QUESTION 1 / *VRAAG 1*

1.1	B✓✓	(2)
1.2	A✓✓	(2)
1.3	D✓✓	(2)
1.4	C✓✓	(2)
1.5	B✓✓	(2)
1.6	C✓✓	(2)
1.7	A✓✓	(2)
1.8	D✓✓	(2)
1.9	C✓✓	(2)
1.10	A✓✓	(2)

[20]

QUESTION 2 / VRAAG 2

2.1   A force that <u>opposes the motion of a moving object relative to a surface.</u> ✓✓/

'n Krag wat <u>teen die beweging van 'n bewegende voorwerp, relatief tot die</u>

<u>*oppervlak,*</u> *inwerk.* ✓✓ (0 or 2 marks / *0 of 2 punte*)   (2)

2.2   0 ✓   (1)

2.3

Accepted labels/*Aanvaarde benoemings*
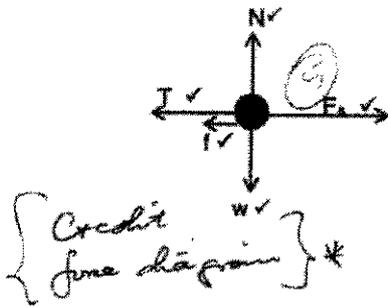
w	F_g / F_w / 29,4N /weight / mg / gravitational force / *gewig* / *gravitasiekrag*
f	$F_{friction}$ / F_f / friction /f_k/$F_{wrywing}$/ F_w / *wrywing*
N	F_N / F_{normal}/ normal force / $F_{normaal}$/ *normaalkrag*
F_A	$F_{Applied/toegepas}$/10 N/ /
T	F_T / tension

(5)

2.4 $F_{net} = m\,a$ ✓

     for the 3 kg   **for 2 kg**

     $\underline{0 = 10 - T - \mu_k \cdot 3 \cdot 9,8}$ ✓ $\underline{0 = T - \mu_k \cdot 2 \cdot 9,8}$ ✓

     $10 = (\mu_k \cdot 2 \cdot 9,8) + (\mu_k \cdot 3 \cdot 9,8)$

     $\underline{\mu_k} = 0,204$ ✓   (4)

POSITIVE MARKING FROM 2.4/ *POSTIEWE NASIEN VANAF 2.4*

2.5

     for the 3 kg   **for 2 kg**

     $F_{net} = F_{applied} - T - \mu_k \cdot 3 \cdot 9,8$ $F_{net} = T - \mu_k \cdot 2 \cdot 9,8$

     ✓$3\,a = \underline{30 - T - 0,204 \cdot 3 \cdot 9,8}$ ✓   ✓$2a = T - \underline{0,204 \cdot 2 \cdot 9,8}$✓

     $3\,a = 30 - 5,997 - T$ $2a = T - 3,998$

     Add the two equation

     $a = 4\ \text{m·s}^{-2}$✓   (5)

                                           [17]

QUESTION 3 / *VRAAG 3*

3.1   It is when the only force acting on the falling object, it is the force of gravity✓✓/
*Dit is as die enigste krag wat op die vallende voorwerp inwerk, die
gravitasiekrag is* ✓✓ (0 or 2 marks / *0 of 2 punte*)   (2)

3.2   Downward / *Afwaarts* ✓   (1)

3.3   OPTION 1/ *OPSIE 1*

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

$\underline{x = 0 + \frac{1}{2} 9,8 t^2}$ ✓ and / *en*   ✓ $\underline{x + 3,05 = 0 + \frac{1}{2} 9,8 (t + 0,1)^2}$ ✓

$= 4,9 t^2$ ✓ $4,9 t^2 + 3,05 = 4,9(t+0,1)^2$

$t = 3,06$ s ✓ (*credit for answer
correctly substituted*).

hence / *dus* $x = 45,95$ m

OPTION 2/ *OPSIE 2*

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

✓ $3,05 = v_i 0,1 + \frac{1}{2} 9,8 \times 0,1^2$ ✓   ✓ $30,01^2 = 0 + 2(9,8) \cdot x$ ✓ ⑥

