basic education

Department:
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REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/ NASIONALE SENIORSERTIFIKAAT-EKSAMEN



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

MAY/JUNE/*MEI/JUNIE* 2024

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 19 pages.
Hierdie nasienriglyne bestaan uit 19 bladsye.

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QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 A ✓✓ (2)

1.5 D ✓✓ (2)

1.6 A ✓✓ (2)

1.7 A ✓✓ (2)

1.8 C ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

[20]

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QUESTION 2/*VRAAG 2*

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 sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig is aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*
The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum in die rigting van die resulterende/netto krag. **(2 or/*of* 0)** (2)

2.2



Accepted labels/*Aanvaarde benoemings:*	
w	F_g/F_w/40,18 N/mg/weight/gravitational force/*gewig*/*gravitasiekrag*
T	F_T/tension/*spanning*/F_{string}/*F_{tou}*
f	(kinetic) friction/F_f/f_k/*(kinetiese) wrywing*
N	F_N/Normal/F_{normal} /*$F_{normaal}$*/*Normaal*
F	F_{app}/*F_{toeg}*/49 N

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* $^4/_5$
- If everything is correct, but no arrows./*Indien alles korrek, maar geen pyltjies nie*: Max/*Maks* $^4/_5$
- If force(s) do not make contact with the dot./*Indien krag(te) nie met die kolletjie kontak maak nie*: Max/*Maks* $^4/_5$

(5)

2.3.1

$f_k = \mu_k F_N$
$f_k = \mu_k(F_g - F_y)$ ✓ Any one/ *Enige een*
$f_k = \mu_k(mg - F\sin\theta)$

$= \underline{(0,35)[(4,1)(9,8) - 49\sin 50°]}$ ✓
$= 0,93$ N ✓ (0,925 N) (3)

2.3.2 **POSITIVE MARKING FROM QUESTION 2.3.1./**
POSITIEWE NASIEN VANAF VRAAG 2.3.1.

For A/*Vir A*:
LEFT AS POSITIVE/
LINKS AS POSITIEF

$F_{net} = ma$
$F_x - T - f = ma$ ✓ Any one/ *Enige een*
$F\cos\theta - T - \mu_k F_N = ma$

$\underline{49\cos 50° - T - 0,93}$ ✓ $= \underline{(4,1)a}$
$T = 30,57 - 4,1a$ ... equation 1

For B/*Vir B*:
UPWARDS AS POSITIVE/
OPWAARTDS AS POSITIEF

✓ Any one/ *Enige een*

$F_{net} = ma$
$T - F_g = ma$
$\underline{T - (2,3)(9,8)}$ ✓$= \underline{(2,3)a}$
$T = 2,3a + 22,54$... equation 2

$30,57 - 4,1a = 2,3a + 22,54$
$a = 1,25$ m·s^{-2} ✓

For A/*Vir A*:
RIGHT AS POSITIVE/
REGS AS POSITIEF

$F_{net} = ma$
$-F_x + T + f = ma$ ✓ Any one/ *Enige een*
$-F\cos\theta + T + \mu_k F_N = ma$

$\underline{-49\cos 50° + T + 0,93}$ ✓ $= \underline{(4,1)a}$
$T = 30,57 + 4,1a$ ... equation 1

For B/*Vir B*:
DOWNWARDS AS POSITIVE/
AFWAARTDS AS POSITIEF

✓ Any one/ *Enige een*

$F_{net} = ma$
$F_g - T = ma$
$\underline{(2,3)(9,8) - T}$ ✓$= \underline{(2,3)a}$
$T = 22,54 - 2,3a$... equation 2

$30,57 + 4,1a = 22,54 - 2,3a$
$a = -1,25$ m·s^{-2}
$a = 1,25$ m·s^{-2} ✓ (5)
[15]

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QUESTION 3/*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 sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

Motion under the influence of gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasiekrag/ swaartekrag.
OR/*OF*
Motion in which the only force acting is gravitational force.
Beweging waar die enigste krag wat inwerk, gravitasiekrag/swaartekrag is.

