GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE EKSAMEN

GRADE/*GRAAD* 12

2026

MARKING GUIDELINES/
NASIENRIGLYNE

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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]

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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.

Newtons 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 / $F_{tension/spanning}$ /Tension force/*Spanningskrag*
w ✓	Weight/*Gewig*/F_g/mg/$F_{gravitation\ force/gravitasiekrag}$ Do not accept gravity/*Moenie gravitasie aanvaar nie*
F ✓	$F_{applied}$ / $F_{toegepas}$ / Force applied /*Toegepaste krag* / 43 N

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* $\frac{0}{3}$

(3)

2.3.1
$F_{net} = ma$
$F - F_g - T = ma$ ✓ Any one/*Enige een*
$F - (F_g + T) = ma$
$43 - ((1)(9,8) + T)$ ✓ $= (1)(2)$ ✓
$T = 31,2$ N ✓

(4)

2.3.2 **Positive marking from QUESTION 2.3.1/*Positiewe nasien van VRAAG 2.3.1***
$F_{net} = ma$
$T - fk = ma$
$31,2 - fk = (6)(2)$ ✓
$fk = 19,2$ N
$fk = \mu_k N$ ✓
$19,2 = \mu_k (6)(9,8)$ ✓
$\mu_k = 0,33$ ✓

(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 decelaration in this question / *AANVAAR vertraging in hierdie vraag*

(2)
[16]

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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***

$g = G\frac{M}{r^2}$ ✓

$= \frac{(6{,}67x10^{-11})(6{,}4x10^{23})}{(3{,}19x10^{6})^2}$ ✓

$= 4{,}19\ \text{m}\cdot s^{-2}$ ✓

OPTION 2/*OPSIE 2*

$F = G\frac{M_1M_2}{r^2}$

$= \frac{(6{,}67x10^{-11})(6{,}4x10^{23})(90)}{(3{,}19x10^{6})^2}$ ✓

= 377,4 N

w = mg

377,4 = 90g

$g = 4{,}19\ \text{m}\cdot s^{-2}$ ✓

Both formulae for one mark/ *Beide formules vir een punt*

(4)

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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	***Positiewe nasien vanaf VRAAG 3.2.1 Nasienkriteria***
• Correct formula for $F=G\frac{m_1m_2}{r^2}$ ✓	• *Korrekte formule vir* $F=G\frac{m_1m_2}{r^2}$ ✓
• Correct substitution of G, m_1 and m_2 into the formula ✓	• *Korrekte vervanging van G,* m_1 *en* m_2 *in die formule* ✓
• Adding 2,36 x 10^6 to the radius of M_1 ✓	• *Bymekaartel van 2,36 x* 10^6 *en die radius van* M_1 ✓
• Correct substitution of r into the formula ✓	• *Korrekte vervanging van r in die formule* ✓
• Correct final answer: 124,73 N ✓	• *Korrekte finale antwoord: 124,73 N* ✓

$$F = G\frac{m_1 m_2}{r^2} \quad ✓$$

$$= \frac{(6{,}67x10^{-11})(6{,}4\ x\ 10^{23})(90)}{(3{,}19x10^{6}+2{,}36\ x\ 10^{6})^2} \quad ✓ \ ✓$$

$$F = 124{,}73\ N \quad ✓$$

(5)

3.4

$$F = \frac{GM_1M_2}{(3r)^2}$$

$\frac{1}{9}$ F ✓✓

(2)

[15]

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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***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$v_f = (0) + (9{,}8)(2)$ ✓	$v_f = (0) + (-9{,}8)(2)$ ✓
v_f = 19,6 m·s^{-1} downwards/ *afwaarts* ✓	$v_f = -19{,}6$ m·s^{-1}
	v_f = 19,6 m·s^{-1} downwards/*afwaarts* ✓

