Province of the
EASTERN CAPE
EDUCATION

NATIONAL/*NASIONALE*
SENIOR
CERTIFICATE/*SERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2017

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

MARKS/*PUNTE*: **150**

This marking guideline consists of 15 pages./
Hierdie nasienriglyne bestaan uit 15 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 verkeerde 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 'n 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 formule 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 no 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, no a full stop, for example, $m \bullet s^{-1}$.
For marking purposes, $m \bullet s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld $m \bullet s^{-1}$. Vir nasiendoeleindes sal $m \bullet s^{-1}$ 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 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 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 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

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

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

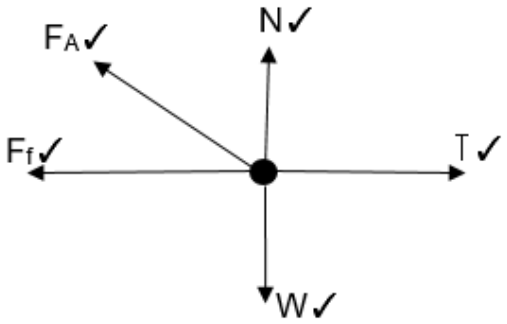
[20]

QUESTION/*VRAAG* 2

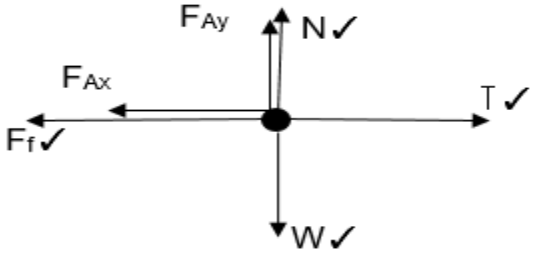
2.1

If the resultant/net force acts on an object, the object will accelerate in the direction of the resultant/net force with an acceleration that is directly proportional to the resultant/net force ✓ and inversely proportional to the mass ✓ of the object.
Wanneer 'n resultante/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die resultante/netto krag met 'n versnelling wat direk eweredig is aan die resultante/netto krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓ (2)

2.2



✓ for both components /
vir albei komponente



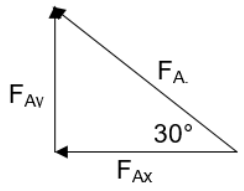
(5)

2.3

2.3.1

(For the vertical motion)
(Vir die vertikale beweging)
$F_{net} = 0$ } ✓ any one
$F_N + F_{AY} + (-w) = 0$ } (*enige een)*
$F_N + F_{AY} = w$
$F_N + F_A \sin 30° = 5 \times 9{,}8$ ✓
$F_N = 49 - (5 \times 9{,}8 \times \sin 30°)$
$F_N = 24{,}5$ N ✓

F_{AY} is the vertical component of F_A.
F_{AY} is die vertikale komponent van F_A.
$F_A = 5$ N



(3)

2.3.2

$f_k = \mu_k N$ } ✓ any one
$f_k = \mu_k mg$ } *enige een*
$f_k = 0{,}2 \times 24{,}5$ ✓
$f_k = 4{,}9$ N ✓ (2)

2.3.3

Positive marking from 2.3.1:
(*Positiewe merk van 2.3.1):*
At 5 kg block B: *(By 5 kg blok)*

Fnet = ma
$T + (-f) + (-F_{AX}) = ma$
$T = 5 \times a$ ✓
$T = 5a + 4{,}9 + 5 \cos 30°$ ✓.....(1)

At 12 kg block A / *By 12 kg blok*
$W + (-T) = ma$
$mg - T = 12 \times a$
$12 \times 9{,}8 - T = 12 \times a$
$T = 117{,}6 - 12a$ ✓..... (2)
(1) = (2):
$117{,}6 - 12a = 5a + 4{,}9 + 5\cos 30°$
$117{,}6 - (4{,}9 + 5\cos 30°) = 5a + 12a$
$108{,}369873 = 17a$
$a = 6{,}37$ m•s^{-2} ✓ (4)

[16]

QUESTION/*VRAAG* 3

3.1

Free-fall is the motion of an object when the only force acting on it is gravitational force ✓✓
Vryval is die beweging van 'n voorwerp indien die enigste krag wat daarop inwerk, gravitasiekrag is. ✓✓ (2)

