basic education

Department:
Basic Education
**REPUBLIC OF SOUTH AFRICA**

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

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

**2022**

## MARKING GUIDELINES/*NASIENRIGLYNE*

**MARKS/*PUNTE*: 150**

**These marking guidelines consist of 28 pages./**
***Hierdie nasienriglyne bestaan uit 28 bladsye.***

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## QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 A ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

**[20]**

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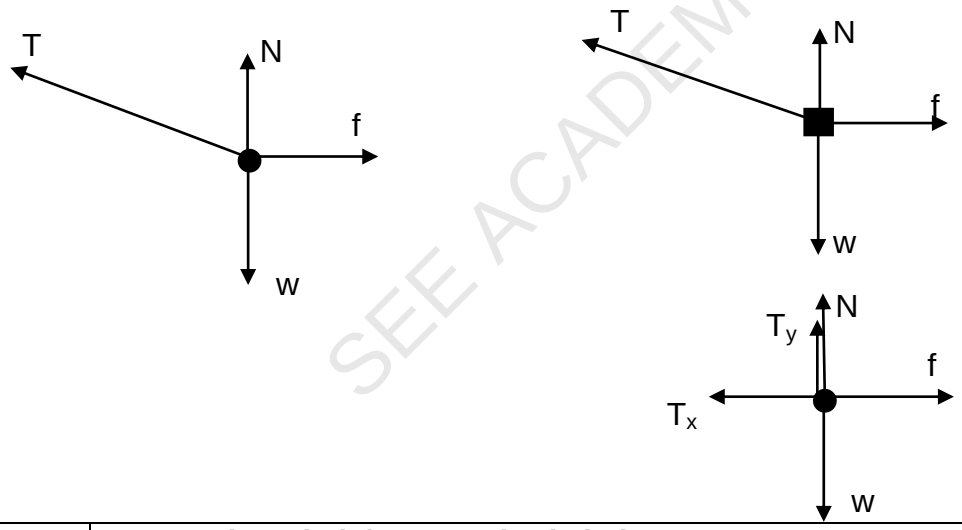
## QUESTION 2/*VRAAG 2*

2.1

| **Marking criteria/*Nasienkriteria:*** |
|---|
| If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.* |

A body will remain in its state of rest or motion at constant velocity unless a (non-zero) resultant/net force/unbalanced force acts on it. ✓✓
*'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk*.
**OR/*OF***
A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net force acts on it. ✓✓
*'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto krag daarop inwerk*. (2)

2.2 **ACCEPT/*AANVAAR***




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| | **Accepted symbols/*Aanvaarde simbole*** |
|---|---|
| N ✓ | $F_N$ /Normal/Normal force/*Normaal/Normaalkrag*/$F_{buoyant}$ |
| f ✓ | $F_f$ /$f_k$/frictional force/*wrywingskrag*/kinetic frictional force/*kinetiese wrywingskrag/300 N* |
| w ✓ | $F_g$/mg/Weight/G*ewig*/$F_{Earth\ on\ man}$/ *$F_{Aarde\ op\ man}$*/$F_w$/Gravitational force/ *Gravitasiekrag/* 686 N |
| T ✓ | Tension/*Spanning*/$F_{Tension}$/$F_{Spanning}$ /$F_T$/$F_S$ / **ACCEPT/ *AANVAAR*** F/$F_{applied}$/*$F_{toegepas}$* |

**Notes/*Aantekeninge***
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van die pyltjies penaliseer nie*.
- Deduct 1 mark for any additional force /*Trek 1 punt af vir enige addisionele krag*
- If T is not shown but $T_Y$ and $T_X$ are shown give 1 mark for both. *Indien T nie aangetoon is nie maar* $T_Y$ en $T_X$ *is getoon, ken 1 punt toe vir beide.*

(4)

2.3

**OPTION 1/*OPSIE 1***

$F_{net} = ma$
$T\cos50° - F_f = ma$ ✓Any one/*Enige een*
$T\cos50° - 300$ ✓$= 0$ ✓ **OR/*OF*** $T\cos50° = 300$ ✓✓
$T = 466,72$ N ✓(468,75 N)

**OR/*OF***
$F_{net} = 0$ ✓✓
$T\cos50° = F_f$ ✓✓

**OPTION 2/*OPSIE 2***

$W_{net} = \Delta E_k$ ✓
$T\Delta x\cos0º + f\Delta x\cos180º = 0$ ✓
$T\cos50° - 300$ ✓ $= 0$
$T = 466,72$ N ✓(468,75 N)

**OR/*OF***
$W_{net} = 0$ ✓✓
$T\Delta x\cos50º = -f\Delta x\cos180º$ ✓✓

**NOTE/*AANTEKENING***
Can use sin40º instead of cos50º.
*Kan ook sin40º i.p.v. cos50º gebruik.*

(4)

2.4 Increases/*Neem toe* ✓

$F_{net}$ increases / $F_{net}$ is not zero / $T_x > f$ / $T\cos50º > f$ ✓
*$F_{net}$ neem toe / $F_{net}$ is nie nul nie* / $T_x > f$ / $T\cos50º > f$

(2)

2.5

**Marking criteria Options 1 & 2/*Nasienkriteria Opsies 1 & 2***
- Substitution to calculate a/*Vervanging om a te bereken* ✓
- Formula to calculate $F_{up/water}$/*Formule om $F_{op/water}$ te bereken* ✓
- Substitution to calculate $F_{up/water}$/*Vervanging om $F_{op/water}$ te bereken* ✓✓
- Final answer/*Finale antwoord*: 679,20 N ✓

**OPTION 1/*OPSIE 1***

**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:***

$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (16)^2 + 2a\,(0,8)$ ✓
$a = -160\ m\cdot s^{-2}$

$F_{net} = ma$
$F_g - F_{up/op} = ma$ ✓Any one/*Enige een*
$(4)(9,8) - F_{up/op}$ ✓$= (4)(-160)$ ✓
$F_{up/op} = -679,20$ N
$F_{up/op} = 679,20$ N ✓

**UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF***

$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (-16)^2 + 2a(-0,8)$ ✓
$a = 160\ m\cdot s^{-2}$

$F_{net} = ma$
$-F_g + F_{up/op} = ma$ ✓Any one/*Enige een*
$-(4)(9,8) + F_{up/op}$ ✓$= (4)(160)$ ✓
$F_{up/op} = 679,20$ N ✓

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**OPTION 2/*OPSIE 2***

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

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

$0,8 = \left(\frac{16 + 0}{2}\right)\Delta t$

$\Delta t = 0,1$ s

$v_f = v_i + a\Delta t$
$0 = 16 + a(0,1)$ ✓
$a = -160\ m\cdot s^{-2}$

**OR/*OF***

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$0,8 = (16)(0,1) + \frac{1}{2}(a)(0,1)^2$ ✓
$a = -160\ m\cdot s^{-2}$

$F_{net} = ma$
$F_g - F_{up/op} = ma$ ✓Any one/*Enige een*
$(4)(9,8) - F_{up/op}$ ✓$= (4)(-160)$ ✓
$F_{up/op} = -679,20$ N
$F_{up/op} = 679,20$ N ✓

