Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIORSERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2024

PHYSICAL SCIENCES P1/ *FISIESE WETENSKAPPE V1* MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: **150**

This marking guideline consists of 18 pages./
Hierdie nasienriglyn bestaan uit 18 bladsye.

GENERAL GUIDELINES/*ALGEMENE RIGLYNE*

1. CALCULATIONS/*BEREKENINGE*

1.1 **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: *korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*

1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there are many relevant symbols and applicable substitutions.
Geen punte *sal toegeken word waar 'n* ***verkeerde of ontoepaslike formule gebruik*** *word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Wanneer 'n fout gedurende ***substitusie in 'n korrekte formule*** *begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar* ***geen verdere punte*** *sal toegeken word nie.*

1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark.**
Indien ***geen formule*** *gegee is nie, maar* ***al die substitusies is korrek****,* ***verloor*** *die kandidaat* ***een punt****.*

1.5 **No penalisation** if **zero substitutions are omitted** in calculations where **correct formula**/**principle** is correctly given.
Geen penalisering *indien* ***nulwaardes nie getoon*** *word nie in berekeninge waar die* ***formule/beginsel korrek gegee is nie****.*

1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal die punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.

1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien ***'n poging tot berekening aangewend*** *is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.*

1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formules ingestel word en nie vir waardes wat voor 'n berekening gelys is nie.

1.9 All calculations, when not specified in the question, must be done to a minimum of two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.

1.10 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

1.11 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.
Vrae waar 'n reeks berekeninge gedoen moet word (bv. 'n stroombaan-diagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.

2. UNITS/*EENHEDE*

2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
*Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag**.*

2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.

2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte sal slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken word nie. Kandidate sal die punt vir die antwoord in die volgende gevalle verbeur:

- *Korrekte antwoord + verkeerde eenheid*
- *Verkeerde antwoord + korrekte eenheid*
- *Korrekte antwoord + geen eenheid*

2.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \bullet s^{-1}$ or $km \bullet h^{-1}$ instead of $m \bullet s^{-1}$ where the question warrants this.
SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \bullet m^{-1}$ in plaas van $N \bullet C^{-1}$, en $cm \bullet s^{-1}$ of $km \bullet h^{-1}$ in plaas van $m \bullet s^{-1}$ waar die vraag dit regverdig.

3. GENERAL/*ALGEMEEN*

3.1 If one answer or calculation is required, but two are given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2 For marking purposes, alternative symbols (s, u, t, etc.) will also be accepted.
Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.

3.3 Separate compound units with a multiplication dot, not a full stop, for example, $m•s^{-1}$.
For marking purposes, $m•s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld $m•s^{-1}$. Vir nasiendoeleindes sal $m•s^{-1}$ en m/s ook aanvaar word.

4. POSITIVE MARKING/*POSITIEWE NASIEN*

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekeninge sal in die volgende gevalle geld:

4.1 **Subquestion to subquestion:** When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 of 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.
***Subvraag na subvraag**: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*

4.2 **A multistep question in a subquestion**: If the candidate has to calculate, for example, current in die first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
*'n **Vraag met veelvuldige stappe in 'n subvraag**: Indien 'n kandidaat bv. die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

5. NEGATIVE MARKING/*NEGATIEWE NASIEN*

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given in QUESTION 3.1, and QUESTION 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. QUESTION 3.1 is based on a calculation, the motivation for the incorrect answer could be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en VRAAG 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. VRAAG 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in VRAAG 3.2 oorweeg word.

QUESTION 1/*VRAAG* 1: MULTIPLE-CHOICE QUESTIONS/ *MEERVOUDIGEKEUSE-VRAE*

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

[20]

