Western Cape Government
Education

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

SEPTEMBER 2016

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 18 pages.
Hierdie memorandum 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 may be 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 given correctly.
       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 the 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 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 is 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 berekenings gedoen moet word (bv. 'n stroomdiagramvraag) 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 word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie. Kandidate sal derhalwe 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 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, $m \cdot s^{-1}$.
For marking purposes $m.s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigpunt en nie met 'n punt nie, byvoorbeeld, $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m.s^{-1}$ em 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 berekenings 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 or 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 the 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 byvoorbeeld, 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 to 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 in 3.2 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 1/*VRAAG 1*

1.1   D ✓✓   (2)

1.2   B ✓✓   (2)

1.3   D ✓✓   (2)

1.4   A ✓✓   (2)

1.5   C ✓✓   (2)

1.6   B ✓✓   (2)

1.7   D ✓✓   (2)

1.8   B ✓✓   (2)

1.9   D ✓✓   (2)

1.10   C ✓✓   (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 liggaam inwerk, versnel die liggaam in die rigting van die krag teen 'n vernselling wat direk eweredig is aan die krag en omgekeerd eweredig is 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 liggaam inwerk is gelyk aan die tempo van verandering in momentum van die liggaam in die die rigting van die resulterende/netto krag   (2)

2.2

Accepted Labels/*Aanvaarde benoemings*	
w	F_g/F_w/force of Earth on crate/weight/19,6 N/mg/gravitational force *F_g/F_w/krag van Aarde op skieër/gewig/19,6 N/mg/gravitasiekrag*
T	F_T/Tension/Force in string *F_T/Spanning/Krag in toutjie*
f_k	f / friction *f / wrywing*
F	F_{appled} / $F_{toegepas}$ / 20 N
N	Normal force / F_N / Force of surface on block *Normale krag / F_N / Krag van oppervlak op blok*
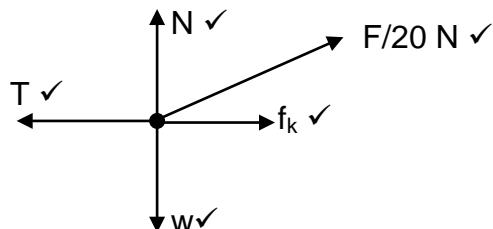
Notes/*Aantekeninge*:

- Any additional forces/ *enige addisionele kragte* max/*maks* $\frac{4}{5}$

- No arrows / *Geen pylties* : $\frac{4}{5}$

- Force(s) not touching object / *Krag(te) nie in aanraking met voorwerp nie* : max/*maks* $\frac{4}{5}$ (5)

2.4

OPTION 1/*OPSIE 1*
2 kg block/*2 kg blok*
F_{net} = ma ✓
$\underline{T – f_k}$ ✓ $– 20\cos20°$ ✓ $= 2(4)$
T - μ_kN – 18,79 = 8
T – $(0,2)\underline{(w – 20\sin20°)}$✓ = 26,79
T - (0,2)(19,6 – 6,84) = 26,79
T = 29,34 N ✓

X kg block/*X kg blok*
F_{net} = ma
w – T = ma ✓
$\underline{(X)(9,8) – 29,34 = X(4)}$ ✓
5,8X = 29,34
X = 5,06 kg ✓   (8)

OPTION 2/*OPSIE 2*

If this option (massless string approximation) is taken max $\frac{4}{8}$

Indien hierdie opsie(massalose toutjie benadering) gebruik word, maks $\frac{4}{8}$

F_{net} = ma ✓
$w - f_k - F_x = (m_1 + m_2)a$
$\underline{(X)(9,8) - \mu_k N - 20\cos20^o - 20\cos20^o = (X + 2)(4)}$✓
$\underline{9,8X - (0,2)\underline{(w - 20\sin20^o)}}$✓ $-20\cos20^o= (X + 2)(4)$
$\underline{9,8X - (0,2)(19,6 - 20\sin20^o) - 20\cos20^o= (X + 2)(4)}$
$\therefore X = 5,06$ kg ✓

(8)

[15]