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

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

$-0,8 = \left(\frac{-16 + 0}{2}\right)\Delta t$

$\Delta t = 0,1$ s

$v_f = v_i + a\Delta t$
$0 = -16 + a(0,1)$ ✓
$a = 160\ m\cdot s^{-2}$

**OR/*OF***

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-0,8 = (-16)(0,1) + \frac{1}{2}(a)(0,1)^2$ ✓
$a = 160\ m\cdot s^{-2}$

$F_{net} = ma$
$-F_g + F_{up/op} = ma$ ✓Any one/*Enige een*
$-(4)(9,8) + F_{up/op}$ ✓$= (4)(160)$ ✓
$F_{up/op} = 679,20$ N ✓

**USING ENERGY PRINCIPLES/GEBRUIK VAN ENERGIE BEGINSELS**
**Marking criteria OPTIONS 3 to 5/Nasienkriteria OPSIES 3 to 5**

- Formula / *Formule* ✓
- Substitution / *Vervanging* ✓✓✓
- Final answer/*Finale antwoord*: 679,20 N ✓

**OPTION 3/*OPSIE 3***

$W_{net} = \Delta K$
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige een*
$(4)(9,8)(0,8)\cos0°$ ✓ $+ F_{up/op}(0,8)\cos180°$ ✓ $= \frac{1}{2}(4)(0 - 16^2)$ ✓
$F_{up/op} = 679,20$ N ✓

**OPTION 4/*OPSIE 4***

$W_{nc} = \Delta K + \Delta U$
$F_{up/op}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓Any one/*Enige een*
$F_{up/op}(0,8)\cos180°$ ✓ $= \frac{1}{2}(4)(0 - 16^2)$ ✓$+ (4)(9,8)(0 - 0,8)$ ✓
$F_{up/op} = 679,20$ N ✓

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**OPTION 5/*OPSIE 5***

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

$$0,8 = \left(\frac{16 + 0}{2}\right)\Delta t$$

$$\Delta t = 0,1 \text{ s}$$

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = (p_{tube/band})_f - (p_{tube/band})_i$
$(F_g - F_{up/op})\Delta t = m(v_{tube/band(f)} - v_{tube/band(i)})$
✓Any one/*Enige een*

$[(4)(9,8)$ ✓ $- F_{up/op}](0,1)$ ✓ $= (4)(0 - 16)$ ✓
$F_{up/op} = 679,20$ N ✓

(5)
**[17]**

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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 are omitted: - 1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.* |

An object which has been given an initial velocity and then it moves under the influence of the gravitational force only/ is in free fall. ✓✓
*'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg/in vryval is.*

(2)

3.2.1

| **OPTION 1/ *OPSIE 1*** | **OPTION 2/ *OPSIE 2*** |
|---|---|
| **UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF*** | **Motion from top/*Beweging van bo*** **UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF*** |
| $v_f = v_i + a\Delta t$ ✓ | $v_f = v_i + a\Delta t$ ✓ |
| $0 = 15 + (-9,8)\Delta t$ ✓ | $-15 = 0 + (-9,8)\Delta t$ ✓ |
| $\Delta t = 1,53$ s ✓ | $\Delta t = 1,53$ s ✓ |
| **DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF*** | **DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF*** |
| $v_f = v_i + a\Delta t$ ✓ | $v_f = v_i + a\Delta t$ ✓ |
| $0 = -15 + (9,8)\Delta t$ ✓ | $15 = 0 + (9,8)\Delta t$ ✓ |
| $\Delta t = 1,53$ s ✓ | $\Delta t = 1,53$ s ✓ |
| **OPTION 3/ *OPSIE 3*** | **OPTION 4/ *OPSIE 4*** |
| **UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF*** | **UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF*** |
| $v_f = v_i + a\Delta t$ ✓ | $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ |
| $-15 = 15 + (-9,8)\Delta t$ ✓ | $0 = (15)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ |
| $\Delta t = 3,06$ s | $\Delta t = 3,06$ s |
| $\Delta t$ up = 1,53 s ✓ | $\Delta t$ up = 1,53 s ✓ |
| **DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF*** | **DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF*** |
| $v_f = v_i + a\Delta t$ ✓ | $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ |
| $15 = -15 + (9,8)\Delta t$ ✓ | $0 = (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ |
| $\Delta t = 3,06$ s | $\Delta t = 3,06$ s |
| $\Delta t$ up = 1,53 s ✓ | $\Delta t_{up} = 1,53$ s ✓ |

(3)

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**Marking criteria OPTIONS 5 to 7/*Nasienkriteria OPSIES 5 tot 7***

- Any formula relating Δy and Δt/ **OR/*OF*** $F_{net}\Delta t = m\Delta v$✓
- Substitution to calculate Δt/*Vervanging om Δt te bereken* ✓
- Final answer/*finale antwoord*: 1,53 s ✓

**OPTION 5/*OPSIE 5***

$(E_{mech})_{Top/Bo} = (E_{mech})_{30\ m}$

$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{30\ m}$

$(mgh + ½mv^2)_{Top/Bo} = (mgh + ½mv^2)_{30\ m}$

$(9,8)h + 0 = 0 + (½)(15)^2$

$\Delta h = 11,48$ m

**OPTION 6/*OPSIE 6***

$W_{nc} = \Delta K + \Delta U$

$W_{nc} = \Delta K + mg(h_f - h_i)$

$0 = ½mv_f^2 - ½mv_i^2 + mgh_f - mgh_i$

$0 = ½(0 - 15^2) + (9,8)\Delta h$

$\Delta h = 11,48$ m

**OPTION 7/*OPSIE 7***

$W_{net} = \Delta E_k$

$w\Delta y\cos\theta = ½mv_f^2 - ½mv_i^2$

$(9,8)\Delta y\cos 180^o = 0 - ½(15)^2$

$\Delta y = 11,48$ m

**OPTION A/*OPSIE A***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

$\Delta y = v_i\Delta t + ½a\Delta t^2$✓

$11,48 = (15)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 1,53$ s ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$11,48 = (-15)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 1,53$ s ✓

**OPTION B/*OPSIE B***

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

$11,48 = \left(\frac{15 + 0}{2}\right)\Delta t$ ✓

$\Delta t = 1,53$ s ✓

**OPTION 8/*OPSIE 8***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

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

$\Delta y = \left(\frac{15 + 0}{2}\right)\Delta t$

$\Delta y = 7,5\ \Delta t$

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

$0 = (15)^2 + 2(-9,8)(7,5\Delta t)$ ✓

$\Delta t = 1,53$ s ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

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

$\Delta y = \left(\frac{-15 + 0}{2}\right)\Delta t$

$\Delta y = -7,5\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = (-15)^2 + 2(9,8)(-7,5\Delta t)$ ✓

$\Delta t = 1,53$ s ✓

**OPTION 9/*OPSIE 9***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$-(9,8)\Delta t = 0 - 15$ ✓

$\Delta t = 1,53$ s ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$(9,8)\Delta t = 15 - 0$ ✓

$\Delta t = 1,53$ s ✓

(3)