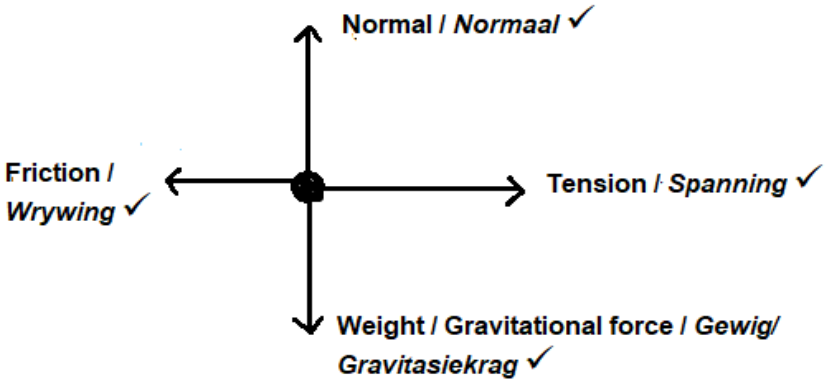
QUESTION 2/*VRAAG 2*

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration 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.

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 van die voorwerp in die rigting van die resulterende/netto krag. (2)

2.2



Accepted labels / *Aanvaarde benoemings*

w	F_g/F_w/weight/gravitational force / *Gewig/gravitasiekrag*	✓
T	F_T/Tension/Force in string/*Spanning/ Spanning in tou*	✓
N	F_N/N/Normal Force/*Normaalkrag*	✓
F_k	f_k/Frictional force/*Wrywingskrag*	✓

(4)

2.3 2.3.1 $f_k = \mu_k N$ ✓

$f_k = \mu_k F_g$

$f_k = (0,25)(4)(9,8)$ ✓

$f_k = 9,8$ N ✓ (3)

2.3.2 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 2.3.1**

$F_{net} = ma$
$F_{net} = T - f$ Any one / *Enige een* ✓
$F_{net} = F_g - T$

4 kg block / *4-kg blok*

$T - 9,8$ ✓$= 4a$

$T = 4a + 9,8$

Any ONE / *Enige EEN* (4a or/*of* 2a) ✓

2 kg block / *2-kg blok*

$(2)(9,8) - T$ ✓ $= 2a$

$T = 19,6 - 2a$

$19,6 - 2a = 4a + 9,8$

$a = 1,63\ m{\cdot}s^{-2}$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = 0^2 + 2(1,63)(1)$ ✓
$v_f = 1,81\ m{\cdot}s^{-1}$ ✓ (7)

2.4 The gravitational force (weight) is not the only force acting on the 2 kg block. ✓✓
Die gravitasiekrag (gewig) is nie die enigste krag wat op die 2 kg-blok inwerk nie.

OR/*OF*

The acceleration is not 9,8 $m.s^{-2}$. ✓✓
Die versnelling is nie 9,8 $m.s^{-2}$ nie. (2)

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QUESTION 3/*VRAAG 3*

3.1 Downwards/*Afwaarts* ✓ (1)

3.2

Upwards positive/*Opwaarts as positief*	**Downwards positive/*Afwaarts as positief***
$v_f = v_i + a\Delta t$ ✓ = 30 ✓ + (-9,8)(2,135) = 9,08 m·s^{-1}, upwards / *opwaarts* ✓	$v_f = v_i + a\Delta t$ ✓ = - 30 ✓ + (9,8)(2,135) = - 9,078 m·s^{-1} = 9,08 m·s^{-1}, upwards/ *opwaarts* ✓

(3)

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 3.2

3.3 **OPTION 1/*OPSIE 1***

Upwards positive / *Opwaarts as positief*	**Downwards positive / *Afwaarts as positief***
Ball **A**: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ Δy = -12(2,5) + ½(-9,8)(2,5)^2 ✓ Δy = - 60,625 m (Height / *Hoogte* = 29,375 m) Ball / *Bal* **B**: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ = 30(2,5) + ½(-9,8)(2,5)^2 ✓ = 44,375 m Distance/*afstand* = 44,375 – 29,375 ✓ = 15 m ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ Δy = 12(2,5) + ½(9,8)(2,5)^2 ✓ Δy = 60,625 m (Height / *Hoogte* = 29,375 m) Ball / *Bal* **B**: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ = -30(2,5) + ½(9,8)(2,5)^2 ✓ = - 44,375 m Distance/*afstand* = 44,375 – 29,375 ✓ = 15 m ✓

