



# 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)**

**NOVEMBER 2012**

**MEMORANDUM**

**MARKS/PUNTE: 150**

**This memorandum consists of 12 pages.  
*Hierdie memorandum bestaan uit 12 bladsye.***

## SECTION A

### QUESTION 1/VRAAG 1

- |     |   |            |
|-----|---|------------|
| 1.1 | Frequency/ <i>Frekwensie</i> ✓                                | (1)        |
| 1.2 | Capacitor/ <i>Kapasitor</i> ✓                                 | (1)        |
| 1.3 | Split ring commutator ✓<br><i>Splitringkommutator</i>         | (1)        |
| 1.4 | Photons/ <i>Fotone</i> ✓                                      | (1)        |
| 1.5 | <u>Relative velocity</u> / <u><i>Relatiewe snelheid</i></u> ✓ | (1)        |
|     |   | <b>[5]</b> |

### QUESTION 2/VRAAG 2

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

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

**SECTION B/AFDELING B**

**QUESTION 3/VRAAG 3**

3.1 Downward/afwaarts ✓ (1)

3.2

3.2.1 **Upwards positive/Opwaarts positief:**

$$\begin{aligned}v_f &= v_i + a\Delta t \checkmark \\ &= 8 \checkmark + (-9,8)(4) \checkmark \\ &= -31,2 \text{ m}\cdot\text{s}^{-1} \\ \therefore v_f &= 31,2 \text{ m}\cdot\text{s}^{-1} \checkmark\end{aligned}$$

**Downwards positive/Afwaarts positief:**

$$\begin{aligned}v_f &= v_i + a\Delta t \checkmark \\ &= -8 \checkmark + (9,8)(4) \checkmark \\ \therefore v_f &= 31,2 \text{ m}\cdot\text{s}^{-1} \checkmark\end{aligned}$$
 (4)

3.2.2

**OPTION 1/OPSIE 1**

**Upwards positive/Opwaarts positief:**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ &= (8)(4) \checkmark + \frac{1}{2}(-9,8)(4)^2 \checkmark \\ &= -46,4 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$\underline{60 - 46,4} \checkmark = 13,6 \text{ m} \checkmark$$

**Downwards positive/Afwaarts positief:**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ &= (-8)(4) \checkmark + \frac{1}{2}(9,8)(4)^2 \checkmark \\ &= 46,4 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$\underline{60 - 46,4} \checkmark = 13,6 \text{ m} \checkmark$$

**OPTION 2/OPSIE 2**

**Upwards positive/Opwaarts positief:**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ &= (27,13) \checkmark (6) \checkmark + \frac{1}{2}(-9,8)(6)^2 \checkmark \\ &= -13,62 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$= 13,62 \text{ m} \checkmark$$

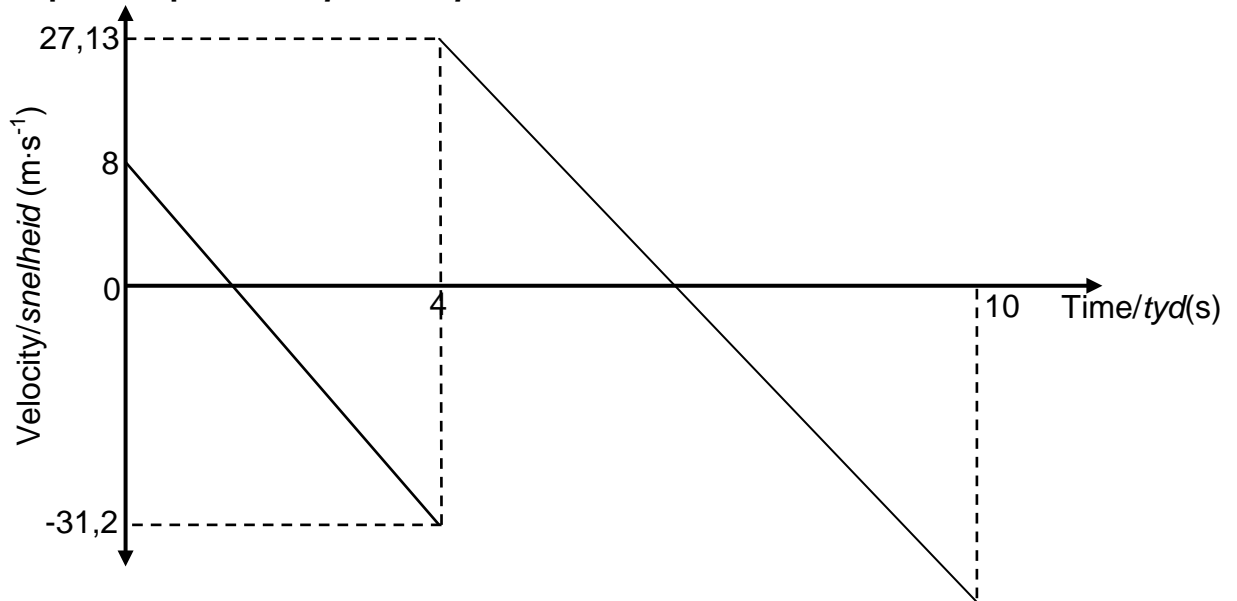
**Downwards positive/Afwaarts positief:**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ &= (-27,13) \checkmark (6) \checkmark + \frac{1}{2}(9,8)(6)^2 \checkmark \\ &= 13,62 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$= 13,62 \text{ m} \checkmark$$
 (5)