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3.2.2

**POSITIVE MARKING FROM QUESTION 3.2.1/**
***POSITIEWE NASIEN VANAF VRAAG 3.2.1***

**Marking criteria/*Nasienkriteria***

- Formula to calculate Δy/*Formule om Δy te bereken* ✓
- Substitution to calculate Δy/*Vervanging om Δy te bereken* ✓
- Substitution of/*Vervanging van* 30 m ✓
- Final answer/*Finale antwoord*: 41,48 m ✓

**NOTE/*AANTEKENING***

$v_f$ and $v_i$ can be swopped
*$v_f$ en $v_i$ kan omgeruil word*

**OPTION 1/*OPSIE 1***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{(15)(1,53) + \frac{1}{2}(-9,8)(1,53)^2}$ ✓
$= 11,48$ m

Height/*hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{(-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2}$ ✓
$= -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**OPTION 2/*OPSIE 2***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0 = (15)^2 + (2)(-9,8)\Delta y}$ ✓
$\Delta y = 11,48$ m

Height/*hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0 = (-15)^2 + (2)(9,8)\Delta y}$ ✓
$\Delta y = -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**OPTION 3/*OPSIE 3***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

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

$\Delta y = \left(\frac{15+0}{2}\right)(1,53)$ ✓
$= 11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

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

$\Delta y = \left(\frac{-15+0}{2}\right)(1,53)$ ✓
$= -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

**OPTION 4/*OPSIE 4***

**UPWARDS AS POSITIVE/**
***OPWAARTS AS POSITIEF***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(-15)^2 + (2)(-9,8)(-30)}$ ✓
$v_f = -28,51$ m·s$^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(-28,51)^2 = (0)^2 + (2)(-9,8)\Delta y}$ ✓
$\Delta y = 41,48$ m
Height/*Hoogte* = 41,48 m ✓

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(15)^2 + (2)(9,8)(30)}$ ✓
$v_f = 28,51$ m·s$^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(28,51)^2 = (0)^2 + (2)(9,8)\Delta y}$ ✓
$\Delta y = 41,48$ m

Height/*Hoogte* = 41,48 m ✓

SEE ACTIVITY

**OPTION 5/ *OPSIE 5***

$(E_{mech})_{Top/Bo} = (E_{mech})_{30\ m}$
$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{30\ m}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{30\ m}$
✓Any one/*Enige een*

$(9,8)h + 0 = (9,8)(30✓) + (½)(15)^2$ ✓
h = 41,48 m ✓

**OPTION 6/*OPSIE 6***

$W_{net} = \Delta E_k$
$w\Delta x\cos 180° = ½m(v_f^2 - v_i^2)$
✓Any one/*Enige een*

$(9,8)(\Delta x)\cos 180° = ½(0 - 15^2)$ ✓
Δx = 11,47 m
Height above the ground/*hoogte bokant grond*= 30 +✓ 11,47 = 41,48 m ✓

**OPTION 7/*OPSIE 7***

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$
✓Any one/*Enige een*

$0 = (9,8)(h_f - 0) + ½(0 - 15^2)$ ✓
h = 11,47 m
Height above the ground/*hoogte bokant grond*= 30 +✓ 11,47 = 41,48 m ✓ (4)

3.3

**POSITIVE MARKING FROM QUESTION 3.2.2/**
***POSITIEWE NASIEN VANAF VRAAG 3.2.2***

**Marking criteria/*Nasienkriteria***

- Formula/*Formule* ✓
- Substitute to calculate $\Delta y_B$ /*Vervang om $\Delta y_B$ te bereken* ✓
- Substitute to calculate $\Delta y_C$/*Vervang om $\Delta y_c$ te bereken* ✓
- Substitute/*Vervang* Δt + 0,5 or/*of* Δt – 0,5 ✓
- Equating $y_B$ and $y_C$ ✓
- Final answer/*Finale antwoord:* 1,71 s ✓

**OPTION 1/*OPSIE 1***

**UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***

Take $y_C$ as height of disc above ground at meeting point / *neem hoogte $y_C$ as die hoogte van teiken bokant grond by ontmoetingspunt*:

$\Delta y_C = v_i\Delta t + ½a\Delta t^2$ ✓
$y_C - 30 = 15\Delta t + ½(-9,8)\Delta t^2$ ✓
$y_C = 15\Delta t - 4,9\Delta t^2 + 30$….. (1)

Take $y_B$ as height of ball above ground at meeting point/*Neem hoogte $y_B$ as die hoogte van bal bokant grond by ontmoetingspunt*:

$\Delta y_B = v_i\Delta t + ½a\Delta t^2$
$y_B - 0 = 40(\Delta t - 0,5✓) + ½(-9,8)(\Delta t - 0,5✓)^2$ ✓
$y_B = 44,9t - 21,225 - 4,9t^2$…..(2)

At meeting point/*By ontmoetingspunt*:

$y_C = y_B$
$15\Delta t - 4,9\Delta t^2 + 30 = 44,9t - 21,225 - 4,9t^2$ ✓
Δt = 1,71 s ✓

SEE ACADEMY

**DOWNWARDS AS POSITIVE/**
***AFWAARTS AS POSITIEF***

Take $y_C$ as height of disc above ground at meeting point/*neem hoogte $y_C$ as die hoogte van teiken bokant grond by ontmoetingspunt*:

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

$y_C - 30 = \underline{-15\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$y_C = -15\Delta t + 4,9\Delta t^2 + 30$….. (1)

Take $y_B$ as height of ball above ground at meeting point/*neem hoogte $y_B$ as die hoogte van bal bokant grond by ontmoetingspunt*:

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

$y_B - 0 = \underline{-40}(\Delta t - 0,5\checkmark) \underline{+ \frac{1}{2}(9,8)}(\Delta t - 0,5\checkmark)^2$ ✓

$y_B = -44,9t + 21,225 + 4,9t^2$…..(2)

At meeting point/*By ontmoetingspunt*:

$y_C = y_B \therefore \underline{-15\Delta t + 4,9\Delta t^2 + 30 = -44,9t + 21,225 + 4,9t^2}$ ✓

$\Delta t = 1,71$ s ✓

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

**UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:***

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

$= \underline{15\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$= 15\Delta t - 4,9\Delta t^2$….. (1)

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

$= \underline{40}(\Delta t - 0,5\checkmark) \underline{+ \frac{1}{2}(-9,8)} (\Delta t - 0,5\checkmark)^2$ ✓

$\Delta y_C$ in terms of/*in terme van* $\Delta y_B$:

$30 + \Delta y_C = 40(\Delta t - 0,5) + \frac{1}{2}(-9,8)(\Delta t - 0,5)^2$

$\Delta y_C = -4,9\Delta t^2 + 44,9\Delta t - 51,225$ …..(2)

Equate (1) and (2)/*Stel (1) en (2) gelyk:*

$\underline{15\Delta t = 44,9\Delta t - 51,225}$ ✓

$\Delta t = 1,71$ s ✓

**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:***

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

$= \underline{-15\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$= 4,9\Delta t^2 - 15\Delta t$ …..(1)

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

$= \underline{-40}(\Delta t - 0,5\checkmark) \underline{+ \frac{1}{2}(9,8)}(\Delta t - 0,5\checkmark)^2$ ✓

$\Delta y_C$ in terms of/*in terme van* $\Delta y_B$:

