NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2015

MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 15 pages

Hierdie memorandum bestaan uit 15 bladsye

GENERAL GUIDELINES

1. CALCULATIONS

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 **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 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.

1.8 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 genoem is nie.

1.9   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.

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 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.

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 or subquestion**.

'n Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag of subvraag**.

2.2   Units are only required in the final answer to a calculation.

Eenhede word slegs in die finale antwoord tot '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, $m·s^{-1}$. 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, $m·s^{-1}$. 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 korrek in 3.2 of 3.3 vervang word, word **volpunte** aan 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, verbeur 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   C ✓✓
1.2   B ✓✓
1.3   C ✓✓
1.4   A ✓✓
1.5   B ✓✓
1.6   C✓✓
1.7   B ✓✓
1.8   B ✓✓
1.9   D ✓✓
1.10   C ✓✓

[20]

QUESTION 2 / VRAAG 2

2.1   <u>The force that opposes the motion of a moving object</u> ✓✓ relative to a surface

<u>Die krag wat die beweging van 'n bewegende voorwerp</u> relatief tot 'n oppervlak
<u>teenwerk</u>   (2)

2.2

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w/force of earth on block/weight / 19,6 N / mg / gravitational force
f_k	f/friction/
T	Tension /
F	F_{app} / F_T / $F_{Toegepas}$ /
N	Normal force / F_N / Force of surface on block
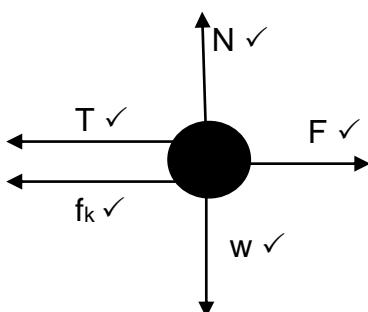
(5)

Notes/Aantekeninge:
- Any additional forces: max $^4/_5$
- No arrows: $^0/_5$

Force(s) not touching object: max $^4/_5$

2.3		✓ For either 2a or 1,5a	
	For 2 kg block:		For 1,5 kg block:
	$F_{net} = ma$ ✓		$F_{net} = ma$
	F – T – f = 2a		T – 1,5(9,8) = 1,5a
	20 – T – 3,1 = <u>2a</u> ✓		<u>T – 14,7</u> ✓ = <u>1,5a</u>
	<u>16,9 – T</u> ✓ = 2a		T = 1,5a + 14,7
	T = 16,9 – 2a		

$$\therefore \underline{16,9 - 2a = 1,5a + 14,7} ✓$$
$$2,2 = 3,5a$$
$$a = 0,63 \text{ m·s}^{-2} ✓$$

OR

$$T = 16,9 - 2a$$
$$\underline{T = 1,5a + 14,7}$$
$$0 = 2,2 - 3,5a \qquad \text{(subtract)}$$
$$a = 0,63 \text{ m·s}^{-2} ✓$$

(6)

[13]

QUESTION 3 / VRAAG 3

3.1   9,8 m·s⁻² ✓ downwards ✓   (2)

3.2   Yes✓. Only force of gravity✓ acts on the ball / Ball is moving under the influence of
       its weight / weight is the only force acting on the ball   (2)

3.3	**Downwards positive:**	**Upwards positive:**
	$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
	$= 8^2$ ✓ $+ \underline{2(9,8)(1,8)}$ ✓	$= (-8)^2$ ✓ $+ \underline{2(-9,8)(-1,8)}$ ✓
	$v_f = 9,96$ m·s⁻¹ ✓	$v_f = 9,96$ m·s⁻¹ ✓

	OPTION 2	**OPTION 3**
	$(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{floor}$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
	$\underline{m(9,8)(1,8) + \frac{1}{2}m(8)^2}$ ✓ $= \underline{0 + \frac{1}{2}mv^2}$ ✓	$\underline{1,8 = 8\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
	$17,64 + \frac{1}{2}(64) = \frac{1}{2}v^2$	$\Delta t = 0,2$ s
	$v = 9,96$ m·s⁻¹ ✓	Both Formulae ✓
		$v_f = v_i + a\Delta t$
		$= \underline{8 + (9,8)(0,2)}$ ✓
		$v_f = 9,96$ m·s⁻¹ ✓

