education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2024

MEMO

MARKS/*PUNTE*: 150

These marking guidelines consists of 13 pages

Hierdie nasienriglyne bestaan uit 13 bladsye

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QUESTION 1 / *VRAAG 1*

1.1	C ✓✓	(2)
1.2	D ✓✓	(2)
1.3	C ✓✓	(2)
1.4	B ✓✓	(2)
1.5	A ✓✓	(2)
1.6	D ✓✓	(2)
1.7	B ✓✓	(2)
1.8	B ✓✓	(2)
1.9	A ✓✓	(2)
1.10	A✓✓	(2)

[20]

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QUESTION 2 / *VRAAG 2*

2.1

Marking criteria/*Nasienkriteria*

If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. */Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

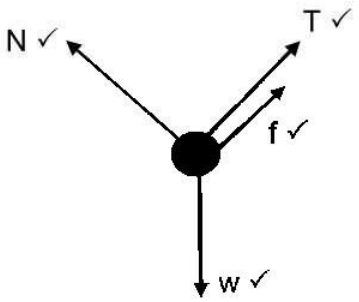
When a net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die resultante/netto 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. **(2 or 0)**
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. ***(2 of 0)***

(2)

2.2 DOWN THE INCLINE / AFWAARTS TEEN DIE HELLING ✓

(1)

2.3



(4)

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / mg / gravitational force / VALUE / gravitasiekrag
T	Tension in rope / F_T / spankrag
F	$F_{friction}$ / F_f / frictional force / wrywing
N	Normal force / F_N / Normaalkrag

Notes/Aantekeninge:

- Mark awarded for label and arrow.
- Any additional forces: deduct 1 mark: max $^3/_4$
- No labels: deduct 1 mark: max $^3/_4$
- If everything correct, but no arrows: deduct 1 mark: $^3/_4$
- Force(s) not touching object: deduct 1 mark: max $^3/_4$
- Ignore relative sizes of the vectors

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2.4

Marking criteria/*Nasienkriteria*:

- Formula for block P or block Q ✓
- Substitution of Fnet for block P ✓
- Substitusion of Fnet for block Q ✓
- 5a **OR** 2a ✓
- Answer ✓

For Block P:		For Block Q:
$F_{net} = ma$ $F_{g\parallel} + (-T) + (-f) = ma$	Any one ✓	$F_{net} = ma$ $T - F_g = ma$
$(5)(9,8)\sin 30^\circ - T - 2,5$ ✓ $= 5a$ ✓		$T - (2)(9,8)$ ✓ $= 2a$
$22 - T = 5a$		$T - 19,6 = 2a$
$T = -5a + 22$		$T = 2a + 19,6$

$\therefore -5a + 22 = 2a + 19,6$

$7a = 2,4$

$a = 0,34\ m \cdot s^{-2}$ ✓

(5)

2.5 GREATER THAN / GROTER AS ✓

F_{net} increases – no more tension pulling back✓

F_{net} neem toe – geen meer spankrag wat terug trek nie (2)

[14]

QUESTION 3 / VRAAG 3

3.1 An object which has been given an initial velocity and then it moves under the influence of the gravitational force only. ✓ ✓ **(2 or 0)**

'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg. **(2 or 0)** (2)

3.2.1

Upwards positive/ Opwaarts positief:	**Downwards positive/ Afwaarts positief:**
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
-30 ✓ $= 30 + (-9,8)\Delta t$ ✓	30 ✓ $= -30 + (9,8)\Delta t$ ✓
$\Delta t = 6,12s$ ✓	$\Delta t = 6,12s$ ✓

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1
POSITIEWE NASIEN VANAF VRAAG 3.2.1

