education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL

SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2016

MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 18 pages

Hierdie memorandum bestaan uit 18 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, $m \cdot s^{-1}$. 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 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

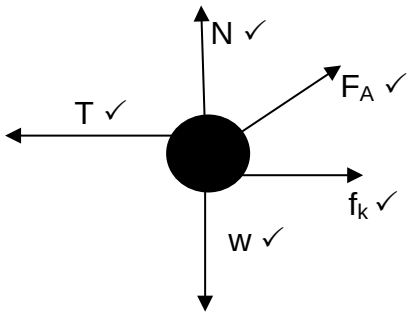
1.1 D ✓✓
1.2 B ✓✓
1.3 A ✓✓
1.4 A ✓✓
1.5 A ✓✓
1.6 B✓✓
1.7 C ✓✓
1.8 A ✓✓
1.9 B ✓✓
1.10 A ✓✓

[20]

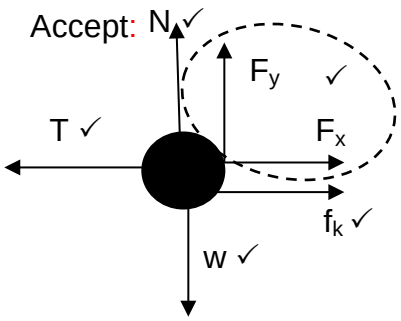
QUESTION 2 / VRAAG 2

2.1

Accepted labels / Aanvaarde benoemings	
w	Fg / Fw/force of earth on block/weight / 58,8 N / mg / gravitational force
f_k	f/friction/
T	Tension /
F_A	F_{app} / F_T / $F_{Toegepas}$ /
N	Normal force / F_N / Force of surface on block



Accept: N ✓



(5)

Notes/Aantekeninge:

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

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

2.2 <u>When a resultant/net force acts on an object, the object will accelerate in the direction of the force</u>✓ at an <u>acceleration directly proportional to the force and</u> (2)

inversely proportional to the mass of the object. ✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag en omgekeerd eweredig 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 voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resulterende/netto krag.

2.3 $F_{net} = ma$
$F_N + F_y = F_g$ } Any one ✓
$F_N + 30\text{Sin}20° = 6(9,8)$ ✓
$F_N = 48,54$ N ✓ (3)

2.4 For 9 kg block:
$F_g - T = ma$
$9(9,8) - T = 9(3,35)$ ✓
$T = 58,05$ N ✓ (2)

2.5 **POSITIVE MARKING FROM 2.3 & 2.4**

For 6 kg block:

$F_{net} = ma$
$-F_x - f_k + T = ma$ — Both formulae ✓
$-30 \text{ Cos } 20°$ ✓ $- fk + 58,05 = 6(3,35)$ ✓
$f_k = 9,76$ N

$f_k = \mu_k \cdot F_N$
$9,76 = \mu_k (48,54)$ ✓
$\mu_k = 0,2$ ✓ (5)

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QUESTION 3

3.1 Each body in the universe attracts every other body with a force that is directly (2)

proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres. ✓

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag direk eweredig aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte.

3.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

$F = \frac{(6,67\times10^{-11})(5,98\times10^{24})(3500)}{(2\times10^{8})^{2}}$ ✓ ✓

$F = 34,9\ N$ ✓

(4)

3.3 $F_{net} = ma$
$F_{earth} = F_{moon}$
$\frac{Gm_sm_E}{r_E^2} = \frac{Gm_sm_m}{r_m^2}$ } Any one✓

$\frac{5,98\times10^{24}}{d^2}$ ✓ $= \frac{7,35\times10^{22}}{(3,8\times10^{8}- d)^{2}}$ ✓

$\frac{(3,8\times10^{8}- d)^{2}}{d^2} = \frac{7,35\times10^{22}}{5,98\times10^{24}}$