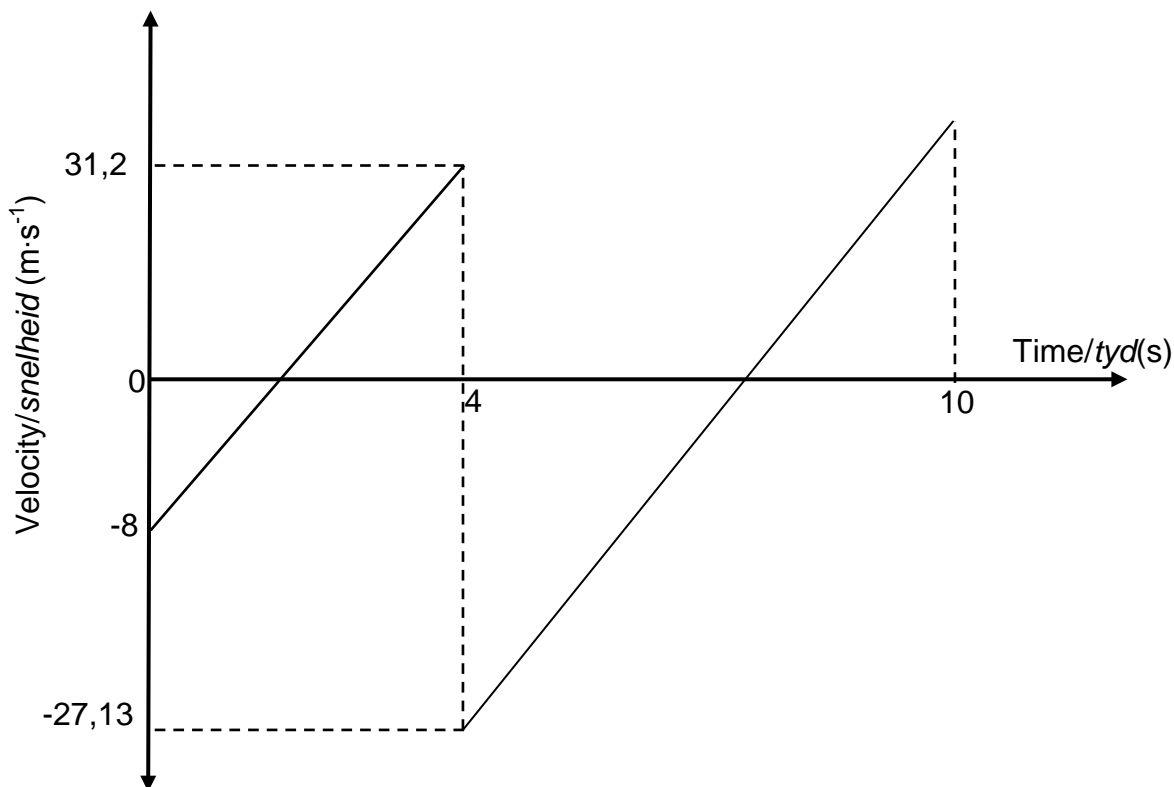
3.3 **OPTION 1/OPSIE 1**  
**Upwards positive/Opwaarts positief:**