(2)

NOTE: if projectile is defined 0/2
NOTA: indien projektiel gedefinieer is 0/2

3.2. NO/*NEE* ✓ (1)

3.3.1

Marking criteria/*Nasienkriteria:*
- Formula with Δt./*Formule met Δt* ✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Final answer/*Finale antwoord*: 1,44 s ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-15 = -3,4\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓	$15 = 3,4\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,44$ s ✓	$\Delta t = 1,44$ s ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-3,4)^2 + 2(-9,8)(-15)$	$v_f^2 = (3,4)^2 + 2(9,8)(15)$
$v_f = -17,48$ m·s^{-1}	$v_f = 17,48$ m·s^{-1}
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$-17,48 = -3,4 + (-9,8)\Delta t$ ✓	$17,48 = 3,4 + (9,8)\Delta t$ ✓
$\Delta t = 1,44$ s ✓	$\Delta t = 1,44$ s ✓

OPTION 3/*OPSIE 3*

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-3,4)^2 + 2(-9,8)(-15)$	$v_f^2 = (3,4)^2 + 2(9,8)(15)$
$v_f = -17,48$ m·s^{-1}	$v_f = 17,48$ m·s^{-1}
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-15 = \left(\frac{-3,4 - 17,48}{2}\right)\Delta t$ ✓	$15 = \left(\frac{3,4 + 17,48}{2}\right)\Delta t$ ✓
$\Delta t = 1,44$ s ✓	$\Delta t = 1,44$ s ✓

(3)

3.3.2 **POSITIVE MARKING FROM QUESTION 3.3.1.**
POSITIEWE NASIEN VANAF VRAAG 3.3.1.

Marking criteria/*Nasienkriteria:*
- Correct formula to calculate Δy./Korrekte *formule om Δy te bereken.*✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Subtraction of displacement from initial height./*Aftrekking van verplasing van oorspronklike hoogte*. ✓
- Final answer/*Finale antwoord*: 10,1 m ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$\Delta y = \underline{-3,4(1,44)} + \frac{1}{2}(0)(1,44)^2$ ✓	$\Delta y = \underline{3,4(1,44)} + \frac{1}{2}(0)(1,44)^2$ ✓
$\Delta y = -4,896$ m	$\Delta y = 4,896$ m
Height = $\underline{15 - 4,896}$✓ = 10,1 m ✓	Height = $\underline{15 - 4,896}$✓ = 10,1 m ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$\Delta y = \left(\frac{-3,4 - 3,4}{2}\right)(1,44)$ ✓	$\Delta y = \left(\frac{3,4 + 3,4}{2}\right)(1,44)$ ✓
$\Delta y = -4,896$ m	$\Delta y = 4,896$ m
Height = $\underline{15 - 4,896}$ ✓ = 10,1 m ✓	Height = $\underline{15 - 4,896}$ ✓ = 10,1 m ✓

OPTION 3/*OPSIE 3*

UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v = \frac{\Delta y}{\Delta t}$ ✓	$v = \frac{\Delta y}{\Delta t}$ ✓
$-3,4 = \frac{\Delta y}{1,44}$ ✓	$3,4 = \frac{\Delta y}{1,44}$ ✓
$\Delta y = -4,896$ m	$\Delta y = 4,896$ m
Height = $\underline{15 - 4,896}$ ✓ = 10,1 m ✓	Height = $\underline{15 - 4,896}$ ✓ = 10,1 m ✓

(4)

3.4 **POSITIVE MARKING FROM Q 3.3.1./*POSITIEWE NASIEN VANAF VR 3.3.1.***

Marking citeria/*Nasienkriteria:*

- Correct formula to calculate Δt./*Korrekte formule om Δt te bereken.* ✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Addition of three time values./*Bymekaartel van drie tydwaardes.* ✓
- Final answer/*Finale antwoord*: 2,37 s ✓

OPTION 1/*OPSIE 1*

UPWARDS AS +/*OPWAARTS AS +*

$v_f = v_i + a\Delta t$ ✓

$0 = \underline{7,2 + (-9,8)\Delta t}$ ✓

$\Delta t = 0,73$ s

DOWNWARDS AS +/*AFWAARTS AS +*

$v_f = v_i + a\Delta t$ ✓

$0 = \underline{-7,2 + (9,8)\Delta t}$ ✓

$\Delta t = 0,73$ s

Note/*Aantekening*: Accept for all options if v_i and v_f are swapped./*Aanvaar vir alle opsies indien v_i en v_f omgeruil is.*

OPTION 2/*OPSIE 2*

UPWARDS AS +/*OPWAARTS AS +*

$v_f = v_i + a\Delta t$ ✓

$-7,2 = \underline{7,2 + (-9,8)\Delta t}$ ✓

$\Delta t = 1,47$ s

Time to max height/*Tyd tot maks hoogte* $\Delta t = 0,73$ s

DOWNWARDS AS +/*AFWAARTS AS +*

$v_f = v_i + a\Delta t$ ✓

$7,2 = \underline{-7,2 + (9,8)\Delta t}$ ✓

$\Delta t = 1,47$ s

Time to max height/*Tyd tot maks hoogte* $\Delta t = 0,73$ s

OPTION 3/*OPSIE 3*

UPWARDS AS +/*OPWAARTS AS +*

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (7,2)^2 + 2(-9,8)\Delta y$

$\Delta y = 2,64$ m

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

$2,64 = \left(\frac{7,2 + 0}{2}\right)\Delta t$ ✓

$\Delta t = 0,73$ s

OR/*OF*

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

$\underline{2,64 = 7,2\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$\Delta t = 0,73$ s

