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 2013

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 16 pages.
Hierdie memorandum bestaan uit 16 bladsye.

SECTION A

QUESTION 1/*VRAAG 1*

1.1 Acceleration / *Versnelling* ✓ (1)

1.2 Wavelength / *Golflengte* ✓ (1)

1.3 Electric field / *Elektriese veld* ✓ (1)

1.4 Gamma / γ (rays) / *Gamma / γ (strale)* ✓ (1)

1.5 Threshold (frequency) / *Drumpel(frekwensie)* ✓ (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 B ✓✓ (2)

2.2 B ✓✓ (2)

2.3 C ✓✓ (2)

2.4 D ✓✓ (2)

2.5 C ✓✓ (2)

2.6 C ✓✓ (2)

2.7 D ✓✓ (2)

2.8 B ✓✓ (2)

2.9 D ✓✓ (2)

2.10 B ✓✓ (2)
[20]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1 $15\ m\cdot s^{-1}$ ✓ (1)

3.2

OPTION 1/*OPSIE 1*

Inelastic ✓

The speed/velocity at which the ball leaves the floor is less / different than that at which it strikes the floor. OR The speed/velocity of the ball changes during the collision. ✓

Therefore the kinetic energy changes/is not conserved. ✓

Onelasties

Die spoed/snelheid waarteen die bal die vloer verlaat is kleiner / verskillend as dit waarteen dit die vloer tref. OF Die spoed / snelheid van die bal verander gedurende die botsing.

Die kinetiese energie verander/bly nie behoue nie.

OPTION 2/*OPSIE 2*

Collision is inelastic. ✓

Botsing is onelasties

$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$= \frac{1}{2}(0,15)(15)^2 - \frac{1}{2}(0,15)(20)^2$ ✓

$= -13,13\ J$

$K_i \neq K_f$ / $\Delta K \neq 0$ ✓

OPTION 3/*OPSIE 3*

Collision is inelastic.

Botsing is onelasties. ✓

$K_f = \frac{1}{2}mv_f^2$

$= \frac{1}{2}(0,15)(15)^2$

$= 16,88\ J$

$K_i = \frac{1}{2}mv_i^2$

$= \frac{1}{2}(0,15)(20)^2$ ✓

$= 30\ J$

$K_f \neq K_1$ / $\Delta K \neq 0$ ✓ (3)

3.3

OPTION 1/*OPSIE 1*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(20)^2$ ✓ $= (10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 15,31\ m$ ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$ ✓

$F_{net}\Delta y\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$

$m(9,8)\Delta y\cos 0°$ ✓ $= \frac{1}{2}m(20^2 - 10^2)$ ✓

$\Delta y = 15,31\ m$ ✓

OPTION 3/*OPSIE 3*

$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$

$(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{bottom}$ } ✓any one/*enige een*

$m(9,8)h + \frac{1}{2}m(10)^2$ ✓ $= m(9,8)(0) + \frac{1}{2}m(20)^2$ ✓

$h = 15,31\ m$ ✓

OPTION 4/*OPSIE 4*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$ ✓

$\therefore \Delta t = 1,02\ s$

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= (10)(1,02)$ ✓ $+ \frac{1}{2}(9,8)(1,02)^2$ ✓

$\therefore \Delta y = 15,3\ m$ ✓

OPTION 5/*OPSIE 5*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$ ✓

$\therefore \Delta t = 1,02$ s

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

$\Delta y = \left(\frac{10+20}{2}\right)$ ✓(1,02) ✓

$\therefore \Delta y = 15,3$ m ✓

OPTION 6/*OPSIE 6*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$ ✓

$\therefore \Delta t = 1,02$ s

Height = area between graph & *t* axis

Hoogte = opperv. tussen grafiek & t-as

= ½(sum ‖ sides)$h_{\perp}$

= ½(10 + 20) ✓1,02 ✓

= 15,3 m✓

= 15,3 m ✓

OPTION 7/*OPSIE 7*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$ ✓

$\therefore \Delta t = 1,02$ s

Height = area between graph & *t* axis

Hoogte = opperv. tussen grafiek & t-as

= lb + ½bh = ½(10 + 20)1,02

= (1,02)(10) ✓ + ½(1,02)(10) ✓

= 15,3 m ✓

OPTION 8/*OPSIE 8*

$F_{net} = ma$

$mg = m\left(\frac{v_f^2 - v_i^2}{2\Delta x}\right)$ ✓

(0,15)(9,8) ✓ =(0,15) $\left(\frac{20^2 - 10^2}{2\Delta x}\right)$ ✓

$\Delta x = 15,31$ m✓ (4)