<b>Criteria for graph/Kriteria vir grafiek:</b>	<b>Marks/Punte</b>
Shape has two parallel lines with a gradient. <i>Vorm het twee ewewydige lyne met gradient.</i>	✓
First part of graph starts at $v = 8 \text{ m}\cdot\text{s}^{-1}$ at $t = 0 \text{ s}$ <i>Eerste deel van grafiek begin by <math>v = 8 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 0 \text{ s}</math>.</i>	✓
<b>Positive marking from QUESTION 3.2.1:</b> <b>Positiewe nasien vanaf VRAAG 3.2.1:</b> First part of the graph extends below the x axis until $v = -31,2 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$ . <i>Eerste deel van die grafiek verleng onder x-as tot <math>v = -31,2 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 4 \text{ s}</math>.</i>	✓
Graph is discontinuous and object changes direction at 4 s. <i>Grafiek is nie kontinu nie en voorwerp verander van rigting by 4 s.</i>	✓
Second part of graph starts at $v = 27,13 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$ . <i>Tweede deel van grafiek begin by <math>v = 27,13 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 4 \text{ s}</math>.</i>	✓
Second part of graph extends below the x axis until $t = 10 \text{ s}$ . <i>Tweede deel van grafiek verleng onder x-as tot <math>t = 10 \text{ s}</math>.</i>	✓

**OPTION 2/OPSIE 2**

**Upwards negative/Opwaarts negatief:**



<b>Criteria for graph/Kriteria vir grafiek:</b>	<b>Marks Punte</b>
Correct shape as shown (two parallel lines). <i>Korrekte vorm soos aangetoon (twee ewewydige lyne).</i>	✓
First part of graph starts at $v = -8 \text{ m}\cdot\text{s}^{-1}$ at $t = 0 \text{ s}$ <i>Eerste deel van grafiek begin by <math>v = -8 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 0 \text{ s}</math></i>	✓
<b>Positive marking from QUESTION 3.2.1.</b> <b>Positiewe nasien vanaf VRAAG 3.2.1.</b> First part of the graph extends above the x axis until $v = 31,2 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$ . <i>Eerste deel van die grafiek verleng bokant x-as tot <math>v = 31,2 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 4 \text{ s}</math>.</i>	✓
Graph is discontinuous and object changes direction at 4 s. <i>Grafiek is nie kontinu en voorwerp verander van rigting by 4 s.</i>	✓
Second part of graph starts at $v = -27,13 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$ . <i>Tweede deel van grafiek begin by <math>v = -27,13 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 4 \text{ s}</math>.</i>	✓
Second part of graph extends above the x axis until $t = 10 \text{ s}$ . <i>Tweede deel van grafiek verleng bokant x-as tot <math>t = 10 \text{ s}</math>.</i>	✓

(6)  
[16]

**QUESTION 4/VRAAG 4**

4.1  $40 \text{ m}\cdot\text{s}^{-1}$  ✓ east/oos ✓ (2)

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

*Die totale (liniêre) momentum bly konstant/behoue ✓  
in 'n geïsoleerde sisteem/geslote sisteem/ die afwesigheid van eksterne kragte./ indien die impuls van eksterne kragte nul is. ✓* (2)

4.3 **East positive/Oos positief:**

$$\Sigma p_i = \Sigma p_f \checkmark$$
$$m(20) \checkmark + 2m(-20) \checkmark = (m + 2m)v_f \checkmark$$
$$\therefore v_f = -6,67 \text{ m}\cdot\text{s}^{-1}$$

$$\therefore v_f = 6,67 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ west /wes } \checkmark$$

**East negative/Oos negatief:**

$$\Sigma p_i = \Sigma p_f \checkmark$$
$$m(-20) \checkmark + 2m(+20) \checkmark = (m + 2m)v_f \checkmark$$
$$\therefore v_f = 6,67 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ west /wes } \checkmark$$

