**NATIONAL
SENIOR CERTIFICATE/
*NASIONALE SENIOR
SERTIFIKAAT***

GRADE/*GRAAD* 12

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**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 $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ 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 the 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/*VRAAG* **1: MULTIPLE-CHOICE QUESTIONS/**
** *MEERVOUDIGEKEUSE-VRAE***

1.1   C ✓✓ (2)

1.2   C ✓✓ (2)

1.3   A ✓✓ (2)

1.4   D ✓✓ (2)

1.5   A ✓✓ (2)

1.6   B ✓✓ (2)

1.7   D ✓✓ (2)

1.8   B ✓✓ (2)

1.9   D ✓✓ (2)

1.10 C ✓✓ (2)
[20]

QUESTION/*VRAAG 2*

2.1 When a resultant/net force acts on an object, it accelerates in the direction of the force. The acceleration is directly proportional to the force and inversely proportional to the mass of the object. ✓✓
Indien 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag. Die versnelling is direk eweredig aan die krag en omgekeerde eweredig aan die massa van die voorwerp. ✓✓   (2)

2.2

OPTION 1/*OPSIE* 1	OPTION 2/*OPSIE* 2

(4)

Mark awarded for arrow and label. / *Punt toegeken vir byskrif en pyltjie.*
Do not penalise for length of arrows since drawing is not drawn to scale./
Moenie vir die lengte van die pyltjies penaliseer nie, aangesien die skets nie volgens skaal geteken is nie.

Any other additional force(s) / *Enige addisionele kragte* $\frac{3}{4}$

If force(s) do not make contact with body. / *Indien die kragte nie kontak maak met die voorwerp nie.* Max./*Maks.* $\frac{3}{4}$

2.3

OPTION 1 (To the right is positive) *OPSIE 1 (Na regs is positief)*	OPTION 2 (To the right is negative) *OPSIE 2 (Na regs is negatief)*
F_{net} = ma F_{net} = 0 N ⎤ Any one / F_g – T = ma ⎦ *Enige een* ✓ 15 x 9,8 - T = 0 ✓ T = 147 N T – Wsin θ – f = ma T – mgsin θ – f = ma 147– 22 x 9,8sin θ – 43,86 = 0✓ θ = 28,58° ✓	F_{net} = ma F_{net} = 0 N ⎤ Any one / T - F_g = ma ⎦ *Enige een* ✓ T – 15 x 9,8 = 0 ✓ T = 147 N Wsin θ + f – T = ma mgsin θ + f – T = ma 22 x 9,8 sin θ + 43,86 – 147 ✓ = 0 θ = 28,58° ✓

(4)

2.4   2.4.1   The kinetic friction force depends on the angle of the inclined to the
                 horizontal and nature of the surface. ✓✓
                 Die kinetiese wrywingskrag is afhanklik van die hoek van die skuinsvlak
                 met die horisontaal en die aard van die oppervlakte. ✓✓   (2)

2.4.2

Positive marking from Question 2.3 / *Merk positier vanaf Vraag 2.3*	Marking criteria / *Merk kriteria*	
For 15 kg block / *Vir 15 kg-blok* F_{net} = ma ✓ F - F_g – T = ma <u>172 – 147 – T</u> ✓ = 15a …(1) For 22 kg block / *Vir 22 kg-blok* T + W sinθ– f = ma T + mg sinθ– f = ma [T + <u>22 x 9,8 sin 28,58°</u> ✓ – 43,86] ✓ = 22a ✓ [T + 101,14 – 43,86] = 22a (2) ∴ a = 2,278 m.s⁻² ✓	F_{net} = ma F - F_g – T = ma T + Wsin θ – f = ma T + mgsin θ – f = ma Calculating $F_{g//}$ *Berekening van* $F_{g//}$ ✓ Substitution for the 15 kg block *Instelling vir die 15 kg-blok* ✓ Substitution for the 22 kg block *Instelling vir die 22 kg-blok* ✓ Substitution for either 15a or 22a *Instelling vir 15a of 22a* ✓ Answer/*Antwoord* ✓	Any one / *Enige een* ✓

(6)

[18]