$\frac{3,8\times10^{8}- d}{d} = 0,11$

$3,8\times10^{8} - d = 0,11\ d$
$1,11\ d = 3,8\times10^{8}$
$d = 3,42\times10^{8}$

$\therefore Distance_{(PQ)} = 3,42\times10^{8}$ ✓ $- 2\times10^{8} = 1,42\times10^{8}\ m$ ✓

(5)
[11]

QUESTION 4 / VRAAG 4

4.1 An object upon which the only force acting is the force of gravity. ✓✓

(2)

4.2.1

OPTION 1

Downwards positive:	**Upwards positive:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = (-15)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = -11,48$ m Max height = 11,48+35✓ = 46,48 m✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = 15^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = 11,48$ m Max height = 11,48+35✓ = 46,48 m✓

OPTION 2: from max height to starting point

Downwards positive:	**Upwards positive:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $15^2 = 0^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 11,48$ m Max height = 11,48+35✓ = 46,48 m✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-15)^2 = 0^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -11,48$ m Max height = 11,48+35✓ = 46,48 m✓

(4)

OPTION 3

Downwards positive:	**Upwards positive:**
$v_f = v_i + a\Delta t$ $0 = -15 + 9,8\Delta t$ — Both formulae ✓ $\Delta t = 1,53$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= (-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2$ ✓ $\Delta y = 11,48$ m Max height = 11,48+35✓ = 46,48 m✓	$v_f = v_i + a\Delta t$ $0 = 15 + (-9,8)\Delta t$ — Both formulae ✓ $\Delta t = 1,53$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= (15)(1,53) + \frac{1}{2}(-9,8)(1,53)^2$ ✓ $\Delta y = 11,48$ m Max height = 11,48+35✓ = 46,48 m✓

(4)

OPTION 4

$(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{max}$ ✓

$m(9,8)(35) + \frac{1}{2}m(15)^2$ ✓ $= m(9,8)h + 0$ ✓

$h = 46,48$ m ✓

(4)

4.2.2

OPTION 1	**OPTION 2**
Downwards positive:	**Downwards positive:**

(4)

