basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

FEBRUARY/MARCH 2014/*FEBRUARIE/MAART 2014*

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 20 pages.
Hierdie memorandum bestaan uit 20 bladsye.

Copyright reserved/*Kopiereg voorbehou*

Learning Outcomes and Assessment Standards ***Leeruitkomste en Assesseringstandaarde***		
LO/*LU* 1	**LO/*LU* 2**	**LO/*LU* 3**
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. *Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.*	**AS 12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.*	**AS 12.3.1:** Research, discuss, compare and evaluate scientific and indigenous knowledge systems and knowledge claims by indicating the correlation among them, and explain the acceptance of different claims. *Doen navorsing, bespreek, vergelyk en evalueer wetenskaplike en inheemse kennissisteme en kennisaansprake deur die ooreenkoms aan te dui en verduidelik die aanvaarding van verskillende aansprake.*
AS 12.1.2: Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. *Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.*	**AS 12.2.2** Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. *Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.*	**AS 12.3.2:** Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. *Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.*
AS 12.1.3: Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingsstrategieë om (ongesiene) probleme op te los.*	**AS 12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS 12.3.3:** Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. *Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.*
AS 12.1.4: Communicate and defend scientific arguments with clarity and precision. *Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.*		

Copyright reserved/*Kopiereg voorbehou*

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.

Copyright reserved/*Kopiereg voorbehou*

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.

Copyright reserved/*Kopiereg voorbehou*

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.*

Copyright reserved/*Kopiereg voorbehou*

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.

Copyright reserved/*Kopiereg voorbehou*

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1 Mechanical energy / *Meganiese energie* ✓ (1)

1.2 Newton's first law / *Newton se eerste wet* ✓ (1)

1.3 (Electrical) potential energy / *(Elektriese) potensiële energie* ✓ (1)

1.4 Diffraction / *Diffraksie* ✓ (1)

1.5 Work function / *Arbeidsfunksie (Werkfunksie)* ✓ (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 D ✓✓ (2)

2.2 A ✓✓ (2)

2.3 D ✓✓ (2)

2.4 D ✓✓ (2)

2.5 C ✓✓ (2)

2.6 C ✓✓ (2)

2.7 D ✓✓ (2)

2.8 B ✓✓ (2)

2.9 B ✓✓ (2)

2.10 A ✓✓ (2)
[20]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

Copyright reserved/*Kopiereg voorbehou*

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1

3.1.1 Upwards / *Opwaarts* ✓ (1)

3.1.2 Downwards / *Afwaarts*✓ (1)

3.2 Q ✓
Weight is the only force acting on the rocket. ✓
Gewig is die enigste krag wat op die vuurpyl inwerk. (2)

3.3

OPTION 1/*OPSIE 1* **Upwards positive/*Opwaarts positief*:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ -225,6 ✓ = (112,8)Δt ✓ + ½(-9,8)Δt^2 ✓ $\therefore$ Δt = 24,87 s ↘ Total time/*Totale tyd*: 4 + ✓ 24,87 = 28,87 s ✓ **Downwards positive/*Afwaarts positief*:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ 225,6 ✓ = (-112,8)Δt ✓ + ½(9,8)Δt^2 ✓ $\therefore$ Δt = 24,87 s ↘ Total time/*Totale tyd*: 4 + ✓ 24,87 = 28,87 s ✓	**Notes/*Aantekeninge*:** Accept/*Aanvaar*: g or/*of* a $s = ut + \frac{1}{2}at^2$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
OPTION 2/*OPSIE 2* **Upwards positive/*Opwaarts positief*:** $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore v_f^2 = (112,8)^2 + 2(-9,8)(-225,6)$ ✓ $\therefore$ v_f = 130,94 m·s^{-1} ↘ $\Delta y = (\frac{v_i + v_f}{2})\Delta t$ ✓ ↘ -225,6 ✓ = $(\frac{112,8 - 130,94}{2})\Delta t$ ✓ $\therefore$ Δt = 24,87 s ↓ Total time/*Totale tyd* : 4 + ✓ 24,87 = 28,87 s ✓ **Downwards positive/*Afwaarts positief*:** $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore v_f^2 = \underline{(-112,8)^2 + 2(9,8)(225,6)}$ ✓ $\therefore$ v_f = 130,94 m·s^{-1} ↘ $\Delta y = (\frac{v_i + v_f}{2})\Delta t$ ✓ ↘	**Notes/*Aantekeninge*:** Accept/*Aanvaar*: g or/*of* a $v_f^2 = vi^2 + 2a\Delta x$ $v^2 = u^2 + 2as$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $s = \left(\frac{u+v}{2}\right)t$