QUESTION/*VRAAG* 3

3.1

UPWARD POSITIVE *OPWAARTS POSITIEF*	UPWARD NEGATIVE *OPWAARTS NEGATIEF*	
$v_f = v_i + a\Delta t$ ✓ $v_f = -3,28 + (-9,8) \times 1,2$ ✓ $v_f = -15,04$ $v_f = 15,04$ m.s^{-1} downwards/*afwaarts* ✓	$v_f = v_i + a\Delta t$ ✓ $v_f = 3,28 + (9,8) \times 1,2$ ✓ $v_f = 15,04$ m.s^{-1} downwards/*afwaarts* ✓	(3)

3.2

OPTION/*OPSIE* 1		
UPWARD POSITIVE ***OPWAARTS POSITIEF***	**UPWARD NEGATIVE** ***OPWAARTS NEGATIEF***	
$\Delta y = v_i \Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\Delta y = $ -3,28 x 1,2 ✓ $+ \frac{1}{2} (-9,8)1,2^2$ ✓ $\Delta y = -10,99$ $\Delta y = 10,99$ m downwards/*afwaarts* ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\Delta y = $ 3,28 x 1,2 ✓ $+ \frac{1}{2} (9,8)1,2^2$ ✓ $\Delta y = 10,99$ m downwards/*afwaarts* ✓	
OPTION /*OPSIE* 2		
Positive marking from Question 3.1/*Positiewe merk vanaf Vraag 3.1*		
UPWARD POSITIVE ***OPWAARTS POSITIEF***	**UPWARD NEGATIVE** ***OPWAARTS NEGATIEF***	
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $-15,04^2$ ✓ $= -3,28^2 + 2 (-9,8) \Delta y$ ✓ $\Delta y = 10,99$ m downwards/*afwaarts* ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $15,04^2$ ✓ $= 3,28^2 + 2 (9,8) \Delta y$ ✓ $\Delta y = 10,99$ m downwards/*afwaarts* ✓	

OPTION/*OPSIE* 3		
Positive marking from Question 3.1/*Positiewe merk vanaf Vraag 3.1*		
UPWARD POSITIVE ***OPWAARTS POSITIEF***	**UPWARD NEGATIVE** ***OPWAARTS NEGATIEF***	
$\Delta y = \frac{v_f + v_i}{2} \Delta t$ ✓ $\Delta y = \frac{-15,04 + (-3,28)}{2}$ ✓ $x1,2$ ✓ $\Delta y = -10,99$ m $\Delta y = 10,99$ m downwards/*afwaarts* ✓	$\Delta y = \frac{v_f + v_i}{2} \Delta t$ ✓ $\Delta y = \frac{15,04 + 3,28}{2}$ ✓ $x1,2$ ✓ $\Delta y = 10,99$ m downwards/*afwaarts* ✓	(4)

3.3

OPTION 1/*OPSIE* 1	
UPWARD POSITIVE *OPWAARTS POSITIEF*	**UPWARD NEGATIVE** *OPWAARTS NEGATIEF*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = -3{,}28^2 + 2(-9{,}8)(30)$ ✓ $v_f^2 = -24{,}47$ m.s^{-1} $v_f^2 = 24{,}47$ m.s^{-1} downwards/*afwaarts* ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 3{,}28^2 + 2(9{,}8)(30)$ ✓ $v_f^2 = 24{,}47$ m.s^{-1} downwards/*afwaarts* ✓

OPTION 2/*OPSIE* 2		
UPWARD POSITIVE *OPWAARTS POSITIEF*	**UPWARD NEGATIVE** *OPWAARTS NEGATIEF*	
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-30 = -3{,}28\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ $\Delta t = 2{,}16$ s $v_f = v_i + a\Delta t$ ✓ $v_f = -3{,}28 + (-9{,}8)(2{,}16)$ ✓ $v_f = -24{,}45$ m.s^{-1} $v_f = 24{,}45$ m.s^{-1} downwards/*afwaarts* ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $30 = 3{,}28\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ $\Delta t = 2{,}16$ s $v_f = v_i + a\Delta t$ ✓ $v_f = 3{,}28 + (9{,}8)(2{,}16)$ ✓ $v_f = 24{,}45$ m.s^{-1} downwards/*afwaarts* ✓	(3)