3.3.2 $F_{net}\Delta t = \Delta p$

$F_{net}\Delta t = mv_f - mv_i$ ✓Any one/*Enige een*

$\Delta p = mv_f - mv_i$

= 0,15(-15 – 20) ✓

= - 5,25 N·s (or - 5,25 kg·m·s^{-1})

Magnitude/*Grootte* = 5,25 N·s or 5,25 kg·m·s^{-1}✓ (3)

3.3.3

OPTION 1 / *OPSIE 1*

Displacement from floor to max. height/ *Verplasing van vloer na maks. hoogte*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(0)^2 = (-15)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = -11,48$ m

Total displacement / *Totale verplasing*

= - 11,48 + 15,3 ✓

= 3,82 m ✓ / 3,83 m

OPTION 2 / *OPSIE 2*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

$\Delta y = v_i\Delta t + ½ a\Delta t^2$

$= (-15)(1,53) + ½ (9,8)(1,53)^2$ ✓

$= -11,48$ m

Total displacement / *Totale verplasing*

= - 11,48 + 15,3 ✓

= 3,82 m ✓

OPTION 3 / *OPSIE 3*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

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

$= \left(\frac{0 + (-15)}{2}\right)(1,53)$ ✓

$= -11,48$ m

Total displacement / *Totale verplasing*

= - 11,48 + 15,3 ✓

= 3,82 m ✓

OPTION 4 / *OPSIE 4*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

Area = ½ bh

= ½ (1,53)(-15) ✓

= -11,48 m

Total displacement / *Totale verplasing*

= - 11,48 + 15,3 ✓

= 3,82 m ✓

OPTION 5 / *OPSIE 5*

$E_{M(initial)} = E_{M(final)}$
$(E_p + E_k)_{initial} = (E_p + E_k)_{final}$
$(mgh + ½ mv^2)_{initial} = (mgh + ½ mv^2)_{final}$
✓Any one /*Enige een*

$(0,15)(9,8)(0) + ½ (0,15)(15)^2 = (0,15)(9,8)h + ½ (0,15)(0)^2$ ✓
h = 11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓ = 3,83 m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta K$ ✓
$F_{net}\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$
$m(9,8)\Delta y\cos 180° = ½ m(0^2 - 15^2)$ ✓
Δy = 11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓
= 3,83 m ✓

OPTION 7/*OPSIE 7*

$F_{net} = ma$

$mg = m\left(\frac{v_f^2 - v_i^2}{2\Delta x}\right)$ ✓

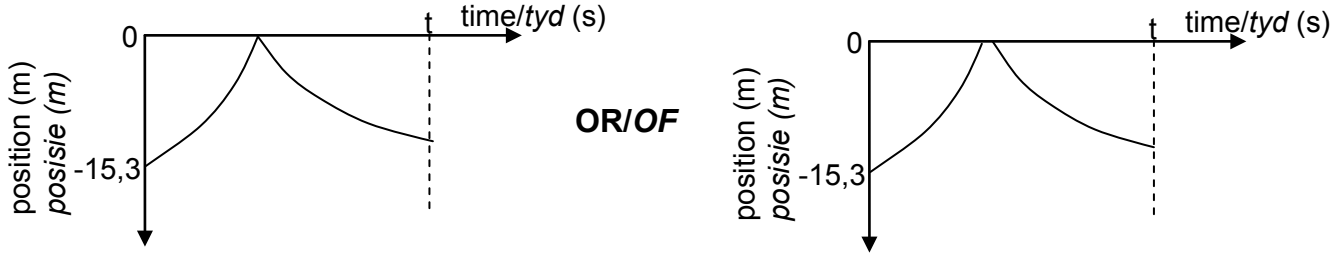
$(0,15)(9,8) = (0,15)\left(\frac{0^2 - (-15)^2}{2\Delta x}\right)$ ✓

Δx = -11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓
= 3,83 m ✓

(4)