$225,6$ ✓ $= (\frac{-112,8+130,94}{2})\Delta t$ ✓

$\therefore \Delta t = 24,87$ s

Total time/*Totale tyd*:
4 + ✓ 24,87 = 28,87 s ✓

OPTION 3/*OPSIE 3*

Upwards positive/*Opwaarts positief*:

Time from point where fuel is used up to maximum height /*Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte* :

$v_f = v_i + a\Delta t$ ✓

$\therefore$ $0 = 112,8 + (-9,8)\Delta t$ ✓

$\therefore \Delta t = 11,51$ s

Time from maximum height to ground / *Tyd vanaf maksimum hoogte tot die grond*:

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

$= (112,8)(11,51) + ½(-9,8)(11,51)^2$

$\therefore \Delta y = 649,18$ m

Maximum height/*Maksimum hoogte*:
225,6 + 649,18 = 874,78 m

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

$\therefore$ $-874,78 = (0)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\therefore \Delta t = 13,36$ s

Total time / *Totale tyd*:
4 + ✓ 11,51 + 13,36 = 28,87 s ✓

Notes/*Aantekeninge*:
Accept/*Aanvaar*:
g or/*of* a
$v = u + at$
$v_f^2 = vi^2 + 2a\Delta x$
$v^2 = u^2 + 2as$
$s = ut + \frac{1}{2}at^2$
$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

Downwards positive/Afwaarts *positief*:

Time from point where fuel is used up to maximum height/ *Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte*:

$v_f = v_i + a\Delta t$ ✓

$\therefore$ $0 = -112,8 + (9,8)\Delta t$ ✓

$\therefore \Delta t = 11,51$·s

Time from maximum height to ground: *Tyd vanaf maksimum hoogte tot die grond*:

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

$= (-112,8)(11,51) + ½(9,8)(11,51)^2$

$\therefore \Delta y = -649,18$ m

Maximum height/ *Maksimum hoogte*:
225,6 + 649,18 = 874,78 m

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

$\therefore$ $874,78 = (0)\Delta t + ½(9,8)\Delta t^2$ ✓

$\therefore \Delta t = 13,36$ s

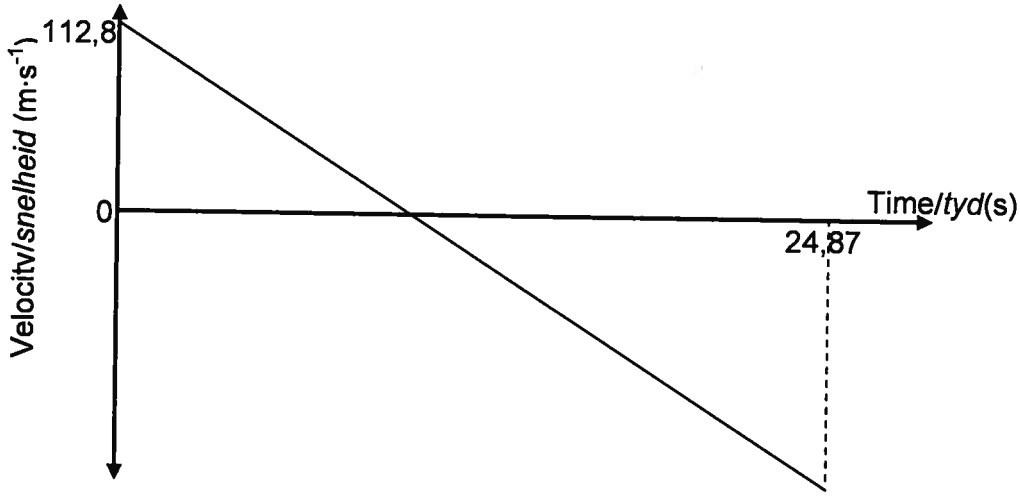
Total time/*Totale tyd*
4 + ✓ 11,51 + 13,36 = 28,87 s ✓

Notes/*Aantekeninge*:
Accept/*Aanvaar*:
g or/*of* a
$v = u + at$
$v_f^2 = vi^2 + 2a\Delta x$
$v^2 = u^2 + 2as$
$s = ut + \frac{1}{2}at^2$
$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