$30 + \Delta y_C = (-40)(t - 0,5) + \frac{1}{2}(9,8)(\Delta t - 0,5)^2$

$\Delta y_C = 4,9\Delta t^2 - 44,9\Delta t + 51,225$…..(2)

Equate (1) and (2)/*Stel (1) en (2) gelyk*:

$\underline{-15\Delta t = -44,9\Delta t + 51,225}$ ✓

$\Delta t = 1,71$ s ✓

SEE ACADEMY

**OPTION 3/*OPSIE 3***

**UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***

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

$= \underline{15}(\Delta t + 0,5$✓$) \underline{+ \frac{1}{2}(-9,8)}(\Delta t + 0,5)^2$ ✓

$= -4,9t^2 + 10,1\Delta t + 6,275$…..(1)

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

$= \underline{40\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$\Delta y_C$ in terms of/*in terme van* $\Delta y_B$:

$30 + \Delta y = 40\Delta t + \frac{1}{2}(-9,8)t^2$

$\Delta y = -4,9\Delta t^2 + 40t - 30$ …..(2)

Equate (1) and (2)/*Stel (1) en (2) gelyk*:

$\underline{10,1\Delta t + 6,275 = 40\Delta t - 30}$ ✓

$\Delta t = 1,21$ s

$\Delta t_{TOT} = 1,21 + 0,5$

$= 1,71$ s ✓

**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***

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

$= \underline{-15}(\Delta t + 0,5$✓$) \underline{+ \frac{1}{2}(9,8)}(\Delta t + 0,5)^2$ ✓

$= 4,9\Delta t^2 - 10,1\Delta t + 6,275$…..(1)

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

$= \underline{-40\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$\Delta y_C$ in terms of/*in terme van* $\Delta y_B$:

$30 + \Delta y = -40\Delta t + \frac{1}{2}(9,8)t^2$

$\Delta y = -4,9\Delta t^2 - 40\Delta t - 30$…..(2)

Equate (1) and (2)/*Stel (1) en (2) gelyk*:

$\underline{-10,1\Delta t + 6,275 = -40\Delta t - 30}$ ✓

$\Delta t = 1,21$ s

$\Delta t_{TOT} = 1,21 + 0,5$

$= 1,71$ s ✓

SSE ACADEMY

**OPTION 4/*OPSIE 4***

| **Marking criteria:** | ***Nasienkriteria:*** |
|---|---|
| • Formula: $\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ | • *Formule:* $\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ |
| • Substitute to calculate $\Delta y_B$ ✓ | • *Vervang om $\Delta y_B$ te bereken* ✓ |
| • Substitute to calculate $\Delta y_C$ ✓ | • *Vervang om $\Delta y_c$ te bereken* ✓ |
| • Substitute $\Delta t = 0,5$ ✓ | • *Vervang* $\Delta t = 0,5$ ✓ |
| • Adding $\Delta y_B$ and $\Delta y_C$ ✓ | • *Som van $\Delta y_B$ en $\Delta y_C$* ✓ |
| • Final answer: 1,71 s ✓ | • *Finale antwoord:* 1,71 s ✓ |

**UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***

Displacement of C after 0,5 s/*Verplasing van C na 0,5 s*

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

$= 15(0,5) + \frac{1}{2}(-9,8)(\underline{0,5}\checkmark)^2$

$\Delta y_C = 6,28$ m

Velocity of C after 0,5 s/ *Snelheid van C na 0,5 s*

$v_f = v_i + a\Delta t$

$= 15 + (-9,8)(0,5)$

$= 10,10\ m\cdot s^{-1}$

Displacement of C at meeting point/*Verplasing van C by ontmoetingspunt*

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

$= \underline{10,1\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$= 10,1\Delta t - 4,9\Delta t^2$

Displacement of B at meeting point/*Verplasing van B by ontmoetingspunt*

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

$= \underline{40\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$= 40t - 4,9t^2$

At meeting point/*By ontmoetingspunt*:

$\underline{\Delta y_C + \Delta y_B = -[10,1\Delta t - 4,9\Delta t^2] + 40\Delta t - 4,9\Delta t^2}$ ✓

$36,28 = -10,10\Delta t + 40\Delta t$

$\Delta t = 1,21$ s

$\Delta t_{tot} = 1,21 + 0,5 = 1,71$ s ✓

SEE ACADEMY

**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***

Displacement of C after 0,5 s/*Verplasing van C na 0,5 s*

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

$= -15(0,5) + \frac{1}{2}(9,8)(\underline{0,5}\checkmark)^2$

$\Delta y_C = -6,28$ m

Velocity of C after 0,5 s/ *Snelheid van C na 0,5 s*

$v_f = v_i + a\Delta t$

$= -15 + (9,8)(0,5)$

$= -10,10\ m\cdot s^{-1}$

Displacement of C at meeting point/*Verplasing van C by ontmoetingspunt*

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

$= \underline{-10,1\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$= -10,1\Delta t + 4,9\Delta t^2$

Displacement of B at meeting point/*Verplasing van B by ontmoetingspunt*

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

$= \underline{-40\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$= -40t + 4,9t^2$

At meeting point/*By ontmoetingspunt*:

$\underline{\Delta y_C + \Delta y_B = -[-10,1\Delta t + 4,9\Delta t^2] - 40\Delta t + 4,9\Delta t^2}$ ✓

$-36,28 = 10,10\Delta t - 40\Delta t$

$\Delta t = 1,21$ s

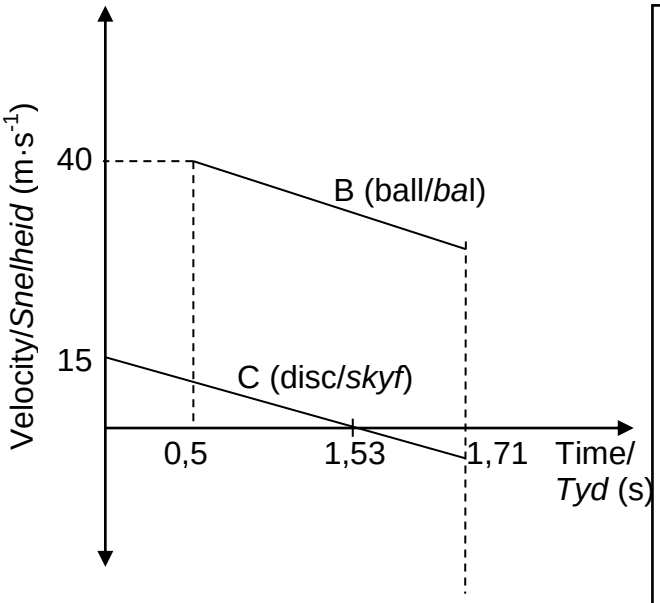
$\Delta t_{tot} = 1,21 + 0,5 = 1,71$ s ✓

(6)

SEE ACADEMY

3.4 **POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.3 /**
***POSITIEWE NASIEN VANAF VRAE 3.2.1 EN 3.3.***