$v_f = v_i + a\Delta t$
$0 = -30 + (9,8)\Delta t$
$\Delta t = 3,06s$

Upwards Positive/ **Opwaarts positief**	**Downwards Positive/** **Afwaarts positief**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\Delta y = \underline{(30)(3,06) + \frac{1}{2}(-9,8)(3,06)^2}$ ✓ $\Delta y = 45,92$ m	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\Delta y = \underline{(-30)(3,06) + \frac{1}{2}(9,8)(3,06)^2}$ ✓ $\Delta y = -45,92$ m
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = \underline{(30)(2,06) + \frac{1}{2}(-9,8)(2,06)^2}$ ✓ $\Delta y = 41,01$ m	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = \underline{(-30)(2,06) + \frac{1}{2}(9,8)(2,06)^2}$ ✓ $\Delta y = -41,01$ m
displacement in the last second = 45,92 – 41,01 = 4,91 m ✓	displacement in the last second = 45,92 – 41,01 = 4,91 m ✓

(4)

3.3

Upwards positive / **Opwaarts positief**	**Downwards positive/** **Afwaarts positief**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -50 ✓$= v_i\ \underline{(4,12) + \frac{1}{2}(-9,8)(4,12)^2}$ ✓ $v_i = 8,05\ m\cdot s^{-1}$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 50 ✓$= v_i\ \underline{(4,12) + \frac{1}{2}(9,8)(4,12)^2}$ ✓ $v_i = -8,05\ m\cdot s^{-1}$ $v_i = 8,05\ m\cdot s^{-1}$✓

(4)

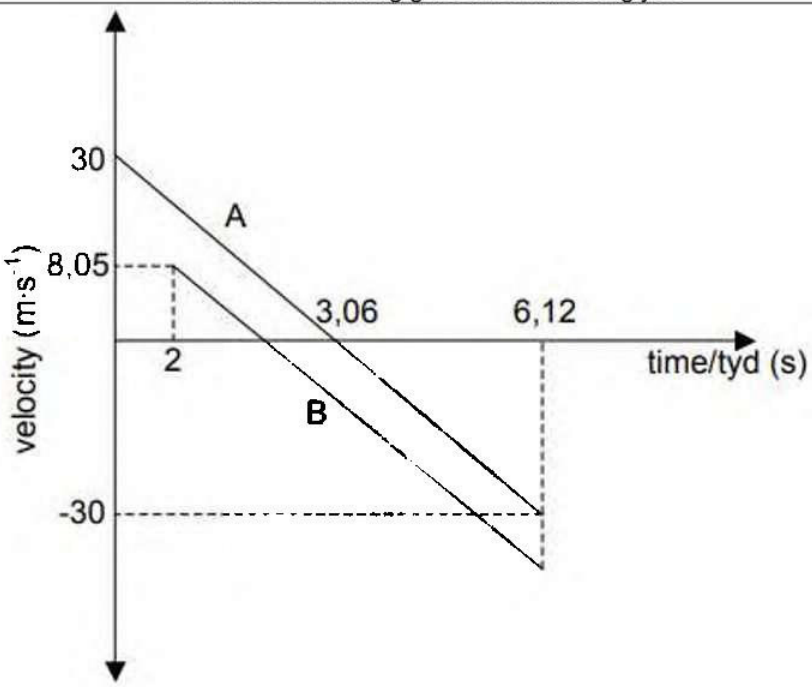
3.4

POSITIVE MARKING FROM/POSITIEWE MERK VANAF 3.2.1 & 3.2.2 & 3.3
UPWARDS POSITIVE/OPWAARTS POSITIEF

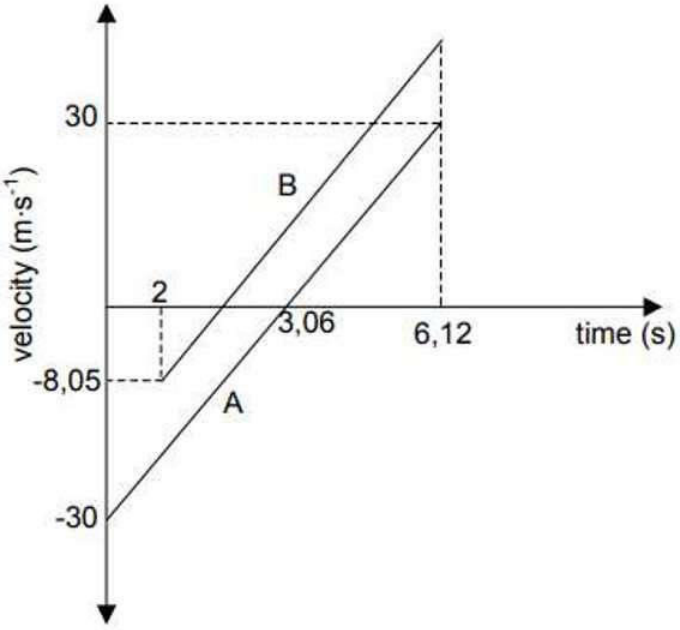
Criteria/Kriteria	**Marks/Punte**
Correct shape of A Korrekte vorm van A	✓
Correct shape of Graph B parallel to A above A Korrekte vorm van Grafiek parallel met A bo A	✓
Time at which both A and B reach the ground (6,12 s) Tyd wat beide A en B die grond bereik (6,12 s)	✓
Time for A to reach the maximum height (3,06 s) shown Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui	✓

