



# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE  
NASIONALE  
SENIOR SERTIFIKAAT**

**GRADE/GRAAD 12**

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

**FEBRUARY/MARCH/FEBRUARIE/MAART 2013**

**MEMORANDUM**

**MARKS/PUNTE: 150**

**This memorandum consists of 18 pages.  
Hierdie memorandum bestaan uit 18 bladsye.**

## SECTION A

### QUESTION 1/VRAAG 1

- |     |   |                   |
|-----|---|-------------------|
| 1.1 | X-rays/ <i>X-strale</i> ✓                           | (1)               |
| 1.2 | Momentum ✓  | (1)               |
| 1.3 | Huygens (principle)/ <i>Huygens (se beginsel)</i> ✓ | (1)               |
| 1.4 | ampere/ <i>ampère</i> ✓                             | (1)               |
| 1.5 | Isolated/closed ✓<br><i>Geïsoleerde/geslote</i>     | (1)<br><b>[5]</b> |

### QUESTION 2/VRAAG 2

- |      |      |                    |
|------|------|--------------------|
| 2.1  | B ✓✓ | (2)                |
| 2.2  | A ✓✓ | (2)                |
| 2.3  | A ✓✓ | (2)                |
| 2.4  | D ✓✓ | (2)                |
| 2.5  | A ✓✓ | (2)                |
| 2.6  | D ✓✓ | (2)                |
| 2.7  | B ✓✓ | (2)                |
| 2.8  | A ✓✓ | (2)                |
| 2.9  | B ✓✓ | (2)                |
| 2.10 | C ✓✓ | (2)<br><b>[20]</b> |

**TOTAL SECTION A/TOTAAL AFDELING A: 25**

**SECTION B/AFDELING B**

**QUESTION 3/VRAAG 3**

3.1 50 N ✓ downwards/afwaarts✓

(2)

3.2

3.2.1

<p><b><u>OPTION 1/OPSIE 1</u></b>  <b>Downward positive:</b>  <b>Afwaarts positief:</b>  <math>v_f^2 = v_i^2 + 2a\Delta y</math> ✓  <math>\therefore v_f^2 = 0^2 + 2(9,8)(0,8)</math> ✓  <math>\therefore v_f = 3,96 \text{ m}\cdot\text{s}^{-1}</math> ✓ downward /afwaarts✓</p> <p><b>Downward negative:</b>  <b>Afwaarts negatief:</b>  <math>v_f^2 = v_i^2 + 2a\Delta y</math> ✓  <math>\therefore v_f^2 = 0^2 + 2(-9,8)(-0,8)</math> ✓  <math>\therefore v_f = -3,96 \text{ m}\cdot\text{s}^{-1}</math>  <math>\therefore v_f = 3,96 \text{ m}\cdot\text{s}^{-1}</math> ✓ downward /afwaarts✓</p>	<p><b><u>Notes/Aantekeninge</u></b>                   Accept/Aanvaar: g or/of a                  Accept/Aanvaar:  <math>v_f^2 = v_i^2 + 2a\Delta x</math>  <math>v^2 = u^2 + 2as</math></p>
<p><b><u>OPTION 2/OPSIE 2</u></b>  <math>(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}}</math> ✓  <math>mgh + 0 = 0 + \frac{1}{2}mv^2</math>  <math>(9,8)(0,8) \checkmark = \frac{1}{2}v^2</math>  <math>v = 3,96 \text{ m}\cdot\text{s}^{-1}</math> ✓ downward/afwaarts✓</p>	<p><b><u>Notes/Aantekeninge</u></b>                   Accept/Aanvaar:  <math>(U + K)_{\text{top/bo}} = (U + K)_{\text{bottom/onder}}</math></p>

(4)