3.2

3.2.1

OPTION 1 / OPSIE 1	**OPTION 2 / *OPSIE 2***
(downwards positive) *(afwaarts positief)* $v_f = v_i + a\Delta t$ ✓ $0 = \underline{(-15) + (9,8)x\ \Delta t}$ ✓ $\Delta t = 1,53$ s✓	(upwards positive) *(opwaarts positief)* $v_f = v_i + a\Delta t$ ✓ $0 = \underline{(15) + (-9,8)\Delta t}$ ✓ $\Delta t = 1,53$ s✓

(3)

3.2.2

OPTION 1 / OPSIE 1	**OPTION 2 / *OPSIE 2***
(downwards positive) *(afwaarts positief)* $v_f = v_i + a\Delta t$ ✓ $= \underline{(-15) + (9,8)(2,4)}$ ✓ $= 8,52$ $v_f = 8,52$ m•s^{-1} ✓ (downwards / *afwaarts)* ✓	(upwards positive) *(opwaarts positief)* $v_f = v_i + a\Delta t$ ✓ $= \underline{(15) + (-9,8)(2,4)}$ ✓ $= -8,52$ $v_f = 8,52$ m•s^{-1} ✓ (downwards / *afwaarts)* ✓
OPTION 3 / OPSIE 3 (downwards positive) (*afwaarts positief)* **Descent (*Afwaarts)*: <u>Y – X:</u>** $\Delta t = 2,4 - 1,53 = 0,87$ s $v_f = v_i + a\Delta t$ ✓ $= 0 + (9,8)(0,87)$ ✓ $= 8,53$ m•s^{-1} ✓ (downwards / *afwaarts)* ✓	**OPTION 2 / *OPSIE 2*** (upwards positive) *(opwaarts positief)* **Descent (*Afwaarts)*: <u>Y – X:</u>** $\Delta t = 2,4 - 1,53 = 0,87$ s $v_f = v_i + a\Delta t$ ✓ $= 0 + (-9,8)(0,87)$ ✓ $= -8,53$ m•s^{-1} $= 8,53$ m•s^{-1} ✓ (downwards / *afwaarts)* ✓

(4)

3.3

OPTION 1 / *OPSIE 1*	**OPTION 2 / OPSIE 2**
(upwards positive/*opwaarts positief)* <u>**A – Y:**</u> $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= 15 \times 1,53 + \frac{1}{2}(-9,8)(1,53)^2$✓ $= 11,48$ m ✓ <u>**Y – X:**</u> $\Delta t = 2,4 - 1,53 = 0,87$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 \times 0,87 + \frac{1}{2}(-9,8)(0,87)^2$✓ $= -3,71$ ✓ $= 3,71$ m downwards/*afwaarts* Height of the building is given by: *Hoogte van die gebou gegee as:* $h = 11,48 + 1,8 - 3,71$ $\therefore h = 9,57$ m ✓	(downwards positive/*afwaarts positief)* <u>**A – Y:**</u> $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= -15 \times 1,53 + \frac{1}{2}(9,8)(1,53)^2$ ✓ $= -11,48$ m ✓ $= 11,48$ m upwards/*opwaarts* <u>**Y – X:**</u> $\Delta t = 2,4 - 1,53 = 0,87$ s $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $= 0 \times 0,87 + \frac{1}{2}(9,8)(0,87)^2$✓ $= 3,71$ m ✓ Height of the building is given by: *Hoogte van die gebou gegee as:* $h = -11,48 - 1,8 + 3,71$ $\therefore h = -9,57$ m $\therefore h = 9,57$ m ✓