OPTION 2/*OPSIE 2*

Ball/*Bal* A

$v_f = v_i + a\Delta t$

v_f = -12 + (-9,8)(2,135)

v_f = 32,923 m·s^{-1}, downwards/*afwaarts*

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

Δy = -32(2,5 – 2,135) + ½(-9,8)(2,5 – 2,135)^2 ✓

Δy = - 12,6696 m

Ball/*Bal* B

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

Δy = 9,08(2,5 – 2,135) + ½(-9,8)(2,5 – 2,135)^2 ✓

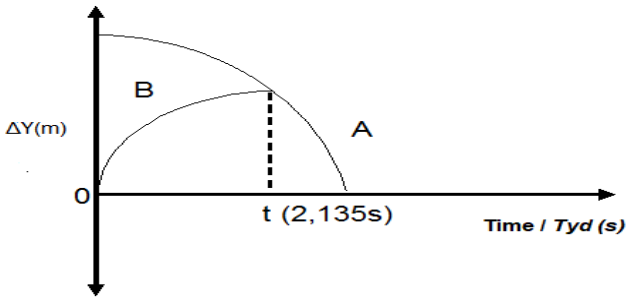
Δy = 2,66 m

Distance/*afstand* = 2,66 + 12,6696 ✓

15,33 m ✓ (5)

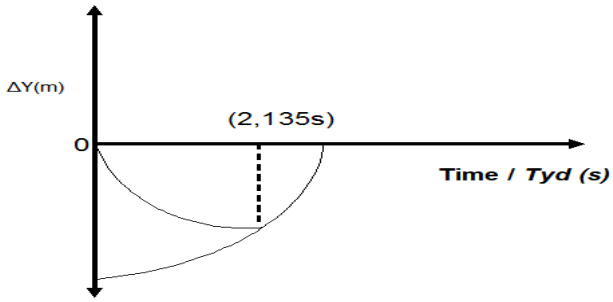
3.4 **OPTION 1/*OPSIE 1***

Upward positive/Opwaarts as positief



OPTION 2/*OPSIE 2*

Upward negative/Opwaarts negatief



Criteria for graph / *Nasienkriteria vir grafiek*	**Marks / *Punte***
Shape for ball **A** up till zero position. *Vorm vir bal **A** tot die nulposisie.*	✓
Shape for ball **B** up till intersection of lines time. 2,135 s/ *Vorm vir bal **B** tot die snypunt van lyne. 2,135 s.*	✓
Indication of time 2,135 s/ *Aandui van tyd 2,135 s*	✓
Ground not zero position (provided everything else is correct): $^2/_3$/ *Grond nie as nulpunt nie (mits alles korrek is)* $^2/_3$	

(3)
[12]

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum ✓ of an isolated system ✓ remains constant / is conserved.
Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant/ behoue. (2)

4.2 **Right as positive/*Reg as positief***

$\Sigma p_i = \Sigma p_f$
$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ } Any one / *Enige een* ✓

$(5\ 000)(15) + (2\ 000)(-20$ ✓ $= (5\ 000)v_f + (2\ 000)(5)$ ✓

$v_i = 5\ m\cdot s^{-1}$ ✓

Left as positive / *Links as positief*

$\Sigma p_i = \Sigma p_f$
$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ } Any ONE / *Enige EEN* ✓

$(5\ 000)(-15) + (2\ 000)(20)$ ✓ $= (5000)v_f + (2000)(-5)$ ✓

$v_i = -5\ m\cdot s^{-1}$

Magnitude of velocity / *Grootte van snelheid* $= 5\ m\cdot s^{-1}$ ✓ (4)

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 4.2/

4.3 **OPTION 1/*OPSIE 1***

$F_{net}\Delta t = \Delta p$
$F_{net}\ \Delta t = mv_f - mv_i$ } Any one / *Enige een* ✓

F_{net} (0,4) ✓ $= (5\ 000)(5) - (5\ 000)(15)$ ✓

$F_{net} = -125\ 000$ N

F_{net} = 125 000 N to the right/*na regs* ✓

OPTION 2/*OPSIE 2*

$F_{net}\Delta t = \Delta p$
$F_{net}\ \Delta t = mv_f - mv_i$ } Any one / *Enige een* ✓