3.2.2

<p><b>POSITIVE MARKING FROM QUESTION 3.2.1</b>  <b>POSITIEWE NASIEN VAN VRAAG 3.2.1</b>  <b>OPTION 1/OPSIE 1</b>  <b>Downward positive/Afwaarts positief:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math> OR <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> ✓  <math>(F_{\text{app}} + mg)\Delta t = \Delta p</math>  <math>(-50 + (0,2)(9,8)\Delta t) \checkmark = 0,2(-3,43 - 3,96) \checkmark</math>  <math>\therefore \Delta t = 0,03 \text{ s} \checkmark (3 \times 10^{-2} \text{ s})</math>  <b>Downward negative/Afwaarts negatief:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math> OR <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> ✓  <math>(F_{\text{app}} + mg)\Delta t = \Delta p</math>  <math>(50 - (0,2)(9,8)\Delta t) \checkmark = 0,2[3,43 - (-3,96)] \checkmark</math>  <math>\therefore \Delta t = 0,03 \text{ s} \checkmark (3 \times 10^{-2} \text{ s})</math></p>	<p><b>Notes/Aantekeninge:</b>                  Substitution: <math>F_{\text{app}}</math> and <math>v_f</math> must have the same sign.                  Substitusie: <math>F_{\text{app}}</math> en <math>v_f</math> moet dieselfde tekens hê.</p>
<p><b>OPTION 2/OPSIE 2</b>  <b>Downward positive/Afwaarts positief:</b>  <math>F_{\text{net}} = ma</math>  <math>F_{\text{app}} + mg = ma</math>  <math>(-50 + (0,2)(9,8) = 0,2a) \checkmark</math>  <math>\therefore a = -240,2 \text{ m}\cdot\text{s}^{-2}</math>  <math>v_f = v_i + a \Delta t</math>  <math>-3,43 = 3,96 + (-240,2)\Delta t \checkmark</math>  <math>\therefore \Delta t = 0,03 \text{ s} \checkmark (3 \times 10^{-2} \text{ s})</math>  <b>Downward negative/Afwaarts negatief:</b>  <math>F_{\text{net}} = ma</math>  <math>F_{\text{app}} + mg = ma</math>  <math>(50 - (0,2)(9,8) = 0,2a) \checkmark</math>  <math>\therefore a = 240,2 \text{ m}\cdot\text{s}^{-2}</math>  <math>v_f = v_i + a \Delta t</math>  <math>3,43 = -3,96 + (240,2)\Delta t \checkmark</math>  <math>\therefore \Delta t = 0,03 \text{ s} \checkmark (3 \times 10^{-2} \text{ s})</math></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 150px;"> <p>✓ both formulae beide formules</p> </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 150px; margin-top: 100px;"> <p>✓ both formulae beide formules</p> </div>	<p><b>Notes/Aantekeninge</b>                  Accept/Aanvaar:  <math>v = u + at</math>  <math>v_f = v_i + a \Delta t</math></p>

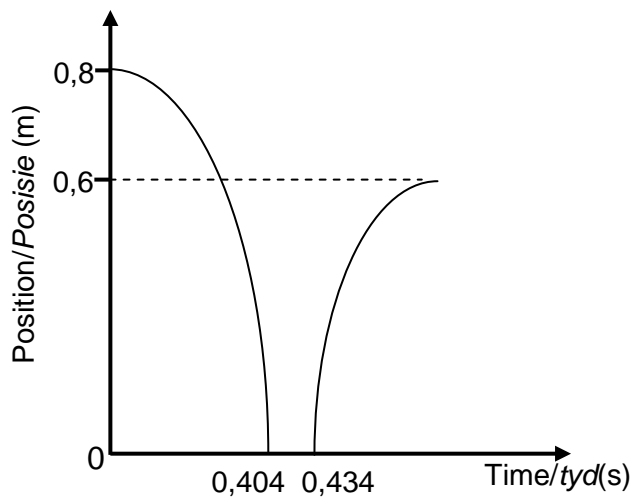
(4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.**  
**POSITIEWE NASIEN VAN VRAAG 3.2.**

**OPTION/OPSIE 1**

**Ground as zero reference and downward negative:**  
**Grond as nulverwysing en afwaarts negatief:**

<b>Criteria for graph/Kriteria vir grafiek:</b>	<b>Marks/Punte</b>
Correct shape (both curves) <i>Korrekte vorm (beide krommes)</i>	✓
Graph starts at $y = 0,8$ m at $t = 0$ s <i>Grafiek begin by <math>y = 0,8</math> m at <math>t = 0</math> s</i>	✓
Second maximum height at $y = 0,6$ m <i>Tweede maksimum by <math>y = 0,6</math> m s</i>	✓
Contact time shown as space on x axis between two curves. <i>Kontaktyd aangetoon as spasie op x-as tussen twee krommes.</i>	✓
Time at which ball leaves the floor shown as $t = 0,434$ s. <i>Tyd wanneer die bal die vloer verlaat getoon as <math>t = 0,434</math> s.</i>	✓