<table>
<tr>
<td></td>
<td>OPTION 3 / OPSIE 3
(upwards positive/opwaarts positief)
(Y-X):
$v_f = v_i + a\Delta t$
$-8,52 = \underline{(0) + (-9,8)}\ \Delta t$
$\Delta t = 0,87$ s ✓
(A-Roof):
$1,53 = \Delta t + 0,87$
$\Delta t = 0,66$ s ✓
(A-X):
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(8,52)^2 = (15)^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = 7,78$ m ✓
Height/Hoogte: h = 7,78 + 1,8
= 9,58 m ✓</td>
<td>OPTION 4 / OPSIE 4
(upwards positive/opwaarts positief)
(Y-X):
$v_f = v_i + a\Delta t$
$-8,52 = \underline{(0) + (-9,8)}\ \Delta t$
$\Delta t = 0,87$ s ✓
(A-Roof):
$1,53 = \Delta t + 0,87$
$\Delta t = 0,66$ s ✓
(A-X):
$\Delta y = v_i . \Delta t + \frac{1}{2} g \Delta t^2$ ✓
$= 15 \times 0,66 + \frac{1}{2} x - 9,8 \times 0,66^2$ ✓
$= 7,77$ m ✓
Height/Hoogte: h = 7,78 + 1,8
= 9,58 m ✓</td>
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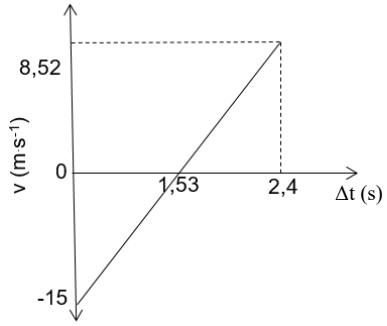
<td>3.4</td>
<td>OPTION 1 / OPSIE 1
(downwards positive)
(afwaarts positief)
 
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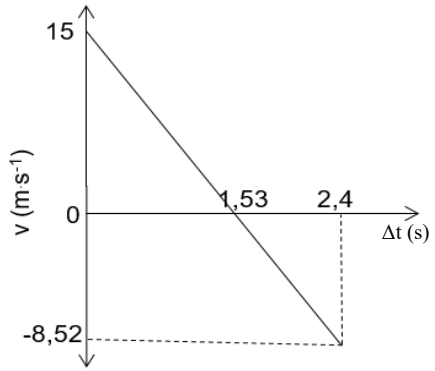
(opwaarts positief)
 
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<tr><td>Initial velocity / Beginsnelheid</td><td>✓</td></tr>
<tr><td>Final velocity / Eindsnelheid</td><td>✓</td></tr>
<tr><td>Time at Y, maximum height / Tyd by Y, maksimum hoogte</td><td>✓</td></tr>
</table></td>
<td>(3)</td>
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[18]

QUESTION/*VRAAG* 4

4.1

In an isolated system ✓the total mechanical energy remains constant. ✓
In 'n geïsoleerde sisteem ✓ bly die totale meganiese energie konstant. ✓ (2)

4.2

OPTION 1 / *OPSIE 1*

E_{mech} at/*by* A = E_{mech} at/*by* B
$(mgh + \frac{1}{2}mv^2)$ at/*by* A = $(mgh + \frac{1}{2}mv^2)$ at/*by* B
✓ Any one / Enige een

$4 \times 9,8 \times (7 \sin 60°)$ ✓+ $\frac{1}{2} \times 4 \times 0 = 4 \times 9,8 \times (4 \sin 60°)$✓+ $\frac{1}{2} \times 4 \times v^2$

$v = 7,14\ m \cdot s^{-1}$ ✓

OPTION 2 / *OPSIE 2*

E_{mech} at/*by* A = E_{mech} at/*by* B ✓
$(mgh + \frac{1}{2}mv^2)$ at A = $(mgh + \frac{1}{2}mv^2)$ at B

$4 \times 9,8 \times (3 \sin 60°)$ ✓+ $\frac{1}{2} \times 4 \times 0 = 4 \times 9,8 \times (0)$✓+ $\frac{1}{2} \times 4 \times v^2$

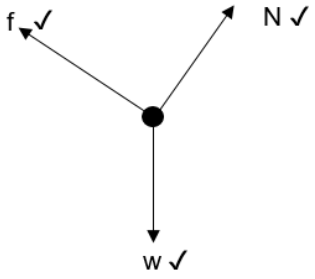
$v = 7,14\ m \cdot s^{-1}$ ✓ (4)

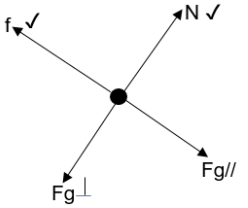
4.3

4.3.1

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

4.3.2





✓ for both components of weight
✓ *vir albei gewigskomponente* (3)

4.3.3

OPTION 1 / *OPSIE 1*

$W_{net} = \Delta E_K$
$W_f + W_{g//} = \frac{1}{2} m(v^2_f - v^2_i)$
✓ any one / *(enige een)*

