education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

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

FEBRUARY/MARCH/*FEBRUARIE/MAART* 2010

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 18 pages.
Hierdie memorandum bestaan uit 18 bladsye.

Learning Outcomes and Assessment Standards ***Leeruitkomste en Assesseringstandaarde***		
LO1/*LU1*	**LO2/*LU2***	**LO3/*LU3***
AS12.1.1: 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 kontrolering van veranderlikes.* **AS12.1.2:** 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.* **AS12.1.3:** Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingstrategieë om (ongesiene) probleme op te los.* **AS12.1.4:** Communicate and defend scientific arguments with clarity and precision. *Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.*	**AS12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.* **AS12.2.2** 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 en konsepte in eie woorde aan te dui.* **AS12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS12.3.1:** 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.* **AS12.3.2:** 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.* **AS12.3.3:** 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.*

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 marks** will be awarded if **no formula is given**, but **correct substitutions OMITTING ZERO SUBSTITUTIONS**.
***Geen punte** sal toegeken word indien'n kandidaat **geen formule** gee nie, maar **korrek substitueer** met **WEGLATING VAN NULWAARDES**.*

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

1.7 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.

1.8 Marks are only awarded for a formula if a **calculation had 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.*

1.9 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.

1.10 All calculations, when not specified in the question, must be done to two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot twee desimale plekke gedoen word.

2. DEFINITIONS/*DEFINISIES*

Two marks will be awarded for a correct definition. No marks will be awarded for an incorrect or partially correct definition.
Twee punte sal vir 'n korrekte definisie toegeken word. Geen punte sal vir 'n verkeerde of gedeeltelik korrekte definisie toegeken word nie.

3. UNITS/*EENHEDE*

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

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

3.3 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*

3.4 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.

4. GENERAL/*ALGEMEEN*

4.1 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.

4.2 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.

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

5. 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:

5.1 **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 korrek in 3.2 of 3.3 vervang word, word **volpunte** aan die daaropvolgende subvraag toegeken.*

5.2 **A multi-step 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.*

5.3 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 tot '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.

5.4 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.

5.5 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.

5.6 Normally, if based on a conceptual mistake, an incorrect answer cannot be correctly motivated. 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 konseptuele 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.

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1	Power / *drywing* ✓	[12.2.1]	(1)
1.2	Monochromatic / *monochromaties* ✓	[12.2.1]	(1)
1.3	Potential difference / *potensiaalverskil* ✓	[12.2.1]	(1)
1.4	Electromagnetic induction / *elektromagnetiese induksie* ✓ OR/*OF* Faraday's law / *Faraday se wet*	[12.2.1]	(1)
1.5	Metastable (state) / *metastabiele (toestand)* ✓	[12.2.1]	(1)
			[5]

QUESTION 2/*VRAAG 2*

2.1	.. equal to the net force. / … *gelyk aan die netto krag.* ✓✓ OR/*OF* The change in momentum is equal to … / *Die verandering in momentum is gelyk aan …*	[12.2.2]	(2)
2.2	…remains constant. / … bly constant. ✓✓	[12.2.2]	(2)
2.3	The light/bright/blue lines in the interference pattern … / Die ligte/helder/ blou lyne in die interferensiepatroon … ✓✓ OR/*OF* … are the result of destructive interference. / … is die gevolg van destruktiewe interferensie.	[12.2.2]	(2)
2.4	… are electromagnetic waves. / … *is elektromagnetiese golwe.* ✓✓	[12.2.3]	(2)
2 .5	… line spectrum. / *lynspektrum.* ✓✓ … line emission spectrum. / *lynemissiespektrum.* … line absorption spectrum. / *lynabsorpsiespektrum.*	[12.2.3]	(2)
			[10]

QUESTION 3/*VRAAG 3*

3.1	B ✓✓	[12.1.2]	(2)
3.2	C ✓✓	[12.2.2]	(2)
3.3	A ✓✓	[12.1.2]	(2)
3.4	C ✓✓	[12.2.2]	(2)
3.5	D ✓✓	[12.1.2]	(2)
			[10]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