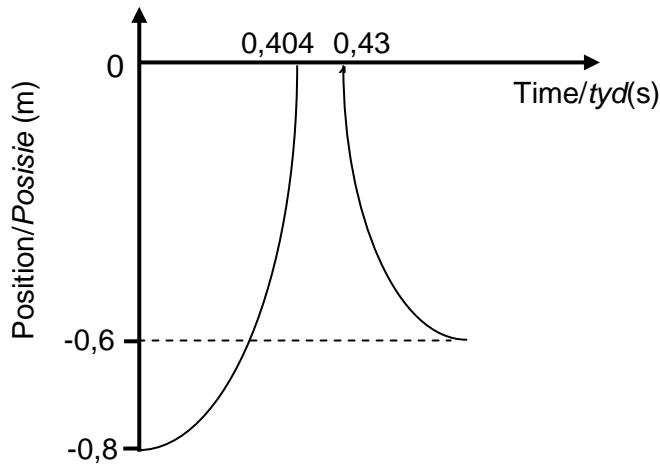


**OPTION/OPSIE 2**

**Ground as zero reference and downward positive:**

**Grond as nulverwysing en afwaarts positief:**

Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Correct shape (both curves) <i>Korrekte vorm (beide krommes)</i>	✓
Graph starts at $y = -0,8$ m at $t = 0$ s <i>Grafiek begin by <math>y = -0,8</math> m at <math>t = 0</math> s</i>	✓
Second maximum height at $y = -0,6$ m <i>Tweede maksimum by <math>y = -0,6</math> m s</i>	✓
Contact time shown as space on x axis between two curves. <i>Kontaktyd aangetoon as spasie op x-as tussen twee krommes.</i>	✓
Time at which ball leaves the floor shown as $t = 0,434$ s. <i>Tyd wanneer die bal die vloer verlaat getoon as <math>t = 0,434</math> s.</i>	✓



(5)  
[15]

**QUESTION 4/VRAAG 4**

4.1 The total (linear) momentum remains constant/is conserved ✓  
 in an isolated/a closed system/the absence of external forces. ✓

*Die totale lineêre momentum bly konstant/behoue ✓  
 in 'n geïsoleerde sisteem/geslote sisteem/die afwesigheid van eksterne  
 kragte. ✓*

**Notes/Aantekeninge:**  
 The mark for 'closed/isolated system' is only awarded if used in conjunction with momentum.  
*Die punt vir 'geslote/geïsoleerde sisteem' word slegs toegeken indien saam met momentum gebruik.*  
**Accept:** The total momentum before a collision equals the total momentum after a collision in a closed system.  
**Aanvaar:** Die totale momentum voor 'n botsing is gelyk aan die totale momentum na 'n botsing in 'n geslote sisteem.

(2)

4.2 **To the right as positive/Na regs as positief:**

$$\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}} \checkmark$$

$$(0,01)(300) \checkmark + (1,99)(0) = (0,01 + 1,99)v_{f2} \checkmark$$

$$\therefore v_{f2} = 1,5 \text{ m}\cdot\text{s}^{-1} \checkmark$$

**To the right as negative/Na regs as negatief:**

$$\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}} \checkmark$$

$$(0,01)(-300) \checkmark + (1,99)(0) = (0,01 + 1,99)v_{f2} \checkmark$$

$$\therefore v_{f2} = -1,5 \text{ m}\cdot\text{s}^{-1}$$

$$\therefore v_{f2} = 1,5 \text{ m}\cdot\text{s}^{-1} \checkmark$$

<p><b>Other formulae/Ander formules:</b>  <math>m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}</math>                  or/of  <math>m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2</math>                  or/of  <math>m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_{f2}</math></p>	<p><b>Notes/Aantekeninge:</b>                  If no formula/principle – Max. <math>\frac{3}{4}</math>                    Indien geen formule/beginsel – Maks. <math>\frac{3}{4}</math></p>
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(4)

4.3 Inelastic/Onelasties ✓  
 Kinetic energy is not conserved./Kinetiese energie bly nie behoue nie. ✓

**OR/OF**

Inelastic/Onelasties ✓  
 Objects stick together/Voorwerpe heg aan mekaar. ✓

**OR/OF**

Inelastic/Onelasties ✓  
 Structural damage to the block./Strukturele skade aan blok. ✓

**OR/OF**

Inelastic/Onelasties ✓  
 There is deformation to the block/bullet./Daar is vervorming van die blok. ✓