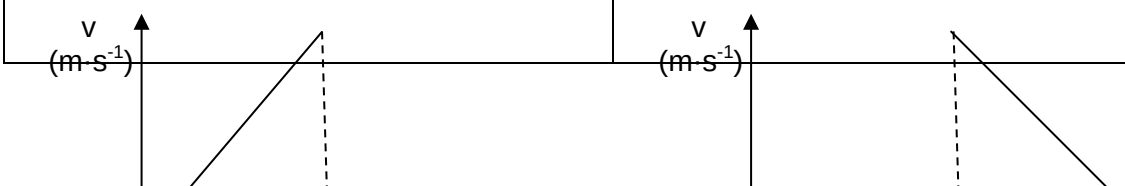
Both formulae ✓

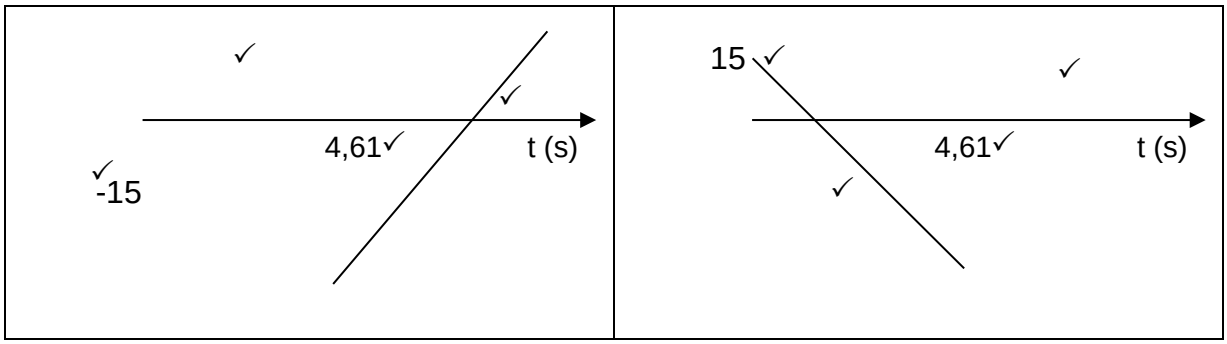
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 35 ✓ $= (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ $4,9\Delta t^2 - 15\Delta t - 35 = 0$ $\therefore \Delta t = 4,61$ s or $-1,55$ s $\therefore \Delta t = 4,61$ s ✓ **Upwards positive:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -35 ✓ $= 15\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $4,9\Delta t^2 - 15\Delta t - 35 = 0$ $\therefore \Delta t = 4,61$ s or $-1,55$ s $\therefore \Delta t = 4,61$ s ✓	$v_f^2 = v_i^2 + 2a\Delta y$ $= (-15)^2 + 2(9,8)(35)$ ✓ $v_f = \pm 30,18$ m·s^{-1} ✓ $v_f = v_i + a\Delta t$ $30,18 = -15 + 9,8\Delta t$ ✓ $\Delta t = 4,61$ s ✓ **Upwards positive:** $v_f^2 = v_i^2 + 2a\Delta y$ Both formulae ✓ $= (15)^2 + 2(-9,8)(-35)$ ✓ $v_f = \pm 30,18$ m·s^{-1} ✓ $v_f = v_i + a\Delta t$ $-30,18 = 15 + (-9,8)\Delta t$ ✓ $\Delta t = 4,61$ s ✓
OPTION 3: POSITIVE MARKING FROM 4.2.1 **Downwards positive:** *From max height:* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $46,48 = 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 3,09$ s Both formulae ✓ *From starting point to max height:* $v_f = v_i + a\Delta t$ $0 = -15 + 9,8\Delta t$ ✓ $\Delta t = 1,53$ s $\therefore t = 3,09 + 1,53 = 4,62$ s ✓	**Upwards positive:** *From max height:* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-46,48 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 3,09$ s Both formulae ✓ *From starting point to max height:* $v_f = v_i + a\Delta t$ $0 = 15 + (-9,8)\Delta t$ ✓ $\Delta t = 1,53$ s $\therefore t = 3,09 + 1,53 = 4,62$ s ✓

(4)

4.3

DOWNWARDS POSITIVE:	DOWNWARDS POSITIVE:





Criteria / Kriteria	Marks
y-intercept: v_i = 15 m·s^{-1} / -15 m·s^{-1}	✓
Shape of graph before bounce: Straight line passing through t-axis	✓
POSITIVE MARKING FROM Q4.2.2 Time shown when ball hits the floor (Δt=4,61 s)	✓
Shape of graph after bounce: Straight line with same gradient as first line,passing through t-axis	✓

(4)

[14]

QUESTION 5

5.1 The total (linear) momentum of a closed system✓ remains constant ✓ (is (2)

conserved).

Die totale (lineêre) momentum in 'n geslote sisteem bly konstant (behoue).

OR

In a closed system the total linear momentum before collision is equal to the total linear momentum after the collision.

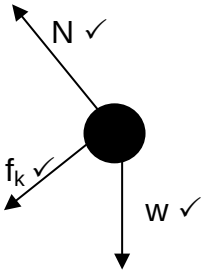
5.2

$\Sigma p_i = \Sigma p_f$ } Any one ✓ $(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ ✓ $\underline{3v_i + 0} = 3\underline{(-0,5) + 6(2,25)}$ ✓ $v_i = 4\ m\cdot s^{-1}$ ✓	$\Sigma p_i = \Sigma p_f$ } Any one ✓ $(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ ✓ $\underline{3v_i + 0} = 3\underline{(0,5) + 6(-2,25)}$ ✓ $v_i = -4\ m\cdot s^{-1}$ $v_i = 4\ m\cdot s^{-1}$ ✓