SECTION B/*AFDELING B*

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum in an isolated system is conserved. ✓✓
Die totale liniêre momentum in'n geslote sisteem bly behoue.
OR/*OF*
If no net external force acts on a system of particles, the total linear momentum of the system cannot change. / *Indien geen netto eksterne krag op'n sisteem van deeltjies inwerk nie, kan die totale liniêre momentum nie verander nie.*

Only/*Slegs* 2/2 or/*of* 0/2

[12.2.1] (2)

4.2 $(U + K)_{bottom} = (U + K)_{top}$ ✓

$0 + \frac{1}{2}(m_1 + m_2)v^2 = mgh + 0$

$\frac{1}{2}(0,015 + 5)(v_f^2)$ ✓$= (0,015 + 5)(9,8)(0,15)$ ✓

$\therefore v_f = 1,71\ m\cdot s^{-1}$

Other formulae / *Ander formules:*
$E_{mech(i)} = E_{mech(f)}$
$(E_p + E_k)_i = (E_p + E_k)_f$
$(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$
$(U + K)_{bottom} = (U + K)_{top}$
$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$

[12.2.3] (3)

4.3 p_t(before/*voor*) = p_t(after/*na*) ✓

$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$

$(0,015)v_{i1} + 0$ ✓$= (0,015 + 5)(1,71)$ ✓

$\therefore\ v_{i1} = 238,7\ m\cdot s^{-1}$ ✓

Any one as formula / *Enige een as formule:*
$\Sigma\ p_{before/voor} = \Sigma\ p_{after/na}$
p_t(before) = p_t(after)
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$
Accept symbols v and u
Accept / *Aanvaar:* $p_{before} = p_{after}$
$p_i = p_f$

[12.2.3] (4)

4.4 According to Newton's third law,
the gun will exert a force on the bullet ✓
and the bullet will exert an equal but opposite force on the gun. ✓
The force of the gun on the officer pushes him slightly backwards. ✓

Volgens Newton se derde wet
oefen die geweer 'n krag op die koeël uit ✓
en die koeël oefen 'n gelyke, maar teenoorgestelde krag op die geweer uit. ✓
Die krag van die geweer op die polisieman druk hom effens terugwaarts. ✓

[12.2.3] (3)
[12]

QUESTION 5/*VRAAG 5*

5.1 Velocity after / *snelheid na* 30 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 0 + 2(9,8)(50 - 20)$ ✓
$v_f = 24,25 \text{ m·s}^{-1}$ ✓

Accept / *Aanvaar:*
$v^2 = u^2 + 2as$/$v = u + at$/$s = ut + ½at^2$
A mixture of the two allowed formulae is not accepted. / *'n Mengsel van die twee erkende formules word nie aanvaar nie.*

OR/*OF*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$30 = (0)\Delta t + ½(9,8)\ \Delta t^2$
$\therefore\ \Delta t = 2,47$ s
$v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,47)$ ✓ $= 24,25 \text{ m·s}^{-1}$ ✓ [12.2.3] (3)

5.2 Velocity after a further / *snelheid na 'n verdere* 18,2 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 24,25^2 + 2(9,8)(20 – 1,8)$ ✓
$\therefore v_f = 30,74 \text{ m·s}^{-1}$

$v_f = v_i + a\Delta t$ ✓
$30,74 = 24,25 + 9,8t$ ✓
$\therefore t = 0,66$ s ✓

Accept / *Aanvaar:*
$v^2 = u^2 + 2as$/ $v = u + at$
A mixture of the two allowed formulae is not accepted.
'n Mengsel van die twee erkende formules word nie aanvaar nie.