QUESTION 3/*VRAAG 3*

3.1   A projectile is an object upon which the <u>only force</u>✓ acting is the force of gravity ✓
'n Projektiel is 'n voorwerp waarop die <u>enigste krag</u> wat daarop inwerk, die gravitatsiekrag/swaartekrag is

(2)

3.2

3.2.1

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
Upwards positive/*Opwaarts positief* $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (3,92)^2 + \underline{2(-9,8)\Delta y}$✓ $\Delta y = 0,78(4)$ m ✓ **Downwards positive/*Afwaarts positief*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (-3,92)^2 + \underline{2(9,8)\Delta y}$ ✓ $\Delta y = 0,78(4)$ m ✓	Accept / *Aanvaar*: g or/*of* a $v_f^2 = v_i^2 + 2a\Delta x$ $v^2 = u^2 + 2as$

(3)

OPTION 2/*OPSIE 2*
Upwards positive/*Opwaarts positief*

$v_f = v_i + a\Delta t$
$0 = 3,92 + (-9,8)\Delta t$ Both/*Beide* ✓
$\Delta t = 0,4$ s
$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$
   $= (3,92)(0,4) + \frac{1}{2} (-9,8)(0,4)^2$ ✓
   $= 0,78(4)$ m ✓

Downwards positive/*Afwaarts positief*

$v_f = v_i + a\Delta t$
$0 = (-3,92) + (9,8)\Delta t$ Both/*Beide* ✓
$\Delta t = 0,4$ s
$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$
   $= (-3,92)(0,4) + \frac{1}{2} (9,8)(0,4)^2$ ✓
   $= 0,78(4)$ m ✓

(3)

OPTION 3/*OPSIE 3*
$(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$ ✓
$(mgh + \frac{1}{2} mv^2)_{bottom} = (mgh + \frac{1}{2} mv^2)_{top}$
$0 + \frac{1}{2} (3,92)^2 = (9,8)h + 0^2$ ✓
$h = 0,78(4)$ m ✓

(3)

| 3.2.2	**OPTION 1/*OPSIE 1*** **Upwards positive/*Opwaarts positief*** $v_f = v_i + a\Delta t$ ✓ <u>$-3,92 = 3,92 + (-9,8)\Delta t$</u> ✓ $\Delta t = 0,8$ s ✓	**Notes/*Aantekeninge*** Accept / *Aanvaar*: g or/*of* a $v = u + at$	
	Downwards positive/*Afwaarts positief* $v_f = v_i + a\Delta t$ ✓ <u>$3,92 = -3,92 + (9,8)\Delta t$</u> ✓ $\Delta t = 0,8$s ✓	Both/*Beide* ✓	(3)
	OPTION 2/*OPSIE 2* **Upwards positive/*Opwaarts positief*** $\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $0 = (3,92)\Delta t + \frac{1}{2} (-9,8)\Delta t^2$ ✓ $\Delta t(3,92 - 4,9\Delta t) = 0$ $\Delta t = 0$ (invalid/*ongeldig*) or/*of* $\Delta t = 0,81$ s ✓		
	Downwards positive/*Afwaarts positief* $\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $0 = (-3,92)\Delta t + \frac{1}{2} (9,8)\Delta t^2$ ✓ $\Delta t(3,92 - 4,9\Delta t) = 0$ $\Delta t = 0$ (invalid/*ongeldig*) or/*of* $\Delta t = 0,81$ s ✓		(3)

3.3	**OPTION 1/*OPSIE 1*** **Upwards positive/*Opwaarts positief*** $F_{net}\Delta t = m\Delta v$ ✓ $F_{net}(0,1) = (0,1)[2,5 - (-3,92)]$ ✓ $F_{net} = 6,42$ N ✓		
	Downwards positive/*Afwaarts positief* $F_{net}\Delta t = m\Delta v$ ✓ $F_{net}(0,1) = (0,1)[-2,5 - 3,92]$ ✓ $F_{net} = -6,42$ N Magnitude of /*Grootte van* $F_{net} = 6,42$ N ✓	Both/*Beide* ✓	(3)
	OPTION 2/*OPSIE 2* **Upwards positive/*Opwaarts positief*** $v_{f} = v_i + a\Delta t$ $2,5 = -3,92 + a(0,1)$ ✓ $a = 64,2$ m·s^{-2} $F_{net} = ma$ $\quad = (0,1)(64,2)$ $\quad = 6,42$ N ✓	Both/*Beide* ✓	
	Downwards positive/*Afwaarts positief* $v_{f} = v_i + a\Delta t$ $-2,5 = 3,92 + a(0,1)$ ✓ $a = -64,2$ m·s^{-2} $F_{net} = ma$ $\quad = (0,1)(-64,2)$ $\quad = -6,42$ N Magnitude of /*Grootte van* $F_{net} = 6,42$ N ✓	Both/*Beide* ✓	(3)