$v_i = 30,01$ ✓ $x = 45,95$ m   (6)

downward +ve   downward -ve
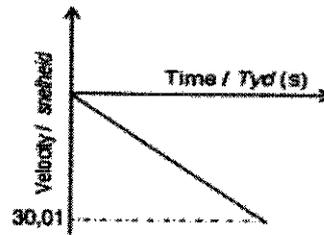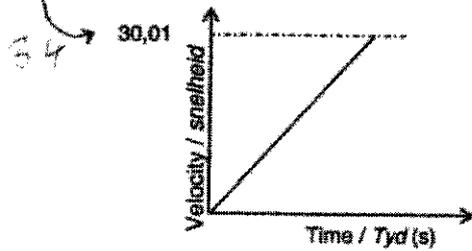
3.4

Criteria / *Kriteria*	Mark/*Punt*
At / *By* t= 0 v=0	1
Shape of the graph	1
Velocity at top 30,01	1

(3)

[12]

QUESTION 4 / VRAAG 4

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

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

4.2 p_A = 6×10^3 kg·m·s^{-1} ✓ east / *oos*   (1)

4.3 $\Delta p_A = p_f - p_i$

       $= 1 \times 10^3 - 6 \times 10^3$

       $= -5 \times 10^3$ kg·m·s^{-1} ✓   hence $\Delta p_B = 5 \times 10^3$ kg·m·s^{-1}

   $p_i = mv_i$ ✓

     5×10^3 $= 2 \times 10^3 - p_i$ ✓ $-3 \times 10^3 = 1500 \times v_i$ ✓

     $p_i = -3 \times 10^3$ kg·m·s^{-1} $v_i = -2$ m·s^{-1}

                                          $= 2$ m·s^{-1} <u>west / *wes*</u> ✓   (5)

OR / *OF*

$\Sigma p_{before} = \Sigma p_{after}$ ✓

$6 \times 10^3 + 1500 \, v_i$ ✓ $= 1 \times 10^3$ ✓ $+ 2 \times 10^3$ ✓

$v_i = -2$ m.s^{-1}

     $= 2$ m. s^{-1} west / *wes* ✓

POSITIVE MARKING FROM 4.3/*POSTIEWE NASIEN VANAF 4.3*

4.4 $E_k = \frac{1}{2} mv^2$ ✓

E_k before / *voor* $= \frac{1}{2} 2000.(\frac{6000}{2000})^2 + \frac{1}{2} 1500.(-2)^2$ ✓ $= 12\,000$ J

E_k after / *na* $= \frac{1}{2} 2000.(\frac{1000}{2000})^2 + \frac{1}{2} 1500.(\frac{2000}{1500})^2$ ✓ $= 1583,33$

✓

<u>E_k before / *voor* $\neq$ E_k after / *na*   Collision is inelastic</u> ✓ / *Botsing onelasties*

                                                  (5)
                                                  [13]

QUESTION 5 / VRAAG 5

5.1 $W = F \, \Delta x \cos \theta$ ✓

   $325 = (130)(5)(\cos \theta)$ ✓

   $\theta = 60°$ ✓   (3)

5.2 $W_f = f \, \Delta x \cos \theta$ $f_k = \mu_k N$ both equations 1 mark/

   $= (25,03)(5)(\cos 180)$ ✓ $= 0,3 \times [(20 \, . 9,8)$ ✓ $- (130 \sin 60)]$ ✓

   $= -125,15$ J ✓ $= 25,03$ N

   (Accept -125,13 J to -125,15 J)   (5)

POSITIVE MARKING FROM 5.2 /POSITIEWE NASIEN VANAF 5.2

5.3 $W_{net} = \Delta K$ ✓

   $\underline{325 - 125,15}$ ✓ $= \frac{1}{2} \, 20 \, v_f^2 - 0$ ✓

   $v_f = 4,47$ m.s^{-1} ✓   (4)

5.4 Increases / neem toe ✓

   Normal forces increases / Normaalkragte neem toe ✓

   Normal force is equal to F_g / Normaalkragte is gelyk aan F_g ✓   (3)

                                                                                            [15]

QUESTION 6 / VRAAG 6

6.1 An (apparent) change in observed/detected frequency (pitch), (wavelength)
    ✓ as a result of the relative motion between a source and an observer ✓
    (listener).
    'n Skynbare verandering in waargenome frekwensie (toonhoogte),(golflengte)   (2)
    ✓ as gevolg van die relatiewe beweging tussen die bron en 'n
    ✓ waarnemer/luisteraar.