(4)

3.4

POSITIVE MARKING FROM Q3.3	
OPTION 1	**OPTION 2**
Downwards positive: $v_f = v_i + a\Delta t$ ✓ $\underline{9,96 = 8 + 9,8\Delta t}$ ✓ $\Delta t = 0,2$ s ✓ **Upwards positive:** $v_f = v_i + a\Delta t$ ✓ $\underline{-9,96 = -8 + (-9,8)\Delta t}$ ✓ $\Delta t = 0,2$ s ✓	**Downwards positive:** $\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $1,8 = \frac{9,96+8}{2}\Delta t$ ✓ $\Delta t = 0,2$ s ✓ **Upwards positive:** $\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $-1,8 = \frac{-9,96+(-8)}{2}\Delta t$ ✓ $\Delta t = 0,2$ s ✓
OPTION 3 **Downwards positive:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\underline{1,8 = 8\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓ $\Delta t = 0,2$ s ✓ **Upwnwards positive:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\underline{-1,8 = (-8)\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓ $\underline{\Delta t = 0,2\ \text{s}}$ ✓	

(3)

3.5

| **POSITIVE MARKING FROM Q3.3**	**POSITIVE MARKING FROM Q3.3**
OPTION 1 80% of 9,96 = 7,97 m·s⁻¹ **Upwards positive:** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\underline{0^2 = (7,97)^2}$ ✓ $+ \underline{2(-9,8)\Delta y}$ ✓ $\Delta y = 3,24$ m ✓ No, ball won't reach the ceiling ✓ **Downwards positive:** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\underline{0^2 = (-7,97)^2}$ ✓ $+ \underline{2(9,8)\Delta y}$ ✓ $\Delta y = -3,24$ m $\Delta y = 3,24$ m ✓ No, ball won't reach the ceiling ✓	**OPTION 2** 80% of 9,96 = 7,97 m·s⁻¹ **Upwards positive** $v_f = v_i + a\Delta t$ $0 = 7,97 + (-9,8)\Delta t$ ✓ $\Delta t = 0,81$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{(7,97)(0,81)}$ ✓ $+ \frac{1}{2}\underline{(-9,8)(0,81)^2}$ ✓ $= 3,24$ m ✓ No, ball won't reach the ceiling ✓ **Downwards positive** $v_f = v_i + a\Delta t$ $0 = -7,97 + (9,8)\Delta t$ ✓ $\Delta t = 0,81$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{(-7,97)(0,81)}$ ✓ $+ \frac{1}{2}\underline{(9,8)(0,81)^2}$ ✓ $= -3,24$ m $= 3,24$ m ✓ No, ball won't reach the ceiling ✓

OPTION 3

80% of 9,96 = 7,97 m·s⁻¹

Upwards positive
$v_f = v_i + a\Delta t$
$0 = 7,97 + (-9,8)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta y = \frac{v_f+v_i}{2}\Delta t$
$= \frac{0+(7,97)}{2}$ ✓ $(0,81)$ ✓

$= 3,23$ m ✓
No, ball won't reach the ceiling ✓

Downwards positive
$v_f = v_i + a\Delta t$
$0 = -7,97 + (9,8)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta y = \frac{v_f+v_i}{2}\Delta t$
$= \frac{0+(-7,97)}{2}$ ✓ $(0,81)$ ✓

$= -3,23$
$= 3,23$ m ✓
No, ball won't reach the ceiling ✓   (5)