(6)

4.4

4.4.1 F ✓  
Newton's Third Law of motion/*Newton se Derde Bewegingswet* ✓ (2)

4.4.2  $-\frac{1}{2} a$  /  $\frac{1}{2} a$  ✓  
(Same/*Dieselfe*  $F_{\text{net}}$ ),  $a \propto \frac{1}{m}$  ✓ (2)

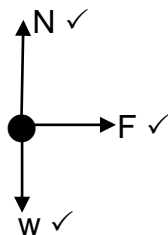
4.4.3 Car driver ✓  
(Car - driver system) have greater acceleration. ✓  
(Car - driver system) have greater change in velocity /greater  $\Delta v$ . ✓

*Motorbestuurder ✓  
(Motor -bestuurder sisteem) het groter versnelling. ✓  
(Motor -bestuurder sisteem) het groter verandering in snelheid / groter  $\Delta v$ . ✓* (3)

[17]

**QUESTION 5/VRAAG 5**

5.1



(3)

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

*Die netto (totale) arbeid verrig (op 'n voorwerp) is gelyk aan die verandering in kinetiese energie (van die voorwerp). ✓*

(2)

5.3

5.3.1  $W_{\text{net}} = \Delta E_k / \Delta K$  ✓ **OR/OF**  $F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$

$F_{\text{net}} (1,02) \cos 180^\circ = \frac{1}{2} (1\,200) (0 - 20^2)$  ✓

$F_{\text{net}} = 235\,294,12 \text{ N}$  ✓  $(2,35 \times 10^5 \text{ N})$

(4)

5.3.2

**OPTION 1 / OPSIE 1**

$F_{\text{net}} \Delta t = m \Delta v$  ✓

$\therefore (-235\,294,12) \Delta t = (1\,200) (0 - 20)$  ✓

$\therefore \Delta t = 0,1 \text{ s}$  ✓  $(0,102 \text{ s})$

**OPTION 2 / OPSIE 2**

$\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$  ✓

$1,02 = \left( \frac{20 + 0}{2} \right) \Delta t$  ✓

$\Delta t = 0,1 \text{ s}$  ✓

(4)

**[13]**

**QUESTION 6/VRAAG 6**

6.1 Frequency/*Frekwensie* ✓

(1)

6.2 There is relative motion between the bird and the bird watcher. ✓

*Daar is relatiewe beweging tussen die voël en die voëlkyker nie.* ✓

(1)

6.3 0,2 m ✓

(1)

6.4

6.4.1  $v = f \lambda$  ✓

$340 = f(0,2)$  ✓

$\therefore f = 1\,700 \text{ Hz}$  ✓

(3)

6.4.2

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$  **OR/OF**  $f_L = \frac{v}{v - v_s} f_s$  ✓

$\therefore 1\,700 = \frac{340}{340 - v_s} (1\,650)$  ✓

$\therefore v_s = 10 \text{ m} \cdot \text{s}^{-1}$  ✓

(5)

**[11]**

**QUESTION 7/VRAAG 7**

7.1 Double slit/Dubbelspleet ✓ (1)

7.2 (Alternate) dark and bright/blue bands. ✓  
Bright / blue bands of equal broadness (width). ✓  
 (Afwissellende) donker en helder/blou bande. ✓  
Helder / blou bande van gelyke breedte. ✓ (2)

7.3

7.3.1  $\tan \theta = \frac{1/2 \text{ central band}}{\text{screen distance}} / \frac{1/2 \text{ sentraleband}}{\text{skermafstand}}$   
 $\therefore \tan \theta = \frac{1/2(0,22)}{1,4}$  ✓  
 $\therefore \theta = 4,49^\circ$  ✓ (3)

7.3.2

<b>OPTION 1/OPSIE 1:</b>	<b>OPTION 2/OPSIE 2:</b>
$\sin \theta = \frac{m\lambda}{a}$ ✓	$\sin \theta = \frac{m\lambda}{a}$ ✓
$\sin 4,49^\circ = \frac{(1)(470 \times 10^{-9})}{a}$	$\sin (-4,49^\circ) = \frac{(-1)(470 \times 10^{-9})}{a}$
$\therefore a = 6 \times 10^{-6} \text{ m} \checkmark (6\ 003,67 \text{ nm})$	$\therefore a = 6 \times 10^{-6} \text{ m} \checkmark (6\ 003,67 \text{ nm})$