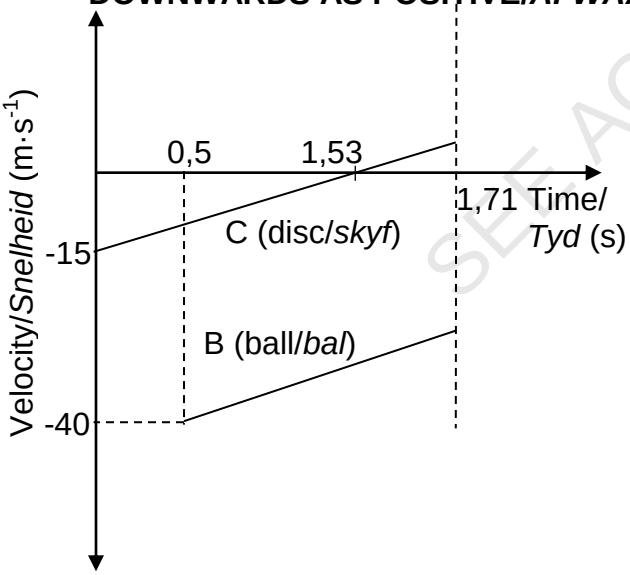
**UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***




**Marking criteria:**
- Initial velocities 40 and 15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with negative gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

***Nasienkriteria:***
- *Aanvanklike snelhede* 40 *en* 15 en reguitlyne ✓
- *B begin by 0,5 s*✓
- *Parallelle lyne met negatiewe gradiënt* ✓
- *Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1)* 1,53 s ✓
- *Tyd wanneer B vir C tref (antwoord van 3.3)* 1,71s ✓

**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***




**Marking criteria:**
- Initial velocities -40 and -15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with positive gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

***Nasienkriteria:***
- *Aanvanklike snelhede* -40 *en* -15 en reguitlyne ✓
- *B begin by 0,5 s*✓
- *Parallelle lyne met positiewe gradiënt* ✓
- *Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1)* 1,53 s ✓
- *Tyd wanneer B vir C tref (antwoord van 3.3)* 1,71s ✓

(5)
**[20]**

SEE ACADEMY

## QUESTION 4 /*VRAAG 4*

4.1 A system on which the resultant/net external force is zero./*'n Sisteem waarop die resultante/netto eksterne krag nul is*. ✓✓ (2 or/*of* 0) (2)

4.2
1. According to Newton 3rd Law ✓ the rocket exerts a force on the toy cart to the left/opposite to direction of motion. ✓

**OR**

2. The toy cart exerts a force on the rocket to the right ✓and the rocket exerts a force on the toy cart to the left/opposite to direction of motion. ✓

**OR**

3. The rocket experiences a change in momentum to the right ✓, the toy cart experiences a change in momentum to the left. ✓

**OR**

4. $\Delta p_{toy\ cart} = -\Delta p_{rocket}$ ✓✓

**OR**

5. Total momentum is conserved / remains constant. ✓
The momentum of the rocket increases. Therefore, the momentum of the toy cart must decrease. ✓

**OR**

6. The rocket experiences an impulse to the right ✓ therefore, the toy cart experiences an impulse to the left. ✓

**OR**

7. $Impulse_{rocket} = -Impulse_{toy\ cart}$ ✓✓

*1. Volgens Newton se derde wet ✓ oefen die vuurpyl 'n krag op die speelgoedwaentjie na links uit/ teen die bewegingsrigting. ✓*

***OF***

2. *Die speelgoedwaentjie oefen 'n krag op die vuurpyl na regs ✓ en die vuurpyl oefen 'n krag op die speelgoedwaentjie na links/teen die bewegingsrigting ✓.*

***OF***

3. *Die vuurpyl ondervind 'n verandering in momentum na regs ✓, die speelgoedwaentjie ondervind 'n verandering in momentum na links.* ✓

***OF***

4. $\Delta p_{speelgoedwaentjie} = -\Delta p_{vuurpyl}$

***OF***

5. *Totale momentum bly behoue.* ✓
*Die momentum van die vuurpyl neem toe.* Dus moet d*ie momentum van die speelgoedwaentjie af neem*. ✓

***OF***

*6. Die vuurpyl ondervind 'n impuls na regs* ✓ dus ondervind die *speelgoedwaentjie 'n impuls na links.* ✓

***OF***

*7.* $Impuls_{vuurpyl} = -Impuls_{speelgoedwaentjie}$ ✓✓ (2)

SEE ACADEMY

4.3

**OPTION 1/*OPSIE 1***

**RIGHT AS POSITIVE/*REGS AS POSITIEF***

$\sum p_i = \sum p_f$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$
$mv_i = m_1v_{1f} + m_2v_{2f}$
✓Any one/*Enige een*

$\underline{(20 + m_2)2,5}$ ✓ $= \underline{20(0,6)}$ ✓ $+ \underline{m_2(30)}$ ✓
$m_2 = 1,38$ kg ✓

**LEFT AS POSITIVE/*LINKS AS POSITIEF***

$\sum p_i = \sum p_f$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$
$mv_i = m_1v_{1f} + m_2v_{2f}$
✓Any one/*Enige een*

$\underline{(20 + m_2)(-2,5)}$ ✓ $= \underline{20(-0,6)}$ ✓ $+ \underline{m_2(-30)}$ ✓
$m_2 = 1,38$ kg ✓

**OPTION 2/*OPSIE 2***

**RIGHT AS POSITIVE/*REGS AS POSITIEF***

$\Delta p_{\text{toy cart/}speelgoedwaentjie} = -\Delta p_{\text{rocket/}vuurpyl}$
$m_1(v_{1(f)} - v_{1(i)}) = -m_2(v_{2(f)} - v_{2(i)})$
✓Any one/*Enige een*

(20) ✓$\underline{(0,6 - 2,5)}$ ✓ $= \underline{-(m)(30 - 2,5)}$ ✓
$m_2 = 1,38$ kg ✓

**LEFT AS POSITIVE/*LINKS AS POSITIEF***

$\Delta p_{\text{toy cart/}speelgoedwaentjie} = -\Delta p_{\text{rocket/}vuurpyl}$
$m_1(v_{1(f)} - v_{1(i)}) = -m_2(v_{2(f)} - v_{2(i)})$
✓Any one/*Enige een*

(20) ✓$\underline{[-0,6 - (-2,5)]}$ ✓ $= \underline{-(m)[(-30) - (-2,5)]}$ ✓
$m_2 = 1,38$ kg ✓

(5)
**[9]**

SEE ACADEMY

## QUESTION 5/*VRAAG 5*

5.1

**Marking criteria/*Nasienkriteria***
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per word/frase.*

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

5.2 $F_{net}$ opposite to direction of displacement $\Delta x$. ✓ / Both frictional force and gravitational force are in opposite direction of displacement $\Delta x$.
*$F_{net}$ teenoorgesteld tot rigting van verplasing $\Delta x$. / Beide wrywingskrag en gravitasie krag is teenoorgesteld tot die verplasing $\Delta x$.*

**OR/*OF***
$\Delta K$ is negative. / The final K is zero. / $E_k$ decreases.
*$\Delta K$ is negatief. / Die finale K is nul. / $E_k$ neem af.*
**OR/*OF***
$W_{net} = F_{net}\ \Delta x\cos\theta$ and/*en* $\theta = 180°/\cos\theta = -1$ (1)