3.6
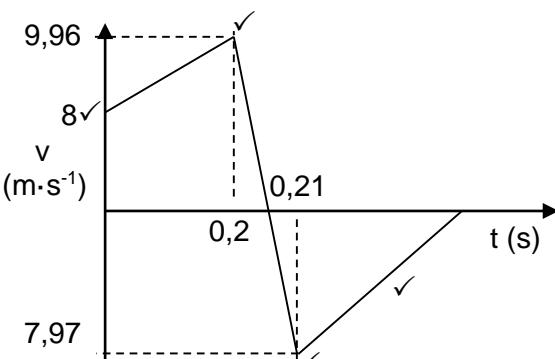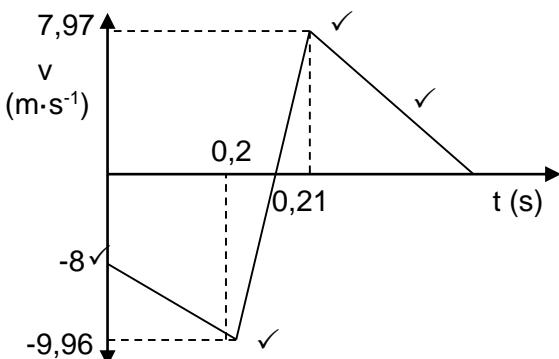
Criteria / Kriteria	Marks
y-intercept at 8 m·s⁻¹ / -8 m·s⁻¹	✓
POSITIVE MARKING FROM Q3.3 & Q3.4 Time and velocity shown with which ball hits the floor (0,2 ; -9,96) or (0,2 ; 9,96)	✓
POSITIVE MARKING FROM Q3.3 and Q3.4 Time and velocity shown with which ball leaves the floor (0,21 ; 7,97) or (0,21 ; -7,97) *Note: time = answer of Q3.3 + 0,01*	✓
Shape/Vorm: 2 Straight parallel lines ending at v=0	✓

(4)

[20]

QUESTION 4

4.1 $\Sigma p_i = \Sigma p_f$

$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ ✓

0✓ $= \underline{1{,}6(0{,}26) + 0{,}8v_f}$ ✓

$v_f = -0{,}52$

$v_f = 0{,}52$ m·s⁻¹ ✓   (4)

4.2   ✓ - F✓ / Experiences the <u>same force in magnitude</u>✓, but in <u>opposite direction</u>✓

<u>Newtons Third Law</u>. ✓   (3)

4.3   External forces present ✓/ friction present ✓   (1)

4.4 $f = \mu_k \cdot N$ ✓
       $= \underline{(0{,}12)(1{,}6 \times 9{,}8 \times Cos\ 30°)}$ ✓
       $= 1{,}63$ N ✓

4.5   **POSITIVE MARKING FROM Q4.4**

OPTION 1/OPSIE 1
$W_{net} = \Delta E_k$ ✓
$W_{w//} + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{(1{,}6 \times 9{,}8 \times Sin\ 30°)(0{,}5)Cos\ 0°}$✓ $+ \underline{(1{,}63)(0{,}5)Cos\ 180°}$✓ $= \frac{1}{2}(1{,}6)v_f^2 - \frac{1}{2}(1{,}6)(0{,}2)^2$✓
$v_f = 1{,}98$ m·s⁻¹ ✓
(5)

OPTION 2/OPSIE 2
$W_{net} = \Delta E_k$ ✓
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{(1{,}6 \times 9{,}8)(0{,}5)Cos\ 60°}$✓ $+ \underline{(1{,}63)(0{,}5)Cos\ 180°}$✓ $= \frac{1}{2}(1{,}6)v_f^2 - \frac{1}{2}(1{,}6)(0{,}2)^2$✓
$v_f = 1{,}98$ m·s⁻¹ ✓
(5)

OPTION 3/OPSIE 3
$W_{net} = \Delta E_k$ ✓
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{(1{,}6 \times 9{,}8)(0{,}25)Cos\ 0°}$✓ $+ \underline{(1{,}63)(0{,}5)Cos\ 180°}$✓ $= \frac{1}{2}(1{,}6)v_f^2 - \frac{1}{2}(1{,}6)(0{,}2)^2$✓
$v_f = 1{,}98$ m·s⁻¹ ✓
(5)

0,5   0,25   30°
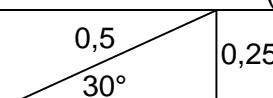
OPTION 4/OPSIE 4
$W_{net} = \Delta E_k$ ✓
$F_{net} \cdot \Delta x \cdot Cos\Theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{(1{,}6 \times 9{,}8 \times Sin 30° - 1{,}63)}$ ✓ $\underline{(0{,}5)Cos 0°}$✓ $= \frac{1}{2}(1{,}6)v_f^2 - \frac{1}{2}(1{,}6)(0{,}2)^2$✓
$v_f = 1{,}98$ m·s⁻¹ ✓
(5)

