ ✓ (5)

6.3 The rate at which work is done or energy is expended. ✓✓ (2 or 0)
Die tempo waarteen arbeid verrig of energie verbruik word. (2)



Acceptable Labels/Aanvaarbare byskrifte	
f	F _f /Frictional force / f _k /wrywingskrag
Notes/LET WEL:	
<ul style="list-style-type: none"> Mark is awarded for label and arrow/Punt word toegeken vir etiket en pyl. Do not penalise for the lengths of vectors/Moenie penaliseer vir die lengtes van vektore nie. If arrow do not touch the dot/As pyl nie aan die kolletjie raak nie: Max/Maks $\frac{1}{2}$ Any additional horizontal force(s)/Enige bykomende horisontale krag(te): Max/Maks $\frac{1}{2}$ No label / geen benoeming $\frac{0}{2}$ If vertical forces are drawn – ignore / Indien vertikale kragte – ignoreer 	

6.5 $P_{ave} = Fv_{ave}$ ✓
 $4596,83 \checkmark = F \left(\frac{23,3+0}{2} \right)$
 $F = 394,32 \text{ N}$
 $F = 394,32 \text{ N}$
*Vir die Afrikaanse vraestelle:
Indien die kandidaat wel 'n poging aangewend het en iets probeer het. Bv. Formule van drywing neergeskryf, maar geen vervanging, gee punte.*
 $P_{ave} = 4596,83 \text{ W}$ ✓✓ (2)
[13]

QUESTION/VRAAG 7

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

Die (skynbare) verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium 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)

7.2 Towards. ✓

For any $v_L > 0$, $\frac{f_L}{f_S} > 1$, implying that $f_L > f_S$ ✓ OR

The ratio $\left(\frac{f_L}{f_S}\right)$ increases as the v_L increases.

Na

Vir enige $v_L > 0$, $\frac{f_L}{f_S} > 1$, wat impliseer dat $f_L > f_S$ OF

Die verhouding $\frac{f_L}{f_S}$ verhoog as die v_L verhoog. (2)

7.3 Inverse of the speed of sound. ✓✓/Omgekeerde van die spoed van klank.

$\frac{f_L}{f_S} = \frac{\frac{\text{Hz}}{\text{m}\cdot\text{s}^{-1}}}{\frac{\text{Hz}}{\text{m}\cdot\text{s}^{-1}}} = \frac{1}{v}$ Accept only if reference is made to SPEED OF SOUND.
Aanvaar slegs indien verwys word na SPOED VAN KLANK. (2)

7.4

OPTION 1/OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \quad \checkmark$$

$$\frac{f_L}{f_S} = \frac{v + v_L}{v}$$

$$1,03 \checkmark = \frac{v + 10}{v} \quad \checkmark$$

$$v = 333,33 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

OPTION 2/OPSIE 2

$$\text{Gradient/Gradiënt} = \frac{1,03 - 1}{10 - 0} \quad \checkmark$$

$$= 0,003$$

$$\text{Gradient/Gradiënt} = \frac{1}{v} \quad \checkmark = \frac{1}{0,003} \quad \checkmark$$

$$= 333,33 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Therefore/Daarom } v = 333,33 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$
 (4)

OPTION 3/OPSIE 3

$$y = mx + c$$

$$\frac{f_L}{f_S} = \frac{v_L}{v} + 1$$

$$1,03 = \frac{10}{v} + 1$$

Then/Dus $v = 333,33 \text{ m}\cdot\text{s}^{-1}$

Marking criteria/Nasienkriteria

- ✓ showing the/wys die $\frac{1}{v}$
- ✓✓ substituting values from the graph/
vervanging van waardes vanaf die grafiek
- ✓ final answer/finale antwoord:
 $333,33 \text{ m}\cdot\text{s}^{-1}$

[10]

QUESTION/VRAAG 8

8.1

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 magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓

Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

8.2

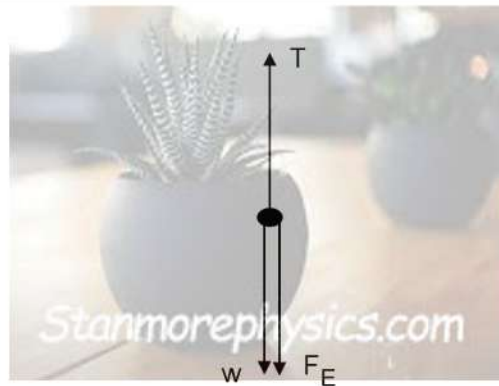
NEGATIVE ✓

- In Diagram 2 the two charges are attracting each other. ✓
- The charges are opposite ✓