3.4

Positive marking from Question 3.2/*Positiewe merk vanaf Vraag 3.2*		
UPWARD POSITIVE *OPWAARTS POSITIEF*	**UPWARD NEGATIVE** *OPWAARTS NEGATIEF*	
$F_{net}.\Delta t = m(v_f - v_i)$ ✓ $205 \times 0{,}1$ ✓ $= \underline{0{,}5\,[v_f - (-24{,}47)]}$ ✓ $v_f = 16{,}53$ m.s^{-1} upwards/*opwaarts* ✓	$F_{net}.\Delta t = m(v_f - v_i)$ ✓ $-205 \times 0{,}1$ ✓ $= \underline{0{,}5\,(v_f - 24{,}47)]}$ ✓ $v_f = -16{,}53$ m.s^{-1} $v_f = 16{,}53$ m.s^{-1} upwards/*opwaarts* ✓	(4)

3.5

OPTION 1/*OPSIE* **1**	
Positive marking from Question 3.1 and 3.3	
Positiewe merk vanaf Vraag 3.1en 3.3	
UPWARD POSITIVE	**UPWARD NEGATIVE**
OPWAARTS POSITIEF	***OPWAARTS NEGATIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0^2 ✓ $= 16{,}53^2 + 2\,(-9{,}8)\,\Delta y$ ✓	0^2 ✓ $= -16{,}53^2 + 2\,(9{,}8)\,\Delta y$ ✓
$\Delta y = 13{,}94$ m	$\Delta y = -13{,}94$ m
width of window / *wydte van venster*	width of window / *wydte van venster*
$= 30 - (10{,}99+13{,}94)$ ✓	$= 30 - (10{,}99 +13{,}94)$ ✓
$= 5{,}07$ m ✓	$= 5{,}07$ m ✓

OPTION 2/*OPSIE* **2**

$W_{net} = \Delta E_k$

$F_{net}\,\Delta y \cos\theta = \Delta E_k$ ⎤   Any one/*Enige een* ✓

$F_g\Delta y \cos\theta = \dfrac{1}{2}mv_f^2 - \dfrac{1}{2}mv_i^2$ ⎦

$4{,}9\ \Delta y\cos 180^\circ$ ✓ $= 0 - \dfrac{1}{2} \times 0{,}5 \times 16{,}53^2$ ✓

$\Delta y = 13{,}94$ m

width of window / *wydte van venster*

$= 30 - (10{,}99 + 13{,}94)$ ✓

$= 5{,}07$ m ✓   (5)

[19]

QUESTION/_VRAAG_ 4

4.1 In an isolated system total linear momentum is conserved. ✓✓
In 'n geïsoleerde sisteem bly die totale lineêre momentum behoue. ✓✓ (2)

4.2 4.2.1 $ME_i = ME_f$
$mgh_1 + \frac{1}{2} mv_i^2 = mgh_2 + \frac{1}{2} mv_f^2$
$0 + \frac{1}{2} \times 2{,}005 \times v_i^2$ ✓ $= 2{,}005 \times 9{,}8 \times 0{,}06 + 0$ ✓
$v_i = 1{,}08$ m.s^{-1}

$\sum p_i = \sum p_f$
$m_{block}v_{iblock} + m_{bullet}v_{ibullet} = (m_{block} + m_{bullet}) v_f$ $\Big]$ Any one/*Enige een* ✓
$0 + 0{,}005 \times v_{ibullet} = 2{,}005 \times 1{,}08$ ✓
$v_{bullet} = 433{,}08$ m.s^{-1} right/*regs* ✓ (5)

4.2.2 **Positive marking from Question 4.2.1/**_Positiewe merk vanaf Vraag 4.2.1_
$\sum p_i = \sum p_f$
$(m_{gun} + m_{bullet})v_i = m_{gun}v_{fgun} + m_{bullet}v_{fbullet} =$ $\Big]$ Any one/*Enige een* ✓
$0 = 5 \times v_{f(gun)} + 0{,}005 \times 433{,}08$ ✓
$v_{f(gun)} = -0{,}43$ m.s^{-1}
$v_{f(gun)} = 0{,}43$ m.s^{-1} left/*links* ✓ (3)