**OR/OF**

Inelastic/Onelasties ✓  
 Energy converted to other forms such as sound and heat./Energie word omgeskakel na ander vorms soos klank en hitte. ✓

(2)

4.4 **POSITIVE MARKING FROM QUESTION 4.2.**  
**POSITIEF NASIEN VAN VRAAG 4.2.**

<p><b>Option 1/Opsie 1:</b>  <math>W_{\text{net}} = \Delta K \checkmark</math>  <b>OR / OF</b>  <math>F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2</math>  <math>(8) \Delta x \cos 180^\circ \checkmark = \frac{1}{2} (2)(0^2 - 1,5^2) \checkmark</math>  <math>\therefore \Delta x = 0,28 \text{ m} \checkmark</math></p>	<p><b>Notes/Aantekeninge:</b>                  Accept/Aanvaar.  <math>E_k</math></p>
<p><b>Option 2/Opsie 2:</b>  <math>F_{\text{net}} = ma</math>  <math>\therefore (-8) = 2a \checkmark</math>  <math>\therefore a = -4 \text{ m} \cdot \text{s}^{-2}</math>  <math>v_f^2 = v_i^2 + 2a\Delta x</math>  <math>0^2 = (1,5)^2 + 2(-4) \Delta x \checkmark</math>  <math>\therefore \Delta x = 0,28 \text{ m} \checkmark</math></p>	<p><b>Notes/Aantekeninge:</b>                  Accept/Aanvaar.  <math>v_f^2 = v_i^2 + 2a\Delta y</math>  <math>v^2 = u^2 + 2as</math></p>

$\checkmark$  Both  
 formulae  
 Beide  
 formules

(4)  
**[12]**

**QUESTION 5/VRAAG 5**

5.1 The total mechanical energy remains constant/is conserved ✓  
 in an isolated/closed system. ✓  
*Die totale meganiese energie bly konstant/bly behoue*  
*in 'n geïsoleerde/geslote sisteem*

**OR/OF**

The sum of the potential and kinetic energy remains constant ✓  
 in an isolated/closed system. ✓  
*Die som van die potensiële en kinetiese energies bly konstant*  
*in 'n geïsoleerde/geslote sisteem*

**Notes/Aantekeninge:**

The mark for 'closed/isolated system' is only awarded if used in conjunction with energy.  
*Die punt vir 'geslote/geïsoleerde sisteem' word slegs toegeken indien saam met energie gebruik.*

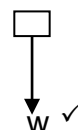
(2)



5.2

5.2.1 **Free-body diagram**  
**Vrye kragtediagram**

**Accept/Aanvaar:** Force diagram/kragtediagram



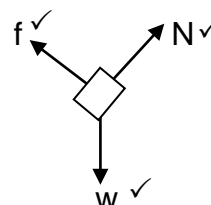
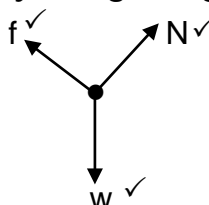
<b>Accepted labels/Aanvaarde benoemings</b>	
W	$F_g/F_w$ /force of Earth on boy/weight/392 N/mg/gravitational force $F_g/F_w$ /krag van Aarde op seun/gewig/392 N/mg/gravitasiekrag

(1)

5.2.2

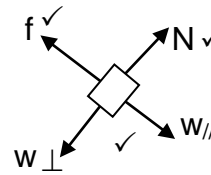
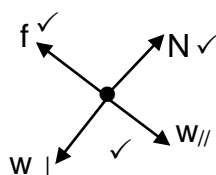
**Free-body diagram**  
**Vrye kragtediagram**

**Accept: Force diagram**  
**Aanvaar: Kragtediagram**



**OR/OF**

**OR/OF**



<b>Accepted labels/Aanvaarde benoemings</b>	
W	$F_g/F_w$ /force of Earth on girl/weight/215,6 N/mg/gravitational force $F_g/F_w$ /krag van Aarde op meisie/gewig/215,6 N/mg/gravitasiekrag
f	$F_{\text{friction}}/F_f$ /friction $F_{\text{wrywing}}/F_f/F_w$ /wrywing
N	$F_N/F_{\text{normal}}$ /normal force/force of slide or surface on girl

(3)

5.3

$$K_i + U_i = K_f + U_f \checkmark \text{ OR } \frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

$$0 + (40)(9,8)(1,5) \checkmark = \frac{1}{2}(40)v_f^2 + 0 \checkmark$$

$$\therefore v_f = 5,42 \text{ m}\cdot\text{s}^{-1} \checkmark$$

**Notes/Aantekeninge:**  
**Accept/Aanvaar**  
 $E_p$  &  $E_k$

(4)