DOWNWARDS AS +/*AFWAARTS AS +*

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (-7,2)^2 + 2(9,8)\Delta y$

$\Delta y = -2,64$ m

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

$-2,64 = \left(\frac{-7,2 + 0}{2}\right)\Delta t$ ✓

$\Delta t = 0,73$ s

OR/*OF*

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

$\underline{-2,64 = -7,2\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$\Delta t = 0,73$ s

$t_3 = \underline{1,44 + 0,2 + 0,73}$ ✓

$= 2,37$ s ✓

(4)

[14]

QUESTION 4 / *VRAAG 4*

4.1

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.*

In an isolated system the total (linear) momentum is conserved/remains constant. ✓✓
In 'n geïsoleerde sisteem bly die totale (lineêre) momentum behoue/konstant.

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(2)

4.2

Marking citeria/*Nasienkriteria:*
- Correct momentum formula/*Korrekte momentumformule.* ✓
- Correct substitution into momentum formula./*Korrekte vervanging in momentum formule.* ✓✓
- Correct substitution into equation of motion/*Korrekte vervanging in bewegingsvergelyking.* ✓
- Final correct answer/*Finale korrekte antwoord*: 0,64 m ✓

OPTION 1/*OPSIE 1*

RIGHT AS POSITIVE/*REGS AS POSITIEF*

$\sum p_i = \sum p_f$ } ✓Any one/ *Enige een*
$m_Av_{iA} + m_Bv_{iB} = m_Av_{fA} + m_Bv_{fB}$ }

0 ✓$= \underline{(3,2)(-0,4) + (2,6)v_f}$ ✓

$\therefore v_f = 0,49\ m\cdot s^{-1}$

LEFT AS POSITIVE/*LINKS AS POSITIEF*

$\sum p_i = \sum p_f$ } ✓Any one/ *Enige een*
$m_Av_{iA} + m_Bv_{iB} = m_Av_{fA} + m_Bv_{fB}$ }

0 ✓$= \underline{(3,2)(0,4) + (2,6)v_f}$ ✓

$\therefore v_f = -0,49\ m\cdot s^{-1}$

OPTION 2/*OPSIE 2*

RIGHT AS POSITIVE/*REGS AS POSITIEF*

$\Delta p_A = -\Delta p_B$ } ✓Any one/ *Enige een*
$m(v_{Af} - v_{Ai}) = -m(v_{Bf} - v_{Bi})$ }

$\underline{3,2(-0,4} - 0)$ ✓$= \underline{-2,6(v_{Bf}} - 0)$ ✓

$\therefore v = 0,49\ m\cdot s^{-1}$

LEFT AS POSITIVE/*LINKS AS POSITIEF*

$\Delta p_A = -\Delta p_B$ } ✓Any one/ *Enige een*
$m(v_{Af} - v_{Ai}) = -m(v_{Bf} - v_{Bi})$ }

$\underline{3,2(0,4} - 0)$ ✓$= \underline{-2,6(v_{Bf}} - 0)$ ✓

$\therefore v = -0,49\ m\cdot s^{-1}$

RIGHT AS POSITIVE/ *REGS AS POSITIEF*

$v = \dfrac{\Delta x}{\Delta t}$

$0,49 = \dfrac{\Delta x}{1,3}$ ✓

$\Delta x_B = 0,64$ m ✓

OR/*OF*

$\Delta x = \left(\dfrac{v_i + v_f}{2}\right)\Delta t$

$= \left(\dfrac{0,49 + 0,49}{2}\right)1,3$ ✓

$\Delta x_B = 0,64$ m ✓

LEFT AS POSITIVE/ *LINKS AS POSITIEF*

$v = \dfrac{\Delta x}{\Delta t}$

$-0,49 = \dfrac{\Delta x}{1,3}$ ✓

$\Delta x_B = -0,64$ m ✓

OR/*OF*

$\Delta x = \left(\dfrac{v_i + v_f}{2}\right)\Delta t$

$= \left(\dfrac{-0,49 - 0,49}{2}\right)1,3$ ✓

$\Delta x_B = -0,64$ m ✓

(5)

4.3 **POSITIVE MARKING FROM QUESTION 4.2.1.**
POSITIEWE NASIEN VANAF VRAAG 4.2.1.