[10]

QUESTION/*VRAAG* 5

5.1 In an isolated system the total mechanical energy is conserved. ✓✓
In 'n geïsoleerde sisteem bly die totale meganiese energie behoue. ✓✓ (2)

5.2 $ME_i = ME_f$
$(E_p + E_k)_A = (E_p + E_k)_B$ ⎫ Any one/*Enige een* ✓
$mgh_1 + E_{k(A)} = mgh_2 + E_{k(B)}$ ⎭
$55 \times 9,8 \times 15 + 0 = 0 + E_{k(B)}$ ✓
$E_{k(B)} = 8085$ J ✓ (3)

5.3 The net work done on an object is equal to the object's change in kinetic energy. ✓✓

OR

The work done by a net force is equal to the object's change in kinetic energy. ✓✓
Die netto arbeid verrig op 'n voorwerp is gelyk aan die voorwerp se verandering in kinetiese energie. ✓✓

OF

Die arbeid verrig deur 'n netto krag is gelyk aan die voorwerp se verandering in kinetiese energie. ✓✓ (2)

5.4 5.4.1 **Positive marking from Question 5.2/*Positiewe merk vanaf Vraag 5.2***
OPTION 1/*OPSIE* 1
$W_{ner} = \Delta E_k$
$W_f + W_{Fg//} = \Delta E_k$ ⎫ Any one/*Enige een* ✓
$f \times \Delta x \cos\theta + mg\sin\theta \, \Delta x \cos\theta = \Delta E_k$ ⎭
$\underline{15 \times 10 \cos 180º}$ ✓ $+ \underline{55 \times 9,8 \sin 15º \times 10 \cos 180º}$ ✓ $= 0 - E_{ki}$
$E_{ki} = 1545,035$ J ✓

OPTION 2/*OPSIE* 2
$W_{nc} = \Delta E_k + \Delta E_p$
$W_f = \Delta E_k + \Delta E_p$ ⎫ Any one/*Enige een* ✓
$f \times \Delta x \cos\theta = \Delta E_p + \Delta E_k$ ⎭
$\underline{15 \times 10 \cos 180º}$ ✓ $= \underline{[55 \times 9,8 \times (10 \sin 15º)] - 0}$ ✓ $+ \underline{0 - E_{ki}}$
$-150 = 1395,035 - E_{ki}$
$E_{ki} = 1545,035$ J ✓

OPTION 3/*OPSIE* 3
$W_{ner} = \Delta E_k$
$W_f + W_{Fg} = \Delta E_k$ ⎫ Any one/*Enige een* ✓
$f \times \Delta x \cos\theta + mg \, \Delta x\cos\theta = \Delta E_k$ ⎭
$\underline{15 \times 10 \cos 180º}$ ✓ $+ \underline{55 \times 9,8 \times 10 \cos (90 + 15)}$ ✓ $= 0 - E_{ki}$
$E_{ki} = 1545,035$ J ✓ (4)

5.4.2

OPTION 1/*OPSIE* 1	**OPTION 2/*OPSIE* 2**
$W_{net} = \Delta E_k$ $W_f = \Delta E_k$ ⎫ Any one/*Enige een* ✓ $f \times \Delta x \cos\theta = \Delta E_k$ ⎭ $\underline{f \times 10 \cos 180º}$ ✓ $= \underline{1545,035}$ ✓ $- 8085$ ✓ 654,00 N ✓	$W_{nc} = \Delta E_k + \Delta E_p$ $W_f = \Delta E_k + \Delta E_p$ ⎫ Any one/ $f \times \Delta x \cos\theta = \Delta E_k + \Delta E_p$ ⎭ *Enige een* ✓ $\underline{f \times 10 \cos 180º}$ ✓ $= \underline{1545,035}$ ✓ $- \underline{8085}$ ✓ $f = 654,00$ N ✓ (5)

[16]

QUESTION/*VRAAG* 6

6.1   Doppler effect/*Doppler effek* ✓   (1)

6.2   AWAY. ✓ The observed frequency is less than the source frequency. ✓
      WEG VAN. ✓ *Die waargenome frekwensie is minder as die bron se*
      frekwensie. ✓   (2)