5.3

**OPTION 1/*OPSIE 1***

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mg\sin\theta\Delta x\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige een*

$(30\ 000)(9,8)\sin28°\Delta x\cos180°$✓ + $(31\ 000)\Delta x\cos180°$✓
$= \frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96,64$ m ✓

**OPTION 2/*OPSIE 2***

$W_{nc} = \Delta K + \Delta U$
$W_f = \Delta K + mg(h_f - h_i)$
$f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
✓Any one/*Enige een*

$31\ 000\Delta x\cos180°$✓ = $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓ + $30\ 000(9,8)(\Delta x\sin28° - 0)$ ✓
$\Delta x = 96,64$ m ✓

**OPTION 3/*OPSIE 3***

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$-\Delta E_p + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$-mg(h_f - h_i) + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige*

$-(30\ 000)(9,8)(\Delta x\sin28° - 0)$✓ + $(31\ 000)\Delta x\cos180°$✓= $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96,64$ m ✓

SEE ACADEMY

**OPTION 4/*OPSIE 4***

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige*
$mg\Delta x\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{(30\ 000)(9,8)\Delta x\cos 118°}$✓ + $\underline{(31\ 000)\Delta x\cos 180°}$✓= $\underline{\frac{1}{2}(30\ 000)(0^2 - 33^2)}$ ✓
$\Delta x = 96,64$ m ✓

**OPTION 5/*OPSIE 5***

$F_{net} = ma$
$F_{net} = F_{w//} + f$
$= \underline{(30\ 000)(9,8)\sin 28° + 31\ 000}$✓
$= 169\ 024,64$ N

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige een*
$\underline{169\ 024,64\Delta x\cos 180°}$✓ = $\underline{\frac{1}{2}(30\ 000)(0^2 - 33^2)}$ ✓
$\Delta x = 96\ 64$ m ✓

(5)

5.4 Ascending/*Opgaande* ✓

1. Ascending/*Opgaande*: $F_{net(A)} = F_{w//} + f$
   Descending/*Afgaande*: $F_{net(D)} = F_{w//} - f$ ✓
   $F_{net(A)} > F_{net(D)}$ ✓

**OR/*OF***

2. Ascending: $F_{w//}$ and f are both acting in the opposite to direction of displacement.
   Descending: only f is acting in the opposite direction of displacement. ✓
   Net force for ascending greater than net force for descending. ✓

   *Opgaande: $F_{w//}$ en f werk beide teen die rigting van verplasing.*
   *Afgaande: slegs f werk teen die rigting van verplasing.*
   *Die netto krag opgaande is groter as die netto krag afgaande.*

**OR/*OF***

3. Ascending: $F_{net}$ acts opposite to the direction of motion. ✓
   Descending: $F_{net}$ acts downwards in the direction of motion. ✓

   *Opgaande: $F_{net}$ werk teen die bewegingsrigting.*
   *Afgaande: $F_{net}$ werk afwaarts in die bewegingsrigting.*

**OR/*OF***

4. Ascending: $F_{w(//)}$ acts opposite to the direction of motion
   Descending: $F_{w(//)}$ acts downwards in the direction of motion ✓
   Net force for ascending greater than net force for descending. ✓

   *Opgaande: $F_{w(//)}$ werk teen die bewegingsrigting.*
   *Afgaande: $F_{w(//)}$ werk afwaarts in die bewegingsrigting.*
   *Die netto krag opgaande is groter as die netto krag afgaande.*

(3)
**[11]**

SEN ACADEMY

## QUESTION 6/*VRAAG 6*

6.1

**Marking criteria/*Nasienkriteria***
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.*

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)

6.2

$v = f\lambda$ ✓
$340 = (880)\,\lambda$ ✓
$\lambda = 0{,}39$ m (0,386) ✓ (3)

6.3

**OPTION 1/*OPSIE 1***

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

$f_L = \left(\frac{340 + 10}{340}\right)$ ✓ $880$ ✓

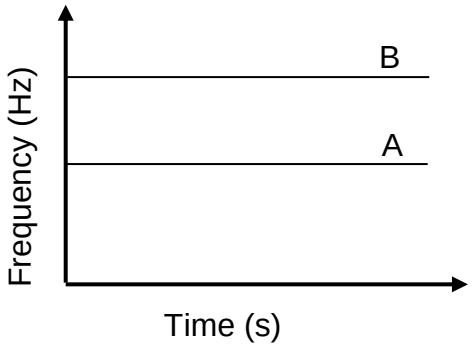
$f_L = 905{,}88$ Hz ✓

**POSITIVE MARKING FROM QUESTION 6.2/**
***POSITIEWE NASIEN VANAF VRAAG 6.2***

**OPTION 2/*OPSIE 2***

$v = f\lambda$ ✓
$340 + 10$ ✓ $= f_L(0{,}39)$ ✓
$f_L = 897{,}44$ Hz ✓ (4)

6.4




**Marking criteria/*Nasienkriteria***
B parallel with A and above A. ✓✓
*B parallel aan A en bokant A.* **2 or/*of* 0**

(2)
**[11]**

SEE ACADEMY

## QUESTION 7/*VRAAG 7*

7.1.1

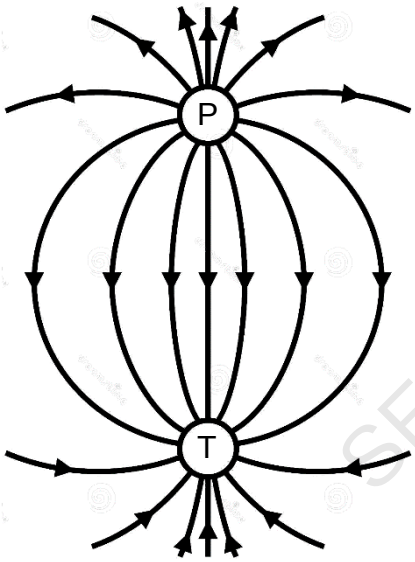
| **Marking criteria/*Nasienkriteria:*** |
|---|
| If any of the underlined key words/phrases in the correct context are omitted:<br>- 1 mark per word/phrase.<br>*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.* |

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

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

(2)

7.1.2




| **Criteria for graph/*Kriteria vir grafiek:*** | |
|---|---|
| Correct shape<br>*Korrekte vorm* | ✓ |
| Correct direction from P to T.<br>*Korrekte rigting van P na T.* | ✓ |
| Lines must not cross and must touch spheres.<br>*Lyne mag nie kruis nie en moet die sfere raak.* | ✓ |
| **<u>NOTE/*AANTEKENING*</u>**:<br>If the net electric field pattern is drawn for two like charges:<br>*Indien die netto elektriese veldpatroon vir twee gelyksoortige ladings geteken is:* | $0/3$ |

(3)

7.1.3 positive/ *positief* ✓ (1)