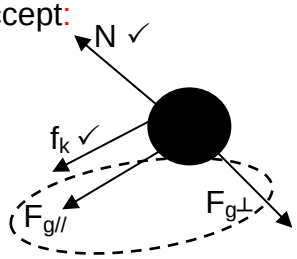
(4)

5.3

Accepted labels / Aanvaarde benoemings	
w	Fg / Fw/force of earth on block/weight / 58,8 N / mg / gravitational force
f_k	f/friction/
N	Normal force / F_N / Force of surface on block



Accept:



(3)

Notes/Aantekeninge:

- Any additional forces: max $^2/_3$
- No arrows: $^0/_3$

✓

Force(s) not touching object: max $^2/_3$

5.4 **Y** to **X** ✓ (1)

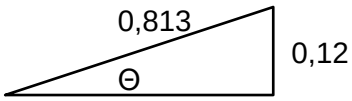
5.5 Force of friction ✓ OR Normal force (1)

5.6

OPTION 1/OPSIE 1

$W_{net} = \Delta E_k$ ✓
$(W_N) + W_{Fg} + W_f = ½mv_f^2 – ½mv_i^2$
(0) + $\underline{(10)\Delta x \text{ Cos } 180°}$✓ + $\underline{(6\times9,8)(0,12)\text{Cos } 180°}$✓ = $\underline{0 – ½(6)(2,25)^2}$✓
$\Delta x = 0,813$ m

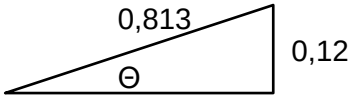
$\text{Sin } \Theta = \frac{0,12}{0,813}$ ✓
$\Theta = 8,49°$ ✓



(6)

OPTION 2/OPSIE 2
$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$(N\cdot\Delta x\cdot\cos\theta) + f\cdot\Delta x\cdot\text{Cos}\theta = (½mv_f^2 – ½mv_i^2) + (mgh_f - mgh_i)$
(0) + $\underline{(10)\Delta x \text{ Cos}180º}$✓= $\underline{[0 - ½(6)(2,25)^2]}$ ✓ + $\underline{[(6)(9,8)(1,2) - 0]}$ ✓
$\Delta x = 0,813$ m

$\text{Sin } \Theta = \frac{0,12}{0,813}$ ✓
$\Theta = 8,49°$ ✓



(6)

[17]

QUESTION 6

6.1

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:

- Observed frequency

Independent variable/Onafhanklike veranderlike:

- Speed of learners

Example/Voorbeeld:
What is the relationship between the speed at which the learners move and the observed frequency? / Wat is die verband tussen die spoed waarteen die leerlinge beweeg en die waargenome frekwensie?

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)

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

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

OR

The change in observed frequency when there is relative motion between a source and an observer.

6.3 800 Hz ✓

It is the observed frequency when there is no relative motion between the listener and the source ✓

OR

It is the observed frequency when the velocity of the learners is 0 $m \cdot s^{-1}$ (2)

6.4 COORDINATES: (4;700)
(8;600) (2)

(12;500)
(17;380)
Any other relevant coordinates

Gradient = $\frac{\Delta f_L}{\Delta v_L} = \frac{700-600}{4-8}$ ✓
= -25 ✓ (m^{-1})

6.5 **POSITIVE MARKING FROM 6.4**

Gradient = $-\frac{f_s}{v}$ ✓

$-\frac{800}{v} = -25$ ✓

$v = 32\ m \cdot s^{-1}$ ✓

NOTE: Using Doppler formula with a pair of coordinates: max $^2/_3$

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

$600 = \frac{v - 8}{v}(800)$ ✓

$v = 32\ m \cdot s^{-1}$ ✓

NOTE:

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

$$\therefore f_L = \frac{v - v_L}{v} f_S$$

$$f_L = f_s - \frac{f_s}{v} v_L$$

$$f_L = -\frac{f_s}{v} v_L + f_s$$

gradient y-intercept

(3)
[**11**]