(6)

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

Upwards positive/*Opwaarts positief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Graph starts at (0; 112,8)./ *Grafiek begin by (0; 112,8).*	✓
Graph is a straight line with a gradient. /*Grafiek is 'n reguitlyn met 'n gradiënt.*	✓
Graph has a negative gradient./*Grafiek het 'n negatiewe gradiënt.*	✓
POSITIVE MARKING FROM QUESTION 3.3./*POSITIEWE NASIEN VANAF VRAAG 3.3.* Graph extends below x-axis until t = 24,87 s. *Grafiek verleng onder x-as tot t = 24,87s.*	✓
Graph extends below the x-axis to a magnitude of the velocity greater than (112,8 $m \cdot s^{-1}$). / *Tweede deel van grafiek verleng onder die x-as tot 'n grootte van die snelheid groter as (112,8 $m \cdot s^{-1}$).*	✓

Notes/*Aantekeninge:*

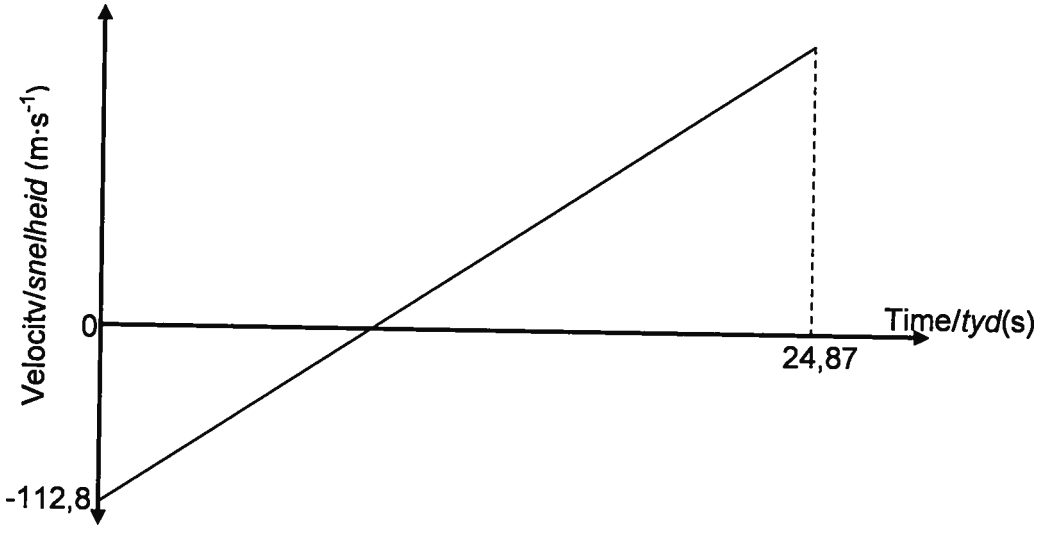
If wrong labels/*Indien verkeerde byskrifte*: Max./*Maks.* $\frac{3}{4}$

Copyright reserved/*Kopiereg voorbehou*

OPTION 2/*OPSIE 2*

If upwards taken as negative: Max $\frac{4}{5}$/

Indien opwaarts as negatief geneem: Maks. $\frac{4}{5}$



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Graph starts at (0; -112,8)./ *Grafiek begin by (0; -112,8).*	✓
Graph is a straight line with a gradient. /*Grafiek is 'n reguitlyn met 'n gradiënt.*	✓
Graph has a positive gradient./*Grafiek het 'n positiewe gradiënt.*	✓
POSITIVE MARKING FROM QUESTION 3.3./*POSITIEWE NASIEN VANAF VRAAG 3.3.* Graph extends above x-axis until t = 24,87 s. *Grafiek verleng bo x-as tot t = 24,87s.*	✓
Graph extends above the x-axis to a magnitude of the velocity greater than (112,8 $m \cdot s^{-1}$). / *Tweede deel van grafiek verleng bo die x-as tot 'n grootte van die snelheid groter as (112.8 $m \cdot s^{-1}$).*	✓

Notes/*Aantekeninge:*
If wrong labels/*Indien verkeerde byskrifte*: Max./*Maks.* $\frac{3}{4}$

(5)
[15]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 4/*VRAAG 4*

4.1 Momentum is the product of the mass and velocity of an object. ✓✓
Momentum is die produk van die massa en snelheid van 'n voorwerp. (2)