SEEN ACADEMY

7.1.4

**Marking criteria/*Nasienkriteria***

- Equation for Coulomb's law./Vergelyking vir *Coulomb se wet.* ✓
- Correct substitution into Coulomb's equation for for $F_{TP}$. ✓
  *Korrekte vervanging in Coulomb se vergelyking vir* $F_{TP}$.
- Correct substitution into Coulomb's equation for $F_{TS}$. ✓
  *Korrekte vervanging in Coulomb se vergelyking vir* $F_{TS}$.
- Correct substitution into resultant force equation (Pythagoras equation). ✓
  Korrekte vervanging in resultante krag vergelyking (Pythagoras vergelyking).
- Substitute into Q = ne. /*Vervang in* Q = ne. ✓
- Final answer/*Finale antwoord*: 3,05 x$10^{13}$ ✓

$$F_{net}^2 = F_{TP}^2 + F_{TS}^2$$

$$= \left(\frac{kQ_1Q_2}{r^2}\right)^2 \text{ ✓} + \left(\frac{kQ_1Q_2}{r^2}\right)^2$$

$$10^2 = \left(\frac{(9\times10^9)(3\times10^{-6})(3\times10^{-6})}{0{,}1^2}\right)^2 \text{ ✓} + \left(\frac{(9\times10^9)(3\times10^{-6})Q_2}{0{,}15^2}\right)^2 \text{ ✓}$$

$Q_S = 4{,}887 \times 10^{-6}$ C

↓ $Q_S = ne$

$4{,}887 \times 10^{-6} = n(1{,}6 \times 10^{-19})$ ✓

n = 3,05 x$10^{13}$ ✓ electrons/*elektrone* (6)

7.2.1 E is directly proportional to $\frac{1}{r^2}$ ./*E is direk eweredig aan* $\frac{1}{r^2}$. ✓

**OR/*OF***

$E \alpha \frac{1}{r^2}$ (1)

7.2.2

| | |
|---|---|
| Gradient = $\frac{\Delta E}{\Delta \frac{1}{r^2}}$ ✓<br>$680$ ✓ $= \frac{E_A - (0)}{\frac{1}{0{,}04^2} - (0)}$ ✓<br>$E_A = 4{,}25 \times 10^5$ N·C$^{-1}$ ✓ | **ACCEPT/*AANVAAR***<br>$E = \frac{kQ}{r^2}$ ✓<br>$E_A = \frac{680}{0{,}04^2}$ ✓ ✓<br>$= 4{,}25 \times 10^5$ N·C$^{-1}$ ✓<br>**OR/*OF***<br>y = mx + c / y = mx ✓<br>$E_A = 680$ ✓ $\left(\frac{1}{0{,}04^2}\right)$ ✓<br>$= 4{,}25 \times 10^5$ N·C$^{-1}$ ✓ |

(4)

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7.2.3 Greater than / *Groter as* ✓

The gradient is equal to kQ./The gradient is proportional to Q. ✓
Graph of sphere B has a steeper gradient than graph of sphere A. ✓
*Die gradiënt is gelyk aan kQ./Die gradiënt is proporsioneel aan Q.*
*Grafiek vir sfeer B het 'n steiler gradiënt as die grafiek vir sfeer A.*

**OR/*OF***

For the same $\frac{1}{r^2}$, E is greater for sphere B. ✓✓

*Vir dieselfde $\frac{1}{r^2}$, is E groter vir sfeer B.*

(3)
**[20]**

**QUESTION 8/*VRAAG 8***

8.1 A conductor (resistor) which obeys Ohm's law./*'n Geleier wat Ohm se wet gehoorsaam.* ✓✓ **(2 or/*of* 0)**

**OR/OF**
V always directly proportional to I at constant temperature. ✓✓ **(2 or/*of* 0)**
*V is altyd direk eweredig aan I by konstante temperatuur.*

**OR/OF**
$\frac{V}{I}$ = constant / k / c*onstant at constant temperature.* ✓✓ **(2 or/*of* 0)**
$\frac{V}{I}$ = konstant / k / *konstant bly by 'n konstante temperatuur.*

**OR/OF**
A conductor for which the resistance remains constant at constant temperature when voltage or current change. ✓✓ **(2 or/*of* 0)**
*'n Geleier waar die weerstand konstant bly by 'n konstante temperatuur wanneer die potensiaalverskil of die stroom verander.* (2)

8.2.1
$R = \frac{V}{I}$ ✓
$4 = \frac{3,2}{I}$ ✓
$I = 0,8$ A ✓ (3)

SEE ACADEMY

8.2.2

**POSITIVE MARKING FROM QUESTION 8.2.1. /**
***POSITIEWE NASIEN VANAF VRAAG 8.2.1.***

**OPTION 1/*OPSIE 1***

$\varepsilon = I(R+r)$ ✓ ✓

$= 0,8\ (4 + 8 + 0,5)$ ✓

$= 10$ V ✓

**OR/*OF***

$\varepsilon = I(R+r)$ ✓

$= 0,8(4 + 8) + 0,8 \times 0,5$ ✓

$= 10$ V ✓

**OPTION 2/*OPSIE 2***

$V_8 = IR$
$= (0,8)(8)$
$= 6,4$ V

$V_{ext} = 3,2 + 6,4$
$= 9,6$ V

$V_{int} = Ir$
$= (0,8)(0,5)$ ✓
$= 0,4$ V

$\varepsilon = I(R + r)$
$= V_{ext} + V_{int}$
✓Any one/*Enige een*

$= 9,6 + 0,4$ ✓
$= 10$ V ✓

(4)

8.3.1

**POSITIVE MARKING FROM QUESTION 8.2.2./**
***POSITIEWE NASIEN VANAF VRAAG 8.2.2.***

**OPTION 1/*OPSIE 1***

$V_{int} = Ir$
$1,2 = I(0,5)$ ✓
$I = 2,4$ A

$R_{ext} = \frac{V}{I}$
$= \frac{8,8✓}{2,4✓}$
$= 3,67\ \Omega$ (3,667)

$R_P = \frac{12R}{12 + R}$

$3,67 = \frac{12R}{12 + R}$ ✓

$R = 5,29\ \Omega$ (5,28) ✓

**OR/*OF***

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

$\frac{1}{3,67} = \frac{1}{R} + \frac{1}{12}$ ✓

$R = 5,29\ \Omega$ (5,28) ✓

**OPTION 2 /*OPSIE 2***

$V_{int} = 10 - 8,8$
$= 1,2$ V

$V_{int} = Ir$
$1,2 = I(0,5)$ ✓
$I = 2,4$ A

$I_{series\ branch} = \frac{V}{R}$
$= \frac{8,8✓}{8+4}$
$= 0,73$ A (0,733)

$I_R = 2,4 - 0,73$ ✓
$= 1,67$ A (1,667)

$R = \frac{V}{I_R}$
$= \frac{8,8}{1,67}$ ✓
$= 5,27\ \Omega$ (5,28) ✓

(5)

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8.3.2 There is a short circuit /*Daar is 'n kortsluiting*.

- The resistance of the connected wire is very low. / The total resistance decreases. ✓
  *Die weerstand van die verbindingsdrade is baie klein. /Die totale weerstand neem af.*
- $I \alpha \frac{1}{R}$, current delivered by the battery is very high. ✓
  $I \alpha \frac{1}{R}$, *stroom gelewer deur die battery is baie groot.*
- Higher current produces more heat. ✓
  *Hoër stroom produseer meer hitte*.