(4)

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DOWNWARDS POSITIVE/AFWAARTS POSITIEF



[18]

QUESTION 4 / VRAAG 4

4.1
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = 0 + 2(9,8)(15)$ ✓
$v_f = 17,15\ m\cdot s^{-1}$ ✓ (3)

4.2.
Impulse is the product of the resultant/net force ✓ acting on an object and the time the net force acts on the object. ✓

Impuls is die produk van die resulterende/netto krag ✓ wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk. ✓ (2)

4.3.1
POSITIVE MARKING FROM QUESTION 4.1

$F_{net} \cdot \Delta t = mv_f - mv_i$ ✓
$F_{net}(0,5) = (1,5)(0 - 17,15)$ ✓
$F_{net} = -51,45\ N$
$F_{net} = 51,45\ N$ ✓ upwards/opwaarts (3)

4.3.2
POSITIVE MARKING FROM QUESTION 4.3.1
$F_{net} = F_{mud} + F_g$ ✓
$-51,45 = F_{mud} + (1,5)(9,8)$ ✓
$F_{mud} = 66,15\ N$ ✓ (3)

4.4
DECREASE/VERMINDER ✓
Δp = constant value ✓
F_{net} is inversely proportional to Δt, therefore the longer the time of contact, the smaller the net force if the change in momentum stays the same. ✓ (3)

[14]

QUESTION 5 / VRAAG 5

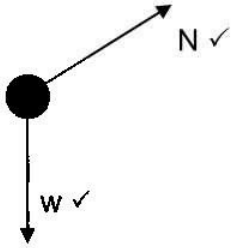
5.1
Marking criteria/*Nasienkriteria*
If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. */Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

A force for which the work done in moving an object between two points depends on the path taken ✓✓

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

5.2
$E_{kT} + E_{pT} = E_{kP} + E_{pP}$ ✓
$\frac{1}{2}(5)(0)^2 + (5)(9,8)(5)$ ✓ $= \frac{1}{2}(5)v^2 + (5)(9,8)(0)$ ✓
$245 = 2,5\ v^2$
$v = 9,90\ m\cdot s^{-1}$ ✓ (4)

5.3



(2)

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / mg / gravitational force /
N	Normal force / F_N

5.4 Velocity stays the same there is no friction working in on the object. (1)

5.5

Marking criteria/*Nasienkriteria*
If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. */Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The net work done on an object is equal to the change in kinetic energy of the object. ✓✓

Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp **OF** die arbeid verrig op die voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

5.6 **POSITIVE MARKING FROM QUESTION 5.2**

OPSIE 1/OPTION 1

$W_{net} = \Delta E_k$
$F_{net}\Delta x \cos\Theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2]$ } Any one ✓

$(18 + (5)(9,8)\sin\theta$✓$)\Delta x \cos 180°$✓ $= [\frac{1}{2}(5)\,0^2 - \frac{1}{2}(5)\,(9,90)^2]$ ✓

$-18x - 49(\frac{3}{x})x = [\frac{1}{2}(5)\,0^2 - \frac{1}{2}(5)\,(9,90)^2]$
$-18x - 49(3) = -245,025$
$\Delta x = 5,445$ m

$\sin\theta = \frac{t}{s}$

$\sin\theta = \frac{3}{5,445}$✓

$\theta = 33,43°$ ✓

(6)