4.2 $\Delta p = 0$ ✓

$F_{net} = \frac{\Delta p}{\Delta t} = 0$ ✓

OR/*OF*

$\Delta p = 0$ ✓

$\Delta v = 0 \therefore a = 0 \therefore F_{net} = ma$ ✓

OR/*OF*

Gradient of graph/ *Gradiënt van grafiek* $= \frac{\Delta p}{\Delta t} = F_{net}$ ✓

Gradient of graph between/*Gradient van grafiek tussen*:
t = 10 s and/*en* 20 s = 0 ✓ (2)

4.3

OPTION 1	**OPTION 2**
$F_{net}\Delta t = \Delta p$ ✓ $= -120 - 50$ ✓ $= -170$ $\therefore F_{net}\Delta t = 170$ N·s / kg·m·s^{-1} ✓	$F_{net} = \frac{\Delta p}{\Delta t}$ ✓ $= \frac{-120 - 50}{50 - 20}$ $\therefore F_{net} = -5,67$ $F_{net}\Delta t = (-5,67)(30)$ ✓ $= -170$ $\therefore F_{net}\Delta t = 170$ N·s / kg·m·s^{-1} ✓

(3)

4.4

OPTION 1/ *OPSIE 1*	**OPTION 2/*OPSIE 2***
$\Sigma p_i = \Sigma p_f$ ✓ $-120 + 70$ ✓ $= 50 + p_{Bf}$ ✓ $\therefore p_{Bf} = -100$ $\therefore p_{Bf} = 100$ kg·m·s^{-1}✓ west / *wes* ✓	$\Delta p_A = -\Delta p_B$ ✓ $50 - (-120)$ ✓ $= -(p_{Bf} - 70)$ ✓ $\therefore p_{Bf} = -100$ $\therefore p_{Bf} = 100$ kg·m·s^{-1}✓ west / *wes* ✓
Other formulae/*Ander formules*: $m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$ or $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ or $m_Av_{iA} + m_Bv_{iB} = m_Av_{fA} + m_Bv_{fB}$ $p_{total\ before} = p_{total\ after}$ Accept /*Aanvaar*: $p_{before} = p_{after}$ $p_i = p_f$	**Notes/*Aantekeninge*:** • If no formula/principle – Max. $\frac{4}{5}$ *Indien geen formule/beginsel* – *Maks.* $\frac{4}{5}$ • Mark direction independently. *Sien rigting onafhanklik na.*

(5)
[12]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 5/*VRAAG 5*

5.1 The rate at which work is done. / Work done per unit time. ✓✓
Die tempo waarteen arbeid verrig word. / Arbeid verrig per eenheidstyd.

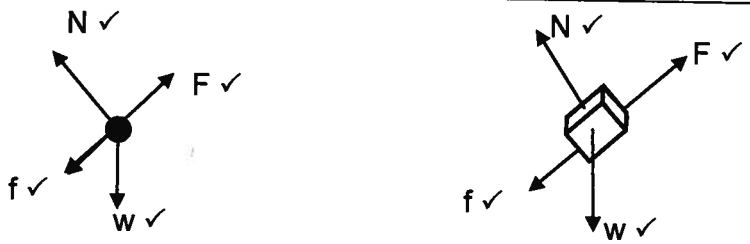
OR/*OF*
The rate at which energy is transferred. / Energy transferred per unit time.
Die tempo waarteen energie oorgedra word. / Energie oorgedra per eenheidstyd.

Notes/*Aantekeninge:*
- No part marking /*Geen gedeelte nasien*- 2 marks or 0./*Twee punte of nul*
- **Accept/*Aanvaar*:**
  The product of force and average / instantaneous velocity. ✓✓
  Die produk van krag en gemiddelde / oombliklike snelheid
- **IF/INDIEN:**
  The product of force and velocity / *Die produk van krag en snelheid.*
  Max/*Maks.* ½

(2)

5.2

Accept/*Aanvaar*: Force diagram/*kragtediagram*



Accepted labels/*Aanvaarde benoemings*	
w	F_g/F_w/force of Earth on truck/weight/12 000 N/mg/gravitational force *F_g/F_w/krag van Aarde op vragmotor/gewig/12 000 N/mg/gravitasiekrag*
N	F_N/normal *F_N/normaal*
F	Force of engine /$F_{net}/F_{applied}$ *Krag van enjin op vragmotor/$F_{net}/F_{toegepas}$*
f	F_f / friction