OPTION 5/OPSIE 5
$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$f \cdot \Delta x \cdot Cos\theta = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$
$\underline{(1{,}63)(0{,}5)Cos 180°}$✓ $= \underline{[\frac{1}{2}(1{,}6)(v_f)^2 - \frac{1}{2}(1{,}6)(0{,}2)^2]}$ ✓ $+ [0 - \underline{(1{,}6)(9{,}8)(0{,}25)}]$ ✓
$v_f = 1{,}98$ m·s⁻¹ ✓
(5)

QUESTION 5

5.1   A force for which the work done in moving an object between two points is independent of the path taken. ✓✓ (2 or 0)

'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, onafhanklik is van die roete wat gevolg word. ✓✓   (2)

5.2 $P = \dfrac{W_{nc}}{\Delta t} = \dfrac{\Delta E_k + \Delta E_p}{\Delta t}$ ⎫

$\quad = \dfrac{(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)}{\Delta t}$ ⎬ Any one✓

$\quad = \dfrac{\left[\frac{1}{2}(87)(2,1)^2 - 0\right]✓ + [(87)(9,8)(35) - 0]✓}{60✓}$

$\quad = 500{,}55 \text{ W } ✓$ (5)

[7]

QUESTION 6

6.1 $10{\times}10^{-4}$ s ✓ / $1{\times}10^{-3}$ s ✓ / $0{,}001$ s ✓   (1)

6.2	**POSITIVE MARKING FROM Q 6.1**

$T = \dfrac{1}{f}$ ✓   **OR** $f = \dfrac{number\ of\ waves}{time}$

$f = \dfrac{1}{0,001}$ ✓ $= \dfrac{0,25}{2,5 \times 10^{-4}}$

$\quad = 1000 \text{ Hz } ✓$ $= 1000 \text{ Hz}$

(3)

6.3   The <u>change in frequency (or pitch) of the sound detected by a listener</u>✓ because the <u>sound source and the listener have different velocities</u>✓ relative to the medium of sound propagation.

Die <u>verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar</u> ✓omdat <u>die klankbron en die luisteraar verskillende snelhede relatief tot die medium</u>✓ waarin die klank voortgeplant word, het.

(2)

6.4   **POSITIVE MARKING FROM 6.2**

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \checkmark$$

$$1000 \checkmark = \frac{340}{340 - v_s} \checkmark (800) \checkmark$$

$v_s = 68 \text{ m·s}^{-1} \checkmark$ (5)

6.5   Decreases$\checkmark$. $f \propto \frac{1}{\lambda} \checkmark$, if velocity stays constant$\checkmark$ (v = fλ)   (3)

[14]

