education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

SEPTEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consists of 15 pages

Hierdie nasienriglyne bestaan uit 15 bladsye

QUESTION 1 / *VRAAG 1*

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 B ✓✓ (2)

1.7 C ✓✓ (2)

1.8 C ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2 / *VRAAG 2*

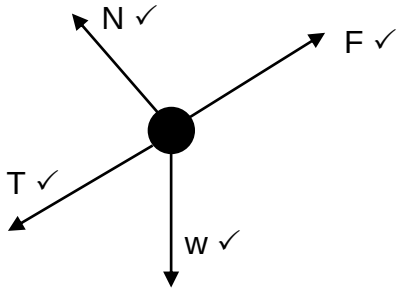
2.1

M**arking 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.*

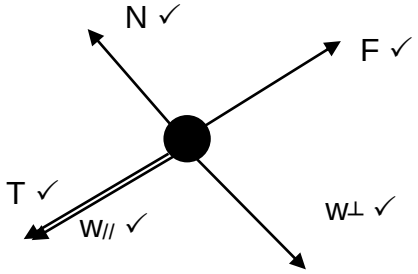
A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net/unbalanced force acts on it. ✓✓
'n Liggaam sal in 'n toestand van rus of beweging teen 'n konstante snelheid volhard, tensy 'n nie-nul resulterende/netto/ongebalanseerde krag daarop inwerk.
OR/*OF*
A body will remain in its state of rest or uniform motion in a straight line unless a non-zero resultant/net/unbalanced force acts on it. ✓
'n Liggaam sal in 'n toestand van rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n nie-nul resulterende/netto/ongebalanseerde krag daarop inwerk.

(2)

2. 2



Accept/*Aanvaar*



(4)

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / mg / gravitational force / 29,4 N
F	$F_{applied}$ / F_A / Applied force
T	Tension in rope / F_T
N	Normal force / F_N / 25,46 N

Notes/Aantekeninge:

- Any additional forces: deduct 1 mark: max $^3/_4$
- No labels: deduct 1 mark: max $^3/_4$
- No arrows: $^0/_4$
- Force(s) not touching object: deduct 1 mark: max $^3/_4$
- Ignore relative sizes of the vectors

2.3

$F = (Fg_{//})_{5kg} + (Fg_{//})_{3kg} - f_s$

$= \underline{5(9,8)Sin30° + 3(9,8)Sin30°}$ ✓ $\underline{- 16,97}$ ✓ $= 22,23$ N ✓

(3)

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 3a ✓
- Answer: a=5,16 m·s^{-2} ✓

For Block P:		For Block Q:
$F_{net} = ma$ $T + (-F_{g//}) + (-f) = ma$	Any one ✓	$F_{net} = ma$ $F + (-F_{g//}) + (-T) = ma$
$\underline{T – (5×9,8)Sin30° - 4,5}$ ✓ $= \underline{5a}$ ✓		$\underline{85 – (3×9,8)Sin30° - T}$ ✓$= 3a$
$T = 5a + 29$		$T = 70,3 – 3a$

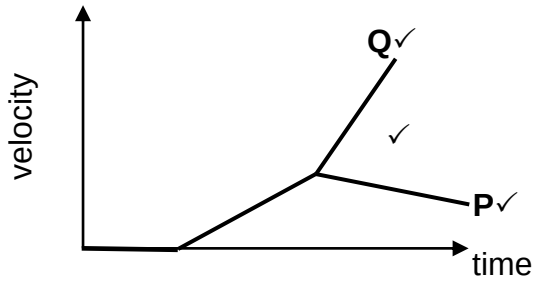
$\therefore 5a + 29 = 70,3 – 3a$

$8a = 41,3$

$a = 5,16$ m·s^{-2} ✓

(5)

2.5



Marking criteria/*Nasienkriteria*

- Both straight lines✓
- For Q: positive gradient and larger than initially✓
- For P: negative gradient✓

(3)

[17]

QUESTION 3 / VRAAG 3

3.1 9,8 m·s^{-2} ✓ downwards / *afwaarts* ✓ (2)

3.2.1 **Note:** do not penalize for the omission of zero(s).