3.4



Marking criteria for graph:/*Nasienriglyne vir grafiek:*	
Correct shape as shown for first part./*Korrekte vorm soos aangetoon vir eerste deel.*	✓
Correct shape as shown for the second part up to t / 2,55 s. *Korrekte vorm soos aangetoon vir tweede deel t / 2,55 s.*	✓
Graph starts at -15,3 m at t = 0 s./*Grafiek begin by -15,3 m by t = 0 s.*	✓
Maximum height after bounce at time *t* / 2,55 s./*Maksimum hoogte na bons by tyd t./ 2,55 s.* Maximum height after bounce less than 15,3 m./*Maksimum hoogte na bons kleiner as 15,3 m.*	✓

(4)
[19]

QUESTION 4/*VRAAG 4*

4.1 West / *Wes* ✓ (1)

4.2 (Newton's) Third Law (of Motion) ✓
When object A exerts a force on object B,
object B exerts a force equal in magnitude on object A✓, but opposite in direction. ✓

(Newton) se Derde (Bewegings)wet
Wanneer voorwerp A 'n krag op voorwerp B uitoefen,
oefen voorwerp B 'n krag van gelyke grootte op voorwerp A, maar in die teenoorgestelde rigting. (3)

4.3

OPTION 1/ *OPSIE 1* **East as positive/Oos *as positief:*** $\Sigma p_i = \Sigma p_f$ ✓ 0 ✓ $= (60)v_f + (5)(4)$ ✓ $\therefore v_f = -0,33$✓ $\therefore v_f = 0,33\ m\cdot s^{-1}$✓	**OPTION 2/*OPSIE 2*** **East as positive/*Oos as positief:*** $\Delta p_A = -\Delta p_B$ ✓ $(60)v_f$ ✓$- 0 = -[(5)(4) - 0]$ ✓ $\therefore v_f = -0,33$ ✓ $\therefore v_f = 0,33\ m\cdot s^{-1}$✓
West as positive/*Wes as positief:* $\Sigma p_i = \Sigma p_f$ ✓ 0 ✓ $= (60)v_f + (5)(-4)$ ✓ $\therefore v_f = 0,33\ m\cdot s^{-1}$✓✓	**West as positive/*Wes as positief:*** $\Delta p_A = -\Delta p_B$ ✓ $(60)v_f$ ✓$- 0 = -[(5)(-4) - 0]$ ✓ $\therefore v_f = 0,33\ m\cdot s^{-1}$✓✓
OPTION 3/ *OPSIE 3* **East as positive/Oos *as positief*** $F_{BP} = -F_{PB}$✓ $m_Ba_B = -m_Pa_P$ $m_B\left(\frac{v_{Bf}-v_{Bi}}{\Delta t}\right) = -m_P\left(\frac{v_{Pf}-v_{Pi}}{\Delta t}\right)$ $(60)\left(\frac{v_{Bf}-0}{\Delta t}\right)$✓$= -(5)\left(\frac{4-0}{\Delta t}\right)$✓ $v_{Bi} = -0,33\ m\cdot s^{-1}$✓ $= 0,33\ m\cdot s^{-1}$✓	**OPTION 4/ *OPSIE 4*** **West as positive/*Wes as positief*** $F_{BP} = -F_{PB}$✓ $m_Ba_B = -m_Pa_P$ $m_B\left(\frac{v_{Bf}-v_{Bi}}{\Delta t}\right) = -m_P\left(\frac{v_{Pf}-v_{Pi}}{\Delta t}\right)$ $(60)\left(\frac{v_{Bf}-0}{\Delta t}\right)$✓$= -(5)\left(\frac{-4-0}{\Delta t}\right)$✓ $v_{Bi} = 0,33\ m\cdot s^{-1}$✓✓

(5)

4.4
4.4.1 Increases / *Verhoog* ✓ (1)

4.4.2 Increases / *Verhoog* ✓

- ∆p package increases, thus ∆p boy increases. ✓
  ∆p pakkie vermeerder, dus ∆p seun vermeerder.
- For the same mass of boy, v will be greater. ✓
  Vir dieselfde massa van die seun sal v groter wees.

OR/*OF*

Increases / *Verhoog*✓

From the equation in QUESTION 4.3: $-m_A v_{Af} = m_B v_{Bf}$

Vanaf die vegelyking in VRAAG 4.3: $-m_A v_{Af} = m_B v_{Bf}$

- If mass of package/B doubles/increases, the momentum of the boy / A doubles / increases.✓
  Indien die massa van pakkie / B verdubbel / toeneem, verdubbel / vermeerder die momentum van die seun / A
- For same mass of boy / A, the velocity of boy / A doubles/increases.✓
  Vir dieselfde massa van die seun / A, verdubbel/vermeerder die snelheid van die seun /A.