QUESTION 7

7.1

Don't penalise if drawn horizontally
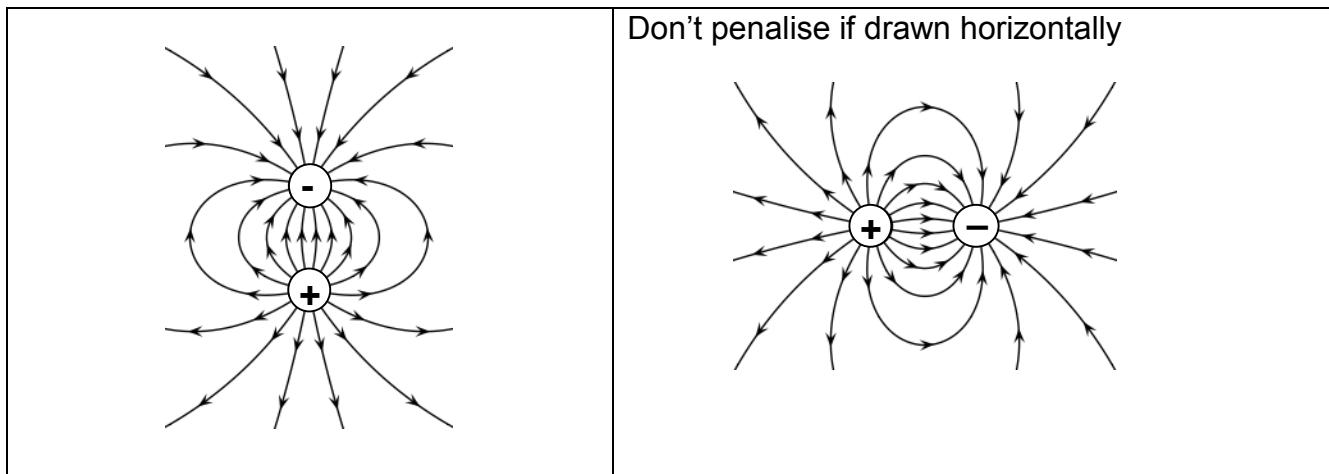
Criteria for sketch:	Marks
Shape of electric field	$\checkmark$
Correct direction of field lines	$\checkmark$
No field lines crossing each other / No field lines inside the sferes	$\checkmark$

(3)

7.2   The magnitude of the <u>electrostatic force</u> 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)
        between them</u> $\checkmark$

        Die grootte van die <u>elektrostatiese krag</u> wat een puntlading (Q_1) op 'n ander
        puntlading (Q_2) uitoefen, is <u>direk eweredig aan die produk van die groottes van die
        ladings</u>$\checkmark$ en <u>omgekeerd eweredig aan die kwadraat van die afstand (r) tussen
        hulle</u>. $\checkmark$ (2)
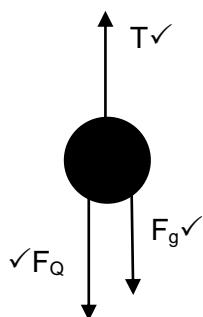
| 7.3 | | T = force of string / scale

F_g = gravitational force /w / mg

F_Q = electrostatic force | (3) |

7.4   19,3 N ✓ (1)

| 7.5 | **POSITIVE MARKING FROM Q7.4**

$F_{net} = 0$
$\underline{T - mg - F_Q = 0}$ ✓
$\underline{19,3 - (0,5)(9,8)}$ ✓ $= F_Q$
$F_Q = 14,4N$

$F = \dfrac{kQ_1Q_2}{r^2}$ ✓
$14,4$ ✓ $= \dfrac{(9\times10^9)(4\times10^{-6})(4\times10^{-6})}{r^2}$ ✓
$r = 0,1$ m ✓ | (6) |

QUESTION 8
8.1   <u>The resistance of a battery</u> ✓ <u>that opposes</u> <u>the flow of charge through the battery</u>. ✓
OR
<u>The resistance of a battery</u>✓ that causes <u>a drop in the reading on a voltmeter</u>
<u>connected over the battery (p.d)</u> if the switch is closed. ✓ (2)
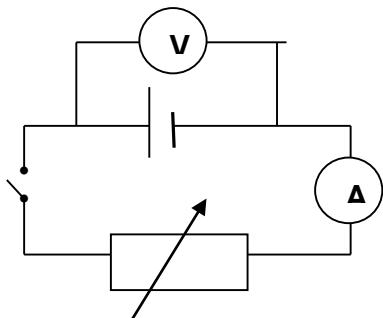
| 8.2 | | • Voltmeter in parallel over battery and ammeter in series ✓
• Rest of components connected so that circuit will work ✓ | (2) |

8.3   EMF / ε ✓

8.4   If I increases then <u>V$_i$ will increase</u>✓ (V$_i$= Ir)
       As <u>ε will remain constant</u>✓
       Therefor <u>V$_e$ (= V$_1$) will decrease</u> ✓ (ε = V$_i$ + V$_e$)   (3)

8.5   Group 1✓.
       The gradient represents the internal resistance and <u>the gradient is steeper</u>✓.   (2)
                                                                                          [10]