3.4

Upwards as positive/*Opwaarts as positief*
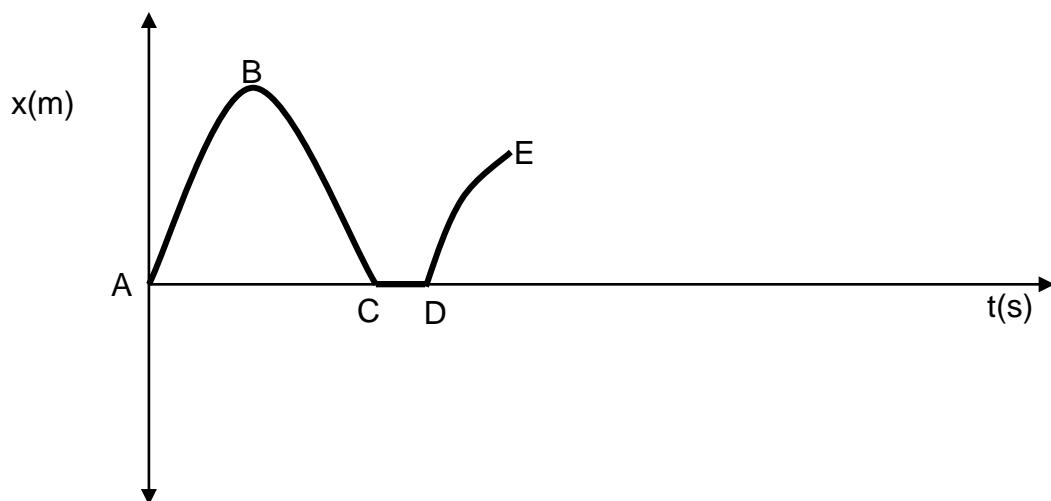
Marking criteria for graph *Nasienriglyne vir grafiek*	Mark Punt
Correct shape of graph A to B to C *Vorm van grafiek A na B na C*	✓
Correct shape of graph C to D *Korrekte vorm van grafiek C na D*	✓
Correct shape of graph D to E *Korrekte vorm van grafiek D na E*	✓

Downwards as positive/*Afwaarts as positief*
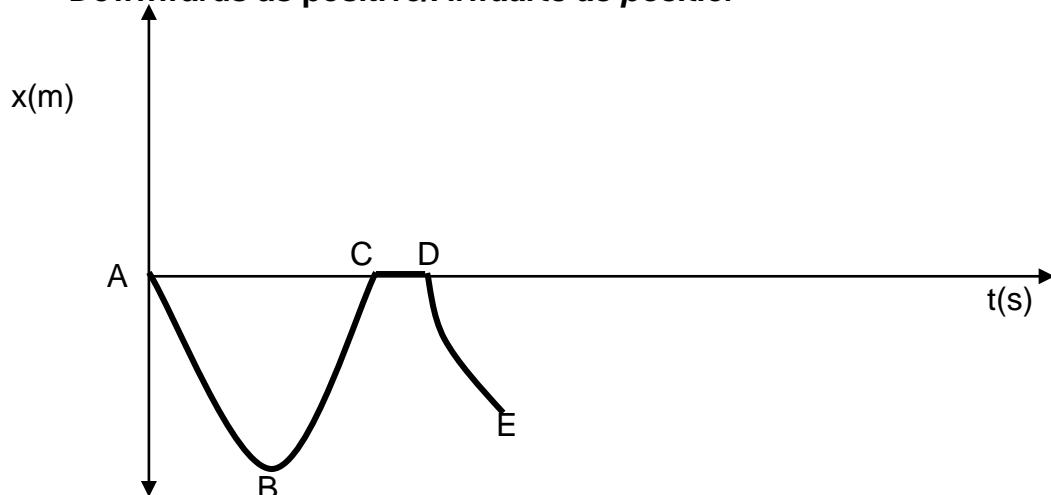
Marking criteria for graph *Nasienriglyne vir grafiek*	Mark Punt
Correct shape of graph A to B to C *Vorm van grafiek A na B na C*	✓
Correct shape of graph C to D *Korrekte vorm van grafiek C na D*	✓
Correct shape of graph D to E *Korrekte vorm van grafiek D na E*	✓