OR/*OF*

Increases / *Verhoog* ✓

$-m_B v_{Bf} = m_p v_{pf}$

$v_B = \frac{-m_p v_{pf}}{m_B}$ ✓ for same m_B, if m_P doubles, ✓ then v_B doubles

(3)
[13]

QUESTION 5/*VRAAG 5*

5.1 The total mechanical energy remains constant / is conserved ✓
in a closed / isolated system / in absence of external forces /non-conservative forces. ✓
Die totale meganiese energie in bly konstant / bly behoue
in 'n geslote / geïsoleerde sisteem /in afwesigheid van eksterne kragte /nie-konserwatiewe kragte.

OR/*OF*

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

OR/*OF*

When the work done on an object by the non-conservative forces is zero✓,
the total mechanical energy is conserved. ✓
Wanneer die arbeid deur die nie-konserwatiewe kragte op 'n voorwerp verrig nul is, bly die totale meganiese energie behoue. (2)

5.2

OPTION 1/*OPSIE 1*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½\ mv^2)_X = (mgh + ½\ mv^2)_Y$
✓Any one/*Enige een*

$\underline{5(9,8)(5)} + ½(5)(0^2)$✓$= \underline{(5)(9,8)(1)} + ½(5)v_f^2$ ✓
$v = 8,85\ m\cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½\ mv^2)_X = (mgh + ½\ mv^2)_Y$
✓ Any one/*Enige een*

$\underline{5(9,8)(4)} + ½(5)(0^2)$✓$= \underline{(5)(9,8)(0)} + ½(5)v_f^2$ ✓
$v = 8,85\ m\cdot s^{-1}$ ✓

(4)

5.3 Weight / gravitational (force) / (force of) gravity ✓
Gewig / Gravitasie(krag)
Normal force / *Normaalkrag* ✓ (2)

5.4 Z to/*na* Y ✓ (1)

5.5

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta y\cos 0° + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(5)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 0^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta x\cos(90^o - \theta) + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$mg\Delta x\sin\theta + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$mg\Delta x\left(\frac{1}{\Delta x}\right) + f\Delta x\cos 180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 5/*OPSIE 5*

$W_{net} = \Delta K$ ✓
$W_{w||} + W_f = ½m(v_f^2 - v_i^2)$
$mgsin\theta\Delta xcos\theta + f\Delta xcos\theta = ½ m(v_f^2 - v_i^2)$
$mg\left(\frac{1}{\Delta x}\right)\Delta xcos0° + f\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
(5)(9,8) ✓ + (10)Δx(-1) ✓ = ½(5)($4^2 - 8,85^2$) ✓
Δx = 20,48 m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta K$ ✓
$F_{net}\Delta xcos\theta = ½m(v_f^2 - v_i^2)$
$(10 - 49sin\theta)\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
$(10 - 49\left(\frac{1}{\Delta x}\right))$✓$\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
$(10\Delta x - 49)(-1)$✓ = ½(5)($4^2 - 8,85^2$) ✓
Δx = 20,48 m

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E_p + \Delta E_k$✓
$f\Delta xcos\theta = (mgh_f - mgh_i) + (½ mv_f^2 - ½ mv_i^2)$
$(10)\Delta xcos180°$ ✓= [0 – (5)(9,8)(1)] ✓ + [½ $(5)(4)^4$ – ½ $(5)(8,85)^2$✓
Δx = 20,48 m✓ (5)

5.6 Equal to / *Gelyk aan* ✓ (1)
[15]

QUESTION 6/*VRAAG 6*

6.1 Doppler flow meter / *Dopplervloeimeter* ✓ (1)

6.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

985 ✓ = $\frac{v}{(v - 10,6)}$ ✓(954,3) ✓
v = 340,1 m·s^{-1} ✓ (5)

6.3 Decreases / *Afneem* ✓ (1)

6.4 For a constant velocity of sound / speed ✓
if the frequency increases, λ decreases. ✓
Vir 'n konstante snelheid van klank /spoed,
as die frekwensie toeneem neem λ af.