QUESTION 9

9.1   P = I^2 R✓
       <u>8,1 = (1,5)^2 R</u> ✓
       R = 3,6 Ω ✓

9.2   **POSITIVE MARKING FROM Q9.1**

OPTION 1	**OPTION 2**
ε = I(R+r) ✓	P = VI
<u>8,4 = 1,5</u>✓ (R$_{//}$ + 3,6 + 0,4✓)	8,1 = V(1,5)
R$_{//}$ = 1,6 Ω	V = 5,4 V
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$ ✓	V$_{lost}$ = Ir = (1,5)(0,4) = 0,6 V✓
$\frac{1}{1,6} = \frac{1}{r_1} + \frac{1}{8}$ ✓	V$_{||}$ = 8,4 − 5,4 − 0,6 V = 2,4 V
R = 2 Ω ✓	
	I$_{8Ω}$ = V/R = 2,4/8 = 0,3 A✓
	I$_{rheostat}$ = 1,5 − 0,3 = 1,2 A
	R = V/I✓ = 2,4✓/1,2✓ = 2 Ω✓

                                                                                          (6)

9.3.1 Increases ✓
9.3.2 Remains the same ✓
9.3.3 Increases ✓   (3)
                                                                                          [12]

QUESTION 10

10.1   Mechanical energy to electrical energy ✓
         Meganiese energie na elektriese energie ✓

         OR/OF

         Kinetic energy to electrical energy ✓
         Kinetiese energie na elektriese energie ✓

(1)

10.2 $P_{avg} = I^2_{rms}R$ ✓
         $80 = I^2_{rms}(2)$ ✓
         I$_{rms}$ = 6,32 A

         I$_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

         $6,32 = \frac{I_{max}}{\sqrt{2}}$ ✓

         $I_{max} = 8,94$ A ✓   (5)

10.3   Cost = kWh × tariff
                = (1,2 × 142)×R1,25 ✓
                = R213 ✓   (2)

[8]

QUESTION 11

11.1   <u>The process whereby electrons are ejected from a metal surface</u> ✓ <u>when light of
         suitable frequency is incident on that surface.</u> ✓

         <u>Die proses waardeur elektrone uit 'n metaaloppervlak vrygestel word</u> <u>wanneer lig
         van geskikte frekwensie invallend op die oppervlak is</u>.

(2)

11.2

Criteria for investigative question/Kriteria vir ondersoekende vraag:	
Dependent and independent variables correctly identified. Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.	✓
Question about the relationship between the independent and dependent variables correctly formulated. Vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek geformuleer.	✓

Dependent variable/Afhanklike veranderlike:
- Ejection of the photoelectrons from the metal

Independent variable/Onafhanklike veranderlike:
- Wavelength

Example/Voorbeeld:
What is the relationship between the wavelength of light incident on the surface of the metal and the ejection of photo-electrons? / Wat is die verband tussen die golflengte van lig wat op die oppervlak van 'n metaal geskyn word en die vrystelling van elektrone daaruit?

Notes/Aantekeninge:
A question that results in a 'yes' / 'no' answer: max $^1/_2$
'n Vraag wat 'n 'ja' of 'nee' as antwoord het: maks $^1/_2$

(2)

11.3   Frequency of light A is higher than the threshold frequency of the metal ($f_A > f_0$). ✓
Frequency of light B is lower than the threshold frequency of the metal ($f_B < f_0$). ✓
OR
Wavelength of light source A is less than wavelength of light source B

(2)

11.4 $E = \frac{hc}{\lambda}$ ✓

$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(570 \times 10^{-9})}$ ✓

$= 3,49 \times 10^{-19}$ J ✓

(3)

11.5   **POSITIVE MARKING FROM Q11.4**
$E = W_o + E_{k(max)}$ ✓

$\frac{hc}{\lambda} = 3,49 \times 10^{-19} + \frac{1}{2}mv^2$

$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(480 \times 10^{-9})}$ ✓ $= 3,49 \times 10^{-19}$ ✓ $+ \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓

$v_{max} = 37\,8845,09$ m·s^{-1} ✓ / $3,79 \times 10^5$ m·s^{-1}

(5)

11.6   Green ✓   (1)

[15]

TOTAL/TOTAAL: 150