(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*:**
Ball A/*Bal A*:	Ball A/*Bal A*:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$\Delta y = 0 + \frac{1}{2}(9,8)(t_A)^2$✓	$\Delta y = 0 + \frac{1}{2}(-9,8)(t_A)^2$✓
$\Delta y_A = 4,9\ t_A^2$ .....**eq 1**	$\Delta y_A = -4,9\ t_A^2$ .....**eq 1**
Ball B/*Bal B*:	Ball B/*Bal B*:
$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$	$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta y_B = (20)(t_A-1)$✓$+ \frac{1}{2}(9,8)(t_A-1)^2$ ✓	$\Delta y_B = (-20)(t_A-1)$✓ $+ \frac{1}{2}(-9,8)(t_A-1)^2$✓
$\Delta y_B = 4,9t_A^2 + 10,2t_A - 15,1$..... **eq 2**	$\Delta y_B = -4,9t_A^2 - 10,2t_A - 15,1$..... **eq 2**
$\Delta y_A = \Delta y_B$	$\Delta y_A = \Delta y_B$
$4,9t_A^{\ 2} = 4,9t_A^2 + 10,2t_A - 15,1$	$4,9t_A^{\ 2} = 4,9t_A^2 - 10,2t_A + 15,1$
$t_A = 1,48$ s ✓	$t_A = 1,48$ s ✓

(5)

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

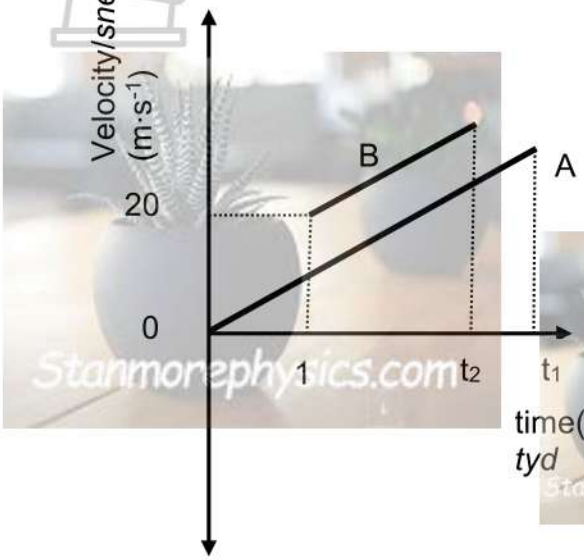
Marking Criteria/*Nasienkriteria*:

- 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: 13,73m*
  Range/*Gebied*: 13,73 – 13,74 m

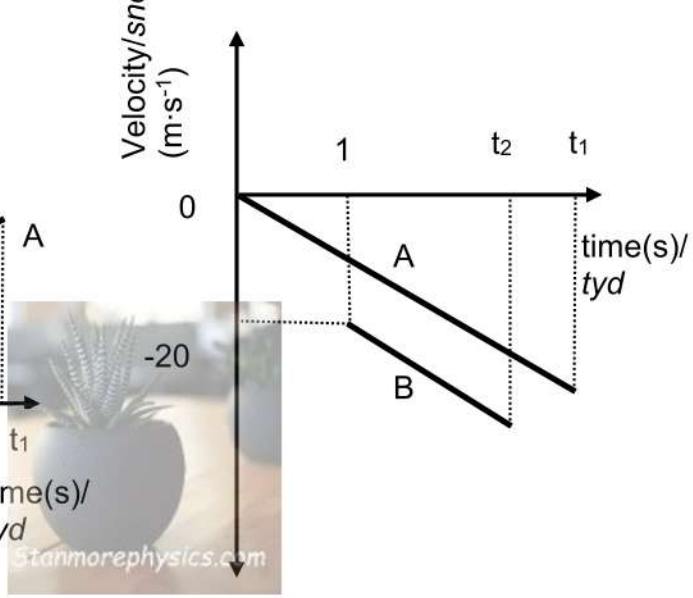
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$\Delta y_A = 0 + \frac{1}{2}(9,8)(1,48)^2$ ✓	$\Delta y_B = (20)(1,48 - 1) + \frac{1}{2}(9,8)(1,48 - 1)^2$ ✓
$\Delta y_A = 10,73296$ m	$\Delta y_B = 10,72896$ m
h = 10,73296 + 3 ✓	$\Delta y_B = 10,72896 + 3$ ✓
height of building = 13,73 m ✓	height of building = 13,73 m ✓
hoogte van gebou = 13,73 m	*hoogte van gebou = 13,73 m*

(4)