OR/*OF*

$\lambda \alpha \frac{1}{f}$ or $f \alpha \frac{1}{\lambda}$ ✓ at constant velocity/speed / *by konstante snelheid/spoed..* ✓ (2)
[9]

QUESTION 7/*VRAAG 7*

7.1 The bending of waves around obstacles / corners / through an opening / aperture ✓✓
Die buiging van golwe om versperrings / hoeke / deur 'n opening.

OR/*OF*
The spreading of waves around the edge of a barrier/through an opening/aperture.
Die uitspreiding van golwe om die kant van 'n versperring/deur 'n opening. (2)

7.2 P ✓ (1)

7.3

7.3.1 Broadness of the central bright band / diffraction pattern / angle of diffraction / degree of diffraction / sin θ / position of the first minimum ✓
Breedte van die sentrale helderband / diffraksiepatroon/hoek van diffraksie / mate van diffraksie / sin θ / posisie van die eerste minimum (1)

7.3.2

Criteria for investigative question/K*riteria vir ondersoekende vraag*:	
Dependent and independent variables correctly identified. *Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.*	✓
Question about the relationship between the independent and dependent variables correctly formulated. Vraag oor die verwantskap tussen die *afhanklike en onafhanklike veranderlikes korrek geformuleer.*	✓

Example/*Voorbeeld*:
What is the relationship between the broadness of the central band and the wavelength (of light used)?
Wat is die verwantskap tussen die breedte van die sentrale band en die golflengte (van die lig)? (2)

7.4

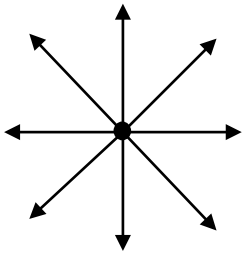
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\sin\theta = \frac{m\lambda}{a}$ ✓ $\sin\theta = \frac{(2)(410\times10^{-9})}{5\times10^{-6}}$ ✓ ✓ ✓ $\therefore\theta = 9{,}44°$ ✓ or $9{,}21°$	$\sin\theta = \frac{m\lambda}{a}$ ✓ $\sin\theta = \frac{(-2)(410\times10^{-9})}{5\times10^{-6}}$ ✓ ✓ ✓ $\therefore\theta = -9{,}44°$ ✓ or $-9{,}21°$

(5)

7.5 Light (bright) and dark bands.✓
Light /dark bands of equal width. ✓
Lig (helder) en donker bande eweredig gespasieer.
Helder / donker bande van gelyke breedte /wydte. (2)
[13]

QUESTION 8/*VRAAG 8*

8.1



Criteria for sketch:/*Kriteria vir skets:*	
Correct shape - field lines radially around charge. *Korrekte vorm – veldlyne radiaal uitwaarts.*	✓
Direction of field lines away from charge. *Rigting van veldlyne weg van lading af.*	✓

(2)

8.2 Non-uniform / *Nie-uniform* ✓ (1)

8.3
$$E = \frac{kQ}{r^2} \checkmark$$
$$= \frac{(9\times10^{9})(16\times10^{-6})}{(0,12)^2} \checkmark$$
$$= 1 \times 10^{7}\ N\cdot C^{-1} \checkmark \text{ east/}oos \checkmark$$ (5)

8.4 Positive / *Positief* ✓ (1)

8.5

West: positive	**West: negative**
$E_A + E_B = E_{net}$	$E_A + E_B = E_{net}$
$-1 \times 10^{7} + E_B$ ✓$= 1 \times 10^{7}$✓	$1 \times 10^{7} + E_B$ ✓$= -1 \times 10^{7}$✓
$\therefore E_B = 2 \times 10^{7}\ N\cdot C^{-1}$	$\therefore E_B = -2 \times 10^{7}\ N\cdot C^{-1}$ $= 2 \times 10^{7}\ N\cdot C^{-1}$
$E_B = \frac{kQ_B}{r^2}$	$E_B = \frac{kQ_B}{r^2}$
$\therefore 2 \times 10^{7}$✓ $= \frac{(9\times10^{9})Q_B}{(0,23)^2}$ ✓	$\therefore 2 \times 10^{7}$ ✓$= \frac{(9\times10^{9})Q_B}{(0,23)^2}$ ✓
$\therefore Q_B = 1,18\times10^{-4}$ C ✓	$\therefore Q_B = 1,18\times10^{-4}$ C ✓
(5)	(5)

(5)

[14]

QUESTION 9/*VRAAG 9*

9.1 12 J of energy are transferred to / work done on ✓
each coulomb (of charge) / per C charge ✓ passing through the battery.