He will not be struck – reaction time is shorter than the time for the brick to reach his head. / *Hy sal nie getref word nie – reaksietyd is korter as die tyd wat dit die baksteen neem om sy kop te bereik.* ✓

OR/*OF*
Distance fallen in 0,4 s / *Afstand geval in 0,4 s*:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓$= (24,25)(0,4) + ½(9,8)(0,4)^2$ ✓$= 10,45$ m✓

Distance above head of supervisor after 0,4 s / *Afstand bo kop van toesighouer na 0,4 s*: 20 – 1,8 – 10,45 = 7,75 m✓✓
He will not be struck – the brick is still 7,75 m above his head./*Hy sal nie getref word nie – die baksteen is steeds 7,75 m bokant sy kop*. ✓ [12.1.3] (6)

[9]

QUESTION 6/*VRAAG 6*

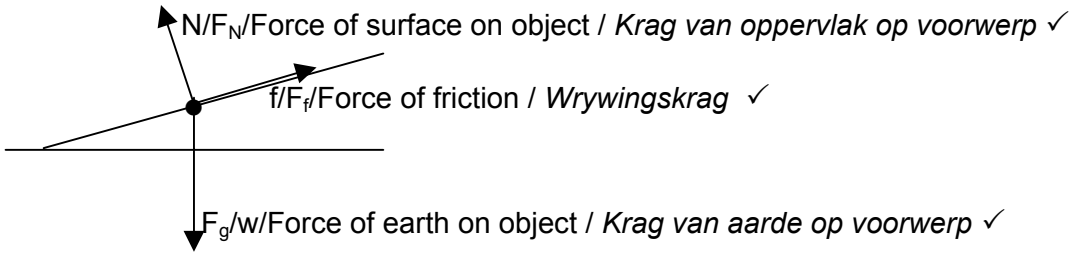
6.1 The net work done on an object is equal to the change in the object's kinetic energy. ✓✓
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.

Only/*Slegs* 2/2 or/*of* 0/2

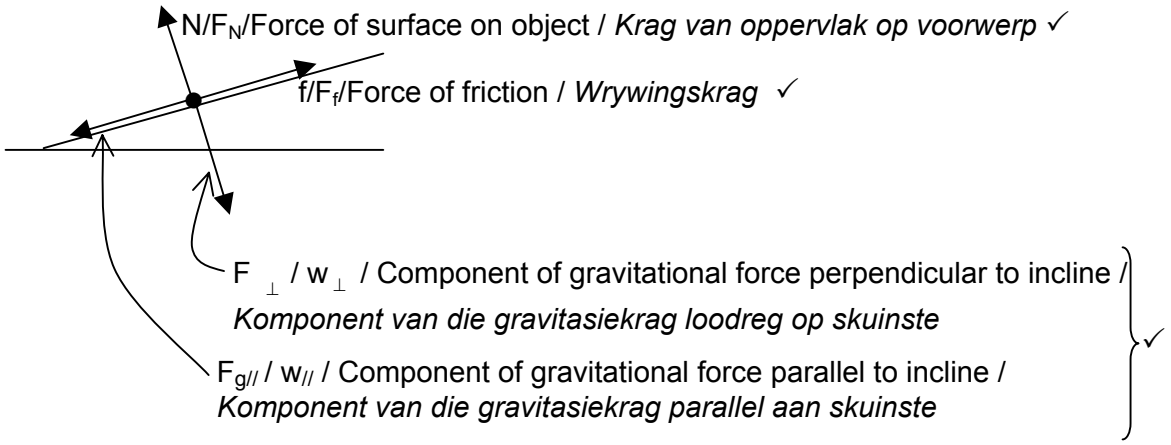
OR/*OF*
The work done on an object by a net force is equal to the change in the object's kinetic energy. / *Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.*

[12.2.1] (2)

6.2



OR/*OF*



[12.1.2] (3)

6.3.1 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= (0)^2 + (2)(2)(10)$ ✓
$= 40\ m^2 \cdot s^{-2}$

Accept/*Aanvaar:*
E_k / K
$v^2 = u^2 + 2as$ / $s = ut + ½at^2$/ $v = u + at$
A mixture of the two allowed formulae is not accepted. / *'n Mengsel van die twee erkende formules word nie aanvaar nie.*