$f \cdot \Delta x \cdot \cos\theta + mg\sin 60 \cdot \Delta x \cdot \cos\theta = \frac{1}{2} \times 4(3^2 - 7,14^2)$ ✓

$f \times \frac{2}{\cos 60°}$ ✓ $\times -1 + 4 \times 9,8 \sin 60$ ✓ $\times \frac{2}{\cos 60°} \times 1 = -83,9592$

$-4f + 135,7927833 = -83,9592$

$f = 54,94$ N ✓

OPTION 2 / *OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_K$
$W_f = mgh_f - mgh_i + \frac{1}{2} mv^2_f - \frac{1}{2} m v^2_i$
$f \cdot \cos\theta \cdot \Delta x = mg(h_f - h_i) + \frac{1}{2} m(v^2_f - v^2_i)$
✓ any one / *enige een*

$f \cdot \cos 0 \times 4$ ✓ $= 4 \times 9,8 (0 - 4 \sin 60°)$✓ $+ \frac{1}{2} \times 4 (3^2 - 7,14^2)$✓

$f = 54,94$ N ✓ (5)

4.4

Remains the same / *Bly dieselfde* ✓ (1)

[17]

QUESTION/*VRAAG* 5

5.1

The total linear momentum of an isolated system remains constant (is conserved) ✓✓ **OR**
Total linear momentum before a collision equals total linear momentum after a collision in an isolated system. ✓✓
Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant (bly behoue) ✓✓ ***OF***
Totale lineêre momentum voor 'n botsing is gelyk aan die totale lineêre momentum na 'n botsing in 'n geïsoleerde sisteem. ✓✓ (2)

5.2

5.2.1

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓	$\Delta y = \frac{v_i + v_f}{2} \Delta t^2$ ✓
$0,32 = v_i \times 0,33 + 0$ ✓	$0,32 = \frac{2v}{2} \times 0,33$ ✓
$V_i = 0,97\ m \cdot s^{-1}$ ✓	$V = 0,97\ m \cdot s^{-1}$ ✓

(3)

5.2.2

Consider LEFT as positive / *Beskou LINKS as positief*

$\sum p_i = \sum p_f$
$(m_c + m_m)v_i = m_c v_{cf} + m_m v_{mf}$ } ✓
0 ✓ $= 2 \times -0,97 + 0,005 \times v_{mf}$ ✓
$v_{fm} = 392\ m \cdot s^{-1}$ east/right/forward / *oos/regs/vorentoe* ✓ (4)

5.3

Impulse $= F_{net} \cdot \Delta t = \Delta p$
$= m(v_f - v_i)$ } ✓ any one / *enige een*
$= 2\ (-0,4 - 0,97)$ ✓
$= -2,74\ N \cdot s$
$= 2,97\ N \cdot s$ ✓ (**3**)

[12]

QUESTION/*VRAAG* 6

6.1	Doppler effect / *Doppler-effek* ✓		(1)
6.2	The number of waves reaching the detector per unit ✓ time decreases ✓. **OR** As the ambulance is moving away from the scene /detector, the wavelengths become longer resulting in less waves reaching the detector ✓ per unit time ✓ hence the frequency decreases. *Die aantal golwe wat die detektor per eenheid ✓ tyd neem af. ✓* **OF** *Soos die ambulans wegbeweeg vanaf die toneel / detektor, word die golflengte langer wat veroorsaak dat minder golwe die detektor ✓ per eenheidstyd ✓ bereik en dus neem die frekwensie af.*		(2)
6.3	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ any one / *enige een* $f_L = \frac{v}{v+v_s} f_s$ 90% × 890 ✓ = $\frac{340}{340+v_s}$ ✓ × 890 ✓ $801 = \frac{340 \times 890}{340+v_s}$ $340 + v_s = \frac{340 \times 890}{801}$ $v_s = 37{,}78\ m \cdot s^{-1}$ ✓		(5)
6.4	Doppler flow meter is used to determine whether arteries are clogged / narrowed ✓ **OR** to determine the rate of flow of blood ✓ *Die Doppler-vloeimeter word gebruik om te bepaal of die are vernou/verstop is ✓* **OF** *om die tempo van bloedvloei te bepaal. ✓*		(1)
6.5	6.5.1	The shift is to a longer wavelength, lower frequency, as the star is moving away from the Earth. ✓ *Die skuif is na 'n langer golflengte, laer frekwensie, so die ster beweeg weg van die Aarde. ✓*	(1)
	6.5.2	A greater shift, therefore it shows that the distant star is moving away at a greater speed than a nearby star. ✓✓ *'n Groter skuif, so dit toon dat die verafgeleë ster beweeg weg teen 'n groter spoed as die nabygeleë ster. ✓✓*	(2)