6.3   As the listener's velocity increases, the observed frequency decreases. ✓✓
      As die luisteraar se snelheid toeneem, verminder die waargenome
      frewensie. ✓✓   (2)

6.4   The intercept on the vertical axis represents the <u>frequency of the source</u>, f_s. ✓✓
      Die afsnit op die vertikale as verteenwoordig die <u>frekwensie van die bron</u>, f_s. ✓✓   (2)

6.5

OPTION 1/*OPSIE* 1	OPTION 2/*OPSIE* 2
Gradient/*Helling* = $\dfrac{492-470}{5-20}$ ✓ $= -\dfrac{22}{15}$ $= -\dfrac{f_s}{v}$ ✓ $-\dfrac{22}{15}$ ✓ $= -\dfrac{f_s}{340}$ ✓ f_s = 498,67 Hz ✓	$f_L = \dfrac{v \pm v_L}{v \pm v_s} f_s$ ✓ 492 ✓ $= \dfrac{340-15}{340}$ ✓✓ x f_s f_s = 499,34 Hz ✓

OPTION 3/*OPSIE* 3	
$f_L = \dfrac{v \pm v_L}{v \pm v_s} f_s$ ✓ 470 ✓ $= \dfrac{340-15}{340}$ ✓✓ x f_s f_s = 499,38 Hz ✓ Range (498,67 Hz – 499,38 Hz)	(5)

6.6

| OPTION 1/*OPSIE* 1	OPTION 2/*OPSIE* 2	OPTION 3/*OPSIE* 3
$v = f\lambda$ 340 = 498,67 λ ✓ λ = 0,68 m ✓ The wavelength produced by the tuning fork is less than the required wavelength. ∴ It is not suitable. ✓ *Die golflengte wat voortgeplant word deur die stemvurk is minder as die benodigde golflengte.* ∴ *Dit is nie geskik nie.* ✓	$v = f\lambda$ 340 = 499,34 λ ✓ λ = 0,68 m ✓ The wavelength produced by the tuning fork is less than the required wavelength. ∴ It is not suitable. ✓ *Die golflengte wat voortgeplant word deur die stemvurk is minder as die benodigde golflengte.* ∴ *Dit is nie geskik nie.* ✓	$v = f\lambda$ 340 = 499,38 λ ✓ λ = 0,68 m ✓ The wavelength produced by the tuning fork is less than the required wavelength. ∴ It is not suitable. ✓ *Die golflengte wat voortgeplant word deur die stemvurk is minder as die benodigde golflengte.* ∴ *Dit is nie geskik nie.* ✓

(3)

[15]

QUESTION/*VRAAG* **7**

7.1 $n = \dfrac{Q}{q_e}$ ✓

$n = \dfrac{2 \times 10^{-6}}{1,6 \times 10^{-19}}$ ✓

$n = 1,25 \times 10^{13}$ ✓   (3)

7.2
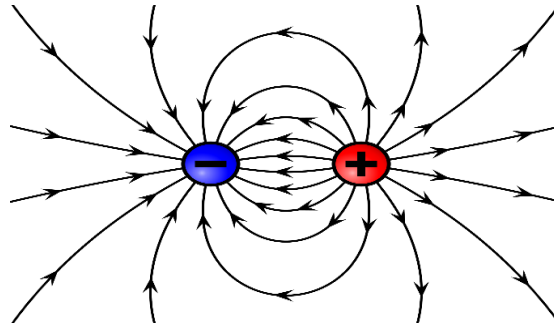
Criteria for marking/*Kriteria vir merk*	
Correct shape / *Korrekte vorm*	✓
Direction of electric field / *Rigting van elektriese veld*	✓
Lines not crossing each other / *Lyne sny nie mekaar nie.*	✓

(3)