**OR/*OF***

Any one of the following equations can be used to explain the effect of current on heat/*Enigeen van die volgende vergelykings kan gebruik word om die effek van stroom op hitte te verdudidelik:*

$W = I^2R\Delta t$ / $W = \frac{V^2}{R}\Delta t$ / $W = VI\Delta t$ / $P = I^2R$ / $P = \frac{V^2}{R}$ / $P = VI$ (3)

**[17]**

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## QUESTION 9/*VRAAG 9*

9.1.1 Electrical to mechanical/kinetic/rotational ✓
*Elektries na meganies/kineties/rotasie* (1)

9.1.2 DC/*GS* ✓ (1)

9.1.3 Ensures continuous rotation of the coil. ✓
*Verseker aanhoudende rotasie van spoel.*

**OR/*OF***
Ensures change in direction of the current in the coil. ✓
*Verseker verandering van rigting van stroom in spoel.* (1)

9.2 **QUESTIONS 9.2.1 AND 9.2.2/*VRAE 9.2.1 EN 9.2.2***
**Only penalise once if subscripts are omitted.**
***Penaliseer slegs een keer indien onderskrifte uitgelaat is.***

9.2.1

**Marking criteria/*Nasienkriteria:***
- Correct formula to calculate resistance. ✓
  *Korrekte formule om weerstand te bereken.*
- Substitute into formula to calculate resistance. ✓
  *Vervang in formule of weerstand te bereken.*
- Final answer/*Finale antwoord:* 484 to/*tot* 493,83 Ω ✓

| **OPTION 1/*OPSIE 1*** | **OPTION 2/*OPSIE 2*** | **OPTION 3/*OPSIE 3*** |
|---|---|---|
| $P_{ave} = \frac{V_{rms}^2}{R}$ ✓<br>$100 = \frac{220^2}{R}$ ✓<br>R = 484 Ω ✓ | $P_{ave} = V_{rms}I_{rms}$<br>$100 = 220I_{rms}$<br>$I_{rms}$ = 0,45 A (0,455)<br>$I_{rms} = \frac{V_{rms}}{R}$ ✓<br>$0,45 = \frac{220}{R}$ ✓<br>R = 488,89 Ω ✓ | $P_{ave} = V_{rms}I_{rms}$<br>$100 = 220I_{rms}$<br>$I_{rms}$ = 0,45 A (0,455)<br>$P_{ave} = I_{rms}^2R$ ✓<br>$100 = (0,45)^2R$ ✓<br>R = 493,83 Ω ✓ |

(3)

SEE ACADEMY

9.2.2

**POSITIVE MARKING FROM QUESTION 9.2.1/**
***POSITIEWE NASIEN VANAF VRAAG 9.2.1.***

**Marking criteria:**

- Uses power of Y in circuit (80 W) to calculate $I_{rms}$ of the circuit. ✓
- Determines $V_{rms}$ across $R_Z$ in the circuit. ✓
- Uses $I_{rms}$ and $V_{rms}$ across $R_Z$ in the circuit to calculate resistance $R_Z$. ✓
- Use of any <u>one</u> relevant power equation. ✓
- Uses $R_Z$ and 220 V to calculate X. ✓
- Final answer for X. ✓

**Accept range*:***
846,07 W to 856,03 W

***Nasienriglyne:***

- *Gebruik drywing van Y in stroombaan (80 W) om $I_{wgk}$ te bereken.* ✓
- *Bepaal $V_{wgk}$ oor $R_Z$ in die stroombaan.* ✓
- *Gebruik $I_{wgk}$ en $V_{wgk}$ oor $R_Z$ in die stroombaan om weerstand $R_Z$ te bereken.* ✓
- *Gebruik van <u>enige</u> drywing-formule.*
- *Gebruik $R_Z$ en 220 V om X te bereken.* ✓
- *Finale antwoord vir X.* ✓

***Aanvaar gebied:***
*846,07 W tot 856,03 W*

**For resistor Y/*Vir resistor Y***

$P_{ave} = I_{rms}^2 R$

$80 = I_{rms}^2 (484)$ ✓

$I_{rms} = 0,407$ A

**OR/*OF***

$P_{ave} = \frac{V_{rms}^2}{R}$

$80 = \frac{V_{rms}^2}{484}$

$V_{rms} = 196,77$ V

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

$= \frac{196,77}{484}$ ✓

$= 0,407$ A

**For/*Vir Z***

$V_{rms} = 220 - 196,77$ ✓

$= 23,23$ V

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

$[0,407 = \frac{23,23}{R}]$ ✓

$R = 57,08\ \Omega$

Range/*Gebied*:
56,66 Ω to/tot 57,13 Ω

**X for Z/*X vir Z:***

$X = P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$= \frac{220^2}{57,08}$ ✓

$= 847,93$ W ✓

**OR/*OF***

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

$= \frac{220}{57,08}$

$= 3,85$ A

$X = P_{ave} = I_{rms}^2 R$ ✓

$= \underline{(3,85)^2(57,08)}$ ✓

$= 846,07$ W ✓

**OR/*OF***

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

$= \frac{220}{57,08}$

$= 3,85$ A

$X = P_{ave} = V_{rms} I_{rms}$ ✓

$= (220)(3,85)$ ✓

$= 847$ W ✓

(6)

**[12]**

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## QUESTION 10/*VRAAG 10*

10.1.1

**Marking criteria/*Nasienkriteria:***
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.*

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)

10.1.2 For one photon/*Vir een foton*:

**NOTE/*LET WEL***
$W_o = hf_o$ $^0/_2$

$E = hf$ ✓
$= (6{,}63 \times 10^{-34})(1{,}2 \times 10^{15})$ ✓
$= 7{,}96 \times 10^{-19}$ J

No of $e^-$ = No of photons/*Hoeveelheid fotone*

$$= \frac{\text{Total energy of photons}}{\text{Energy of one photon}} \,/\, \frac{\text{Totale energie van fotone}}{\text{Energie van een foton}}$$

$$= \frac{1{,}75 \times 10^{-9}}{7{,}96 \times 10^{-19}} \checkmark$$

$= 2{,}2 \times 10^9$ ✓ $(2{,}198 \times 10^9)$ (4)

10.1.3 **POSITIVE MARKING FOR E ONLY FROM QUESTION 10.1.2/ *POSITIEWE NASIEN VIR SLEGS E VANAF VRAAG 10.1.2***

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

$7{,}96 \times 10^{-19}$ ✓ $= (6{,}63 \times 10^{-34})(9{,}09 \times 10^{14})$ ✓ $+ \frac{1}{2}(9{,}11 \times 10^{-31})v_{max}^2$ ✓

$v_{max} = 6{,}51 \times 10^5$ m·s$^{-1}$ ✓ (5)

10.2 An atom (electron) in higher (excited) energy state/level returns to a lower energy state/level. ✓
Energy is released as light (photons/frequencies of light are released). ✓
'*n Atoom (elektron) in 'n hoër (opgewekte) energie toestand/vlak keer terug na 'n laer energievlak (grondvlak).*
*Energie word vrygestel as lig (fotone/frekwensies van lig word vrygestel).* (2)
**[13]**

**TOTAL/*TOTAAL*: 150**

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