OPSIE 2/OPTION 2

$W_{nc} = \Delta Ek + \Delta Ep$ } Any one ✓

$f\Delta x \cos\Theta = [½mv_f^2 - ½mv_i^2] + [mgh_f - mgh_i]$

$18\Delta x \cos 180° ✓ = [½(5)\,0^2 - ½(5)\,(9,90)^2]$ ✓ $+ [(5)(9,8)(3) - (5)(9,8)(0)]$ ✓

$-18\Delta x = -245 + 147$

$\Delta x = 5,44$ m

$\sin\theta = \frac{t}{s}$

$\sin\theta = \frac{3}{5,44}$ ✓

$\theta = 33,47°$ ✓

[17]

UESTION 6 / VRAAG 6

6.1

Marking criteria/*Nasienkriteria*
If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. */Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The change in frequency/pitch/wavelength 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 van frekwensie/toonhoogte/golflengte van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoorplanting het.

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

(2)

6.2

$f = \frac{2}{4\times10^{-5}}$ or $\frac{1}{1\times10^{-4}}$

= 40 000 Hz ✓ ✓

(2)

6.3

Waves in front of source are more compact/ wavelength decreases ✓
Dolphin is moving towards the recorder. ✓

(2)

6.4 **POSITIVE MARKING FROM QUESTION 6.2**

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \checkmark \quad \text{OR} \quad f_L = \frac{v}{v - v_S} f_S$$

$$40\,000 \checkmark = \frac{1500 + 0}{1500 - v_S} \checkmark \; 39\,000 \checkmark$$

$$v_S = 37{,}5 \text{ m.s}^{-1} \checkmark$$

(5)
[11]

QUESTION 7 / VRAAG 7

7.1

Marking criteria/Nasienriglyne:
-1 mark for each of the 3 key words omitted in the correct context.
-1 punt vir elk van die 3 sleutelwoorde weggelaat in die korrekte konteks.

The electric field is an **area in space** where an electric **charge** experiences a **force**. ✓✓
*Die elektriese veld is 'n **gebied in die ruimte** waarin 'n elektriese **lading** 'n **krag** ondervind*

(2)

7.2

$E_{nett} = E_1 + E_2$

$E_{net} = \frac{kQ}{r^2} - \frac{kQ}{r^2}$ ✓ (Mark for/Punt vir E = $\frac{kQ}{r^2}$)

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

= 2,3 x 10^6 N. C^{-1} ✓ right/ regs/east/oos✓

(6)

7.3 -0,5 x 10^{-6} C ✓✓ (2)

7.4 **POSITIVE MARKING FROM QUESTION 7.3**

$F = \frac{kQ_1Q_2}{r^2}$ ✓ $F = \frac{kQ_1Q_2}{r^2}$

$F_{(Q1 \text{ on } 3)} = \frac{(9\times10^9)(0,5\times10^{-6})Q_3}{(0,25)^2}$ ✓ $F_{(Q1 \text{ on } 2)} = \frac{(9\times10^9)(0,5\times10^{-6})(0,5\times10^{-6})}{(0,2)^2}$ ✓

= 72000 x Q_3 N = 0,05625 N

$F_{net} = \sqrt{(F_{1,3})^2 + (F_{1,2})^2}$ ✓

5,4 x10^{-1} ✓ = $\sqrt{(72000\ Q_3)^2 + (0,05625)^2}$

Q_3 = 7,459 x 10^{-6} C ✓

(6)

[16]

QUESTION 8 / VRAAG 8

8.1.1 6V ✓ (1)

8.1.2 0,2 A ✓ (1)

8.2.1 **POSITIVE MARKING FROM Q 8.1.1 AND 8.1.2**

$R = \frac{V}{I}$ ✓

$= \frac{3}{0,2}$ ✓

$= 15\ \Omega$ ✓ (3)