4.3 **Using down as positive/**
Af as positief

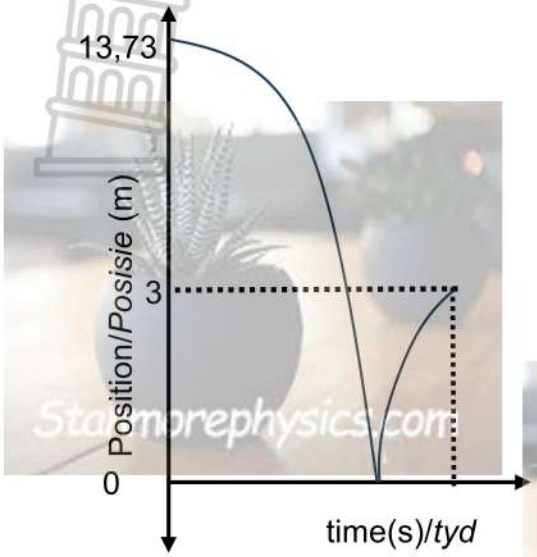


Using down as negative
Af as negatief

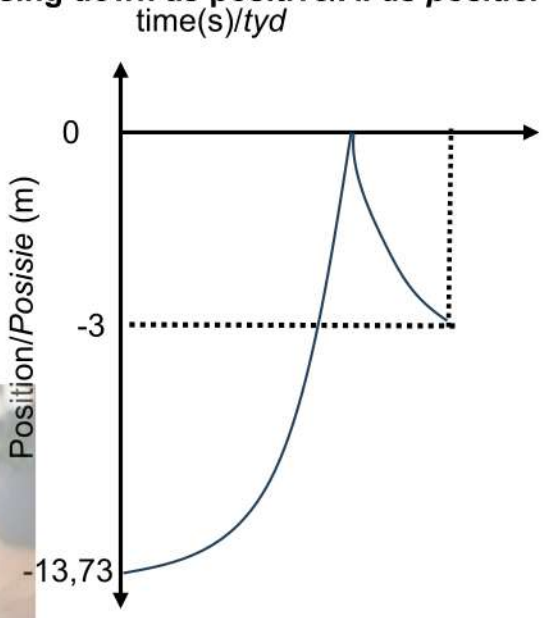


Marking Criteria/*Nasienkriteria*:	
• Correct initial velocities of both ball A and B with correct shape (straight lines with both positive/both negative slopes). *Korrekte aanvanklike snelhede van beide bal A en B met korrekte vorm (reguit lyne met albei positiewe/albei negatiewe hellings).*	✓
• Correct initial times for ball A and B, B starting 1 s after the intercept of A./*Korrekte aanvanklike tye vir bal A en B, B begin 1 s na die afsnit van A.*	✓
• 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). *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).*	✓
• Graphs parallel to each other and B to the left of A. *Grafieke parallel aan mekaar en B links van A*	✓
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*



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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***

$\Sigma p_i = \Sigma p_f$

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

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

$\underline{(4)(7) + (5)(-7)}$ ✓ $= \underline{(4+5)\, v_f}$ ✓

$v_f = -0,78$

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

✓ Any one/*Enige een*

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

✓ Any one/*Enige een*

(4)

5.2.2 **Positive marking from 5.2.1/*Positiewe nasien vanaf 5.2.1***
Range: 1036,67 - 1037,33

Left as positive/*Links as positief*	**Right as positive/*Regs as positief***
$F_{net} = \frac{m(vf-vi)}{\Delta t}$ ✓ $= \frac{(4)(-0{,}78-7)}{(0{,}03)}$ ✓ = - 1037,33 F_{net} = 1037,33 N ✓right/*regs* ✓	$F_{net} = \frac{m(vf-vi)}{\Delta t}$ ✓ $= \frac{(4)(0{,}78-(-7))}{(0{,}03)}$ ✓ F_{net} = 1037,33 N ✓right/*regs* ✓
Left as positive/*Links as positief*	**Right as positive/*Regs as positief***
$F_{net} = \frac{m(vf-vi)}{\Delta t}$ ✓ $= \frac{(5)(-0{,}78-(-7))}{(0{,}03)}$ ✓ = -1036,67 F_{net} = 1036,67 N right /*regs*	$F_{net} = \frac{m(vf-vi)}{\Delta t}$ ✓ $= \frac{(5)(-0{,}78-(-7))}{(0{,}03)}$ ✓ F_{net} = 1036,67 N right /*regs*

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(4)

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

VERHOOG
Kontaktyd vergroot.
Impuls is $F_{net}\Delta t$

(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 $W_{nc} = \Delta E_K + \Delta E_P$ ✓
$-8\,700 = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$
$-8\,700$ ✓ $= \frac{1}{2}(62)(23,3)^2 - \frac{1}{2}(62)(8,5)^2$ ✓ $+ 0 - (62)(9,8)h_i$ ✓
$-8\,700 = 16829,59 - 2239,75 - 607,6h_i$
$h_f = 38,33$ 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)