$E_{kf} = ½m v_f^2$ ✓
$= ½(60)(40)$ ✓
$= 1\ 200$ J ✓

OR/*OF*

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$10 = (0)\Delta t\ \ ½(2)\ \Delta t^2$
$\therefore\ \Delta t = 3,16$ s

$v_f = v_i + a\Delta t = 0 + (2)(3,16)$ ✓ $= 6,32\ m \cdot s^{-1}$

$E_{kf} = ½m v_f^2$ ✓
$= ½(60)(6,32)^2$ ✓
$= 1\ 200$ J ✓

[12.1.3] (5)

6.3.2 $W_g = W_{g//}\ \Delta x\cos\theta$ ✓
$= mg\sin 25°$✓ $(10)(\cos 0°)$✓
$= (60)(9,8)\sin 25°10(1)$
$= 2\ 485$ J ✓

OR/*OF*

$W_g = W_{g//}\ \Delta x\cos\theta$ ✓
$= mgh\cos 0°$
$= (60)(9,8)$ ✓ $(10)\sin 25°(1)$ ✓
$= 2\ 485$ J ✓

OR/*OF*

$W_g = -\Delta U$ ✓
$= -(0 - mgh)$ ✓
$= -(0 - (60)(9,8)(10)\sin 25°$ ✓
$= 2\ 485$ J ✓

[12.2.3] (4)

6.3.3

OPTION 1/*OPSIE 1:*

$W_{net} = \Delta E_k$ ✓

$W_{g(\text{parallel to slope/}parallel\ aan\ helling)} + W_f = \Delta E_k$ ✓

$2\ 485 + W_f = 1\ 200$ ✓

$W_f = -\ 1\ 285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

OPTION 2/*OPSIE 2:*

$W_{net} = W_g + W_f$ ✓

$ma\Delta x = W_g + W_f$

$(60)(2)(10)$ ✓ $= 2\ 485$ ✓ $+ W_f$

$\therefore W_f = -\ 1\ 285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

OPTION 3/*OPSIE 3*:

$W_{(\text{applied/}toegepas)} = \Delta E_k + \Delta E_p - W_f$

$0 = (\frac{1}{2}m v_f^2 - 0) + (0 - mgh) - W_f$ **Max./*Maks.*:** $\frac{3}{4}$

$0 = \frac{1}{2}m v_f^2 - mgh - W_f$ ✓

$0 = 1\ 200 - 2\ 485 - W_f$ ✓

$\therefore W_f = -1\ 285$ J ✓

$W_{appl/toegep} = \Delta U + \Delta K + W_f$ $\frac{0}{4}$

Marking rule 1.6
Nasienreël 1.6

OPTION 4 / *OPSIE 4*:

$(U + K)_i + W_f = (U + K)_f$ **Max./*Maks.*:** $\frac{3}{4}$

$mgh + 0 + W_f = 0 + \frac{1}{2}m v_f^2$ ✓

$2\ 485 + W_f = 1\ 200$ ✓

$W_f = -\ 1\ 285$ J✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

$(U + K)_i - W_f = (U + K)_f$ $\frac{0}{4}$

Marking rule 1.6
Nasienreël 1.6

OPTION 5/*OPSIE 5:*

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$= (\frac{1}{2}m v_f^2 - 0) + (0 - mgh)$

$= \frac{1}{2}m v_f^2 - mgh$ ✓

$= 1\ 200 - 2\ 485$ ✓

$\therefore W_{nc} = W_f = -1\ 285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

(4)

[12.2.3]

6.3.3

OPTION 1/*OPSIE 1*
$W_f = F_f \Delta x\cos\theta$ ✓
$-1\,285 = f(10)\cos180°$ ✓
$F_f = 128{,}5$ N ✓

OPTION 2/*OPSIE 2*
$F_{net} = F_{g(\text{parallel to slope/}parallel\ aan\ helling)} - F_f$ ✓
$ma = mg\sin25° - F_f$
$(60)(2) = (60)(9{,}8)\sin25° - F_f$ ✓
$F_f = 128{,}5$ N ✓

[12.2.3] (3)
[21]