OPTION 1/*OPSIE 1*	
RIGHT AS POSITIVE/ ***REGS AS POSITIEF:*** **For A/*Vir A:*** $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een* $\underline{(-4,2)\Delta t = 3,2(-0,4} - 0)$ ✓ $\Delta t = 0,3$ s ✓	**LEFT AS POSITIVE/** ***LINKS AS POSITIEF:*** **For A/*Vir A:*** $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een* $\underline{(4,2)\Delta t = 3,2(0,4} - 0)$ ✓ $\Delta t = 0,3$ s ✓
OPTION 2/*OPSIE 2*	
RIGHT AS POSITIVE/ ***REGS AS POSITIEF:*** **For B/*Vir B:*** $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een* $\underline{(4,2)\Delta t = 2,6(0,49} - 0)$ ✓ $\Delta t = 0,3$ s ✓	**LEFT AS POSITIVE/** ***LINKS AS POSITIEF:*** **For B/*Vir B:*** $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een* $\underline{(-4,2)\Delta t = 2,6(-0,49} - 0)$ ✓ $\Delta t = 0,3$ s ✓

(3)

4.4 LESS THAN✓
Final momentum/change in momentum remains constant. ✓
If mass/inertia increases, velocity decreases.✓

KLEINER AS
Finale momentum/verandering in momentum bly konstant.
Indien massa/traagheid toeneem, sal snelheid afneem. (3)
[13]

QUESTION 5/*VRAAG 5*

5.1

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 total mechanical energy/sum of the gravitational potential energy and kinetic energy/sum of E_p and E_k in an isolated system remains constant. ✓✓
Die totale meganiese energie/som van die gravitasie potensiële energie en kinetiese energie/som van E_p en E_k in 'n geïsoleerde sisteem bly konstant. (2)

5.2

OPTION 1/*OPSIE 1*

$(E_{mech})_{A/Top/Bo} = (E_{mech})_{B/Bottom/Onder}$
$(E_P + E_K)_{A/Top/Bo} = (E_P + E_K)_{B/Bottom/Onder}$
$(mgh + ½mv^2)_{A/Top/Bo} = (mgh + ½mv^2)_{B/Bottom/Onder}$ } ✓ Any one/E*nige een*

$\underline{(18)(9,8)(3) + 0 = 0 + (½)(18)v^2}$ ✓
$v = 7,67\ m\cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$
$W_{nc} = ½mv_f^2 - ½mv_i^2 + mgh_f - mgh_i$ } ✓ Any one/*Enige een*

$\underline{0 = ½(18)(v_f^2 - 0^2) + (18)(9,8)(0 - 3)}$ ✓
$v = 7,67\ m\cdot s^{-1}$ ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta E_k$
$mg\Delta y\cos\theta = ½mv_f^2 - ½mv_i^2$ } ✓ Any one/*Enige een*

$(18)(9,8)(3)\cos0° = ½(18)v_f^2 - 0$ ✓
$v = 7,67\ m\cdot s^{-1}$ ✓

(3)

5.3

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 net/total work done (on an object) is equal to the change in the object's kinetic energy. ✓✓
Die netto/totale arbeid wat (op 'n voorwerp) verrig is, is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/*OF*
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓
Die arbeid verrig op 'n voorwerp deur die resultante/netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

5.4

POSITIVE MARKING FROM QUESTION 5.2.
POSITIEWE NASIEN VANAF VRAAG 5.2.

OPTION 1/*OPSIE 1*

$W_{net} = \Delta E_k / E_{kf} - E_{ki} / ½mv_f^2 - ½mv_i^2$
$W_f = \Delta E_k / E_{kf} - E_{ki} / ½mv_f^2 - ½mv_i^2$
$f\Delta x\cos180° = \Delta E_k / E_{kf} - E_{ki} / ½mv_f^2 - ½mv_i^2$ } ✓ Any one/ *Enige een*

$\underline{(40,6)\Delta x(-1)}$ ✓ $= \underline{½(18)[(0)^2 - (7,67)^2]}$ ✓
$\Delta x = 13,04\ m$ ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$
$W_{nc} = mg(h_B - h_C) + ½mv_f^2 - ½mv_i^2$
$W_f = \Delta E_p + \Delta E_k$
$f\Delta x\cos180° = mg\Delta h + ½mv_f^2 - ½mv_i^2$ } ✓ Any one/Enige een

$\underline{(40,6)\Delta x(-1)}$ ✓ $= 0 + \underline{½(18)[(0)^2 - (7,67)^2]}$ ✓
$\Delta x = 13,04\ m$ ✓