5.4

<p><b>Option 1/Opsie 1</b>  <math>W_{\text{net}} = \Delta K \checkmark</math>  <math>w\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2</math>  <math>mg\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2</math>  <math>(22)(9,8)(3)\cos 60^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark</math>  <math>\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	<p><b>Accept/                  Aanvaar:</b>  <math>\Delta y/\Delta x</math></p>
<p><b>Option 2/Opsie 2</b>  <math>W_{\text{net}} = \Delta K \checkmark</math>  <math>w\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2</math>  <math>mg \sin \theta \Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2</math>  <math>(22)(9,8)\sin 30^\circ(3)\cos 0^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark</math>  <math>\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	<p><b>Accept/                  Aanvaar:</b>  <math>\Delta y/\Delta x</math></p>
<p><b>Option 3/Opsie 3</b>  <math>W_{\text{net}} = \Delta K \checkmark</math>  <math>mgh \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2</math>  <math>(22)(9,8)(1,5)\cos 0^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark</math>  <math>\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	<p><b>Accept/                  Aanvaar</b>  <math>h/\Delta y/\Delta x</math></p>
<p><b>Option 4/Opsie 4</b>  <math>W_{\text{net}} = \Delta K \checkmark</math>  <math>-\Delta U + W_f = \Delta K</math>  <math>-(mgh_f - mgh_i) + W_f = \Delta K</math>  <math>-(0 - (22)(9,8)(1,5)) \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark</math>  <math>\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	<p><b>Accept/                  Aanvaar</b>  <math>h/\Delta y/\Delta x</math></p>

(5)

5.5 Equal to/Gelyk aan  $\checkmark$

(1)

[16]

**QUESTION 6/VRAAG 6**

6.1 The approaching observer (higher f) passes the source at t = 6 s and moves away (lower f) from the source. ✓

*Die naderende waarnemer (hoër f) beweeg verby die bron by t = 6 s en beweeg weg (laer f) van die bron af.*

(1)

6.2

6.2.1

<p><b><u>OPTION 1/OPSIE 1</u></b> Approaching observer: <i>Naderende waarnemer:</i> <math>f_L = \frac{v \pm v_L}{v \pm v_s} f_s</math> <b>OR/OF</b> <math>f_L = \frac{v + v_L}{v} f_s</math> ✓ <math>\therefore 900 \checkmark = \frac{340 + v_L}{340} \checkmark (850) \checkmark</math> <math>\therefore v_L = 20 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	<p><b><u>Notes:</u></b> • Any other Doppler formula, e.g. <math>f_L = \frac{v - v_L}{v - v_s}</math> - Max. <math>\frac{3}{4}</math></p> <p><b><u>Aantekeninge:</u></b> • <i>Enige ander Dopplerformule, bv.</i> <math>f_L = \frac{v - v_L}{v - v_s}</math> - Maks. <math>\frac{3}{4}</math></p>
<p><b><u>OPTION 2 / OPSIE 2</u></b> Observer moving away: <i>Waarnemer beweeg weg:</i> <math>f_L = \frac{v \pm v_L}{v \pm v_s} f_s</math> <b>OR/OF</b> <math>f_L = \frac{v - v_L}{v} f_s</math> ✓ <math>\therefore 800 \checkmark = \frac{340 - v_L}{340} \checkmark (850) \checkmark</math> <math>\therefore v_L = 20 \text{ m}\cdot\text{s}^{-1} \checkmark</math></p>	

(5)

6.2.2

**POSITIVE MARKING FROM QUESTION 6.2.1**  
**POSITIEWE NASIEN van VRAAG 6.2.1**

<p><b><u>Option 1/Opsie 1:</u></b> <math>\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark</math> <math>= (20)(6) \checkmark + \frac{1}{2}(0) \Delta t</math> <math>\therefore \Delta x = 120 \text{ m} \checkmark</math></p>	<p><b><u>Notes/Aantekeninge</u></b> Accept/Aanvaar. <math>s = ut / s = vt</math> <math>s = ut + \frac{1}{2} at^2</math> <math>\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2</math></p>
<p><b><u>Option 2/Opsie 2:</u></b> <math>\Delta x = v \Delta t \checkmark</math> <math>= (20)(6) \checkmark</math> <math>\therefore \Delta x = 120 \text{ m} \checkmark</math></p>	