OPTION 1

Upwards positive:	**Downwards positive:**
$\Delta y = -50-(-1,5) = -48,5$ m✓	$\Delta y = 50-1,5 = 48,5$ m✓
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= \underline{0 + 2(-9,8)(-48,5)}$ ✓	$= \underline{0 + 2(9,8)(48,5)}$ ✓
$v_f = 30,83$ m·s^{-1} ✓	$v_f = 30,83$ m·s^{-1} ✓

OPTION 2

$(mgh+½mv^2)_{top} = (mgh+½mv^2)_P$ ✓	$(mgh+½mv^2)_{top} = (mgh+½mv^2)_P$ ✓
$\underline{m(9,8)(50)+0}$✓ $= \underline{m(9,8)(1,5)+½(m)v^2}$✓	$\underline{m(9,8)(48,5}$✓$\underline{) + 0 = 0 + ½(m)v^2}$ ✓

(4)

	v = 30,83 m·s^{-1} ✓	v = 30,83 m·s^{-1} ✓
3.2.2	**OPTION 1** **Upwards Positive** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-48,5 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 3,15$ s ✓	**Downwards Positive** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $48,5 = 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 3,15$ s ✓
	OPTION 2 **POSITIVE MARKING FROM Q3.2.1** **Upwards Positive** $v_f = v_i + a\Delta t$ ✓ $-30,83 = 0 + (-9,8)\Delta t$ ✓ $\Delta t = 3,15$ s ✓	**Downwards Positive** $v_f = v_i + a\Delta t$ ✓ $30,83 = 0 + (9,8)\Delta t$ ✓ $\Delta t = 3,15$ s ✓
	OPTION 3 **Upwards Positive** $F_{net}\cdot\Delta t = mv_f - mv_i$ ✓ $m(-9,8)\Delta t = m(-30,83) - 0$ ✓ $\Delta t = 3,15$ s ✓	**Downwards Positive** $F_{net}\cdot\Delta t = mv_f - mv_i$ ✓ $(m\times 9,8)\Delta t = m(30,83) - 0$ ✓ $\Delta t = 3,15$ s ✓

(3)

3.3

Marking criteria/Nasienkriteria:

- Formula for motion at constant velocity
- Substitution for motion at constant velocity
- Formula to calculate v_i for vertical motion
- Substitution to calculate v_i
- Final answer: 13,28 m·s^{-1}

Motion at constant velocity:

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$11 = 2,3\ \Delta t$ ✓
$\Delta t = 4,78$ s

OR/ *OF*

$\Delta x = \frac{(v_f+v_i)}{2}\Delta t$ ✓
$11 = \frac{(2,3+2,3)}{2}\Delta t$ ✓
$\Delta t = 4,78$ s

OR/ *OF*

Distance = speed×time ✓
$11 = 2,3\ \Delta t$ ✓
$\Delta t = 4,78$ s

Vertical motion:

Upwards positive
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-48,5 = v_i(4,78) + \frac{1}{2}(-9,8)(4,78)^2$ ✓
$v_i = 13,28$ m·s^{-1} ✓

Downwards positive
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$48,5 = v_i(4,78) + \frac{1}{2}(9,8)(4,78)^2$ ✓
$v_i = -13,28$ m·s^{-1}
$v_i = 13,28$ m·s^{-1} ✓

(5)

[14]

QUESTION 4 / VRAAG 4

	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.*	
4.1	A system on which the <u>resultant/net</u> <u>external force</u> is <u>zero</u> *'n Sisteem waarin die <u>resulterende/netto</u> <u>eksterne krag</u> <u>nul</u> is.*	(2)

4.2.1	$p = mv$ ✓ <u>$8,4 = m(560)$</u> ✓ $m = 0,015$ kg ✓	(3)

4.2.2	**POSITIVE MARKING FROM 4.2.1**	
	$\Sigma p_i = \Sigma p_f$ $(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ } ✓ Any one <u>$(0,015)(560) + (3)(-2,5)$</u> ✓ = <u>$(0,015)(80) + (3)(v)$</u> ✓ $v = -0,1$ $v = 0,1$ m·s^{-1} ✓	(4)

4.2.3	**POSITIVE MARKING FROM QUESTION 4.2.1** **<u>OPTION 1</u>** $F_{net} \cdot \Delta t = mv_f - mv_i$✓ <u>$F_{net}(0,02) = 0,015(80-560)$</u> ✓ $F_{net} = -360$ $F_{net} = 360$ N✓ East/*Oos*✓ **Accept:** Right/Regs	
	POSITIVE MARKING FROM QUESTION 4.2.2 **<u>OPTION 2</u>** $F_{net} \cdot \Delta t = mv_f - mv_i$✓ <u>$F_{net}(0,02) = 3(0,1 - 2,5)$</u> ✓ $(F_{net})_{block} = -360$ $(F_{net})_{bullet} = 360$ N✓ East/*Oos*✓ **Accept:** Right/Regs	(4)

[13]

QUESTION 5 / VRAAG 5

5.1

OPTION 1

$(E_m)_A = (E_m)_B$
$(mgh + ½mv^2)_A = (mgh + ½ mv^2)_B$ } Any one ✓
$\underline{m(9,8)(0,7) + ½ m(2)^2 = 0 + ½mv^2}$ ✓
$v = 4,21 \text{ m·s}^{-1}$ ✓

OPTION 2

$W_{nc} = \Delta E_k + \Delta E_p$ } Any one ✓
$0 = [½mv_f^2 – ½mv_i^2] + [mgh_f – mgh_i]$
$\underline{0 = [½mv^2 – ½m(2)^2] + [0 – m(9.8)(0,7)]}$ ✓
$v = 4,21 \text{ m·s}^{-1}$ ✓ (3)

5.2 **Marking criteria/*Nasien kriteria***

- Formula for E_k = 11,17
- Substitution of mv=5,79
- Final answer: $v = 3,86 \text{ m·s}^{-1}$

OPTION 1 $p = mv = 5,79$ $E_k = ½mv^2 = 11,17$	 $½mv·v = 11,17$✓ $½(\underline{5,79})v$ ✓$= 11,17$ $v = 3,86 \text{ m·s}^{-1}$ ✓
OPTION 2 $p = mv = 5,79$ $m = \frac{5,79}{v}$ →	 $E_k = ½mv^2 = 11,17$✓ $\frac{1}{2}\left(\frac{5,79}{v}\right)v^2$✓$=11,17$ $v = 3,86 \text{ m·s}^{-1}$ ✓

(3)

5.3

M<u>arking criteria/*Nasienkriteria*</u>
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 <u>net work done on an object</u> is <u>equal to</u> the <u>change in kinetic energy</u> of the object. ✓✓
Die <u>netto arbeid op 'n voorwerp verrig</u> is <u>gelyk aan</u> die <u>verandering in die kinetiese energie</u> van die voorwerp. (2)

5.4 **POSITIVE MARKING FROM Q5.2**

OPTION 1
$mv = 5,79$
$\underline{m(3,86)=5,79}$✓
$m = 1,5 \text{ kg}$

OR/*OF*
$½mv^2 = 11,17$
$\underline{½ m(3,86)^2 = 11,17}$✓
$m = 1,5 \text{ kg}$

$W_{net} = \Delta E_k$ } Any one ✓
$f\Delta x\cos\Theta = ½mv_f^2 – ½mv_i^2$
$\underline{(3)(X)\cos180°}$✓$= \underline{0 – ½(1,5)(3,86)^2}$✓
$X = 3,72 \text{ m}$ ✓

OPTION 2

$mv = 5,79$ $\quad$ $\frac{1}{2}mv^2 = 11,17$

$\underline{m(3,86)=5,79}$ ✓ $\quad$ $\underline{\frac{1}{2}\, m(3,86)^2 = 11,17}$ ✓

$m = 1,5\ kg$ $\quad$ $m = 1,5\ kg$

$W_{nc} = \Delta Ek + \Delta Ep$

$f\Delta x \cos\Theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$ } Any one ✓

$\underline{(3)(X)\cos180°}$ ✓ $= \underline{[0 - \frac{1}{2}(1,5)(3,86)^2] + 0}$ ✓

$X = 3,72\ m$ ✓

(5)

[13]

QUESTION 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 listerner 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 sounce 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

Waves in front of source are more compact/wavelength decreases ✓
More waves per second reaches the detector/listener ✓
Golwe voor die bron kompakteer / golflengte neem af ✓
Meer golwe per sekonde bereik die detector ✓ (2)

6.3.1

Moving towards	Moving away
$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓ OR $f_L = \frac{v}{v - v_S} f_S$	$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ OR $f_L = \frac{v}{v + v_S} f_S$
$950 ✓ = \frac{330}{330 - v_s} f_s ✓$	$750 ✓ = \frac{330}{330 + v_s} f_s ✓$
$f_s = \frac{950(330 - v_s)}{330}$	$f_s = \frac{750(330 + v_s)}{330}$

$\therefore 950(330 - v_s) = 750(330 + v_s)$
$200(330) = 1700 v_s$
$v_s = 38{,}82 \text{ m·s}^{-1}$ ✓ (6)

6.3.2 **POSITIVE MARKING FROM Q6.3.1**

OPTION 1	**OPTION 2**	**OPTION 3**
Δt = 12,5-8✓= 4,5 s	Δt = 12,5-8✓= 4,5 s	Δt = 12,5-8✓= 4,5 s
$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ = (38,82)(4,5) ✓ = 174,69 m✓	$\Delta x = \frac{(v_f + v_i)}{2} \Delta t$ ✓ $= \frac{(38{,}82 + 38{,}82)}{2} (4{,}5)$ ✓ = 174,69 m✓	Distance = speed×time✓ = (38,82)(4,5) ✓ = 174,69 m✓

(4)
[14]

QUESTION 7 / VRAAG 7

7.1.1

M**arking 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.*

Note: If **masses** used ($^0/_2$)

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges ✓ and inversely proportional to the square of the distance (r) between them ✓
Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. ✓ (2)

7.1.2 Negative/*Negatief*✓ (1)

7.1.3

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$57,6 = \frac{(9\times10^9)Q^2}{(0,1)^2}$ ✓

$Q = 8\times10^{-6}$ C ✓ Accept: $Q = -8\times10^{-6}$ C (3)

7.2.1

Marking criteria/Nasienriglyne:
-1 mark for each of the 5 key words omitted in the correct context.
-1 punt vir elk van die 5 sleutelwoorde weggelaat in die korrekte konteks.

The electric field at a point is the (electrostatic) force experienced per unit positive charge placed at that point.
Die elektriese veld by 'n punt is die (elektrostatiese) krag wat per positiewe eenheids-lading wat by daardie punt geplaas is, ondervind word. (2)

7.2.2

$E = \frac{kQ}{r^2}$ ✓

$= \frac{(9\times10^9)(8\times10^{-9})}{(0,2)^2}$ ✓

$= 1\ 800$ N·C^{-1}✓ to the left✓ (4)

7.2.3

$E_{net} = E_x - E_y$

$120 = \frac{(9\times10^{9})Q}{0,2^2}$ -✓ $\frac{(9\times10^{9})(4\times10^{-9})}{0,08^2}$ ✓

$Q = 2,55\times10^{-8}$ C

$n = \frac{Q}{e^-}$ ✓

$= \frac{(2,55\times10^{-8}-8\times10^{-9})}{1,6\times10^{-19}}$ ✓ **OR/*OF*** $\frac{-2,55\times10^{-8}-(-8\times10^{-9})}{-1,6\times10^{-19}}$

$= 1,1\times10^{11}$ ✓ (5)

[17]

QUESTION 8 / VRAAG 8

8.1 7,2 (V) ✓ (1)

NOTE: Penalize once in Q8.2 for incorrect use of $\times10^{-2}$

8.2.1 Gradient= $-r = \frac{V_2-V_1}{I_2-I_1}$

$= \frac{7,2-0}{0-150\times10^{-2}}$ ✓

$r = 4,8\ \Omega$✓

NOTE: Can use any coordinates on the line, eg
$(100\times10^{-2}$; 2,4)
$(67,5\times10^{-2}$; 4,0)
$(17,5\times10^{-2}$; 6,4)

(2)

8.2.2 **POSITIVE MARKING FROM Q8.1 AND Q8.2.1**

OPTION 1	**OPTION 2**
$\varepsilon = I(R+r)$ ✓	$V = IR$✓
$7,2 = (117,5\times10^{-2})[R+4,8]$ ✓	$1,6 = (117,5\times10^{-2})R$✓
$R = 1,33\ \Omega$✓	$R = 1,36\ \Omega$✓

(3)

[6]

QUESTION 9 / VRAAG 9

9.1 The potential difference across a conductor is directly proportional to the current in the conductor ✓ at constant temperature. ✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur. (2)

9.2.1

OPTION 1	**OPTION 2**
$V_{6\Omega} = IR$ $= 0,5(6)$ ✓ $= 3$ V $I_{12\Omega} = {}^{V}/_{R} = {}^{3}/_{12} = 0,25$ A✓ $I_1 = \underline{0,5+0,25} = 0,75$ A✓	$R_{6\Omega} : R_{12\Omega}$ 6 : 12 $I_{6\Omega} : I_{12\Omega}$ 12 : 6 0,5 : $\underline{0,25}$✓ $I_1 = \underline{0,5+0,25}$✓$=0,75$ A✓

(3)

9.2.2

POSITIVE MARKING FROM Q9.2.1
$V_{20\Omega}=IR$ $= 0,75(20)$ $= 15$ V $P=VI$✓ $\underline{16 = (15+3)I}$✓ $I_2 = 0,89$ A✓

(3)

9.2.3 **POSITIVE MARKING FROM Q9.2.1 & Q9.2.2**

OPTION 1
$I_T=0,75+0,89 = 1,64$ A✓ $\varepsilon = I(R+r)$ ✓ $= \underline{(1,64)(10,98+1)}$ ✓ $= 19,65$ V✓
OPTION 2
$I_T=0,75+0,89 = 1,64$ A✓ $\varepsilon = Ve + Ir$ ✓ $= \underline{18 + (1,64)(1)}$ ✓ $= 19,64$ V✓

(4)
[12]

QUESTION 10/*VRAAG 10*

10.1.1 Split ring/Split ring commutator/commutator✓
Splitring/splitring kommutator/kommutator (1)

10.1.2 Anticlockwise/Antikloksgewys✓✓ (2)

10.1.3 Electrical (energy) TO mechanical/kinetic (energy)✓
Elektriese (energie) NA meganiese/kinetiese (energie) (1)

10.2.1

M**arking 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 AC current which dissipates the same amount of energy as an equivalent DC current. ✓✓ *Die WS-stroomsterkte wat dieselfde hoeveelheid energie verbruik as die ekwivalente GS-stroomsterkte.* **ACCEPT/*AANVAAR*** The DC current which dissipates the same amount of energy as an equivalent AC current. *Die GS-stroomsterkte wat dieselfde hoeveelheid energie verbruik as die ekwivalente WS-stroomsterkte.*

(2)

10.2.2

OPTION 1

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

$= \frac{8}{\sqrt{2}}$ ✓

$= 5{,}66$ A

$P_{ave} = I_{rms}^2 R$ ✓

$= (5{,}66)^2(40)$ ✓

$= 1280$ W ✓

OPTION 2

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

$= \frac{8}{\sqrt{2}}$ ✓

$= 5{,}66$ A

$V_{rms} = I_{rms} R$

$= (5{,}66)(40)$

$= 226{,}4$ V

$P_{avg} = V_{rms} I_{rms}$ ✓

$= (226{,}4)(5{,}66)$ ✓

$= 1281{,}42$ W ✓

OR/*OF*

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$= \frac{(226{,}4)^2}{40}$ ✓

$= 1281{,}42$ W ✓

(5)

[11]

QUESTION 11 / VRAAG 11

11.1

M**arking 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 of light needed to eject electrons from a metal/surface. ✓✓
Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.

Note: If referred to frequency: $^{0}/_{2}$

(2)

11.2

Zinc✓
Photons that have shorter wavelengths will have higher frequencies and thus a higher energy. ✓✓
OR/*OF*
photons that have longer wavelengths will have lower frequencies, and thus a lower energy ✓✓
OR/*OF*
$W_0 \propto \frac{1}{\lambda_0}$✓, *h&c constant*✓
OR/*OF*
$f_0 \propto \frac{1}{\lambda_0}$✓, $c = constant$✓
$W_0 \propto f_0$✓, $h = constant$✓
OR/*OF*
W_0 is inversely proportional to λ_0 ✓ (with h and c staying constant✓).

(3)

11.3

Frequency of photon is less than✓ the threshold frequency of the metal✓
Die frekwensie van die foton is minder as die drumpelfrekwensie van die metaal.
OR/*OF*
Energy of the photon is less✓ than the work function of the metal. ✓
Die energie van die foton is minder as die arbeidsfunksie/werksfunksie van die metaal.

(2)

11.4

OPTION 1

$E = W_0 + E_{k(max)}$

$hf = hf_0 + \frac{1}{2}mv_{max}^2$ } Any one ✓

$hf = \frac{hc}{\lambda_0} + E_{k(max)}$

$(6,63\times10^{-34})(5\times10^{14})$✓ $= \frac{(6,63\times10^{-34})(3\times10^{8})}{10\times10^{-7}}$✓ $+ E_{k(max)}$

$E_{k(max)} = 1,33 \times 10^{-19}$ J ✓

OPTION 2

$c = f_0\lambda_0$

$3\times10^{8} = f_0(10\times10^{-7})$

$f_0 = 3\times10^{14}$ Hz

$hf = hf_0 + E_{k(max)}$✓

$(6,63\times10^{-34})(5\times10^{14})$✓ $= (6,63\times10^{-34})(3\times10^{14})$✓ $+ E_{k(max)}$

$E_{k(max)} = 1,33 \times 10^{-19}$ J ✓

(4)

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

11.5.2 Increases/*Toeneem*✓ (1)

[13]

TOTAL/*TOTAAL*: 150