NEGATIEF

- In diagram 2 trek die twee ladings mekaar aan.
- Die ladings is teenoorgesteld. (3)

8.3



(3)

Accepted label/Aanvaarde benoemings	
F_E ✓	Electrostatic force between charges X and Y/ $F_{\text{electrostatic}}$ / F_{AonC} / F_{AC} <i>Elektrostatiese krag tussen ladings X en Y/$F_{\text{elektrostaties}}$</i>
w ✓	F_g /gravitational force on X/ <i>gravitasiekrag op X</i> / mg
T ✓	Tension force/ <i>Spanningskrag</i> / F_T
Note/LET WEL:	
<ul style="list-style-type: none"> Any additional forces/<i>Enige addisionele kragte</i>: deduct 1 mark/<i>trek 1 punt af</i>: max/maks $\frac{2}{3}$ No labels/<i>Geen benoeming</i>: deduct 1 mark/<i>trek 1 punt af</i>: max/maks $\frac{2}{3}$ No arrows/<i>Geen pyltjies</i>: $\frac{0}{3}$ Force(s) not touching the object/<i>Krag(te) raak nie aan die voorwerp nie</i>: deduct 1 mark/<i>trek 1 punt af</i>: max/maks $\frac{2}{3}$ 	
Ignore relative sizes of the vectors/<i>Ignoreer relatiewe groottes van die vektore</i>	

8.4

OPTION 1/OPSIE 1

Diagram 2	Diagram 3
$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$ $F_{AC} = \frac{9 \times 10^9 Q_A 2 \times 10^{-3}}{(0,04)^2} \quad \checkmark$	$F = \frac{kQ_1Q_2}{r^2}$ $\frac{9 \times 10^9 Q_A 2 \times 10^{-3}}{(0,04)^2} = \frac{9 \times 10^9 Q_D Q_A}{(0,024)^2} \quad \checkmark$ $Q_D = 7,2 \times 10^{-4} \text{ C} \quad \checkmark$

OPTION 2/OPSIE 2

$E = \frac{kQ_A}{r^2}$ $\frac{F}{Q_C} = \frac{kQ_A}{(4 \times 10^{-2})^2}$	$E = \frac{kQ_A}{r^2}$ $\frac{F}{Q_D} = \frac{kQ_A}{(2,4 \times 10^{-2})^2}$
$\frac{F(4 \times 10^{-2})^2}{Q_C} = \frac{kQ_A}{(2,4 \times 10^{-2})^2}$ $\frac{F(4 \times 10^{-2})^2}{2 \times 10^{-3}} = \frac{Q_D}{Q_D}$	
$Q_D = 7,2 \times 10^{-4} \text{ C}$	

(4)

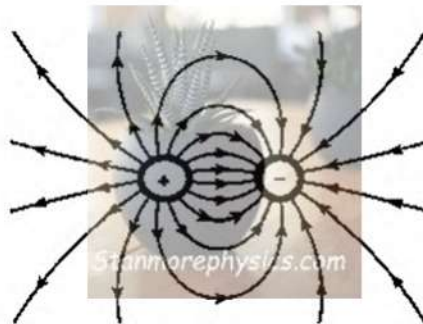
[12]

QUESTION/VRAAG 9

9.1 **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 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 per eenheids positiewe-lading wat by daardie punt geplaas is. (2)

9.2



Criteria for sketch/Kriteria vir skets	Marks/Punte
Correct shape as shown/Korrekte vorm soos getoon	✓
Direction away from positive to negative/ Rigting weg an positief na negatief	✓
Field lines start on spheres and do not cross for correct diagram and there are no straight lines /Veldlyne begin op elke sfeer en kruis nie vir korrekte diagram en daar is geen reguit lyne nie.	✓

(3)

9.3.1

$$n = \frac{Q}{q_e} \quad \checkmark$$

$$7,5 \times 10^{12} = \frac{Q}{1,6 \times 10^{-19}} \quad \checkmark \text{ accept if negative substituted/aanvaar indien negatief invervang}$$

$$Q = 1,20 \times 10^{-6} \text{ C}$$

$$Q = -1,20 \times 10^{-6} \text{ C} \quad \checkmark \text{ Answer should be negative (excess electrons) Antwoord moet negatief wees (oormaat elektrone)}$$

(3)