(3)  
[9]

**QUESTION 7/VRAAG 7**

7.1 B ✓ (1)

7.2 Constructive ✓ interference ✓  
Konstruktiewe interferensie (2)

7.3

7.3.1 

$c = f\lambda$ ✓ $3 \times 10^8 = 4,54 \times 10^{14} \lambda$ ✓ $\therefore \lambda = 6,61 \times 10^{-7} \text{ m}$ ✓	<b>Notes/Aantekeninge</b> Accept/Aanvaar $v = f\lambda$
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 (3)

7.3.2 **POSITIVE MARKING FROM QUESTION 7.3.1**  
**POSITIEWE NASIEN VAN VRAAG 7.3.1**

<p><b>OPTION 1/OPSIE 1</b></p> $\tan \theta = \frac{\frac{1}{2} \text{centralband}}{\text{screen distance}}$ $\therefore \tan \theta = \frac{\frac{1}{2}(0,2)}{1,5}$ ✓ $\therefore \theta = 3,81^\circ$ $\sin \theta = \frac{m\lambda}{a}$ ✓ $\sin 3,81^\circ = \frac{(1)(6,61 \times 10^{-7})}{a}$ ✓ $\therefore a = 9,95 \times 10^{-6} \text{ m}$ ✓	<p><b>Notes/Aantekeninge</b>                  Accept final answer in range:  <math>9,94 \times 10^{-6}</math> to <math>9,95 \times 10^{-6} \text{ m}</math>                  Aanvaar finale antwoorde in die gebied:  <math>9,94 \times 10^{-6}</math> to <math>9,95 \times 10^{-6} \text{ m}</math>                  IF distance is not half of                  central band: Max <math>\frac{4}{6}</math>                  INDIEN afstand nie helfte van                  sentrale band is nie: Maks <math>\frac{4}{6}</math></p>
<p><b>OPTION 2/OPSIE 2</b></p> $\tan \theta = \frac{\frac{1}{2} \text{centralband}}{\text{screen distance}}$ $\therefore \tan \theta = \frac{\frac{1}{2}(0,2)}{1,5}$ ✓ $\therefore \theta = 3,81^\circ$ $\sin \theta = \frac{m\lambda}{a}$ ✓ $\sin(-3,81^\circ) = \frac{(-1)(6,61 \times 10^{-7})}{a}$ ✓ $\therefore a = 9,95 \times 10^{-6} \text{ m}$ ✓	<p><b>Notes/Aantekeninge</b>                  Accept final answer in range:  <math>9,94 \times 10^{-6}</math> to <math>9,95 \times 10^{-6} \text{ m}</math>                  Aanvaar finale antwoorde in die gebied:  <math>9,94 \times 10^{-6}</math> to <math>9,95 \times 10^{-6} \text{ m}</math>                  IF distance is not half of                  central band: Max <math>\frac{4}{6}</math>                  INDIEN afstand nie helfte van                  sentrale band is nie: Maks <math>\frac{4}{6}</math></p>

 (6)

7.4 Decreases/Verminder ✓ (1)  
**[13]**

**QUESTION 8/VRAAG 8**

8.1 Stores (electric) charge/energy. ✓  
Stoor (elektriese) lading/energie.

**OR/OF**

Releases (stored) charge instantly/very fast. ✓  
Stel (gestoorde) lading onmiddellik vry/baie vinnig vry. (1)

8.2 The brightness of the bulb decreases (gradually) ✓  
until it stops glowing/dies.  
*Die helderheid van die gloeilamp verminder (geleidelik).*

**OR/OF**

The bulb glows dimmer ✓  
until it stops glowing/dies.  
*Die gloeilamp gloei flouer totdat dit ophou gloei/uitbrand.* (1)

8.3

8.3.1 0 (V) ✓ (1)

8.3.2 12 V ✓ (1)

8.4 **POSITIVE MARKING FROM QUESTION 8.3.2.**  
**POSITIEWE NASIEN VAN VRAAG 8.3.2.**

8.4.1  $E = \frac{V}{d}$  ✓  
 $= \frac{12}{5,4 \times 10^{-3}}$  ✓  
 $= 2,22 \times 10^3 \text{ V} \cdot \text{m}^{-1}$  ✓ (2 222,22  $\text{V} \cdot \text{m}^{-1}$ ) (3)