(3)
[14]

QUESTION 4/*VRAAG 4*

4.1   The total linear momentum in a closed system remains constant (is conserved).. .✓✓
        Die totale liniêre momentum in 'n geslote sisteem bly konstant (bly behoue)

        OR/*OF*
        The total momentum before a collision is equal to the total momentum after the collison in a closed system
        Die totale momentum voor 'n botsing is gelyk aan die totale momentum na botsing in 'n geslote sisteem   (2)

4.2   Equal to / *Gelyk aan* ✓   (1)

4.3   The change in momentum for both objects are equal and opposite ✓
        Die verandering in momentum vir beide voorwerpe is gelyk en teenoorgesteld
        ($m_1 \Delta v_1 = -m_2 \Delta v_2$)
        The impulse experienced by both objects is equal and opposite ✓
        Die impuls wat deur beide voorwerpe ondervind word is gelyk en teenoorgesteld
        ($F_1 \Delta t = - F_2 \Delta t$)
        For the same time interval $F_1 = -F_2$ ✓
        Vir dieselfde tyd interval is $F_1 = -F_2$ (3)

4.4   Take motion to the right as positive/*Neem beweging na regs as positief.*
        $\Sigma p_i = \Sigma p_f$
        $(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$ } ✓ | Any one/*Enige een* |
        $(m_1+m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$
        $(1 +100)\underline{(0)}$ ✓ $= \underline{(1)(10) + (100)}\ v_{f2}$✓
        $v_{f2} = -0,1$ m·s^{-1} ✓
        Speed/*Spoed* = 0,1 m·s^{-1}

        $\Delta x = v \Delta t$
        $60 = (0,1)\Delta t$ ✓
        $\Delta t = 600$ s ✓

        OR/OF
        Take motion to the left as positive/*Neem beweging na links as positief.*
        $\Sigma p_i = \Sigma p_f$
        $(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$ } ✓ | Any one/*Enige een* |
        $(m_1+m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$
        $(1 + 100)\underline{(0)}$ ✓ $= \underline{(1)(-10) + (100)}\ v_{f2}$✓
        $v_{f2} = 0,1$ m·s^{-1}✓

        $\Delta x = v \Delta t$
        $60 = (0,1)\Delta t$ ✓
        $\Delta t = 600$ s ✓   (6)
                                                                              [12]

QUESTION 5/*VRAAG 5*

5.1

	Accepted Labels/*Aanvaarde benoemings*
w	F_g/F_w/force of Earth on crate/weight/39,2 N/mg/gravitational force *F_g/F_w/krag van Aarde op krat/gewig/39,2 N/mg/gravitasiekrag*
f	f / friction *f / wrywing*
N	Normal force / F_N / Force of surface on block *Normale krag / F_N / Krag van oppervlak op blok*
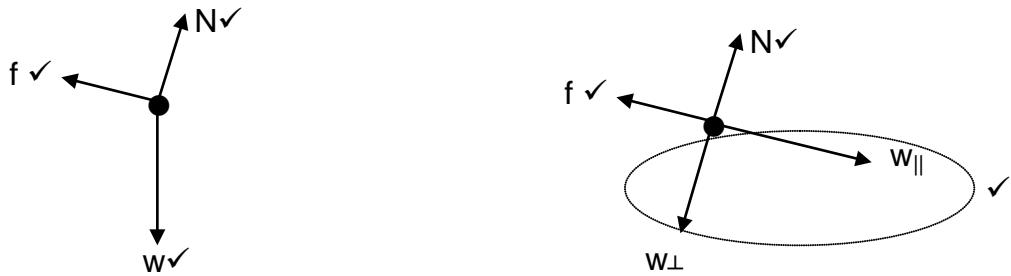
	Notes / *Aantekeninge*