QUESTION 7

7.1 The electric field at a point is the <u>electrostatic force experienced</u> ✓ <u>per unit positive charge placed at that point</u>.✓

(2)

7.2 $E_{Q1}=\frac{kQ}{r^2}$ ✓

$=\frac{(9\times10^9)(3\times10^{-6})}{0,4^2}$ ✓

$=1,69\times10^5$ N·C^{-1} (east / right)

$E_{Q2}=\frac{kQ}{r^2}$

$=\frac{(9\times10^9)(5\times10^{-6})}{0,1^2}$ ✓

$= 4,5\times10^6$ N·C^{-1} (west / left)

$E_{net} = 4,5\times10^6$ ✓ $- 1,69\times10^5 = 4,33\times10^6$ N·C^{-1} ✓ <u>west</u> ✓ (6)

7.3 $Q = \frac{3\times10^{-6}+(-5\times10^{-6})}{2}$ ✓

$= -1\times10^{-6}$ C ✓ (2)

7.4 Negative ✓ (1)

7.5

OPTION 1

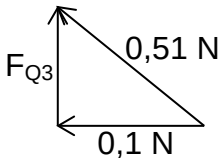
$F_{Q2}=\frac{kQ_1Q_2}{r^2}$ ✓

$=\frac{(9\times10^9)(1\times10^{-6})(1\times10^{-6})}{0,3^2}$ ✓

$= 0,1$ N

<u>$0,51^2$ = $0,1^2$ + F_{Q3}^2</u> ✓

$F_{Q3} = 0,5$ N



$F_{Q3}=\frac{kQ_1Q_3}{r^2}$

$0,5=\frac{(9\times10^9)(1\times10^{-6})Q_3}{0,25^2}$ ✓

$Q_3 = 3,47\times10^{-6}$ C ✓

(5)

OPTION 2

$F_{net}^2 = F_{Q2}^2 + F_{Q3}^2$

$F_{net}^2 = \frac{kQ_1Q_2}{r^2}$ ✓ $+ \frac{kQ_1Q_3}{r^2}$

$(0,51)^2 = \left[\frac{(9\times10^9)(1\times10^{-6})(1\times10^{-6})}{0,3^2}\right]^2$ ✓ $+ \left[\frac{(9\times10^9)(1\times10^{-6})Q_3}{0,25^2}\right]^2$ ✓

$(0,51)^2 = (0,1)^2 + \left[\frac{(9\times10^9)(1\times10^{-6})Q_3}{0,25^2}\right]^2$

$0,5=\frac{(9\times10^9)(1\times10^{-6})Q_3}{0,25^2}$

$Q_3 = 3,47\times10^{-6}$ C ✓

[16]

QUESTION 8

8.1 24 J of work done per +1C charge moving from one point in the circuit to another
OR
It is the amount of work done (24 J) per unit positive charge (+1C) moving it from one point in the circuit to another (2)

8.2 $V=IR$ ✓
$\underline{(24-22,26)=I(0,5)}$ ✓
$I=3,48$ A ✓ (3)

8.3 **POSITIVE MARKING FROM 8.2**
$V_{5\Omega}=IR$
$=(3,48)(5)$
$=17,4$ V

$V_{//} = \underline{22,26-17,4}$ ✓ $= 4,86$ V

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

8.4 **POSITIVE MARKING FROM 8.2 & 8.3**

Current through 2 Ω: $I = \frac{V}{R}$ ✓ $= \frac{4,86}{2}$ ✓ $= 2,43$ A

Current through 16 Ω: $I = \frac{V}{R} = \frac{4,86}{16} = 0,3$ A

$I_R = \underline{3,48 – 2,43 – 0,3}$ ✓ $= 0,75$ A ✓ (4)

8.5 Increases ✓

Total resistance (R_T) increases ✓
Total current (I_T) decreases ✓

∴lost volts (Vi) AND $V_{5\Omega}$ decreases, therefor $\underline{V_{//} \text{ increases}}$ ✓