8.4.2 **POSITIVE MARKING FROM QUESTION 8.4.1.**  
**POSITIEWE NASIEN VAN VRAAG 8.4.1.**

$E = \frac{F}{q}$  ✓  
 $\therefore 2,22 \times 10^3 = \frac{F}{1,6 \times 10^{-19}}$  ✓  
 $\therefore F = 3,56 \times 10^{-16} \text{ N}$  ✓ (3)

8.5

8.5.1 5,4 mm – 3,8 mm = 1,6 mm ✓ (1)

8.5.2 **POSITIVE MARKING FROM QUESTION 8.4.2 & 8.5.1.**  
**POSITIEWE NASIEN VAN VRAAG 8.4.2 & 8.5.1.**

$$\begin{aligned} W &= F\Delta x \cos\theta \checkmark \\ &= (3,56 \times 10^{-16})(1,6 \times 10^{-3}) \checkmark \cos 0^\circ \checkmark \\ &= 5,69 \times 10^{-19} \text{ J } \checkmark \end{aligned}$$

(4)  
[15]

**QUESTION 9/VRAAG 9**

9.1

9.1.1 Potential difference/*Potensiaalverskil* ✓ (1)

9.1.2 Temperature/*Temperatuur* ✓  
Resistance/*Weerstand* (1)

9.1.3 Current is directly proportional to potential difference. ✓✓  
*Stroom is direk eweredig aan potensiaalverskil*

**OR/OF**

The ratio of potential difference to current is constant. ✓✓  
*Die verhouding van potensiaalverskil tot stroom is konstant.*

**IF/INDIEN:**

Current is proportional to potential difference. ✓  
*Stroom is eweredig aan potensiaalverskil.* (2)

9.1.4

$$\begin{aligned} \text{Gradient/m} &= \frac{0,18 - 0}{0,5 - 0} \checkmark = 0,36 \\ R &= \frac{1}{0,36} = 2,78 \Omega \checkmark \checkmark \end{aligned}$$

**Notes/Aantekeninge:**

Accept any set of correct values from the graph.  
*Aanvaar enige stel waardes vanaf die grafiek.* (4)

9.2

9.2.1

$$\begin{aligned} \frac{1}{R_p} &= \frac{1}{R_1} + \frac{1}{R_2} \checkmark \\ &= \frac{1}{6} + \frac{1}{10} \checkmark \\ \therefore R_p &= 3,75 \Omega \checkmark \end{aligned} \quad (3)$$

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1.**  
**POSITIEWE NASIEN VAN VRAAG 9.2.1.**

<p><b><u>OPTION 2 / OPSIE 2</u></b></p> $V_p = I_{10\Omega} R$ $= 0,6 \times 10 \checkmark$ $= 6 \text{ V}$ $I_p = \frac{V_p}{R_p}$ $= \frac{6}{3,75} \checkmark$ $= 1,6 \text{ A} \checkmark$ <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 150px; margin-top: 20px;"> <math>\checkmark</math> Any one                  Enige een             </div>	<p><b><u>Notes/Aantekeninge</u></b></p> <p>Do not penalise for subscripts.  <i>Moenie penaliseer indien onderskrifte weggelaat is nie.</i></p>
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<p><b><u>OPTION 1/OPSIE 2</u></b></p> $V_{10\Omega} = I_{10\Omega} R$ $= 0,6 \times 10 \checkmark$ $= 6 \text{ V}$ $I_{6\Omega} = \frac{V}{R}$ $= \frac{6}{6} \checkmark$ $= 1 \text{ A}$ $I_{\text{tot}} = 1 + 0,6 = 1,6 \text{ A} \checkmark$ <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 150px; margin-top: 20px;"> <math>\checkmark</math> Any one                  Enige een             </div>	<p><b><u>Notes/Aantekeninge</u></b></p> <p>Do not penalise for subscripts.  <i>Moenie penaliseer indien onderskrifte weggelaat is nie.</i></p>
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(4)

9.2.3 **POSITIVE MARKING FROM QUESTION 9.2.1.**  
**POSITIEWE NASIEN VAN VRAAG 9.2.1.**

$$E = I(R + r) \checkmark$$

$$30 \checkmark = 1,6(3,75 + 5 + 8 + r) \checkmark$$

$$\therefore r = 2 \Omega \checkmark$$

(4)