F_{net} (0,4) ✓ $= (2000)(-5) - (2000)(20)$ ✓

$F_{net} = -125\ 000$ N

F_{net} = 125 000 N to the right/*na regs* ✓ (4)
[10]

QUESTION 5/*VRAAG 5*

5.1 Backwards/behind him / *Terugwaarts/agter hom* ✓ (1)

5.2 Newton's third Law ✓of motion/*Newton se derde wet van beweging*
When one body exerts a force on a second body, the second body exerts a force of equal magnitude ✓ in the opposite direction on the first body. ✓
Wanneer voorwerp A 'n krag uitoefen op voorwerp B, sal voorwerp B gelyktydig 'n krag van gelyke grootte in in die teenoorgestelde op voorwerp A uitoefen. (3)

5.3 **OPTION 1/*OPSIE 1***

$W_{net} = \Delta K$
$W_g + W_f = \Delta K$ } Any one/*Enige een* ✓

$F_g \Delta x \cos\Theta + f\Delta x \cos\Theta = \Delta K$

$(57)(9,8)(4)\cos180^\circ$ ✓ $+ 40\Delta x \cos180^\circ$ ✓ $= \underline{0 - ½(57)(6^2)}$ ✓

$\Delta x = -30,21$ m

$\text{Sin } \Theta = \frac{4}{30,21}$

$\Theta = 7,61^\circ$ ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta U + \Delta K$ / $W_{nc} = \Delta E_p + \Delta E_k$ ✓

$40\Delta x \cos180^o$ ✓ $= \underline{(57)(9,8)(4) - (57)(9,8)(0)}$ ✓ $+ \underline{½(57)(0)^2 - ½(57)(6)^2}$ ✓

$\Delta x = -30,21$ m

$\text{Sin } \Theta = \frac{4}{30,21}$

$\Theta = 7,61^\circ$ ✓ (5)

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

$W_{net} = \Delta K$
$W_T + W_g + W_f = \Delta K$ } Any ONE/*Enige EEN* ✓

$(80)(5)(4)\cos0^\circ$ ✓$+ \underline{(4)(9,8)\sin30^\circ \bullet (5)\cos180^\circ}$ ✓ $+ (15)(5)\cos180^\circ$ ✓

$= ½(4)v_f^2 - ½(4)(3^2)$ ✓

$v_f = 11,07 \text{ m·s}^{-1}$ ✓

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

$W_{nc} = \Delta U + \Delta K$
$W_T + W_f = \Delta U + \Delta K$ } Any one/*Enige een* ✓

$(80)(5)(4)\cos0^\circ$ ✓$+ (15)(5)\cos180^\circ$ ✓ =

$\underline{(4)(9,8)(\sin30^\circ)(5) - (4)(9,8)(0)}$ ✓ $+ \underline{½(4)v_f^2 - ½(4)(3)^2}$ ✓

$v_f = 11,07 \text{ m·s}^{-1}$ ✓ (6)

[15]

QUESTION 6/*VRAAG 6*

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

OR/OF

The (apparent) change in frequency/pitch ✓ of the (sound) wave heard by a listener when there is relative motion between the listener and the source producing the sound waves. ✓/
Die (waarskynlike) verandering in frekwensie / toonhoogte van (klank) soos gehoor deur 'n luisteraar wanneer daar relatiewe beweging tussen die luisteraar en bron wat die klankgolwe produseer. (2)

6.2 6.2.1 INCREASE/*TOENEEM* ✓ (1)

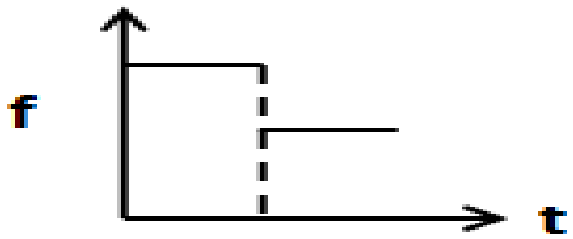
6.2.2 DECREASE/*AFNEEM* ✓ (1)

6.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ or/of $f_L = \frac{v + v_L}{v} f_S$ ✓

$f_L = \frac{330 + 30}{330 - 0}$ ✓ x 1 800 ✓

f_L = 1 963,6 Hz ✓ (5)