[12]

QUESTION/*VRAAG* 7

7.1

The electrostatics force between the two charges is directly proportional the product of the two charges and inversely proportional to the square of the distance between them. ✓✓

Die elektrostatiese krag tussen die twee ladings is direk eweredig aan die produk van die twee ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓✓ (2)

7.2

$F_J = \frac{kQ_JQ_L}{r^2}$✓

$F_J = \frac{(9 \times 10^9)(3 \times 10^{-6})(2 \times 10^{-6})}{(0,2)^2}$ ✓✓

F_J = 1,35 N right / *regs* ✓ (4)

7.3

7.3.1

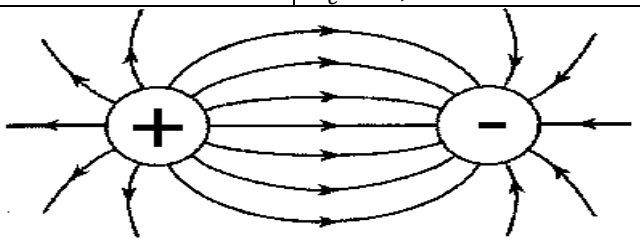
$Q_L = -3 \times 10^{-6}$ ✓ (1)

7.3.2

OPTION 1/*OPSIE 1*	**OPTION 2 /*OPSIE 2***
$n_e = \frac{Q_f - Q_i}{q_e}$✓	$n_e = \frac{Q_f - Q_i}{q_e}$✓
$n_e = \frac{-3\times10^{-6} - 2\times10^{-6}}{1,6\times10^{-19}}$✓	$n_e = \frac{-3 \times 10^{-6} + 8 \times 10^{-6}}{1,6 \times 10^{-19}}$✓
$n_e = 3,125 \times 10^{13}$✓	$n_e = 3,125 \times 10^{13}$✓

(3)

7.3.3



Criteria for sketch / *Kriteria vir skets*	**Marks/*Punte***
Correct shape / *Korrekte vorm*	✓
Correct direction / *Korrekte rigting*	✓
Field lines not crossing each other *Veldlyne kruis nie*	✓

(3)

7.4

OPTION 1 / *OPSIE 1*

$E_J = \frac{kQ_J}{r^2}$✓ = $\frac{9 \times 10^9 \times 3 \times 10^{-6}}{(0,12)^2}$ ✓= 1 875 000 N•C^{-1} West/Left / (*Wes / Links)*

$E_M = \frac{kQ_M}{r^2} = \frac{9 \times 10^9 \times 3 \times 10^{-6}}{(0,08)^2}$✓ = 4 218 750 N•C^{-1} West/Left / (*Wes / Links)*

Left positive / *Links positief:*

$E_{net} = E_J + E_M$✓

$E_{net} = (+1\ 875\ 000) + (+4\ 218\ 750)$ ✓(both substitutions)(*albei instellings)*

$E_{net} =$ 6 093 750 N•C^{-1} West/Left */(Wes / Links)* ✓

OPTION 2 /*OPSIE 2*

$E_{net} = E_J + E_M$ ✓

$= \frac{kQ_J}{r^2} + \frac{kQ_M}{r^2}$ ✓

$= \frac{(9\times10^9)\times(3\times10^{-6})}{(0,12)^2}$ ✓ + $\frac{(9\times10^9)\times(3\times10^{-6})}{(0,08)^2}$ ✓ one of the two/*enige een van die twee*

= 6 093 750 N•C^{-1} West/Left *(Wes / Links)* ✓ (6)