**[19]**

**QUESTION 10/VRAAG 10**

10.1 Q/split ring commutator/commutator ✓  
Q/splitringkommutator/kommutator (1)

10.2 Replace Q/split ring commutator with slip rings. ✓  
Vervang Q/splitringkommutator met sleepringe. (1)

10.3 AC can be stepped-up at power stations/WS kan by die kragstasie verhoog word ✓  
to reduce energy loss during transmission./om energieverlies tydens transmissie te verminder. ✓ (2)

10.4  
10.4.1

$$I_{\text{rms/wgk}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} \checkmark$$

$$= \frac{0,35}{\sqrt{2}} \checkmark$$

$$\therefore I_{\text{rms/wgk}} = 0,25 \text{ A} \checkmark$$

**Notes/Aantekeninge**  
If subscripts omitted: no mark for formula  
Indien onderskifte weggelaat is: geen punt vir formule

(3)

10.4.2

<p><b><u>OPTION 1/OPSIE 1</u></b></p> $P_{\text{ave/gemid}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$ $60 = \frac{240^2}{R} \checkmark$ $\therefore R = 960 \Omega \checkmark$	<p><b><u>Notes/Aantekeninge</u></b> Do not penalise if subscripts are omitted. Moenie penaliseer indien onderskifte weggelaat is nie</p>
<p><b><u>OPTION 2/OPSIE 2</u></b></p> $P_{\text{ave/gemid}} = I_{\text{rms/wgk}}^2 R \checkmark$ $60 = (0,25)^2 R \checkmark$ $\therefore R = 960 \Omega \checkmark$	
<p><b><u>OPTION 3/OPSIE 3</u></b></p> $R = \frac{V_{\text{rms/wgk}}}{I_{\text{rms/wgk}}} \checkmark$ $= \frac{240}{0,25} \checkmark$ $= 960 \Omega \checkmark$	<p><b><u>Notes/Aantekeninge</u></b> <b>Accept/Aanvaar:</b> <math>R = \frac{V}{I}</math> as formula/formule</p>

(3)  
**[10]**



**QUESTION 11/VRAAG 11**

11.1 Quantum/packet of energy/*Kwantum/pakkie energie* ✓  
 found in light/*In lig gevind* ✓ (2)

11.2

11.2.1

<p><b>OPTION 1/OPSIE 1</b></p> $E = \frac{hc}{\lambda} \checkmark$ $6,9 \times 10^{-19} \checkmark = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda} \checkmark$ $\therefore \lambda = 2,9 \times 10^{-7} \text{ m} \checkmark$		<p><b>Notes/Aantekeninge</b>                  Accept/Aanvaar: <math>v = f\lambda</math></p>
<p><b>OPTION 2 / OPSIE 2</b></p> $E = hf$ $6,9 \times 10^{-19} \checkmark = 6,63 \times 10^{-34} f \checkmark$ $\therefore f = 1,04 \times 10^{15} \text{ Hz}$	<p>✓ Both formulae                  Beide formules</p>	
$c = f\lambda$ $\underline{3 \times 10^8 = 1,04 \times 10^{15} \lambda} \checkmark$ $\therefore \lambda = 2,88 \times 10^{-7} \text{ m} \checkmark$		(5)

11.2.2  $E = W_o + E_k \checkmark$   
 $6,9 \times 10^{-19} = 6,4 \times 10^{-19} + E_k \checkmark$   
 $\therefore E_k = 5 \times 10^{-20} \text{ J} \checkmark$  (3)

11.3

11.3.1 Increases/*Vermeerder* ✓  
 • More photons (packets of energy) strike the surface of the metal per unit time./*Meer fotone (pakkies energie) tref die oppervlakte van die metaal per eenheid tyd.* ✓  
 • More (photo)electrons ejected per unit time./*Meer (foto)elektrone vrygestel per eenheid tyd.* ✓ (3)

11.3.2 Increases/*Vermeerder* ✓  
 • (Photo)electrons are emitted with higher kinetic energy/move faster./*(Foto)elektrone word vrygestel met hoër kinetiese energie/beweeg vinniger.* ✓  
 • Increase in rate of flow of charge./*Same number of charges pass a point in a shorter time./Toename in tempo van vloei van lading/dieselfde aantal lading beweeg verby 'n punt in 'n korter tyd.* ✓ (3)

**[16]**

**TOTAL SECTION B/TOTAAL AFDELING B: 125**  
**GRAND TOTAL/GROOTTOTAAL: 150**