6.4



Marking Criteria/*Nasienkriteria*	
Labels of axes/*Benoeming van asse*	✓
Higher frequency initially/*Hoër aanvanklike frekwensie*	✓
Lower frequency as time increases/ *Laer frekwensie soos tyd toeneem*	✓

(3)

6.5 Bloodflow meter ✓ / Doppler flow meter ✓
Bloedvloeimeter / Doppler-vloeimeter (1)

[13]

QUESTION 7/ *VRAAG 7*

7.1 The electrostatic force between two point charges is directly proportional to the product of the magnitude of the charges, ✓ and inversely proportional to the square of the distance between them. ✓
Die elektrostatiese krag tussen twee puntladings 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 Since/*Aangesien* $F_{K\text{ on }M} = F_{G\text{ on }M}$ ✓

$(F_{net})^2 = (F_{K\text{ on }M})^2 + (F_{G\text{ on }M})^2$ ✓

$(2{,}864 \times 10^{-6})^2$ ✓ $= F^2 + F^2$

$F = 2{,}025 \times 10^{-6}$ N ✓ (4)

$F = \frac{kQ_1Q_2}{r^2}$ ✓

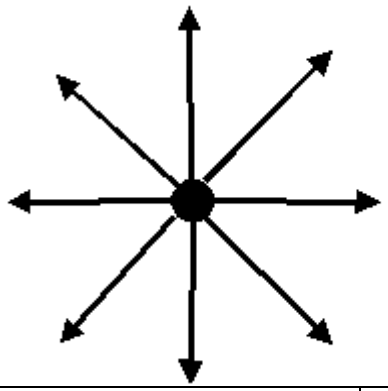
$2{,}025 \times 10^{-6}$ ✓ $= \frac{9 \times 10^9 \times 6 \times 10^{-9} \times 6 \times 10^{-9}}{(X)^2}$ ✓

$X = 0{,}4$ m ✓ (8)

[10]

QUESTION 8/*VRAAG 8*

8.1



✓✓✓

Criteria for marking / *Nasienkriteria*	
Correct shape / *Korrekte vorm*	✓
Correct direction / *Korrekte rigting*	✓
Lines touching charge and not crossing/ *Lyne raak lading en kruis nie*	✓

(3)

8.2 It is the electrostatic force exerted **per unit positive charge** placed at that point. ✓✓/
Dit is die elektrostatiese krag **wat *per eenheidspositiewe-lading*** *wat by daardie punt geplaas is.* (2)

8.3 $E_P = \frac{kQ_1}{r^2}$ ✓

$E_P = \frac{9 \times 10^9 \times 200 \times 10^{-9}}{(0,2)^2}$ ✓

$E_P = 45\ 000\ N.C^{-1}$ to the right / *na regs*

$E_Q = \frac{kQ_2}{r^2}$

$E_Q = \frac{9 \times 10^9 \times 200 \times 10^{-9}}{(0,4)^2}$ ✓

$E_Q = 11\ 250\ N.C^{-1}$ to the left / *na links*

$E_{net} = 45\ 000 + (-11\ 250)$ ✓

$E_{net} = 33\ 750\ N.C^{-1}$ to the right / *na regs* ✓ (5)

[10]

QUESTION 9/*VRAAG 9*

9.1 The potential difference is directly proportional to current, ✓ provided the temperature remains constant. ✓
Die potensiaalverskil is direk ewerewig aan die stroom, mits die temperatuur konstant bly.

OR/*OF*

The ratio of potential difference to current ✓ at constant temperature ✓ is a constant./
Die verwantskap tussen potensiaalverskil tot stroom by konstante temperatuur is konstant. (2)

9.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$P = \frac{V^2}{R}$ ✓ $13,5 = \frac{(18)^2}{R}$ ✓ $R = 24\ \Omega$ ✓	$P = VI$ ✓ $I_R = P/V = 13,5/18$ ✓ $= 0,75$ A $V = IR$ $R = V/I_R = 18/0,75 = 24\ \Omega$ ✓

(3)