12 J energie word oorgedra aan / arbeid word verrig op
elke coulomb (lading) / per C lading wat deur die battery beweeg. (2)

9.2

OPTION 1/*OPSIE 1*

$P = I^2R$ ✓
$5 = I^2(5)$ ✓
$\therefore I = 1$ A ✓

OPTION 2/*OPSIE 2*

$P = \frac{V^2}{R}$
$5 = \frac{V^2}{5}$ ✓
$V = 5$ V

$P = VI$
$5 = (5)I$ ✓
$I = 1$ A✓

OPTION 3/*OPSIE 3*

$P = \frac{V^2}{R}$
$5 = \frac{V^2}{5}$ ✓
$V = 5$ V

$V = IR$
$5 = I(5)$ ✓
$I = 1$ A✓

(3)

9.3

OPTION 1 / *OPSIE 1*

Emf = $I(R + r)$ ✓
12 ✓= (1)(R + 1)
R = 11 Ω

$R_p = 11 - 5$✓ = 6 Ω

OPTION 2 / *OPSIE 2*

Emf = $I(R + r)$ ✓
12 ✓= (1)(R_p + 5 + 1)✓
$\therefore R_p = 6$ Ω

OPTION 3/OPSIE 3

$V = I R_T$ ✓
12✓ = (1)R
$R_T = 12$ Ω

$R_p = R_T - (5 + 1)$
$= 12 - 6$ ✓
$= 6$ Ω

$\frac{1}{R_p} = \frac{1}{R_{12}} + \frac{1}{R}$ ∴ $\frac{1}{6}$✓$= \frac{1}{12}$✓$+ \frac{1}{4 + R_X}$✓∴ $\frac{1}{12} = \frac{1}{4 + R_X}$ ∴ 12 = 4 + R_x ∴R_x = 8 Ω✓

OR/*OF*

$R_p = \frac{(4 + R_X)(12)}{4 + R_X + 12}$ ∴ $R_p = \frac{(4 + R_X)(12)}{4 + R_X + 12}$ ∴ 6✓ $= \frac{(4 + R_X)(12)}{4 + R_X + 12}$ ∴ R_x = 8 Ω ✓

OPTION 4/*OPSIE 4*

$V_{5\Omega} = IR$ ✓
$= (1)(5)$
$= 5$ V

$V_{internal} = Ir$
$= (1)(1)$
$= 1$ V

$V_{parallel} = 12$✓$- (1 + 5)$ ✓
$= 6$ V

$V_{parallel} = IR$
$6 = I(12)$ ✓
$\therefore I = 0,5$ A

$I_{Rx} = 1 - 0,5$
$= 0,5$ A

$V = IR$
6✓ $= (0,5)(4 + R_x)$ ✓
$\therefore R_x = 8$ Ω ✓

(7)

9.4 

No / *Nee* ✓

Total resistance (R) increases. / *Totale weerstand (R) neem toe*.✓
Current (I) decreases / *Stroom (I) neem af.* ✓
(For a constant R) power (P = I^2R) decreases.✓
(Vir konstante R) drywing (P = I^2R) verminder. (4)
[16]

QUESTION 10/*VRAAG 10*

10.1
10.1.1 slip rings / *sleepringe* ✓ (1)

10.1.2 brush(es) / *borsel(s)* ✓ (1)

10.2 Maintains electrical contact with the slip rings.
Handhaaf elektriese kontak met die sleepringe.

OR/*OF*
To take current out/in of the coil.
Om die stroom uit/in die spoel te neem. (1)

10.3 Mechanical /kinetic energy to electrical energy. ✓
Meganiese / kinetiese energie na elektriese energie. (1)

10.4 1½ ✓ (1)

10.5

OPTION 1/ *OPSIE 1*

$f = \frac{1}{T}$ ✓

$= \frac{1}{0,02}$ ✓

= 50 Hz ✓

(3)

OPTION 2/ *OPSIE 2*

$f = \frac{\text{number of cycles}}{\text{time}}$ ✓

$= \frac{1,5}{0,03}$ or/of $\frac{1}{0,02}$ or/of $\frac{0,5}{0,01}$ ✓

= 50 Hz ✓

(3)