(4)

5.5 Less than/*Kleiner as* ✓
Mechanical/Gravitational potential energy at A is less/ *Meganiese/Gravitasie potensiële energie by A is minder* ✓
Velocity/speed/Kinetic energy at B/ΔE_k will be less ✓
Snelheid/spoed/Kinetiese energie by B/ΔE_k sal minder wees (3)
[14]

QUESTION 6/*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 sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

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

MOVING TOWARDS OBSERVER/
BEWEGING NA LUISTERAAR:

$f_L = \frac{v \pm v_L}{v \pm v_s} f_S$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_S$

$615 = \left(\frac{v}{v - 26}\right) f_s$ ✓

$f_s = \frac{615(v - 26)}{v}$ equation 1/*vergelyking 1*

✓ Any one/Enige een

MOVING AWAY FROM OBSERVER/
BEWEGING WEG VAN LUISTERAAR:

$f_L = \frac{v \pm v_L}{v \pm v_s} f_S$ **OR/*OF*** $f_L = \frac{v}{v + v_s} f_S$

$526 = \left(\frac{v}{v + 26}\right) f_s$ ✓

$f_s = \frac{526(v + 26)}{v}$ equation 2/*vergelyking 2*

$\frac{615(v - 26)}{v} = \frac{526(v + 26)}{v}$ ✓

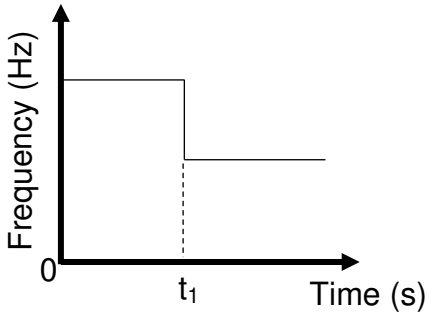
$v = 333{,}33 \text{ m·s}^{-1}$ ✓ (5)

6.3

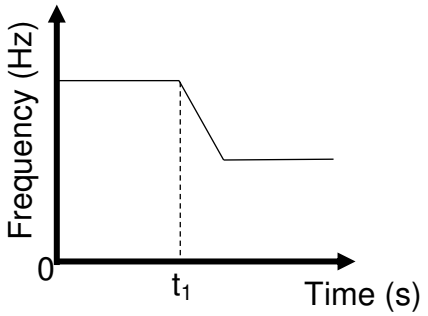
POSITIVE MARKING FROM QUESTION 6.2. *POSITIEWE NASIEN VANAF VRAAG 6.2.*	
Substitution into equation 1/ ***Vervanging in vergelyking 1***	**Substitution into equation 2/** ***Vervanging in vergelyking 2***
$f_s = \frac{615(333,33 - 26)}{333,33}$ ✓ **OR/*OF***	$f_s = \frac{526(333,33 + 26)}{333,33}$ ✓
$f_s = 567,03$ Hz	$f_s = 567,03$ Hz
$v = f\lambda$ ✓ $333,33 = 567,03\lambda$ ✓ $\lambda = 0,59$ m ✓	

(4)

6.4



OR/*OF*

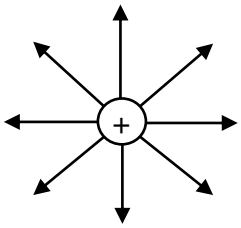


Criteria for graph/*Kriteria vir grafiek:*	
The lines before and after t_1 are horisontal./ *Die lyne voor en na t_1 is horisontaal.*	✓
The frequency after t_1 is less than before t_1./Die f*rekwensie na t_1 is kleiner as voor t_1.*	✓
Time t_1 correctly indicated./*Tyd t_1 word korrek aangedui*.	✓

(3)
[14]

QUESTION 7/VRAAG 7

7.1.1



Criteria for sketch/*Kriteria vir skets:*	
Correct shape./*Korrekte vorm.*	✓
Correct direction away from the charge./*Korrekte rigting weg van die lading.*	✓
Notes/*Aantekeninge:* If electric field lines cross or touch/*Indien elektriese veldlyne kruis of raak*: Max/*Maks* $^1/_2$	

(2)

7.1.2 $E = \frac{kQ}{r^2}$ ✓

$= \frac{(9 \times 10^{9})(4 \times 10^{-9})}{(0,025)^2}$ ✓

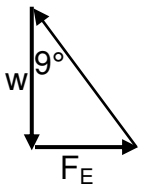
$= 5,76 \times 10^{4}\ N \cdot C^{-1}$ ✓ $(57\ 600\ N \cdot C^{-1})$ (3)

7.2.1 **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 magnitude of the electrostatic force exerted by one point charge on another 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 uitoefen, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