	• Any additional forces max $\frac{2}{3}$
	   Enige addisionel kragte maks $\frac{2}{3}$
	 • No arrows max $\frac{2}{3}$
	   Geen pylpunte maks $\frac{2}{3}$
	 • Forces not touching dot max $\frac{2}{3}$
	   Kragte wat nie kolletjie raak nie maks $\frac{2}{3}$

(3)

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

5.3   **Incline/*Skuinsvlak***
$W_{fk} = f_k \Delta x \cos\theta$ ✓ $= \mu_k N \Delta x \cos\theta$ ✓ $= \mu_{k(} mg\cos30^o \Delta x \cos180^o$ ✓
$= (0,2)(4)(9,8)\cos 30^o(3)(-1)$✓
$= -20,3689$ J
$W_w = w\Delta x\cos60^o = (4)(9,8)(3)\cos 60^o = 58,8$ J

$W_{net} = \Delta K = K_f - K_i$. ✓
$W_w + W_N + W_f = K_f - 0$
$\underline{58,8 + 0 \ -620,3689)}$ ✓ $= K_f$
$K_f = 38,431$J✓

Horizontal surface/*Horisontale opplervlak*
$W_{net} = \Delta K$
$W_w + W_N + W_f = K_f - K_i$
$0 + 0 + \mu_k N \Delta x \cos\theta = 0 - 38,431$
$\underline{(0,5)(4)(9,8)\Delta x \cos180^o = -38,431}$ ✓
$\Delta x = 1,96$ m ✓   (8)

[16]

QUESTION 6/*VRAAG 6*

6.1 $v = f\lambda =$ ✓
$340 = f(0,72)$ ✓
$f = 472,22$ Hz✓   (3)

6.2   The apparent change in the observed frequency as a result of relative motion
between the source and the listener.✓✓/
*Die skynbare verandering in die waargenome frekwensie as gevolg van die
relatiewe beweging tussen die bron en die luisteraar*

OR/*OF*
An (apparent) change in observed/detected frequency (pitch), (wavelength) ✓
as a result of the relative motion between a source and an observer ✓
(listener).
*'n Skynbare verandering in waargenome frekwensie (toonhoogte),(golflengte)
as gevolg van die relatiewe beweging tussen die bron en 'n
waarnemer/luisteraar.*   (2)

6.3   Towards/*Na.* ✓
The frequency of the sound waves heard by the traffic official is greater than
the frequency of the sound waves emitted by the hooter.✓
*Die frekwensie van die klankgolwe wat deur die verkeersbeampte gehoor
word is groter as die frekwensie van die klankgolwe wat deur die toeter
vrygestel word.*   (2)

6.4

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$

$$472,22\checkmark = \frac{340}{340 - v_s} \checkmark (433,64)\checkmark$$

$v_s = 27,28 \text{ m·s}^{-1} \checkmark$

The car is not exceeding the speed limit$\checkmark$ as the speed limit is 100 km·h^{-1} (27,78 m.s^{-1}), while the speed of the car is 100 km.h^{-1}(27,78 m.s^{-1}) $\checkmark$
Die motor oorskry nie die spoedgrens nie aangesien dit 100 km·h^{-1} (27,78 m·s^{-1}) is , terwyl die spoed van die motor is 100 km·h^{-1} (27,78 ms^{-1}) is (6)

6.4   Less than / *Minder as* $\checkmark$ (1)

[14]

QUESTION 7/*VRAAG 7*

7.1   The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is <u>directly proportional to the product of the magnitudes of the charges</u> $\checkmark$ and <u>inversely proportional to the square of the distance (r)</u> $\checkmark$ between them.
Die grootte van die elektrostatiese krag wat uitgeoefen word deur een puntlading (Q_1) op 'n ander puntlading (Q_2) is <u>direk eweredig aan die produk van die grootte van die ladings</u> en <u>omgekeerd eweredig aan die kwadraat van die afstand (r)</u> tussen hulle (2)