6.4

f ←●
✓✓

(2)

	Acceptable Labels/*Aanvaarbare byskrifte*
f	F_f/Frictional force / f_k /*wrywingskrag*

Notes/*LET WEL*:
- 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 pyle 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 $P_{ave} = Fv_{ave}$ ✓
$4\,596,83$ ✓ $= F(\frac{23,3+0}{2})$
$F = 394,32$ N
$F = 394,32$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.
$P_{ave} = 4\,596,83$ W ✓✓ (2)
[13]

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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 $(\frac{f_L}{f_S})$ 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.*
$\frac{f_L}{f_S} = \frac{\frac{Hz}{Hz}}{m.s^{-1}} = \frac{1}{v}$ 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*	**OPTION 2/*OPSIE 2***
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓	Gradient/*Gradiënt* $= \frac{1{,}03-1}{10-0}$ ✓
$\frac{f_L}{f_s} = \frac{v+v_L}{v}$	$= 0{,}003$
$1{,}03$✓ $= \frac{v+10}{v}$ ✓	Gradient/*Gradiënt* $= \frac{1}{v}$ ✓ $= \frac{1}{0{,}003}$ ✓ $= 333{,}33\ m.s^{-1}$
$v = 333{,}33\ m.s^{-1}$ ✓	Therefore/*Daarom* $v = 333{,}33\ m.s^{-1}$ ✓

(4)

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OPTION 3/*OPSIE 3*	Marking criteria/*Nasienkriteria*
$y = mx + c$ $\frac{f_L}{f_S} = \frac{v_L}{v} + 1$ $1{,}03 = \frac{10}{v} + 1$ Then/*Dus* $v = 333.33\ m.s^{-1}$	✓ showing the/*wys die* $\frac{1}{v}$ ✓✓ substituting values from the graph/ *vervanging van waardes vanaf die grafiek* ✓ final answer/*finale antwoord*: $333{,}33\ m.s^{-1}$

[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

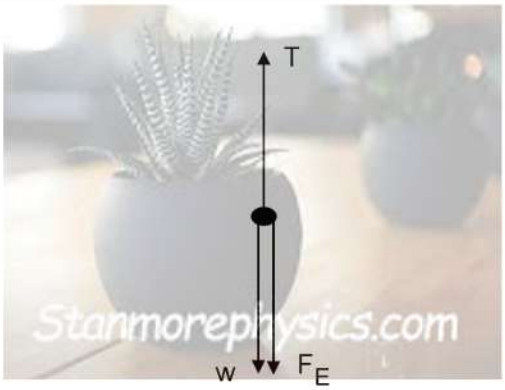
NEGATIVE ✓
- In Diagram 2 the two charges are attracting each other. ✓
- The charges are opposite ✓

NEGATIEF
- *In diagram 2 trek die twee ladings mekaar aan.*
- *Die ladings is teenoorgesteld.*

(3)

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8.3



(3)

Accepted label/*Aanvaarde benoemings*	
F_E ✓	Electrostatic force between charges X and Y/$F_{electrostatic}$ / F_{AonC}/ F_{AC} *Elektrostatiese krag tussen ladings X en Y/$F_{elektrostaties}$*
w ✓	Fg/gravitational force on X/*gravitasiekrag op X/ mg*
T ✓	Tension force/*Spanningskrag* / F_T

Note/*LET WEL*:

- Any additional forces/*Enige addisionele kragte*: deduct 1 mark/*trek 1 punt af*: max/*maks* $\frac{2}{3}$
- No labels/*Geen benoeming*: deduct 1 mark/*trek 1 punt af*: max/*maks* $\frac{2}{3}$
- No arrows/*Geen pyltjies*: $\frac{0}{3}$
- Force(s) not touching the object/*Krag(te) raak nie aan die voorwerp nie*: deduct 1 mark/*trek 1 punt af*: max/*maks* $\frac{2}{3}$

Ignore relative sizes of the vectors/*Ignoreer relatiewe groottes van die vektore*

8.4 **OPTION 1/*OPSIE 1***

Diagram 2	**Diagram 3**
$F=\frac{kQ_1Q_2}{r^2}$ ✓ $F_{AC} = \frac{9x10^9Q_A2x10^{-3}}{(0,04)^2}$ ✓	$F=\frac{kQ_1Q_2}{r^2}$ $\frac{9x10^9Q_A2x10^{-3}}{(0,04)^2} = \frac{9x10^9Q_DQ_A}{(0,024)^2}$ ✓ Q_D = 7,2 x 10^{-4} C ✓