7.2.2 $F_E = w(\tan\theta)$
$F_E = mg(\tan\theta)$
$F_E = \frac{w}{\tan(90° - \theta)}$ } ✓ Any one/ Enige een



$F_E = (0,012)(9,8)(\tan 9°)$ ✓
$= 0,0186\ N$

$F = \frac{kQ_AQ_B}{r^2}$ ✓

$0,0186 = \frac{(9 \times 10^{9})(Q^2)}{0,1^2}$ ✓

$Q = 1,44 \times 10^{-7}\ C$
$Q_B = 2 \times 1,44 \times 10^{-7}$ ✓
$= 2,88 \times 10^{-7}\ C$ ✓ (range: $2,88 \times 10^{-7} - 2,98 \times 10^{-7}$) (6)

[13]

QUESTION 8/*VRAAG 8*

8.1 The resistor/R_Z is short circuited./*Die resistor/R_z word gekortsluit.* ✓

OR/*OF*

Current follows the path of least resistance./*Stroom volg die pad van minste weerstand.*

OR/*OF*

Branch with switch has no resistance./*Tak met skakelaar het geen weerstand nie.*

OR/*OF*

Total current will flow through branch with S_1./*Totale stroom vloei deur die tak met S_1.*

(1)

8.2

<u>OPTION 1/*OPSIE 1*</u>

$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$ ✓

$\frac{1}{R_p} = \boxed{\frac{1}{R} + \frac{1}{2R}}$ ✓ ($R_X = R$)

$R_p = 0,67R$

OR/*OF*

$R_p = \frac{R_X R_Y}{R_X + R_Y}$ ✓

$R_p = \boxed{\frac{(R)(2R)}{R + 2R}}$ ✓ ($R_X = R$)

$R_p = 0,67R$

$\varepsilon = I(R + r)$ ✓

$\underline{12 = 5,5(0,67R + 0,2)}$ ✓

$R = 2,96\ \Omega$

$R_Y = 2(2,96)$

$= 5,92\ \Omega$ ✓ (range 5,92 Ω – 5,95 Ω)

<u>OPTION 2/*OPSIE 2*</u>

$\varepsilon = I(R + r)$ ✓

$\underline{12 = 5,5(R + 0,2)}$ ✓

$R = 1,98\ \Omega$

$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$ ✓

$\frac{1}{1,98} = \boxed{\frac{1}{R} + \frac{1}{2R}}$ ✓ ($R_X = R$)

$R = 2,97\ \Omega$

$R_Y = 2(2,97)$

$= 5,94\ \Omega$ ✓(range 5,92 – 5,95)

OR/*OF*

$R_p = \frac{R_X R_Y}{R_X + R_Y}$ ✓

$1,98 = \boxed{\frac{(R)(2R)}{R + 2R}}$ ✓ ($R_X = R$)

$R = 2,97\ \Omega$

$R_Y = 2(2,97)$

$= 5,94\ \Omega$ ✓

(range 5,92 – 5,95)

OPTION 3/*OPSIE 3*

$\varepsilon = I(R + r)$
$\varepsilon = V_{ext} + Ir$ ✓ Any one/ *Enige een*
$12 = V_{ext} + 5,5(0,2)$ ✓
$V_{ext} = 10,9$ V

$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$ ✓

$\frac{1}{R_p} = \left(\frac{1}{R} + \frac{1}{2R}\right)$ ✓ $(R_X = R)$

$R_p = 0,67R$

$R_p = \frac{V_p}{I_T}$

$0,67R = \frac{10,9}{5,5}$

$R = 2,96\ \Omega$

$R_Y = 2(2,96)$

$= 5,92\ \Omega$ ✓(range 5,92 – 5,95)

OR/*OF*

$R_p = \frac{V_p}{I_T}$

$= \frac{10,9}{5,5}$

$= 1,98\ \Omega$

$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$ ✓

$\frac{1}{1,98} = \left(\frac{1}{R} + \frac{1}{2R}\right)$ ✓ $(R_X = R)$

$R = 2,97\ \Omega$

$R_Y = 2(2,97)$

$= 5,94\ \Omega$ ✓

(range 5,92 – 5,95)

(5)

8.3 **POSITIVE MARKING FROM QUESTION 8.2.**
POSITIEWE NASIEN VANAF VRAAG 8.2.