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QUESTION/*VRAAG* 8

8.1	8.1.1	V_{max} ✓ **OR/*OF*** maximum voltage (*maksimum spanning)* ✓	(1)
	8.1.2	$P_{average} = V_{rms} \cdot I_{rms}$ ✓ ($P_{gem} = V_{wgk} \cdot I_{wgk}$ ✓) $= (\frac{94,3}{\sqrt{2}})$ ✓ . $(\frac{3}{100} \times \frac{94,3}{\sqrt{2}})$ ✓ = 133,39 W ✓	(4)
	8.1.3	Replacing the slip rings with a split-ring commutator ✓✓ *Vervang die sleepringe met 'n split-ring kommutator* ✓✓	(2)
8.2	8.2.1	$P = \frac{(V_{rms})^2}{R}$ ✓ ($P = V_{wgk}^2/R$ ✓) 56✓ = $\frac{90^2}{R}$ ✓ $R = 144,64\ \Omega$ ✓	(4)
	8.2.2	Too bright ✓ The power of the generator is greater than the power of the light bulb. ✓ **OR** The power of the light bulb is smaller than the power of the generator. ✓ *Te helder* ✓ *Die drywing van die generator is groter as die drywing van die gloeilamp* ✓ ***OF*** *Die drywing van die gloeilamp is kleiner as die drywing van die generator.* ✓	(2)

[13]

QUESTION/*VRAAG* 9

9.1	Emf / *Emk* ✓			(1)
9.2	9.2.1	**OPTION 1 / *OPSIE 1*** $V_{lost/verlore} = Ir$ ✓ 0,9 ✓= 4,5 × r ✓ r = 0,2 Ω ✓	**OPTION 2 / *OPSIE 2*** Emf (*Emk)* = I (R + r) ✓ 22,14 = $V_{ext/ekst}$ + Ir 22,14✓ = 21,24 + 4,5 × r ✓ r = 0,2 Ω ✓	(4)
	9.2.2	**OPTION 1 / *OPSIE 1*** $V_{4\Omega} = IR_{4\Omega}$ = 4,5 × 4 ✓ = 18 V $V_{ext} = V_p + V_{4\Omega}$ ✓ 21,24 = V_p + 18 ✓ V_p = 3,24 V ✓ $R_{eff} = \frac{3,24}{4,5}$ ✓ R_{eff}= 0,72 Ω ✓	**OPTION 2 / *OPSIE 2*** $V_{4\Omega} = IR_{4\Omega}$ = 4,5 × 4 ✓ = 18 V $V_{ext} = V_p + V_{4\Omega}$ 21,24 = V_p + 18 ✓ V_p = 3,24 V ✓ $I_{4\Omega} = \frac{V}{R} = \frac{3,24}{4}$ = 0,81 A $I_{3\Omega} = \frac{V}{R} = \frac{3,24}{3}$ = 1,08 A $I_{R_1} = I_p - (I_{4\Omega} + I_{3\Omega})$ I_{R_1} = 4,5 – (0,81 + 1,08) = 2,61 A ✓ $R_1 = \frac{3,24}{2,61}$ = 1,24 Ω ✓ $\frac{1}{R_{eff,}} = \frac{1}{4} + \frac{1}{3} + \frac{1}{1,24}$ = 1,39 :. R_{eff} = 0,72 Ω ✓	(6)
9.3	Temperature / *Temperatuur* ✓			(1)
9.5	Increase / *Neem toe* ✓			(1)

[13]

QUESTION/*VRAAG* 10

10.1		Work function of a metal is a minimum energy needed by a metal in order to release/ejects electrons from its surface. ✓✓ *Werksfunksie van 'n metaal is die minimum energie wat 'n metaal benodig om elektrone van sy oppervlak vry te laat* ✓✓	(2)
10.2		$W_0 = hf_0$ ✓ $= (6{,}63 \times 10^{-34}) \times (1{,}4 \times 10^{15})$ ✓ $= 9{,}28 \times 10^{-19}$J ✓	(3)
10.3	10.3.1	Remains the same / *Bly dieselfde* ✓	(1)
	10.3.2	Increase / *Neem toe* ✓	(1)
10.4		$E_k = \frac{1}{2}mv^2$ ✓ $0{,}7 \times 10^{-18} = \frac{1}{2} \times 9{,}11 \times 10^{-31} \times v^2$ ✓ $v = \sqrt{\frac{0{,}7 \times 10^{-18} \times 2}{9{,}11 \times 10^{-31}}}$ $v = 1{,}24 \times 10^6$ m•s^{-1} ✓	(3)

[10]

TOTAL/*TOTAAL*: 150