QUESTION 7/*VRAAG 7*

7.1 Doppler effect / *Doppler-effek* ✓ [12.2.1] (1)

7.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ / $f_L = \frac{v}{v + v_s} f_s$

$\frac{90}{100} f_s$ ✓ = $(\frac{340}{340 + v_s})$ ✓f_s ✓ $(f_L = \frac{90}{100} f_s)$

$v_s = 37{,}78\ m{\cdot}s^{-1}$ ✓

Any other formula / *Enige ander formule* 0/5

[12.1.3] (5)
[6]

QUESTION 8/*VRAAG 8*

8.1.1 Additive / *additief* ✓ [12.2.1] (1)

8.1.2 X: yellow / *geel* ✓
Y: magenta ✓
Z: cyan / *siaan* ✓ [12.2.3] (3)

8.1.3 P: red / *rooi* ✓
Q: blue / *blou* ✓ [12.2.3] (2)

8.2 Green plants will reflect green light ✓and very little light will be available ✓for (photosynthesis) food production in the plant.

Groen plante weerkaats groen lig ✓ *en baie min lig is beskikbaar* ✓ *vir (fotosintese) produksie van voedsel in die plante.* [12.3.2] (2)
[8]

QUESTION 9/*VRAAG 9*

9.1 Wave nature / *Golfaard* ✓
OR/*OF*
Light has wave properties. / *Lig het golfeienskappe*. [12.2.1] (1)

9.2 Wavefronts from the slit arrive at point P out of phase and <u>interfere destructively</u>. ✓✓
Goffronte vanaf die spleet kom uit fase by punt P aan en ondergaan <u>destruktiewe interferensie</u>. ✓✓
OR/OF
A crest meets a trough at P and <u>destructive interference</u> takes place. ✓✓ / 'n *Kruin ontmoet 'n trog by P en <u>destruktiewe interferensie</u> vind plaas.* [12.2.3] (2)

9.3 ✓
$\sin\theta = \frac{m\lambda}{a}$ ✓= $\frac{(1)(600\times10^{-9})}{3{,}2\times10^{-5}}$ ✓ $\therefore\ \theta$ = 1,07°

$\tan\theta = \frac{OP}{Q}$

$\therefore$ tan 1,07° = $\frac{2{,}5\times10^{-2}}{Q}$ ✓

$\therefore$ Q = 1,34 m ✓ [12.1.3] (5)

9.4.1 Smaller than / *Kleiner as* ✓ [12.2.2] (1)

9.4.2 If OP increases:

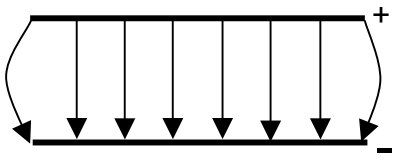
$\sin\theta$ increases ✓ OR degree of diffraction increases
$\sin\theta\ \alpha\ \frac{1}{a}$ ✓ (and thus *a* decreases)

Indien OP toeneem:
$\sin\theta$ neem toe ✓ OF mate van diffraksie vermeerder
$\sin\theta\ \alpha\ \frac{1}{a}$ ✓(en dus neem a af) [12.2.2] (2)
[11]

QUESTION 10/*VRAAG 10*

10.1 Dielectric / Diëlektrikum ✓
Distance between plates / Afstand tussen plate ✓ [12.2.1] (2)

10.2.1



Checklist / *Kontrolelys*	**Mark / *Punt***
Evenly spaced field lines. / *Eweredig gespasieerde veldlyne.*	✓
Direction of field lines from positive to negative. / *Rigting van veldlyne vanaf positief na negatief*.	✓
Field lines curved at the ends. / *Veldlyne gekrom by die ente.*	✓

NOTE: If charges on plates not indicated, maximum $\frac{2}{3}$ (no mark for direction)

LET WEL: Indien ladings op plate nie aangedui is nie, maksimum $\frac{2}{3}$ *(geen punt vir rigting)*

[12.1.2] (3)