$V_p = I_T R_p$
$= (5,5)(1,98)$ ✓
$= 10,89$ V

OR/*OF*

$\varepsilon = I(R + r)$
$\varepsilon = V_{ext} + Ir$
$12 = V_{ext} + 5,5(0,2)$ ✓
$V_{ext} = 10,9$ V
$V_p = 10,9$ V

$I_x = \frac{2}{3}(5,5)$ ✓
$= 3,67$ A

OR/*OF*

$I_X = \frac{V_p}{R_X}$
$= \frac{10,9}{2,97}$ ✓
$= 3,67$ A

OPTION 1/*OPSIE 1*

$P = I^2R$ ✓
$= (3,67)^2(2,97)$ ✓
$= 40$ W ✓

OPTION 2/*OPSIE 2*

$P = \frac{V^2}{R}$ ✓
$= \frac{10,9^2}{2,97}$ ✓
$= 40$ W ✓

OPTION 3/*OPSIE 3*

$P = VI$ ✓
$= (10,9)(3,67)$ ✓
$= 40$ W ✓

(4)

8.4 **POSITIVE MARKING FROM QUESTION 8.2.**
POSITIEWE NASIEN VANAF VRAAG 8.2.

$V = IR$ ✓
$= 1,3 \times 5,94$ ✓
$= 7,72\ V$ ✓ (3)

8.5 **POSITIVE MARKING FROM QUESTION 8.2.**
POSITIEWE NASIEN VANAF VRAAG 8.2.

Marking citeria/*Nasienkriteria:*
Calculation of R_Z/*Berekening van R_Z*:
- Correct formula $\varepsilon = I(R + r)$./*Korrekte formule* $\varepsilon = I(R + r)$. ✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Correct substitution to calculate R_Z./*Korrekte vervanging om R_Z te bereken.* ✓

Calculation of I/*Berekening van I*:
- Addition of R_p and R_Z./*Bymekaartel van R_p en R_Z.*
- Correct substitution to calculate I./*Korrekte vervanging om I te bereken*.
- Correct final answer/*Korrekte finale antwoord*: (range: 2,26 A – 2,28 A)

S_1 AND S_2 OPEN/*S_1 EN S_2 OOP:*

$\varepsilon = I(R + r)$ ✓
$12 = 1,3(R_T + 0,2)$ ✓
$R_T = 9,03\ \Omega$

$R_T = R_Y + R_z$
$9,03 = 5,95 + R_z$ ✓
$R_z = 3,08\ \Omega$

S_1 OPEN AND S_2 CLOSED/*S_1 OOP EN S_2 GESLUIT:*

$R_p = 0,67R$
$= (0,67)(2,97)$
$= 1,98\ \Omega$

$\varepsilon = I(R + r)$
$12 = 5,5(R + 0,2)$
$R_p = 1,98\ \Omega$

$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$
$\frac{1}{R_p} = \frac{1}{2,97} + \frac{1}{5,94}$
$R_p = 1,98\ \Omega$

$R_p = \frac{R_X R_Y}{R_X + R_Y}$
$R_p = \frac{(2,97)(5,94)}{2,97 + 5,94}$
$R_p = 1,98\ \Omega$

✓
$R_T = 1,98 + 3,08$
$R_T = 5,06\ \Omega$

$\varepsilon = I(R + r)$
$12 = I(5,06 + 0,2)$ ✓
$I = 2,28\ A$ ✓

$R = \frac{V}{I}$
$5,26 = \frac{12}{I}$ ✓
$I = 2,28\ A$ ✓

(6)
[19]

QUESTION 9/*VRAAG 9*

9.1 Y to/*na X* ✓✓ (2)

9.2 Mechanical/Kinetic to electrical energy.✓
Meganiese/Kineties na elektriese energie. (1)

9.3

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 rms potential difference is the alternating current potential difference which dissipates/produces the same amount of energy as an equivalent DC potential difference.✓✓
Die wgk-potensiaalverskil is die wisselstroom potensiaalverskil wat dieselfde hoeveelheid energie verbruik/vervaardig as die ekwivalente GS-potensiaalverskil. (2)

9.4
$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$$
$$= \frac{125}{\sqrt{2}} \checkmark$$
$$= 88{,}39 \text{ V} \checkmark$$ (3)