7.2   Q = ne $\checkmark$
-2 x 10^{-4} = n(-1,6 x 10^{-19}) $\checkmark$
n = 1,25 x 10^{15} $\checkmark$ electrons/*elektrone* (3)

7.3

$$F_{Q1Q2} = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{Q1Q2} = 9 \times 10^9 \frac{(2 \times 10^{-5})(2 \times 10^{-4})}{(0,5)^2} \checkmark$$

F_{Q1Q2} = 144 N East/*Oos*

$$F_{Q1Q3} = \frac{kQ_1Q_2}{r^2}$$

$$F_{Q1Q3} = 9 \times 10^9 \frac{(2 \times 10^{-5})(2 \times 10^{-4})}{(0,4)^2} \checkmark$$

F_{Q1Q2} = 225 N South/*Suid*

$$F_{net/netto} = \sqrt{225^2 + 144^2} \checkmark$$

$$= 267,13 \text{ N}$$

$$\tan\theta = \frac{225}{144}$$

θ = 57,38^o
Fnet/*netto* = 267,13 N $\checkmark$ 57,38^o south of east/*suid van oos*$\checkmark$ (6)

[11]

QUESTION 8 /VRAAG 8

8.1   Electric field at a point is defined as the force acting per unit charge. ✓✓
Elektriese veld by 'n punt is gedefinieer as die krag wat inwerk per eenheids lading

OR/*OF*
It is the force experienced by a unit positive charge placed at that point. ✓✓
Dit is die krag wat deur 'n eenheids positiewe lading geplaas by daardie punt ondervind word.   (2)

8.2 $E_{net} = E_{Q1} - E_{Q2}$ ✓

$= \dfrac{kQ_1}{r_1^2} + \dfrac{kQ_2}{r_2^2}$ ✓

$= \dfrac{(9 \times 10^9)(3 \times 10^{-6})}{(0,4)^2}$ ✓ - $\dfrac{(9 \times 10^9)(5 \times 10^{-6})}{(0,1)^2}$ ✓

$= 168\ 750 - 4\ 500\ 000$
$= -4\ 331\ 250$ N·C^{-1} ✓

Mangitude / *Grootte* $= 4,33 \times 10^6$ / 4 331 250 N·C^{-1} ✓   (6)

[9]

QUESTION 9/*VRAAG 9*

9.1
9.1.1   6 V ✓   (1)

9.1.2   **POSITIVE MARKING FROM QEUSTION 9.1.1**
POSITIEWE NASIEN VANAF VRAAG 9.1.1

$V = \varepsilon - V_{0,4}$
$= 6$✓ $- 4$ ✓
$= 2$ V ✓   (3)

9.2
9.2.1   24 J of work ✓ done per unit positive charge ✓ (+1C) moving from one point in the circuit to another
24 J arbeid per eenheid positiewe lading (+ 1C) verrig in die beweging van een punt na 'n ander in die stroombaan

OR/OF
It is the amount of work done (24 J) per unit positive charge (+1C) moving it from one point in the circuit to another
Dit is die hoeveelheid arbeid (24 J) per eenheid positiewe lading (+ 1C) verrig om dit van die een punt na 'n ander in die stroom baan te beweeg   (2)

9.2.2   V=IR ✓
      (24-22,26)=I(0,5) ✓
      I=3,48 A

      $V_{5Ω}$=IR
         =(3,48)(5) ✓
         =17,4 V

      V// = 22,26-17,4 ✓ = 4,86 V

      $P = \dfrac{V^2}{R}$ ✓
      $P = \dfrac{(4,86)^2}{16}$ ✓
        = 1,48 W ✓   (7)

9.2.3   **POSITIVE MARKING FROM QEUSTION 9.2.2**
      POSITIEWE NASIEN VANAF VRAAG 9.2.2

      Current through/*Stroom deur* 2 Ω: $I = \dfrac{V}{R}$ ✓ $= \dfrac{4,86}{2}$ ✓ = 2,43 A

      Current through/*Stroom deur* 16 Ω: $I = \dfrac{V}{R} = \dfrac{4,86}{16}$ = 0,3 A

      I_R = 3,48 – 2,43 – 0,3 ✓ = 0,75 A ✓   (4)