(3)

10.6 Parallel to / *Parallel aan* ✓ (1)

10.7

OPTION 1/ *OPSIE 1*

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{V_{max}}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓ (1 mark for both formulae / *1 punt vir beide formules*)

$= \left(\frac{311}{\sqrt{2}}\right)$✓$\left(\frac{21{,}21}{\sqrt{2}}\right)$ ✓

= 3 298,16 W ✓ (Accept range / *Aanvaar gebied*: 3298,13 – 3299,18 W)

OPTION 2/ *OPSIE 2*

$P_{ave} = \frac{V_{max}I_{max}}{2}$ ✓✓

$= \frac{(311)(21.21)}{2}$ ✓✓

= 3298,16 W✓

OPTION 3 / *OPSIE 3*

$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{311}{\sqrt{2}}$ ✓= 219,91 V ✓

$I_{rms} = \frac{I_{max}}{\sqrt{2}} = \frac{21{,}21}{\sqrt{2}}$ ✓= 14,998 A

$P_{ave} = V_{rms}I_{rms}$ ✓

= (219,91)(14,998)

= 3 298,21 W ✓

OPTION 4/ *OPSIE 4*

$R = \frac{V_{max}}{I_{max}}$

$= \frac{311}{21{,}21}$ ✓

= 14,66 Ω

$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{311}{\sqrt{2}}$ ✓= 219,91 V

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$= \frac{(219{,}91)^2}{14{,}66}$ ✓

= 3 298,8 W✓

OPTION 6/*OPSIE 6*

$R = \frac{V_{max}}{I_{max}}$

$= \frac{311}{21{,}21}$ ✓

= 14,66 Ω

$I_{rms} = \frac{I_{max}}{\sqrt{2}} = \frac{21{,}21}{\sqrt{2}}$ ✓= 14,998 A

$P_{ave} = I_{rms}^2R$ ✓

$= (14{,}998)^2(14{,}66)$ ✓

= 3 297,62 W✓

(5)
[14]

QUESTION 11/*VRAAG 11*

11.1

11.1.1 Photo-electric effect / *Foto-elektriese effek* ✓ (1)

11.1.2

OPTION 1/*OPSIE 1*

$E = W_0 + E_k$

$hf = hf_0 + E_k$

$\frac{hc}{\lambda} = W_0 + ½mv^2$

✓ Any one/*Enige een*

$\frac{(6{,}63 \times 10^{-34})(3x10^8)}{200 \times 10^{-9}}$ ✓ = 8 x 10^{-19} ✓ + ½(9,11 x 10^{-31})v^2 ✓

v= 6,53 x 10^5 m·s^{-1} ✓ (653454,89 m·s^{-1})

OPTION 2 / *OPSIE 2*

c = fλ
3 x 10^8 = f(200 x 10^{-9})
f = 1,5 x 10^{15} Hz

$hf = hf_0 + E_k$✓

(6,63 x 10^{-34})(1,5 x 10^{15}) ✓= 8 x 10^{-19} ✓ + ½(9,11 x 10^{-31})v^2 ✓

v= 6,53 x 10^5 m·s^{-1} ✓ (5)

11.1.3 Increases / *Vermeerder* ✓ (1)

11.1.4 Remains the same / *Bly dieselfde* ✓
(-) Intensity only affects number of photoelectrons emitted per second. ✓
Intensiteit beïnvloed slegs die getal foto-elektrone vrygestel per sekonde.

OR/*OF*

Remains the same / *Bly dieselfde* ✓
(-) The kinetic energy of the emitted photoelectrons remains the same.
Die kinetiese energie van die vrygestelde foto-elektrone bly dieselfde.

OR/*OF*

Remains the same / *Bly dieselfde* ✓
(-) Only the frequency/wavelength of the incident light affects the maximum kinetic energy.
Slegs the frekwensie/golflengte van die invallende lig beïnvloed die maksimum kinetiese energie. (2)

11.2 B ✓
Orange light has a higher frequency than red light. ✓
Oranje lig het 'n hoër frekwensie as rooi lig.

OR/*OF*

Orange light has smaller wavelength than red light.
Oranje lig het 'n kleiner golflengte as rooi lig. (2)

11.3 Line emission (spectra) / *Lyn emissie(spektrum)* ✓ (1)
[12]

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