7.3   7.3.1 $v_f = v_i + a\Delta t$ ✓

$6,25 \times 10^3 = 0 + 2 \times 10^{-3}\, a$ ✓

$a = 3,125 \times 10^6 \text{ m.s}^{-2}$

$F_{net} = ma$ Any one /*Enige een* ✓

$F_{net} = 5 \times 10^{-6} \times 3,125 \times 10^6$ ✓

$F_{net} = 15,625 \text{ N}$

$E_{net} = \dfrac{F_{net}}{q}$ ✓

$E_{net} = \dfrac{15,625}{2 \times 10^{-6}}$ ✓

$E_{net} = 7,81 \times 10^6 \text{ N.C}^{-1}$ ✓   (6)

7.3.2

Positive marking from Question 7.3.1/*Positiewe merk vanaf Vraag 7.3.1*	
OPTION 1/*OPSIE* **1**	**OPTION 2/***OPSIE* **2**
$E = \dfrac{kQ}{r^2}$ ✓ $7,81 \times 10^6 = \dfrac{9 \times 10^9 \times 2 \times 10^{-6}}{r^2}$ ✓ $\therefore r = 4,80 \times 10^{-2} \text{ m}$ ✓	$v_f{}^2 = v_i{}^2 + 2a\,\Delta x$ ✓ $(6,25 \times 10^3)^2 = 0^2 + 2(3,125 \times 10^6)\Delta x$ ✓ $\Delta x = 6,25 \text{ m}$ ✓

Using equations of motion / *Gebruik van bewegingsvergelykings*	
OPTION 3/*OPSIE* **3**	**OPTION/***OPSIE* **4**

$\Delta x = \frac{1}{2}(v_f + v_i)\,\Delta t$ ✓
  $= \frac{1}{2}(6,25 \times 10^3 + 0)(2 \times 10^{-3})$ ✓
 $\Delta x = 6,25 \text{ m}$ ✓
	$\Delta x = v_i\,\Delta t + \frac{1}{2}\,a\,\Delta t^2$ ✓
	  $= 0 + \frac{1}{2}(3,125 \times 10^6)(2 \times 10^{-3})^2$ ✓
	 $\Delta x = 6,25 \text{ m}$ ✓

(3)

7.3.3	**Positive marking from Question 7.3.1 and 7.3.2** *Positiewe merk vanaf Vraag 7.3.1en 7.3.2*	
	OPTION 1/*OPSIE* **1**	**OPTION 2/***OPSIE* **2**
	$F_E = \dfrac{kQ_1Q_2}{r^2}$ ✓ $15{,}625 ✓ = \dfrac{9 \times 10^9 \, x \, Q \, x \, 2 \, x 10^{-6}}{\left(4{,}80 \, x 10^{-2}\right)^2}$ ✓ $\therefore Q = 2{,}00 \times 10^{-6}$ C ✓	$F_E = \dfrac{kQ_1Q_2}{r^2}$ ✓ $15{,}625 ✓ = \dfrac{(9 \times 10^9)(Q1)(2 \times 10^{-6})}{6{,}25^2}$ ✓ $\therefore Q = 3{,}39 \times 10^{-2}$ C ✓

(4)

[19]

QUESTION/*VRAAG* **8**

8.1 Resistance/*Weerstand* ✓ (1)

8.2 8.2.1 Gradient/*Helling* = $\dfrac{4,2 \overset{✓}{-} 0,2}{24 - 0}$ ✓

$= \dfrac{1}{6}$

$= \dfrac{1}{\text{emf}}$

$\dfrac{1}{\text{emf}} = \dfrac{1}{6}$ ✓

$\therefore \text{emf} = 6 \text{ V}$ ✓ (4)

8.2.2

Positive marking from Question 8.2.1/*Positiewe merk vanaf Vraag 8.2.1*	
OPTION 1/*OPSIE* **1**	**OPTION 2/***OPSIE* **2**
Intercept on vertical axis = $\dfrac{r}{\text{emf}}$ $0,2 = \dfrac{r}{\text{emf}}$ ✓ $0,2 = \dfrac{r}{6}$ ✓ r = 1,2 Ω ✓	$\varepsilon = I\,(R + r)$ ✓ $6 = \dfrac{1}{4,2}\,(24 + r)$ ✓ r = 1,2 Ω ✓

(3)