9.2.4   Increases /*Neem toe* ✓

      Total resistance (R_T) increases /*Totale weerstand neem toe* ⎫ ✓
      Total current (I_T) decreases /*Totale stoom neem af* ⎭

      ∴lost volts (Vi) AND $V_{5Ω}$ decreases, therefore <u>V//</u> increases / *Verlore volts en V_{5Ω} neem af dus neem V|| toe* ✓

      $P \propto I^2$ ✓ if/*indien* R=constant/*konstant*
      OR/*OF*
      $P \propto V^2$ if/*indien* R=constant/*konstant*   (4)
   **[21]**

QUESTION 10/*VRAAG 10*

10.1   Clockwise/*Kloksgewys* ✓   (1)

10.2
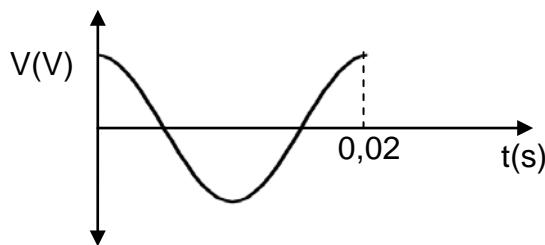
Marking criteria/*Nasienriglyne*	Mark/*Punt*
Correct shape / *Korrekte vorm*	✓
Correct time indicated / *Korrekte tyd aangetoon*	✓

(2)

10.3.1

$P = \dfrac{W}{\Delta t}$ ✓

$= \dfrac{9{,}45 \times 10^6}{2(3600)}$ ✓

$= 1\ 312{,}5\ W$ ✓   (3)

10.3.2

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM 10.3.1
POSITIEWE NASIEN VANAF 10.3.1

$P_{ave/gemid} = V_{rms/wgk} I_{rms/wgk}$ ✓

$= \dfrac{V_{max/maks}}{\sqrt{2}} \times \dfrac{I_{max/maks}}{\sqrt{2}}$ ✓

$1\ 312{,}5$ ✓ $= \dfrac{311{,}13}{\sqrt{2}} \times \dfrac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 8{,}44\ A$ ✓

(5)

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 10.3.1
POSITIEWE NASIEN VANAF 10.3.1

$V_{rms/wgk} = \dfrac{V_{max/maks}}{\sqrt{2}}$

$V_{rms/wgk} = \dfrac{311{,}13}{\sqrt{2}}$ ✓

$V_{rms} = 220{,}00\ V$

$P_{ave} = V_{rms} I_{rms}$ ✓

$1\ 312{,}5 = (220)I_{rms/wgk}$ ✓

$I_{rms/wgk} = 5{,}96(6)\ A$

$I_{rms/wgk} = \dfrac{I_{max/maks}}{\sqrt{2}}$

$5{,}966 = \dfrac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 8{,}44\ A$ ✓

(5)

[11]

QUESTION 11/*VRAAG 11*

11.1   The minimum energy that an electron in the metal needs to be emitted from the surface of a metal ✓✓
Die minimum energie wat 'n elektron in die metaal benodig om vanaf die oppervlak van die metaal vrygestel te word   (2)

11.2 $W_o = hf_o$ ✓
$= (6{,}63 \times 10^{-34})(9 \times 10^{14})$ ✓
$= 5{,}967) \times 10^{-19}$ J ✓   (3)

11.3   **POSITIVE MARKING FROM 11.2**
POSITIEWE NASIEN VANAF 11.2
$E = W_o + E_{k(max/maks)}$ ✓
$(6{,}63 \times 10^{-34})(14 \times 10^{14})$✓ $= (6{,}63 \times 10^{-34})9 \times 10^{14}$✓ $+ E_1$
$\therefore E_1 = 3{,}315 \times 10^{-19}$ J✓   (4)

11.4   Remain the same/*Dieselfde bly* ✓

Velocity of photoelectrons depends on the frequency of the incident light ✓
Snelheid van foto-elektrone hang van die frekwensie van die invallende lig af

OR/OF
Intensity affects the number of photoelectrons emitted✓
Intensiteit beinvloed die aantal fotoelektrone vrygestel   (2)
[11]
TOTAL/*TOTAAL*:   150