6.2 Moving away ✓ / weg beweeg   (1)

6.3 Smaller than/ Kleiner as ✓   (1)

6.4 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓   or/of $f_L = \frac{v}{v - v_s} f_s$ or/of $f_L = \frac{v}{v + v_s} f_s$

   ✓ $751 = \frac{340}{340 - v_s} f_s$ ✓   and /en   ✓ $749 = \frac{340}{340 + v_s} f_s$ ✓

   $v_s = 0,4533$ m.s^{-1} ✓ range/interval (0,45 -0,50)   (6)

                                                                                            [10]

QUESTION 7 / VRAAG 7

7.1   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 deur een puntlading (Q_1) op 'n ander puntlading (Q_2) uitgeoefen word, is direk eweredig aan die produk van die grootte van hul ladings✓ en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. ✓   (2)

7.2 $F = G\dfrac{m_1 m_2}{d^2}$ ✓ $F = \dfrac{kQ_1 Q_2}{r^2}$ ✓

   ✓ $\dfrac{6,67\times10^{-11}\times10\times10}{r^2} = \dfrac{9\times10^9\times Q_2^{\,2}}{r^2}$ ✓ $Q_1 = Q_2$

   $Q_2 = 8,6088 \times 10^{-10}\,C$✓   (5)

7.3.1   X✓   (1)

7.3.2 $E = \dfrac{kQ}{r^2}$ ✓

   $E_{q1} = \dfrac{9\times10^9 . 20\times10^{-9}}{(0,7)^2}$ ✓ $= 367,3469$ NC^{-1} East / Oos

   $E_{q2} = \dfrac{9\times10^9 . 80\times10^{-9}}{(0,2)^2}$ ✓ $= 18000$ NC^{-1} West / Wes

   $E_{net} = 18000 - 367,3469$ ✓ $= \underline{17632,85306}$ N.C^{-1} West / Wes ✓   (6)
   (positive marking)   [14]

QUESTION 8 / *VRAAG 8*

8.1
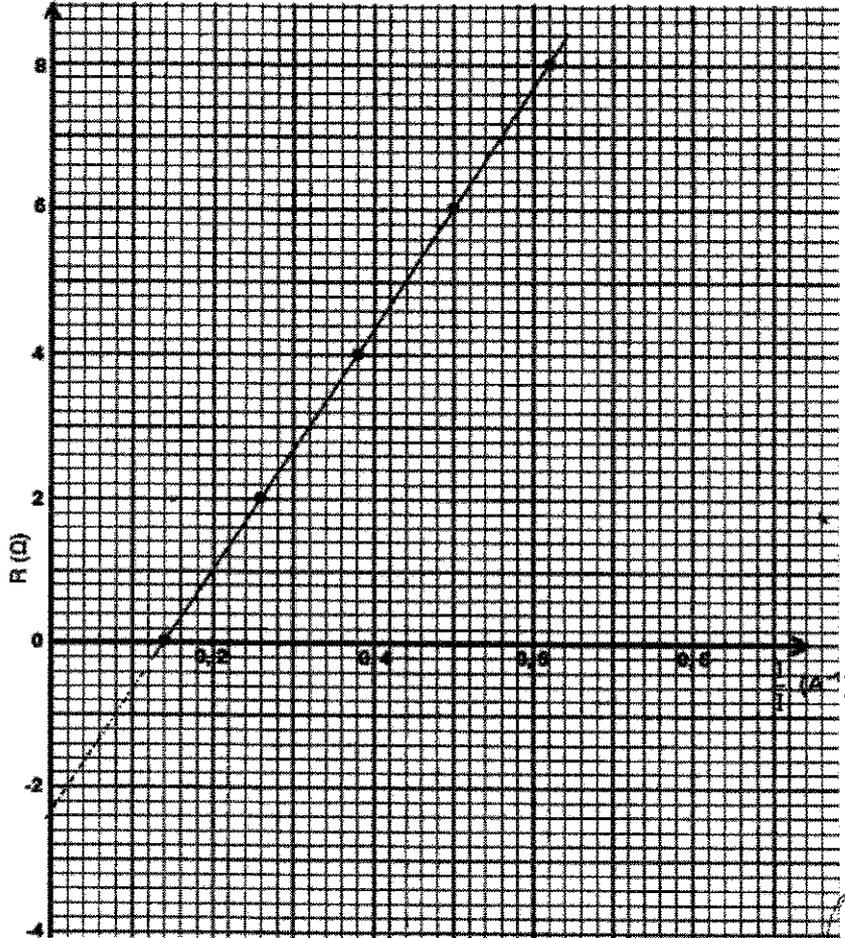
Criteria/*Kriteria*	Marks / *Punte*
Two points correctly plotted/*Twee punte korrek gestip*	✓
ALL points correctly plotted/ *ALLE punte korrek gestip*	✓
Correct line of best fit if all plotted points used/ *Korrekte lyn van beste pas indien alle punte gebruik word*	✓