8.2.2 **POSITIVE MARKING FROM Q8.1.2 (I=0,1A + Answer Q8.1.2)**

OPTION 1

$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$

$= \frac{1}{45} + \frac{1}{90}$ } Any one ✓

$R = 30\ \Omega$

$R_e = 30 + 60$ ✓ $= 90\ \Omega$

$\varepsilon = I(R+r)$ ✓

$= (0,3)(90 + 2)$ ✓

$= 27,6$ V ✓

OPTION 2

$V_p = IR$

$= (0,3)(30)$ ✓

$= 9$ V

$V_{bulb} = IR$ ✓

$= (0,3)(60)$

$= 18$ V ✓

$V_i = Ir$

$= (0,3)(2)$

$= 0,6$V

$\varepsilon = V_p + V_{bulb} + V_i$

$= 9 + 18 + 0,6$ ✓

$= 27,6$ V ✓ (5)

8.2.3 **POSITIVE MARKING FROM Q8.1.2 + Q8.2.2**

OPTION 1

$P = I^2R$ ✓

$= (0,3)^2(60)$ ✓

$= 5,4$ W ✓

OPTION 2

$P = VI$ ✓

$= (18)(0,3)$ ✓

$= 5,4$W ✓

OPTION 3

$P = \frac{V^2}{R}$ ✓

$= \frac{18^2}{60}$ ✓

$= 5,4$ W ✓ (3)

8.3 0 V ✓ (1)

8.4

Total resistance increases ✓ ∴Total current decreases ✓ ∴'lost volts' (V_i) DECREASE ✓ because $V_i \propto I$ (r = constant)

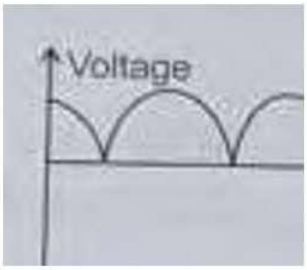
(3)
[17]

QUESTION 9 /*VRAAG 9*

9.1.1 Anti-clockwise✓ (1)

9.1.2 Electrical energy to kinetic(mechanical) energy✓
Elektriese enegie na kinetiese(meganiese) energie (1)

9.1.3



Marking criteria for graph:
Correct shape *Korrekte vorm* ✓
Two complete cycle/Twee *volledige siklus* ✓

(2)

9.2.1 The AC potential difference/voltage which dissipates the same amount of energy✓ as DC potential potential difference. ✓
Die WS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as GS potensiaalverskil/spanning.
OR/OF
(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy✓ as AC potential difference/voltage. ✓
Dit is die GS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as WS potensiaalverskil/spanning. (2)

9.2.2

OPTION 1	**OPTION 2**
$P_{ave} = V_{rms} \cdot I_{rms}$ ✓ $= 230 \cdot \frac{I_{max}}{\sqrt{2}}$ 2100 ✓ = $230 \frac{I_{max}}{\sqrt{2}}$ ✓ $I_{max} = 12{,}9\ A$ ✓	$P_{ave} = V_{rms} \cdot I_{rms}$ ✓ $2100 = 230\ I_{rms}$ ✓ $I_{rms} = 9{,}13\ A$ $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $9{,}13 = \frac{I_{max}}{\sqrt{2}}$ ✓ $I_{max} = 12{,}91\ A$✓

(4)
[10]

QUESTION 10 / VRAAG 10

10.1 $3,6 \times 10^{-19}$ J ✓ (1)

10.2 The maximum kinetic energy is inversely proportional✓✓ to the wavelength. (2)

10.3

Marking criteria/*Nasienkriteria*
If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. */Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓ *Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel..*

(2)

10.4

$$W_o = \frac{hc}{\lambda_0} \checkmark$$

$$= \frac{(6,63\times10^{-34})(3\times10^{8})}{4,9\times10^{-7}} \checkmark$$

$$= 4,06 \times 10^{-19} \text{ J} \checkmark$$

(3)

10.5 **POSITIVE MARKING FROM 10.4**

$E = W_o + E_{k(max)}$ ✓

$\frac{hc}{\lambda} = W_o + \frac{1}{2}mv^2$

$\frac{(6,63\times10^{-34})(3\times10^{8})}{\lambda}$ ✓ $= (4,06\times10^{-19})$ ✓ $+ \frac{1}{2}(9,11\times10^{-31})(2,6\times10^{6})^2$ ✓

$\lambda = 5,7 \times 10^{-8}$ m ✓

(5)

[13]

TOTAL/*TOTAAL*: 150