(4)

5.3

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge:***
$W_{net} = \Delta K$ ✓ $W_F + W_f + W_w = K_f - K_i$ $W_F - 8,5 \times 10^4$ ✓$+ (5\,000)(9,8)(55)\cos 180°$✓ $= 0$✓ $\therefore W_F = 2,78 \times 10^6$ J✓	Accept/*Aanvaar:* $W_{net} = \Delta E_k$ $W_{net} = E_{kf} - E_{ki}$
OPTION 2/*OPSIE 2*	**Notes/*Aantekeninge:***
$W_{net} = \Delta K$ ✓ $W_F + W_f - \Delta E_p = K_f - K_i$ $W_F - 8,5 \times 10^4$✓ $- (5\,000)(9,8)(55)$ ✓ $= 0$✓ $\therefore W_F = 2,78 \times 10^6$ J ✓	Accept/*Aanvaar:* $W_{net} = \Delta E_k$ $W_{net} = E_{kf} - E_{ki}$

(5)

Copyright reserved/*Kopiereg voorbehou*

POSITIVE MARKING FROM 5.3/*POSITIEWE NASIEN VANAF VRAAG 5.3*

5.4
$$P = \frac{W}{\Delta t} \checkmark$$
$$= \frac{2{,}78 \times 10^6}{60} \checkmark$$
$$= 4{,}63 \times 10^4 \text{ W} \checkmark$$
(3)

5.5 Smaller than /*Kleiner as*✓
Weight / gravitational force does positive work on the truck. ✓
Gewig / gravitasiekrag verrig positiewe arbeid op die trok. (2)
[16]

QUESTION 6/*VRAAG 6*

6.1 Away (from the observer) ✓

Detected frequency must be less than or equal to 800 Hz. ✓
If the car moves away from the observer, less waves reaches her per unit time. ✓

OR/OF
Away (from the observer) ✓
The apparent wavelength increases. ✓
For the same speed of sound, the apparent frequency decreases. ✓ (3)

6.2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$
$$800 \checkmark = \frac{340}{340 + v_s} \checkmark (850) \checkmark$$
$$\therefore v_s = 21{,}25 \text{ m·s}^{-1} \checkmark$$
(5)

6.3 **ANY ONE:**
Measurement of foetal heart beat. ✓
Measurement and monitoring blood flow./ Doppler flow meter (1)
[9]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 7/*VRAAG 7*

7.1 To produce coherent waves. / Act as coherent source. ✓

OR/*OF*
To produce waves with a constant phase relationship.

Accept: To create an interference pattern./
Aanvaar: Om 'n interferensiepatroon te vorm. (1)

7.2.1 Increases ✓ (1)

7.2.2 Decreases ✓ (1)

7.2.3 Increases ✓ (1)

7.3 A bright broad central band. ✓
On either side alternating bright and dark bands ✓ (of different widths and intensity). (2)

7.4 $\sin\theta = \frac{m\lambda}{a}$ ✓

$\sin 25^\circ$ ✓$= \frac{(4)(450 \times 10^{-9})}{a}$ ✓ ✓

$a = 4{,}26 \times 10^{-6}$ m ✓ (5)

7.5 $\lambda_{sound} > \lambda_{light}$ ✓
diffraction of sound waves > diffraction light waves ✓

OR
Sound waves have wavelength larger than the opening and therefore are effectively diffracted. ✓
Light waves have wavelength much smaller than the opening and there is virtually no diffraction. ✓

OR
For diffraction to occur, the wavelength must be comparable to the size of the opening. ✓
Since wavelengths of light waves are much smaller than sound waves, ✓
diffraction effects are more visible with sound than with light. (2)
[13]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 8/*VRAAG 8*

8.1 Coulomb's law / *Coulomb se wet* ✓ (1)

8.2 A: Field lines too dense in relation to C/ Number of field lines differ. /*A: Veldlyne te dig in vergelyking met C/ Aantal veldlyne verskil.* ✓
B: Field lines are crossing each other. /*B: Veldlyne kruis mekaar.* ✓
C: Direction of field lines should be away from C/ *C: Rigting van veldlyne moet weg van C af wees.* ✓ (3)

8.3

OPTION 1/*OPSIE 1*

$F_{AC} = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^9)(100\times10^{-6})(100\times10^{-6})}{(0,06)^2}$ ✓