OPTION 2/*OPSIE 2*

$$E = \frac{kQ_A}{r^2} \qquad E = \frac{kQ_A}{r^2}$$

$$\frac{F}{Q_c} = \frac{kQ_A}{(4x10^{-2})^2} \qquad \frac{F}{Q_D} = \frac{kQ_A}{(2,4x10^{-2})^2}$$

$$kQ_A = kQ_A$$

$$\frac{F(4x10^{-2})^2}{Q_c} = \frac{F(2,4x10^{-2})^2}{Q_D}$$

$$\frac{F(4x10^{-2})^2}{2x10^{-3}} = \frac{F(2,4x10^{-2})^2}{Q_D}$$

$$Q_D = 7,2 \text{ x } 10^{-4} \text{ C}$$

(4)
[12]

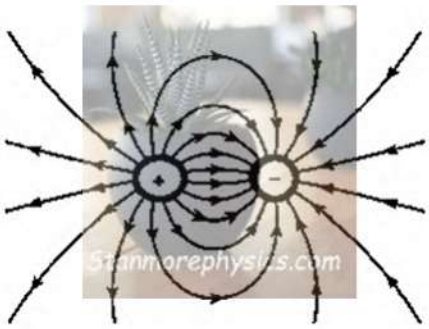
QUESTION/*VRAAG* 9

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

$$n = \frac{Q}{q_e} \quad ✓$$

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

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

$Q = -1{,}20 \times 10^{-6}$ C ✓ Answer should be negative (excess electrons)
Antwoord moet negatief wees (oormaat elektrone) (3)

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9.3.2 **POSITIVE MARKING FROM QUESTION 9.3.1**
POSITIEWE NASIEN VANAF VRAAG 9.3.1

$E_{at\ P} = \frac{kQ}{r^2}$ ✓

$E_{at\ P} \frac{(9x10^9)(0,7x10^{-6})}{(0,04)^2}$ ✓

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

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

$E_{at\ P} \frac{(9x10^9)(1,2x10^{-6})}{(0,08)^2}$ ✓

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

E_{net} = 3,93 x 10^6 + 1,69 x 10^6
= 5,63 x 10^6 N·C^{-1} to the right/*na regs* ✓ (4)

[12]

QUESTION/*VRAAG* 10

10.1.1 3,7 (V) ✓ (1)

10.1.2

Gradient = $\frac{\Delta y}{\Delta x}$ = $\frac{3,7-0}{0-147x10^{-2}}$ ✓ ✓ = - 2,52 r = 2,52 Ω ✓	Use any correct set of values from the graph. *Gebruik enige korrekte stel waardes vanaf die grafiek.* y = mx + c can also be used *kan ook gebruik word*

(3)

10.1.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
V = IR ✓ 2 = (67,2 x 10^{-2})R ✓ R = 2,98 Ω ✓	Emf = I(R + r) ✓ 3,7 = 0,672(R + 2,52) ✓ R = 2,98 Ω ✓

(3)

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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*	**OPTION 2/*OPSIE 2***
V = IR 3 = I(2) ✓ I = 1,5 A Emf = I(R + r) ✓ = (1,5)(8 + 0,5) ✓ = 12,75 V ✓	V = IR 3 = I(2) ✓ I = 1,5 A V = IR = (1,5)(6) = 9 V V_{term} = 3 + 9 = 12 V V_{int} = Ir = (1,5)(0,5) = 0,75 A Emf = I(R + r) ✓ = V_{term} + V_{int} = 12 + 0,75 ✓ = 12,75 V ✓

(4)

10.2.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
V_{int} = 12,75 – 10,25 = 2,5 V V_{int} = Ir 2,5 = I(0,5) ✓ I = 5 A $I_{series} = \frac{V}{R}$ $= \frac{10,25\ ✓}{8} = 1,28$ A I_R = 5 – 1,28 ✓= 3,72 A $R = \frac{V}{I_R}$ $= \frac{10,25}{3,72}$ ✓ = 2,76 Ω ✓	V_{int} = Ir 2,5 = I(0,5) ✓ I = 5 A $R_{ext} = \frac{V}{I}$ $= \frac{10,25\ ✓}{5\ ✓}$ = 2,05 Ω $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{2,05} = \frac{1}{R} + \frac{1}{8}$ ✓ R = 2,76 Ω ✓

(5)
[18]

TOTAL/*TOTAAL:* 150