8.3 8.3.1

OPTION 1/*OPSIE* **1**	**OPTION 2/***OPSIE* **2**
P = VI ✓ 3 = I x 1,5 ✓ I = 2 A ✓	$P = \dfrac{V^2}{R}$ $3 = \dfrac{1,5^2}{R}$ R = 0,75 Ω $P = I^2 R$ ✓ $3 = I^2 \times 0,75$ ✓ I = 2 A ✓

(3)

8.3.2

Positive marking from Question 8.2.1en 8.2.2 _Positiewe merk vanaf Vraag 8.2.1en 8.2.2_	
OPTION 1/_OPSIE_ **1**	**OPTION 2/**_OPSIE_ **2**
$P = \dfrac{V^2}{R_{toy\,car}}$ $3 = \dfrac{1,5^2}{R_{toy\,car}}$ ✓ $R_{toy\,car} = 0,75\ \Omega$ $emf = I(R_{ext} + r)$ ✓ $6 = 2(R_{ext} + 1,2)$ ✓ $R_{ext} = 1,8\ \Omega$ $R_{ext} = R_{toy\,car} + R_p$ <u>$1,8 = 0,75 + R_p$</u> ✓ $R_p = 1,05\ \Omega$ $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ $\dfrac{1}{1,05} = \dfrac{1}{3} + \dfrac{1}{R}$ ✓ $R = 1,62\ \Omega$ ✓	$P = \dfrac{V^2}{R_{toy\,car}}$ $3 = \dfrac{1,5^2}{R_{toy\,car}}$ ✓ $R_{toy\,car} = 0,75\ \Omega$ $emf = I(R_{ext} + r)$ ✓ $6 = 2(R_{ext} + 1,2)$ ✓ $R_{ext} = 1,8\ \Omega$ $R_{ext} = R_{toy\,car} + R_p$ <u>$1,8 = 0,75 + R_p$</u> ✓ $R_p = 1,05\ \Omega$ $R_p = \dfrac{R_1 R_2}{R_1 + R_2}$ $1,05 = \dfrac{3 \times R}{3 + R}$ ✓ $R = 1,62\ \Omega$ ✓

(6)

8.4   No, ✓ the external resistance will increase. Current will decrease. ✓
$P = I^2 R$, $P\ \alpha\ I^2$ since resistance remain constant, power will decrease. ✓
Nee, ✓ _die eksterne weerstand sal toeneem. Stroom sal afneem._ ✓
$P = I^2 R$, $P\ \alpha\ I^2$ _aangesien die weerstand constant bly sal die drywing afneem._ ✓   (3)

[20]

QUESTION/*VRAAG* 9

9.1 (Electric) motor/ (*Elektriese) motor* ✓ (1)

9.2 Electrical energy ✓ to mechanical energy ✓
Elektriese energie ✓ *na meganiese energie* ✓ (2)

9.3 CLOCKWISE / *KLOKSGEWYS* ✓ (1)

9.4 Replace the split ring with slip rings. ✓
Replace the cell with a resistor / ammeter / voltmeter. ✓
Vervang die split ring met sleepringe ✓
Vervang die sel met 'n resistor / ammeter / voltmeter. ✓ (2)

9.5 9.5.1 $P_{average} = \dfrac{V_{rms}^2}{R}$ ✓

$1500 = \dfrac{230^2}{R}$ ✓

$R = 35{,}27 \ \Omega$ ✓ (3)

9.5.2

OPTION 1/*OPSIE* 1	**OPTION 2/*OPSIE* 2**
$R = \dfrac{V_{rms}}{I_{rms}}$ $35{,}27 = \dfrac{230^2}{I_{rms}}$ ✓ $I_{rms} = 6{,}52 \ A$ $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ ✓ $6{,}52 = \dfrac{I_{max}}{\sqrt{2}}$ ✓ $I_{max} = 9{,}22 \ A$ ✓	$P_{average} = V_{rms} I_{rms}$ $1\,500 = I_{rms} \times 230$ ✓ $I_{rms} = 6{,}52 \ A$ $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ ✓ $6{,}52 = \dfrac{I_{max}}{\sqrt{2}}$ ✓ $I_{max} = 9{,}22 \ A$ ✓

(4)

[13]

TOTAL/*TOTAAL*: 150