$= 2,5 \times 10^4$ N to the right/*na regs*

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

$= \frac{(9\times10^9)(100\times10^{-6})(100\times10^{-6})}{(0,03)^2}$ ✓

$= 1 \times 10^5$ N to the right/*na regs*

✓Any one

$F_{net} = F_{AC} + F_{BC}$
$= 2,5 \times 10^4 + 1 \times 10^5$
$= 1,25 \times 10^5$ N ✓ to the right/*na regs* ✓

OPTION 2/*OPSIE 2*

$F_{AC} = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^9)(100\times10^{-6})(100\times10^{-6})}{(0,06)^2}$ ✓

$= 2,5 \times 10^4$ N to the right/*na regs*

$r_{BC} = ½ r_{AC}$
$F_{BC} = 4 F_{BC}$ ✓ $= 4(2,5 \times 10^4) = 1 \times 10^5$ N to the right

$F_{net} = F_{AC} + F_{BC}$
$= 2,5 \times 10^4 + 1 \times 10^5$
$= 1,25 \times 10^5$ N ✓ to the right/*na regs* ✓

(6)

8.4 Net force acting on charge at B = 0 N/
Netto krag wat op lading inwerk by B = 0 N ✓
$F_{AB} = - F_{CB}$ ✓ (2)
[12]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 9/*VRAAG 9*

9.1 The amount of energy ✓ given to each coulomb of charge ✓passing through the battery./*Die hoeveelheid energie ✓ oorgedra aan elke coulomb lading ✓ wat deur die battery beweeg.*

OR/*OF*

The maximum ability of a cell to do work./*Die maksimum vermoë van 'n sel om arbeid te verrig.* (2)

9.2 3 V ✓ (1)

9.3

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}$ ✓ $=\frac{1}{4}+\frac{1}{1}$ ✓$=\frac{5}{4}$ $\therefore R_p = 0,8\ \Omega$ V = IR✓ 2,8 = I(0,8) ✓ I = 3,5 A✓	Current through 4 Ω resistor/*Stroom deur 4 Ω-weerstand*: V = IR✓ 2,8 = I(4) ✓ $\therefore$ I = 0,7 A Current through 1 Ω resistor/ *Stroom deur 1 Ω-weerstand*: V = IR 2,8 = I(1) ✓ $\therefore$ I = 2,8 A Total current through battery/*Totale stroom deur battery*: $I_T = I_1 + I_2$ = 0,7 + 2,8 ✓= 3,5 A ✓

(5)

9.4 **POSITIVE MARKING FROM QUESTION 9.3./*POSITIEWE NASIEN VAN VRAAG 9.3.***

OPTION 1 / *OPSIE 1*

Emf = I(R + r) ✓
3 ✓= 3,5(0,8 + 2r) ✓
2r = 0,06 Ω (0,057 Ω) ✓
$\therefore$ r = 0,03 Ω✓

OPTION 2 / *OPSIE 2*

$V_{"lost"}$ = 3 – 2,8 ✓= 0,2 V
$V_{"lost"}$ =Ir_{total}✓
0,2 = 3,5r ✓
r_{total} = 0,057 Ω✓
$\therefore r_{internal}$ of each cell = 0,03 Ω✓ (5)

9.5

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

9.5.2 Decreases/*Neem af* ✓
Total resistance decreases./*Totale weerstand verminder.* ✓
Current (through battery) increases./*Stroom (deur die battery) verhoog* ✓
'Lost volts' increases./*'Verlore volts' neem toe.* ✓ (4)

[18]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 10/*VRAAG 10*

10.1

10.1.1 A: coil / rotor / armature / *spoel* ✓
B: brushes / *borsels*✓
C: commutator / *kommutator* OR/*OF*
split-ring (commutator) / *(split-ring)kommutator* ✓ (3)

10.1.2 **ANY ONE/*ENIGE EEN*:**
Takes current into the coil./ *Neem stroom in spoel* in. ✓
Maintains contact with the commutator / *Bly in kontak met kommutator.* (1)

10.1.3 DC motor /*GS Motor* ✓ (1)

10.1.4 Due to the motor effect / *As gevolg van die motoreffek* ✓✓

OR / OF
There is an interaction between the external magnetic field ✓and the magnetic field produced by the current in the conductor. ✓
Daar is 'n wisselwerking tussen die eksterne magneetveld en die magneetveld veroorsaak deur die stroom in die geleier. (2)