9.3.2 POSITIVE MARKING FROM QUESTION 9.3.1
POSITIEWE NASIEN VANAF VRAAG 9.3.1

$$E_{\text{at P}} = \frac{kQ}{r^2} \quad \checkmark$$

$$E_{\text{at P}} = \frac{(9 \times 10^9)(0,7 \times 10^{-6})}{(0,04)^2} \quad \checkmark$$

$E_{\text{at P by R}} = 3\,937\,500 \text{ N}\cdot\text{C}^{-1}$ to the right/ to the direction $(3,93 \times 10^6)$ /na regs/in die rigting $(3,93 \times 10^6)$

$$E_{\text{at P}} = \frac{kQ}{r^2}$$

$$E_{\text{at P}} = \frac{(9 \times 10^9)(1,2 \times 10^{-6})}{(0,08)^2} \quad \checkmark$$

$E_{\text{at P by S}} = 1\,687\,500 \text{ N}\cdot\text{C}^{-1}$ to the right/ to the direction $(1,69 \times 10^6)$ /na regs/in die rigting $(1,69 \times 10^6)$

$$E_{\text{net}} = 3,93 \times 10^6 + 1,69 \times 10^6$$
$$= 5,63 \times 10^6 \text{ N}\cdot\text{C}^{-1} \text{ to the right/na regs} \quad \checkmark$$

(4)
[12]

QUESTION/VRAAG 10

10.1.1 3,7 (V) \checkmark

(1)

10.1.2

<p>Gradient = $\frac{\Delta y}{\Delta x}$</p> <p>$= \frac{3,7 - 0}{0 - 147 \times 10^{-2}}$ \checkmark</p> <p>$= -2,52$</p> <p>$r = 2,52 \Omega$ \checkmark</p>	<p>Use any correct set of values from the graph.</p> <p><i>Gebruik enige korrekte stel waardes vanaf die grafiek.</i></p> <p>$y = mx + c$ can also be used <i>kan ook gebruik word</i></p>
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(3)

10.1.3

<p>OPTION 1/OPSIE 1</p> <p>$V = IR$ \checkmark</p> <p>$2 = (67,2 \times 10^{-2})R$ \checkmark</p> <p>$R = 2,98 \Omega$ \checkmark</p>	<p>OPTION 2/OPSIE 2</p> <p>$\text{Emf} = I(R + r)$ \checkmark</p> <p>$3,7 = 0,672(R + 2,52)$ \checkmark</p> <p>$R = 2,98 \Omega$ \checkmark</p>
--	--

(3)

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

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

(2)

10.2.2

OPTION 1/OPSIE 1

$$V = IR$$

$$3 = I(2) \quad \checkmark$$

$$I = 1,5 \text{ A}$$

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

$$= (1,5)(8 + 0,5) \quad \checkmark$$

$$= 12,75 \text{ V} \quad \checkmark$$

OPTION 2/OPSIE 2

$$V = IR$$

$$3 = I(2) \quad \checkmark$$

$$I = 1,5 \text{ A}$$

$$V = IR$$

$$= (1,5)(6) = 9 \text{ V}$$

$$V_{\text{term}} = 3 + 9 = 12 \text{ V}$$

$$V_{\text{int}} = Ir$$

$$= (1,5)(0,5) = 0,75 \text{ A}$$

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

$$= V_{\text{term}} + V_{\text{int}}$$

$$= 12 + 0,75 \quad \checkmark$$

$$= 12,75 \text{ V} \quad \checkmark$$

(4)

10.2.3

OPTION 1/OPSIE 1

$$V_{\text{int}} = 12,75 - 10,25$$

$$= 2,5 \text{ V}$$

$$V_{\text{int}} = Ir$$

$$2,5 = I(0,5) \quad \checkmark$$

$$I = 5 \text{ A}$$

$$I_{\text{series}} = \frac{V}{R}$$

$$= \frac{10,25}{8} = 1,28 \text{ A}$$

$$I_R = 5 - 1,28 \quad \checkmark = 3,72 \text{ A}$$

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

$$= \frac{10,25}{3,72} \quad \checkmark$$

$$= 2,76 \Omega \quad \checkmark$$

OPTION 2/OPSIE 2

$$V_{\text{int}} = Ir$$

$$2,5 = I(0,5) \quad \checkmark$$

$$I = 5 \text{ A}$$

$$R_{\text{ext}} = \frac{V}{I}$$

$$= \frac{10,25}{5} \quad \checkmark$$

$$= 2,05 \Omega$$

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

$$\frac{1}{2,05} = \frac{1}{R} + \frac{1}{8} \quad \checkmark$$

$$R = 2,76 \Omega \quad \checkmark$$

(5)

[18]
150

TOTAL/TOTAAL: