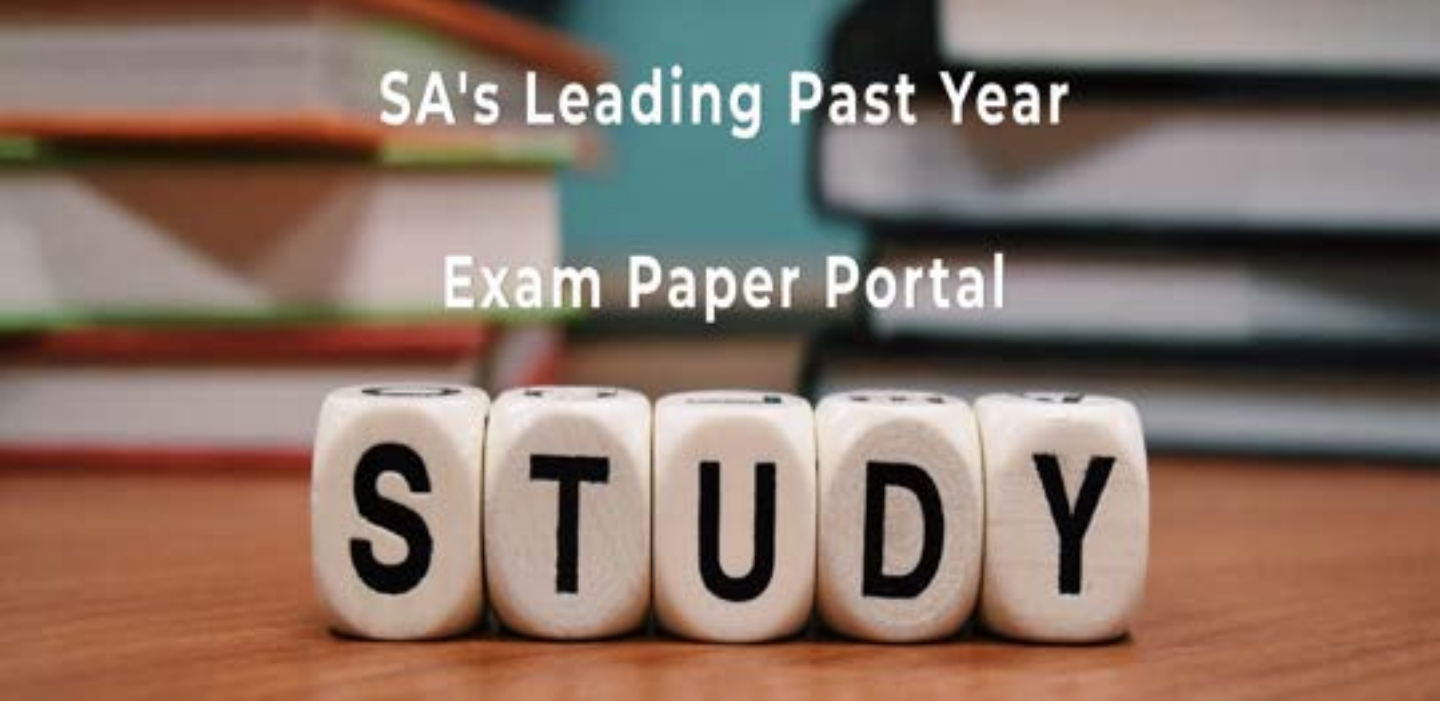


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**GRADE/*GRAAD* 12**

**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*

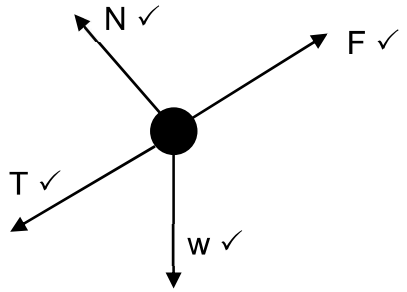
2.1

| |
|---|
| 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.* |

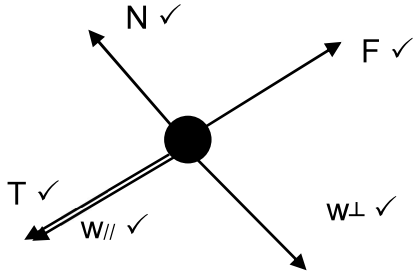
A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net/unbalanced force acts on it. ✓✓
*'n Liggaam sal in 'n toestand van rus of beweging teen 'n konstante snelheid volhard, tensy 'n nie-nul resulterende/netto/ongebalanseerde krag daarop inwerk.*
**OR/*OF***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

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

$= \underline{5(9,8)\sin 30° + 3(9,8)\sin 30°}$ ✓ $\underline{- 16,97}$ ✓ $= 22,23$ 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: |
|---|---|---|
| $F_{net} = ma$<br>$T + (-F_{g//}) + (-f) = ma$ | Any one ✓ | $F_{net} = ma$<br>$F + (-F_{g//}) + (-T) = ma$ |
| $\underline{T - (5\times 9,8)\sin 30° - 4,5}$ ✓ $= \underline{5a}$ ✓ | | $\underline{85 - (3\times 9,8)\sin 30° - T}$ ✓$= 3a$ |
| $T = 5a + 29$ | | $T = 70,3 - 3a$ |

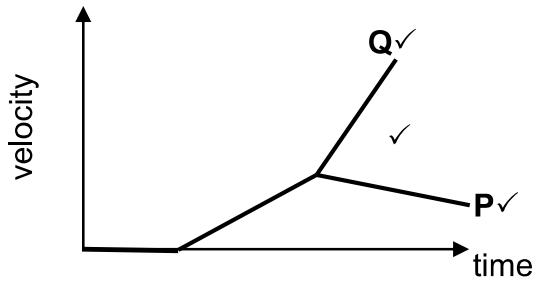
$\therefore 5a + 29 = 70,3 - 3a$

$8a = 41,3$

$a = 5,16$ 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**<br>**Upwards Positive**<br>$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓<br>$-48,5 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓<br>$\Delta t = 3,15$ s ✓ | **Downwards Positive**<br>$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓<br>$48,5 = 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓<br>$\Delta t = 3,15$ s ✓ |
| | **OPTION 2**<br>**POSITIVE MARKING FROM Q3.2.1**<br>**Upwards Positive**<br>$v_f = v_i + a\Delta t$ ✓<br>$-30,83 = 0 + (-9,8)\Delta t$ ✓<br>$\Delta t = 3,15$ s ✓ | **Downwards Positive**<br>$v_f = v_i + a\Delta t$ ✓<br>$30,83 = 0 + (9,8)\Delta t$ ✓<br>$\Delta t = 3,15$ s ✓ |
| | **OPTION 3**<br>**Upwards Positive**<br>$F_{net}\cdot\Delta t = mv_f - mv_i$ ✓<br>$m(-9,8)\Delta t = m(-30,83) - 0$ ✓<br>$\Delta t = 3,15$ s ✓ | **Downwards Positive**<br>$F_{net}\cdot\Delta t = mv_f - mv_i$ ✓<br>$(m\times 9,8)\Delta t = m(30,83) - 0$ ✓<br>$\Delta t = 3,15$ 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** | **Downwards positive** |
|---|---|
| $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ | $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ |
| $-48,5 = v_i(4,78) + \frac{1}{2}(-9,8)(4,78)^2$ ✓ | $48,5 = v_i(4,78) + \frac{1}{2}(9,8)(4,78)^2$ ✓ |
| $v_i = 13,28$ m·s$^{-1}$ ✓ | $v_i = -13,28$ m·s$^{-1}$ |
| | $v_i = 13,28$ m·s$^{-1}$ ✓ |

(5)

**[14]**

## QUESTION 4 / VRAAG 4

| | | |
|---|---|---|
| | **Marking criteria/*Nasienkriteria*** <br> 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> <br> *'n Sisteem waarin die <u>resulterende/netto</u> <u>eksterne krag</u> <u>nul</u> is.* | (2) |

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

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

| | | |
|---|---|---|
| 4.2.3 | **POSITIVE MARKING FROM QUESTION 4.2.1** <br> **<u>OPTION 1</u>** <br> $F_{net} \cdot \Delta t = mv_f - mv_i$ ✓ <br> <u>$F_{net}(0,02) = 0,015(80-560)$</u> ✓ <br> $F_{net} = -360$ <br> $F_{net} = 360$ N✓ East/*Oos*✓ **Accept:** Right/Regs | |
| | **POSITIVE MARKING FROM QUESTION 4.2.2** <br> **<u>OPTION 2</u>** <br> $F_{net} \cdot \Delta t = mv_f - mv_i$ ✓ <br> <u>$F_{net}(0,02) = 3(0,1 - 2,5)$</u> ✓ <br> $(F_{net})_{block} = -360$ <br> $(F_{net})_{bullet} = 360$ 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 ✓
$m(9,8)(0,7) + ½ m(2)^2 = 0 + ½mv^2$ ✓
$v = 4,21 \text{ m·s}^{-1}$ ✓

**OPTION 2**

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

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

(3)

5.3

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

(2)

5.4 **POSITIVE MARKING FROM Q5.2**

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

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

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

**OPTION 2**

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

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

$m = 1,5$ kg | $m = 1,5$ 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 ✓

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

$X = 3,72$ 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** |
|---|---|---|
| $\Delta t$ = 12,5-8✓= 4,5 s | $\Delta t$ = 12,5-8✓= 4,5 s | $\Delta t$ = 12,5-8✓= 4,5 s |
| $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓<br>= (38,82)(4,5) ✓<br>= 174,69 m✓ | $\Delta x = \frac{(v_f + v_i)}{2} \Delta t$ ✓<br>$= \frac{(38{,}82 + 38{,}82)}{2} (4{,}5)$ ✓<br>= 174,69 m✓ | Distance = speed×time✓<br>= (38,82)(4,5) ✓<br>= 174,69 m✓ |

(4)
**[14]**

## QUESTION 7 / VRAAG 7

7.1.1

**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.*

**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** |
|---|---|
| $V_{6\Omega} = IR$<br>$= 0,5(6)$ ✓<br>$= 3$ V<br>$I_{12\Omega} = {}^{V}/_{R} = {}^{3}/_{12} = 0,25$ A✓<br>$I_1 = 0,5+0,25 = 0,75$ A✓ | $R_{6\Omega} : R_{12\Omega}$<br>6 : 12<br>$I_{6\Omega} : I_{12\Omega}$<br>12 : 6<br>0,5 : 0,25✓<br>$I_1 = 0,5+0,25$✓$=0,75$ A✓ |

(3)

9.2.2 **POSITIVE MARKING FROM Q9.2.1**

$V_{20\Omega} = IR$
$= 0,75(20)$
$= 15$ V
$P = VI$✓
$16 = (15+3)I$✓
$I_2 = 0,89$ 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✓
$\varepsilon = I(R+r)$ ✓
$= (1,64)(10,98+1)$ ✓
$= 19,65$ V✓

**OPTION 2**
$I_T = 0,75+0,89 = 1,64$ A✓
$\varepsilon = Ve + Ir$ ✓
$= 18 + (1,64)(1)$ ✓
$= 19,64$ 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

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

(2)

10.2.2

| **OPTION 1** | **OPTION 2** |
|---|---|
| $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓<br>$= \frac{8}{\sqrt{2}}$ ✓<br>= 5,66 A<br><br>$P_{ave} = I_{rms}^2 R$ ✓<br>$= (5,66)^2(40)$ ✓<br>= 1280 W ✓ | $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓<br>$= \frac{8}{\sqrt{2}}$ ✓<br>= 5,66 A<br>$V_{rms} = I_{rms} R$<br>= (5,66)(40)<br>= 226,4 V<br><br>$P_{avg} = V_{rms} I_{rms}$ ✓<br>= (226,4)(5,66) ✓<br>= 1281,42 W ✓<br><br>**OR/*OF***<br><br>$P_{ave} = \frac{V_{rms}^2}{R}$ ✓<br>$= \frac{(226,4)^2}{40}$ ✓<br>= 1281,42 W ✓ |

(5)
**[11]**

## QUESTION 11 / VRAAG 11

11.1

**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 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 $\lambda_0$ ✓ (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**