10.2.2 $C = \frac{\varepsilon_0 A}{d}$ ✓$= \frac{(8{,}85\times10^{-12})(2\times10^{-2})(10\times10^{-2})}{0{,}2\times10^{-3}}$ ✓ ✓ ✓

$= 8{,}85 \times 10^{-11}$ F ✓

(5)
[12.1.3] **[9]**

QUESTION 11/*VRAAG 11*

11.1 The current through a conductor is directly proportional to the potential difference across its ends at constant temperature. ✓✓

Only/*Slegs* 2/2 or/*of* 0/2

Die stroom in'n geleier is direk eweredig aan die potetsiaal-verskil oor sy ente by konstante temperatuur. [12.2.1] (2)

11.2 Equal / *gelyk* ✓
2 A divides equally at T (and since I_M = 1 A it follows that I_N = 1 A) ✓
2 A verdeel gelyk by T en omdat I_M = 1 A volg dit dat I_N = 1 A)

OR/*OF*

$I \alpha \frac{1}{R}$, $\therefore R_M = R_N$ [12.2.2] (2)

11.3 emf = $IR + Ir$ ✓$\therefore$ 17 = 14 + Ir ✓$\therefore$ Ir = 3 V

$r = \frac{V_{lost}}{I}$ ✓= $\frac{3}{2}$✓ = 1,5 Ω ✓ [12.1.3] (5)

11.4 $V_N = IR_N$ ✓= (1)(2) ✓= 2 V ✓ [12.2.3] (3)

11.5 V_Y = 14 – 2 = 12 V ✓

$V_Y = IR_Y$ ✓$\therefore$ 12 = (2)R_Y ✓
$\therefore$ R_Y = 6 Ω ✓ [12.1.3] (4)
[16]

QUESTION 12/*VRAAG 12*

12.1.1 AC / *WS* – alternating current / *wisselstroom* ✓
A separate slip ring connected to each wire. / *'n Aparte sleepring is aan elke draad geskakel.* ✓ [12.2.1] (2)

12.1.2 Increase in peak (or rms) voltage / *Toename in piekspanning (of wgk-spanning)* ✓
Increase in frequency / *Toename in frekwensie* ✓ [12.2.2] (2)

12.1.3 The plane of the coil is parallel to the magnetic field. ✓
Die vlak van die spoel is parallel aan die magneetveld. [12.2.2] (1)

12.2 Advantage */ Voordeel:*
Less environmental pollution ✓ (noise, gases, etc.) *Minder omgewingbesoedeling (geraas, gasse, ens.)*

Disadvantage / *Nadeel*:
- Will not operate in absence of wind. / *Sal nie in afwesigheid van wind werk nie.* ✓
- Many windmills needed to generate sufficient electricity – unsightly appearance in environment. / *Baie windlaaiers benodig om genoeg elektrisiteit op te wek – is onooglik in omgewing.*

[12.3.2] [12.3.3] (2)
[7]

QUESTION 13/*VRAAG 13*

13.1
$$V_{rms} = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$$
$$\therefore\ 220 = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$$
$$\therefore\ V_{max/maks} = 311{,}13\ V \checkmark$$ [12.2.3] (3)

13.2
$$P_{average/gemid} = \frac{V_{rms}^2}{R} \checkmark$$
$$\therefore 100 = \frac{(220)^2}{R} \checkmark$$
$$\therefore R = 484\ \Omega \checkmark$$ [12.2.3] (3)

13.3 $P_{ave} = V_{rms}I_{rms}$ ✓
$2\ 200 = (220)I_{rms}$ ✓
$I_{rms} = 10\ A$ ✓

The iron draws a current of 10 A. Therefore together with the lights the total current will exceed 10 A ✓and the fuse wire will blow and the current will stop. ✓

Die yster trek'n stroom van 10 A. Dus sal dit, tesame met die ligte,'n groter stroom as 10 A trek en die smeltdraad sal brand en geen stroom sal vloei nie. [12.3.2] (5)

[11]