(3)

8.2   emf /*emk* (ε)✓   ( )   (1)

     Please turn over/Blaai om asseblief

8.3.1　Gradient / *Gradiënt* = $\dfrac{\Delta y}{\Delta x} = \dfrac{2-0 \checkmark}{0,26-0,14 \checkmark} = 16,66667$ V $\checkmark$

Can use any values / *Kan enige waardes gebruik*　　(3)

8.3.2　POSITIVE MARKING FROM 8.3.1
POSTIEWE NASIEN VANAF 8.3.1

$\varepsilon = I(R + r)$

$16,67 = 3,85 (2 + r)$ $\checkmark$

$\underline{r = 2,33\ \Omega}\checkmark$

Other substitutions and answers/
Ander substitusies en antwoorde

R	I	r
4	2,63	2,34
6	2	2,33
8	1,613	2,33
10	1,35	2,35
12	1,163	2,33

OR/*OF*

Extrapolate the graph to the y axis (must be shown) see the graph drawn$\checkmark$
value notes and written 2,2 or 2,4 $\Omega\checkmark$
*Ekstrapoleer die grafiek om die y-as (moet getoon word) sien die grafiek
geteken waardenotas en skriftelike 2,2 of 2,4 Ω*　　(2)

8.4　From the graph / *uit die grafiek*　　　　$\varepsilon = I(R + r)$

R = 0　　　　　　　　　　　　　　　　$16,667 = I(0 + 2,33)$ $\checkmark$

$\dfrac{1}{I} = 0,14\checkmark$　　　　　　　　　　$I = 7,15$ A$\checkmark$

$I = 7,14$ A $\checkmark$　　　　　　　　　　　　　　　　　　　(2)

[11]

QUESTION 9 / VRAAG 9

9.1   The potential difference across a conductor is directly proportional to the current in the conductor ✓ at constant temperature. (provided temperature and all other physical conditions are constant) ✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier ✓ by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly) ✓   (2)

9.2.1 $\varepsilon = I(R + r)$ ✓

$\varepsilon = \dfrac{12}{3}(3 + r)$ ✓ when S_1 closed / *as S_1 gesluit is*

$\varepsilon = \dfrac{16}{6}(6 + r)$ ✓ when S_2 is closed / *as S_2 gesluit is*

equating/*stelvergelyking gelyk*

$\dfrac{12}{3}(3 + r) = \dfrac{16}{6}(6 + r)$

$r = 3\ \Omega$ ✓

$\varepsilon = \underline{24\ V}$ ✓

9.2.2   **POSITIVE MARKING FROM 9.1 and 9.2.1**
POSTIEWE NASIEN VANAF 9.1 en 9.2.1
$\varepsilon = I(R + r)$ ✓

$\underline{24 = I\ (2 + 3)}$ ✓

$I = 4,8\ A$ ✓

$V = I \times R$ ✓

$= 4,8 \times 2$ ✓

$= \underline{9,6\ V}$ ✓

[13]

QUESTION 10 / VRAAG 10

10.1   Left to right / *Links na regs*✓   (1)

10.2   Increases / *Neem toe*✓   (1)

10.3   Mechanical to electrical / *Meganies na elektries*✓   (1)

10.4
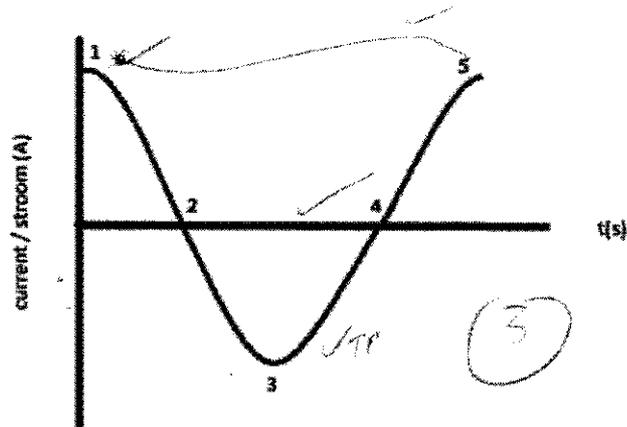
(3)