$P \propto V^2$ if R=constant ✓ (5)

OR

Increases ✓

Total resistance (R_T) increases ✓
Total current (I_T) decreases ✓

V_i decreases and $V_{5\Omega}$ decreases ⇒ $\underline{V_{//} \text{ increases}} \Rightarrow \underline{I_{16\Omega} \text{ increases}}$ ✓
$P \propto I^2$ if R=constant ✓

[18]

QUESTION 9

9.1 AC ✓ (1)

9.2 From electrical energy✓ to light / heat energy ✓ (2)

9.3 Faradays principle / electromagnetic induction✓ (1)

9.4 $f = \frac{\text{number of waves}}{\text{time}}$

$f = \frac{2}{5\times10^{-2}}$ ✓

$= 40$ Hz ✓

OR

$f = \frac{1}{T} = \frac{1}{2,5\times10^{-2}} = 40$ Hz (2)

9.5

OPTION 1

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$

$= \frac{311}{\sqrt{2}}$ ✓

$V_{max} = 219,91$ V

$P_{avg} = V_{rms}I_{rms}$ ✓

$120 = I_{rms}(219,91)$ ✓

$I_{rms} = 0,55$ A ✓

(4)

OPTION 2

$P_{avg} = V_{rms}I_{rms}$ ✓

$P_{avg} = \frac{V_{max}}{\sqrt{2}} \cdot I_{rms}$

120 ✓ $= I_{rms}(\frac{V_{max}}{\sqrt{2}})$

$120 = I_{rms}(\frac{311}{\sqrt{2}})$ ✓

$I_{rms} = 0,55$ A ✓

9.6

OPTION 1

$V_{rms} = I_{rms} \cdot R$ ✓

$\underline{219,91 = 0,55\ R}$ ✓

$R = 399,84\ \Omega$ ✓

OPTION 2

$P_{avg} = \frac{V_{rms}^2}{R}$ ✓

$120 = \frac{(219,91)^2}{R}$ ✓

$R = 403\ \Omega$ ✓

(3)

[13]

QUESTION 10

10.1 The minimum frequency (of light) needed ✓ to emit electrons from a certain metal surface. ✓
Die minimum frekwensie (lig) benodig om elektrone uit 'n sekere metaaloppervlak vry te stel. (2)

10.2 $E_{k(max)} \propto \frac{1}{\lambda}$ ✓✓

OR

$E_{k(max)}$ is inversely proportional to λ

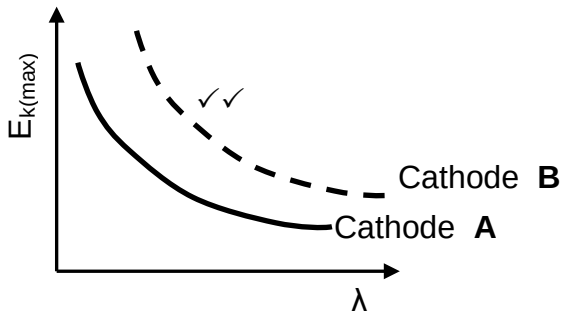
(2)

10.3 Stays the same ✓
Only frequency influences the $E_{k(max)}$ ✓
OR: Intensity only influences the number of photo electrons per second (2)

10.4
$E = W_o + E_{k(max)}$ ✓
$\frac{hc}{\lambda} = hf_0 + ½mv^2$
$\frac{(6,63\times10^{-34})(3\times10^{8})}{(160\times10^{-9})}$✓ = $(6,63\times10^{-34})(1,18\times10^{15})$ ✓ + ½$(9,11\times10^{-31})v^2$ ✓
$v_{max} = 1,01\times10^{6}\ m\cdot s^{-1}$ ✓

(5)

10. 5



(2)
[13]

TOTAL/TOTAAL: 150