(5)

7.4  $\lambda_{\text{red light}} > \lambda_{\text{blue light}}$  ✓  
 (Degree of) diffraction/sin  $\theta / \theta \propto$  wavelength ( $\lambda$ ) ✓  
 $\lambda_{\text{rooilig}} > \lambda_{\text{bloulig}}$  ✓  
 Diffraksie  $\propto$  golflengte ( $\lambda$ ) ✓ (2)

**[13]**



**QUESTION 8/VRAAG 8**

8.1  $R = \frac{V}{I} \checkmark$   
 $1\ 000 = \frac{12}{I} \checkmark$   
 $\therefore I = 0,01\ A \checkmark$  (3)

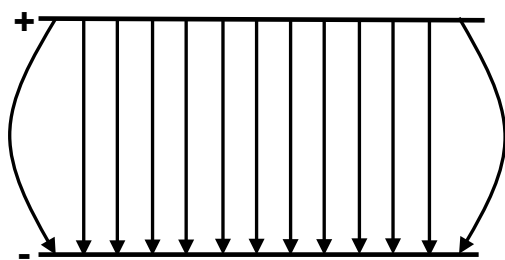
8.2  $12\ V \checkmark$  (1)

8.3  $C = \frac{Q}{V} \checkmark$   
 $120 \times 10^{-6} = \frac{Q}{12} \checkmark$   
 $\therefore Q = 1,44 \times 10^{-3}\ C \checkmark$  (3)

8.4  
 8.4.1 Decreases/*Verminder*  $\checkmark$  (1)

8.4.2 Increases/*Vermeerder*  $\checkmark$  (1)

8.5  
 8.5.1



Criteria for sketch:/ <i>Kriteria vir skets:</i>	Marks/ <i>Punte</i>
Parallel lines equally spaced. <i>Parallele lyne eweredig gespaseer.</i>	$\checkmark$
Direction from positive plate towards negative plate. (Polarity of plates must be indicated) <i>Rigting vanaf positiewe plaat na negatiewe plaat. (Polariteit van plate moet aangedui word)</i>	$\checkmark$
Field curved at the ends of the plates. <i>Veld gekrom aan einde van die plate.</i>	$\checkmark$

(3)

8.5.2  $E = \frac{V}{d} \checkmark$   
 $= \frac{12}{12 \times 10^{-3}} \checkmark$   
 $\therefore E = 1\ 000\ V \cdot m^{-1} \checkmark$  (3)

**[15]**

**QUESTION 9/VRAAG 9**

9.1

9.1.1 
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$= \frac{1}{60} + \frac{1}{60} \checkmark$$

$$\therefore R_p = 30 \Omega \checkmark$$
 (3)

9.1.2	<p><b><u>OPTION 1 / OPSIE 1</u></b>  <math>R_{ext} = 30 + 25 = 55 \Omega \checkmark</math>  <math>Emf/emk = I(R + r) \checkmark</math>  <math>\therefore 12 \checkmark = I(55 + 1,5) \checkmark</math>  <math>\therefore I = 0,21 A \checkmark</math></p>	<p><b><u>OPTION 2 / OPSIE 2:</u></b>  <math>R_{tot} = (30 + 25) \checkmark + 1,5 = 56,5 \Omega</math>  <math>V = IR \checkmark</math>  <math>12 \checkmark = I(56,5) \checkmark</math>  <math>\therefore I = 0,21 A \checkmark</math></p>
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(5)

9.1.3	<p><b><u>OPTION 1/OPSIE 1</u></b>  <math>V = IR \checkmark</math>  <math>= (0,21)(30) \checkmark</math>  <math>= 6,3 V \checkmark</math></p>	<p><b><u>OPTION 2/OPSIE 2</u></b>  <math>V = IR \checkmark</math>  <math>= (0,105)(60) \checkmark</math>  <math>= 6,3 V \checkmark</math></p>
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(3)

9.2

9.2.1  $1,5 V \checkmark$  (1)