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 9.2

9.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$R = \frac{V}{I}$ ✓ ✓ $24 = (18)$ $I = \frac{I}{0,75\ A}$ $R = \frac{V_p}{I_{12}}$ $12 = \frac{18}{I_{12}}$ $I_{12} = 1,5$ A ✓ $I_{Total} = 1,5 + 0,75 = 2,25$ A ✓	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $\frac{1}{R_P} = \frac{1}{12} + \frac{1}{24}$ ✓ $R_P = 8\ \Omega$ ✓ $V = IR_P$ $18 = I\ (8)$ ✓ $I = 2,25$ A ✓

(5)

9.4 Internal resistance is the opposition to the flow of charge within a battery ✓✓/
Interne weerstand is die teenstanding van die vloei van lading binne die battery. (2)

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 9.3

9.5 $V_{10} = IR_{10}$ ✓
$V_{10} = 2,25 \times 10$ ✓
$V_{10} = 22,5$ V ✓ (3)

9.6 **OPTION 1/*OPSIE 1***

$V_1 = V_{ext}$
$V_1 = V_P + V_{10}$
$V_1 = 18 + 22,5$ ✓
$V_1 = 40,5$ V
When the switch is open the Emf / *Wanneer die skakelaar oop is, is die emk* = 45,9 V
The 'lost volts' is / *Die 'verlore spanning' is*: V_{lost} = emf/*emk* – V_{ext}
= 45,9 – 40,5 ✓ = 5,4 V

$r = \frac{V_L}{I}$ ✓

$r = \frac{5,4}{2,25}$ ✓

r = 2,4 Ω ✓

OPTION 2/*OPSIE 2*

Emf = I (R + r) ✓

45,9✓ = (2,25) (8 + 10 + r) ✓

r = 2,4 Ω ✓

$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2}$

$\frac{1}{R_P} = \frac{1}{12} + \frac{1}{24}$ ✓

R_P = 8 Ω (5)

9.7 Remain the same/*Bly dieselfde* (1)
[21]

QUESTION 10/*VRAAG 10*

10.1 To ensure continuous rotation of the coil. ✓/
Om te verseker dat die spoel aanhoudend roteer. (1)

10.2 (i) Replace the source of potential difference with load/resistor. ✓/
Vervang die bron van die potensiaalverskil met 'n resistor
(ii) Replace the split ring (commutator) with (two) slip rings ✓/
Vervang die splitring (kommutator) met (twee) sleepringe. (2)

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 10.2

10.3 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

$I_{rms} = \frac{0,54}{\sqrt{2}}$ ✓

I_{rms} = 0,38 A

$P_{ave} = V_{rms}I_{rms}$ ✓

60 = V_{rms} x 0,38 ✓

V_{rms} = 157,89 V ✓ (5)
[8]

QUESTION 11/*VRAAG 11*

11.1 $c = f \times \lambda$ ✓

Accept/*Aanvaar* $v = f\lambda$

$3 \times 10^{8} = f \times 229 \times 10^{-9}$ ✓

$f = 1{,}31 \times 10^{15}$ Hz ✓ (3)

11.2 Threshold frequency / *Drumpelfrekwensie* ✓ (1)

11.3 Work function is the minimum amount of energy required to eject an electron out of a surface of a given solid, usually a metal. ✓✓/
Werkfunksie is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel. (2)

11.4 $E = W_o + E_{k(\text{max/maks})}$ ✓

$hf = W_o + \frac{1}{2}mv^2$

$6{,}63 \times 10^{-34} \times f$ ✓ $= (6{,}63 \times 10^{-34} \times 1{,}31 \times 10^{15}) + \frac{1}{2}(9{,}11 \times 10^{-31})(1{,}57 \times 10^{6})^2$ ✓

$f = 3 \times 10^{15}$ Hz ✓ (4)

11.5 INCREASES / *TOENEEM* ✓
A decrease in wavelength results in an increase in the frequency. ✓ Work function increases. ✓
'n Afname in die golflengte lei na 'n toename in die frekwensie. Arbeidsfunksie neem toe.

OR / *OF*

$W_o \propto \frac{1}{\lambda_o}$ ✓ (3)

[13]

TOTAL/*TOTAAL*: 150