QUESTION 14/*VRAAG 14*

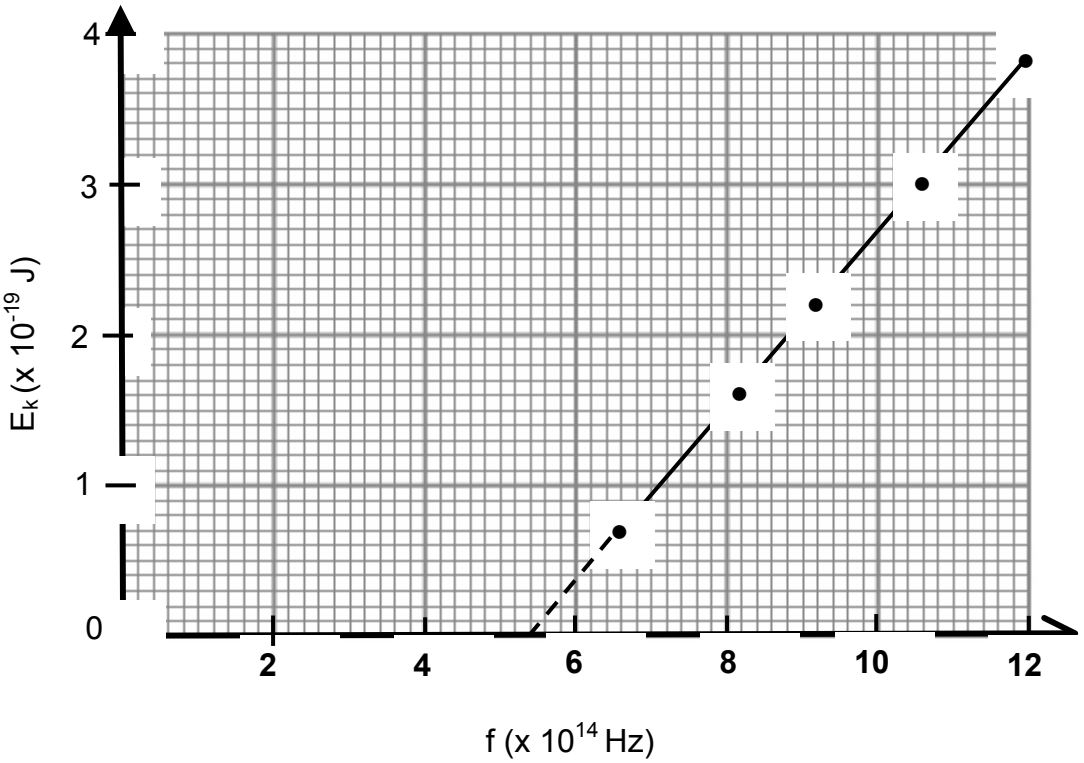
14.1 Minimum amount of energy needed to remove an electron from the surface of a metal/conducting material. ✓✓

Only/*Slegs* 2/2 or/*of* 0/2

Minimum energie benodig om'n elektron vanaf die oppervlak van'n metaal/geleidende materiaal te verwyder. [12.2.1] (2)

14.2

Graph of kinetic energy versus frequency
Grafiek van kinetiese energie teenoor frekwensie



Checklist/*Kontrolelys* Criteria for graph / *Kriteria vir grafiek*	**Marks / *Punte***
Relevant heading / *Geskikte opskrif*	✓
Axes labelled correctly with units. / *Asse korrek benoem met eenhede.*	✓
Appropriate scale. / *Geskikte skaal.*	✓
Plotting all the points. / *Alle punte gestip.*	✓✓
Line of best fit. / *Beste paslyn getrek.*	✓

[12.1.2] (6)

14.3

14.3.1 $f_o = 5{,}4 \times 10^{14}$ Hz ✓✓ [12.1.2] (2)

14.3.2 Threshold frequency / Drumpelfrekwensie ✓ [12.2.1] (1)

14.3 $W_o = hf_o$ ✓
$= (6{,}63 \times 10^{-34})(5{,}4 \times 10^{14})$ ✓
$= 3{,}58 \times 10^{-19}$ J ✓ [12.1.2] (3)

[14]

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