9.2.2 
$$\text{gradient/m} = \frac{\Delta V}{\Delta I}$$

$$= \frac{0,65 - 1,5 \checkmark}{1,0 - 0 \checkmark}$$

$$= - 0,85 \Omega \checkmark$$
 (3)

9.2.3 Internal resistance  $\checkmark \checkmark$   
Interne weerstand (2)

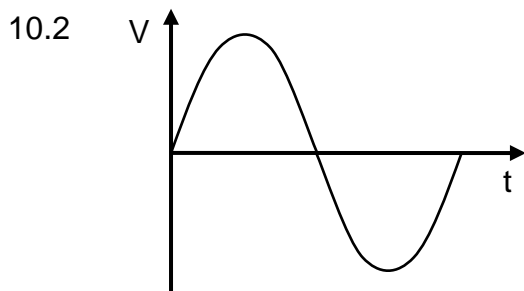
9.2.4 Decreases/Verminder  $\checkmark$   
 When I increases/*Wanneer I toeneem:*  
 "Lost volts"/ Ir increases./"*Verlore volts*"/*Ir neem toe.*  $\checkmark$   
 $V_{ext} = \underline{emf - Ir \text{ decreases.}} \checkmark / V_{ext} = \underline{emk - Ir \text{ neem af.}}$  (3)

**[20]**

**QUESTION 10/VRAAG 10**

10.1 AC /WS ✓

(1)



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Correct shape as shown; accept more than one cycle. <i>Korrekte vorm soos aangetoon; aanvaar meer as een siklus.</i>	✓✓
If no/wrong labels: minus 1 mark <i>Indien geen/verkeerde byskifte: minus 1 punt</i>	

(2)

10.3

<b>OPTION 1/OPSIE 1</b>	<b>OPTION 2 / OPSIE 2</b>
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$ $= \frac{30 \times 10^3}{\sqrt{2}} \checkmark$ $= 2,12 \times 10^4 \text{ V}$ $P_{ave} = V_{rms} I_{rms} / P_{gem.} = V_{wgk} I_{wgk} \checkmark$ $4,45 \times 10^9 \checkmark = (2,12 \times 10^4) I_{rms/wgk}$ $\therefore I_{rms/wgk} = 2,10 \times 10^5 \text{ A} \checkmark$	$P_{ave} = V_{rms} I_{rms} / P_{gem.} = V_{wgk} I_{wgk}$ $P_{ave/gem.} = \frac{V_{max} I_{rms}}{\sqrt{2}} / \frac{V_{maks} I_{wgk}}{\sqrt{2}} \checkmark \checkmark$ $4,45 \times 10^9 \checkmark = \frac{(30 \times 10^3) I_{rms/wgk}}{\sqrt{2}} \checkmark$ $\therefore I_{rms/wgk} = 2,10 \times 10^5 \text{ A} \checkmark$

(5)

10.4 Less loss in (electrical) energy (as heat). ✓

Minder verlies aan (elektriese) energie (as hitte). ✓

(1)

[9]

**QUESTION 11/VRAAG 11**

- 11.1
- 11.1.1 Kinetic energy / *Kinetiese energie* ( $E_k$ ) ✓ (1)
- 11.1.2 Frequency / *Frekwensie* ✓ (f) (1)
- 11.1.3 (Type of) metal ✓  
(*Soort*) metaal ✓ (1)
- 11.2 The minimum frequency needed to emit electrons ✓  
from (the surface of) a metal. ✓  
*Die minimum frekwensie benodig om elektrone vry te stel*  
*vanaf (die oppervlak van) 'n metaal.* (2)
- 11.3  $9 \times 10^{14}$  Hz ✓ (1)
- 11.4
- $E = W_0 + E_k$  } ✓ Any one / *Enige een*  
 $hf = hf_0 + E_k$  }
- $(6,63 \times 10^{-34})(14 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(9 \times 10^{14}) \checkmark + E_k$
- $\therefore E_k = 3,32 \times 10^{-19} \text{ J} \checkmark (3,31 \times 10^{-19} \text{ J})$  (4)
- 11.5 Remains the same / *Bly dieselfde* ✓ (1)

[11]

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