10.2

10.2.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{1}{\sqrt{2}}$ ✓
$= 0{,}707$ V ✓ (3)

10.2.2 0,04 s ✓✓

(v doubles ∴ emf doubles ∴ f doubles ∴ period halves)
(v verdubbel ∴ emk verdubbel ∴ f verdubbel ∴ periode halveer)

Notes/*Aantekeninge:*
IF/*INDIEN:* 0,04 - Max/*Maks.* $\frac{1}{2}$

(2)

10.2.3 **POSITIVE MARKING FROM QUESTION 10.2.1.**
POSITIEWE NASIEN VANAF VRAAG 10.2.1.

OPTION 1 / OPSIE 1

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{V_{max}}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓ (1 mark for formula/*1 punt vir formule*)

$= \left(\frac{1}{\sqrt{2}}\right)$ ✓ $\left(\frac{2}{\sqrt{2}}\right)$

$= 1$ W ✓

OPTION 2 / *OPSIE 2*

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{1}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓

$= \left(\frac{1}{\sqrt{2}}\right)\left(\frac{2}{\sqrt{2}}\right)$ ✓

$= 1$ W ✓

(4)
[16]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 11/*VRAAG 11*

11.1.1 The emission of electrons from the surface of a metal ✓ by light of an appropriate frequency. ✓/*Die vrystelling van elektrone vanaf die oppervlak van 'n metaal/Deur lig van 'n toepaslike frekwensie* (2)

11.1.2 Total energy transferred per second = $1,8 \times 10^{-9}$ J
Totale energie oorgedra per sekonde = 1,8 x 10^{-9} J
Energy of one photon/*Energie van een foton*:

$E_{photon/foton} = hf$
$= \frac{hc}{\lambda}$ } (any one/*enige een*) ✓

$= \frac{(6,63 \times 10^{-34})(3 \times 10^{8})}{260 \times 10^{-9}}$ ✓
$= 7,65 \times 10^{-19}$ J

Number of electrons in one second = $\frac{1,8 \times 10^{-9}}{7,65 \times 10^{-19}}$ ✓ ✓ $= 2,35 \times 10^{9}$ ✓

OR/OF

Total energy transferred per second = $1,8 \times 10^{-9}$ J
Totale energie oorgedra per sekonde = 1,8 x 10^{-9} J
Energy of one photon/*Energie van een foton*

$E_{photon/foton} = hf$
$= \frac{hc}{\lambda}$ } ✓any one /*enige een*

Number of electrons /*Aantal elektrone* = $\frac{1,8 \times 10^{-9}}{hf}$ ✓ $= \frac{1,8 \times 10^{-9} \times \lambda}{hc}$

Number of electrons ejected/*Aantal elektrone vrygestel* = $\frac{1,8 \times 10^{-9} \times 2,6 \times 10^{-7}}{6,63 \times 10^{-34} \times 3 \times 10^{8}}$ ✓ ✓

$\therefore N_e = 2,35 \times 10^{9}$ (electrons per second) ✓ (5)

11.1.3 **POSITIVE MARKING FROM QUESTION 11.1.2.**
POSITIEWE NASIEN VANAF VRAAG 11.1.2.

$q = N_e \times e$
$= (2,35 \times 10^{9})(1,6 \times 10^{-19})$ ✓ $= 3,76 \times 10^{-10}$ C
$q = I\Delta t$ ✓

$\therefore I = \frac{q}{\Delta t} = \frac{3,76 \times 10^{-10}}{1}$ ✓

$I = 3,76 \times 10^{-10}$ A ✓ (4)

11.2.1 Electrons in excited state fall back to ground state/ lower energy state. ✓
Elektrone in opgewekte toestand val terug na grondtoestand /laer energietoestand
Energy radiated as light. /*Energie uitgestraal as lig.* ✓ (2)

11.2.2 To identify elements. /*Om elemente te identifiseer.* ✓
Accept / *Aanvaar:*
To determine the temperature of stars/ Fluorescent lights/ Neon signs./ (1)
Om die temperatuur van sterre te bepaal/ Fluoreserende ligte/ Neontekens **[14]**

TOTAL SECTION B/*TOTAAL AFDELING B*: 125
GRAND TOTAL/*GROOTTOTAAL*: 150

Copyright reserved/*Kopiereg voorbehou*