Must draw a sinodal graph to satisfy the following criteria	
CRITERIA/ *KRITERIA*	**MARK/ *PUNTE***
Start 1 at t=0 and 5 at I maximum/ *Begin by t=0 en 5 by I maksimum*	✓
2 and 4 at I = 0/ *2 en 4 by I=0*	✓
Graph turns at 3/ *grafiek draai by 3*	✓

10.5   OPTION 1/ OPSIE 1

$P_{ave} = V_{rms}I_{rms}$ ✓ /$P_{gemiddeld} = V_{wgk}I_{wgk}$

20✓ $= \dfrac{12}{\sqrt{2}}$ ✓ $\dfrac{I_{max}}{\sqrt{2}}$ ✓

$I_{max} = 3,33$ A✓

OPTION 2/ OPSIE 2

$V_{rms} = \dfrac{V_{max}}{\sqrt{2}} = \dfrac{12}{\sqrt{2}} = 8,485V$ ✓

$P_{ave} = V_{rms}I_{rms}$ ✓

✓ $20 = 8,485 I_{rms}$

$I_{rms} = 2,357A$ ✓

$I_{max} = I_{rms}\sqrt{2} = 2,357\sqrt{2} = 3,33A$ ✓

(5)

[11]

QUESTION 11 / VRAAG 11

11.1   *cut off frequency* Threshold frequency✓/ *Drumpelfrekwensie*   (1)

11.2   By the gradient✓ / *Deur die helling te bepaal*   (1)

11.3   The energy of the incident light is✓ lesser than work function of the metal used. ✓ / *Die energie van die lig laer as die werksfunksie*
OR $f_i < f_o$
The incident light does not have the minimum energy ✓ to emit electrons from the surface of the metal ✓ / *Die lig het minder energie as die minimum energie benodig.*   (2)

11.4 $W_o = hf_o$ ✓

$= 6{,}63 \times 10^{-34} \times 5{,}6 \times 10^{14}$✓

$= 3{,}7128 \times 10^{-19}$ J✓   (3)

11.5 $E = W_o + E_{k(max)}$ ✓   or / of $E = W_o + K_{max}$ or/ of $2hf_0 = hf_0 + \tfrac{1}{2} mv^2$

$hf = W_o + E_k$

$2 \times 6{,}63 \times 10^{-34} \times 5{,}6 \times 10^{14}$ ✓ $= 3{,}7128 \times 10^{-19} +$

$= 6{,}63 \times 10^{-34} \times 5{,}6 \times 10^{14}$ ✓$+ \tfrac{1}{2} 9{,}11 \times 10^{-31} \times v^2$ ✓

OR/OF
$2 \times 3{,}7128 \times 10^{-19}$ J✓ $= 3{,}7128 \times 10^{-19}$ J✓ $x + \tfrac{1}{2} 9{,}11 \times 10^{-31} \times v^2$ ✓   (5)

$v = 9{,}03 \times 10^{6}$ m·s^{-1}✓

11.6
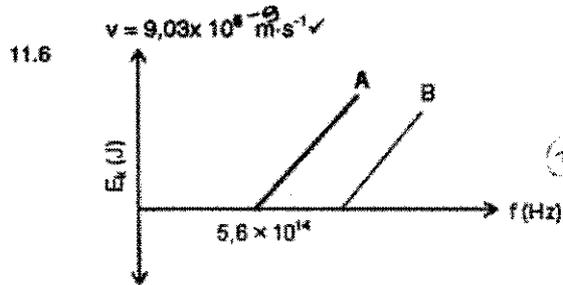
Criteria/ *Kriteria*	Mark/ *punt*
Straight line on the right of A *Reguit lyn, regs van A*	1
Line drawn parallel to A *Lyn parallel met A*	1

(2)

[14]

TOTAL 150 marks