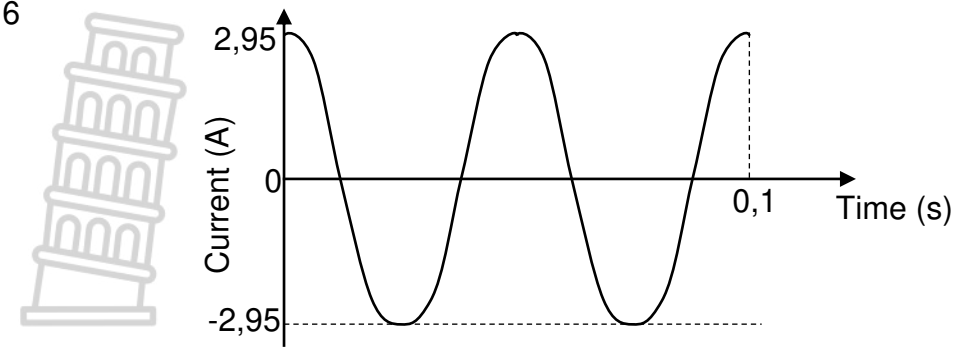
9.5

OPTION 1/*OPSIE 1*
$$I_{max} = \frac{V_{max}}{R} \checkmark$$
$$= \frac{125}{42{,}4} \checkmark$$
$$= 2{,}95 \text{ A} \checkmark$$

OPTION 2/*OPSIE 2*
$$I_{rms} = \frac{V_{rms}}{R}$$
$$= \frac{88{,}39}{42{,}4}$$
$$= 2{,}08 \text{ A}$$
$$I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$$
$$2{,}08 = \frac{I_{max}}{\sqrt{2}} \checkmark$$
$$I_{max} = 2{,}94 \text{ A} \checkmark$$

Notes/*Aantekeninge:*
Do not deduct a mark if subscripts are ommited from V = IR formula./*Moenie penaliseer indien onderskrifte uitgelaat is uit die formule V = IR nie.* (3)

9.6



Criteria for graph/*Kriteria vir grafiek*	
Two complete cycles indicated./*Twee volledige siklusse aangedui.*	✓
Graph stops at 0,1 s **OR** one cycle in 0,05 s./ *Grafiek stop by 0,1 s **OF** een siklus in 0,05 s*	✓
Maximum current (2,95 A) correctly indicated./ *Maksimum stroom (2,95 A) korrek aangedui.*	✓
Correct shape (cosine graph)./Korrekte vorm (cosinus grafiek)	✓

(4)
[15]

QUESTION 10/*VRAAG 10*

10.1

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 process whereby electrons are ejected from a (metal) surface when light of suitable frequency is incident on that surface. ✓✓
Die proses waartydens elektrone vrygestel word vanaf 'n (metaal) oppervlak wanneer lig van geskikte frekwensie invallend is op die oppervlak.

(2)

10.2

OPTION 1/*OPSIE 1*

$$E = W_0 + K_{max}$$
$$\frac{hc}{\lambda} = hf_0 + \frac{1}{2}mv_{max}^2$$
✓ Any one/ Enige een

$$\frac{(6,63 \times 10^{-34})(3 \times 10^{8})}{4,7 \times 10^{-7}} \checkmark = (6,63 \times 10^{-34})(4,37 \times 10^{14}) \checkmark + \tfrac{1}{2}(9,11 \times 10^{-31})v_{max}^2 \checkmark$$

$$v_{max} = 5,41 \times 10^{5}\ m \cdot s^{-1} \checkmark \quad (541\,292,69\ m \cdot s^{-1})$$

OPTION 2/*OPSIE 2*

$$c = f\lambda$$
$$3 \times 10^{8} = f\,(4,7 \times 10^{-7})$$
$$f = 6,38 \times 10^{14}\ Hz$$

$$E = W_0 + K_{max}$$
$$hf = hf_0 + \frac{1}{2}mv_{max}^2$$
✓ Any one/ Enige een

$$(6,63 \times 10^{-34})(6,38 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(4,37 \times 10^{14}) \checkmark + \tfrac{1}{2}(9,11 \times 10^{-31})v_{max}^2 \checkmark$$

$$v_{max} = 5,41 \times 10^{5}\ m \cdot s^{-1} \checkmark \quad (541\,292,69\ m \cdot s^{-1})$$

(5)

10.3.1 Higher than/*Hoër as* ✓ (1)

10.3.2
- Photons of (UV light) eject electrons (from the disc/Zn). ✓
- The negative charge on the electroscope decreases/becomes zero✓
- The electrostatic/repulsive force on the foil decreases/becomes zero. ✓
- *Fotone van (UV lig) stel elektrone vry (vanaf die skyf/Zn).*
- *Die negatiewe lading op die elektroskoop verlaag/word nul*
- *Die elektrostatiese/afstotende krag op die foelie verlaag/word nul.*

(3)

10.3.3 No/*Nee* ✓
Photons will still have the same energy **OR** increasing the intensity does not increase the energy of the photon(s) ✓
*Fotone sal nog steeds dieselfde enegie besit **OF** verhoging van intensiteit verhoog nie die energie van die foton(e) nie.* (2)

[13]

TOTAL/*TOTAAL*: 150

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