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)

EXEMPLAR 2014
MODEL 2014

MEMORANDUM

MARKS/*PUNTE*: 150

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

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 A ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 C ✓✓ (2)

1.10 C ✓✓ (2)

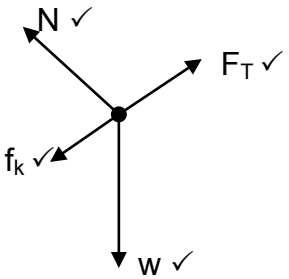
[20]

QUESTION 2/*VRAAG 2*

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force ✓and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n liggaam inwerk, sal die liggaam in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die liggaam. (2)

2.2 Remains the same / *Bly dieselfde* ✓ (1)

2.3



Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w / weight / mg / gravitational force *F_g / F_w / gewig / mg / gravitasiekrag*
f	$F_{friction}$ / F_f / friction *$F_{wrywing}$ / F_w / wrywing*
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / *normaalkrag*
F_T	F_t / T / tension F_t / T / *spanning*

(4)

2.4

2.4.1 Up the incline as positive/*Teen die skuinste op as positief:*
$F_{net} = ma$
$F_T + f_k + w_{//} = ma$
$F_T + \mu_k N + w\sin30° = ma$
$F_T + \mu_k mg\cos30° + mg\sin30° = ma$
} ✓ Any one/*Enige een*
$F_T – (0,2)(6)(9,8)\cos30°$✓ $- (6)(9,8)\sin30°$✓ $= (6)(4)$ ✓
$\therefore F_T = 63,58$ N ✓ (5)

2.4.2 Up the incline as positive/*Teen die skuinste op as positief:*
$F_{net} = ma$
$F + f_{k(6\ kg)} + f_{k(3\ kg)} + w_{//} = ma$
$F + \mu_k N_{(6\ kg)} + \mu_k N_{(3\ kg)} + mg\sin30° = ma$
} ✓ Any one/*Enige een*
$F – (0,2)(6)(9,8)\cos30°$✓ $- (0,1)(3)(9,8)\cos30°$✓ $- (9)(9,8)\sin30°$✓ $= 0$ ✓
$\therefore F = 56,83$ N ✓ (6)

2.5 Decreases / *Afneem* ✓ (1)
[19]

QUESTION 3/*VRAAG 3*

3.1 0,5 m ✓ (1)

3.2 **OPTION 1/*OPSIE 1***

Upwards positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-2)^2 + 2(-9,8)(-1,8)$ ✓
$v_f = -6,27\ m\cdot s^{-1}$ ✓

$v_f = v_i + a\Delta t$
$-6,27 = -2 + (-9,8)\Delta t$ ✓
$\Delta t = 0,44\ s$ ✓

✓Both equations/*Beide vergelykings*

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (2)^2 + 2(9,8)(1,89)$ ✓
$v_f = 6,27\ m\cdot s^{-1}$ ✓

$v_f = v_i + a\Delta t$
$6,27 = 2 + (9,8)\Delta t$ ✓
$\Delta t = 0,44\ s$ ✓

✓Both equations/*Beide vergelykings*

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$-1,8$ ✓$= (-2)\Delta t$ ✓ $+ \frac{1}{2}(-9,8)\Delta t^2$ ✓

$$\Delta t = \frac{-2 \pm \sqrt{(2)^2 - 4(4,9)(-1,8)}}{2(4,9)}$$

$= 0,44\ s$ ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$1,8$ ✓ $= (2)\Delta t$ ✓ $+ \frac{1}{2}(9,8)\Delta t^2$ ✓

$$\Delta t = \frac{-2 \pm \sqrt{(-2)^2 - 4(4,9)(-1,8)}}{2(4,9)} = 0,44\ s$$ ✓

(5)

3.3 **Upwards positive/*Opwaarts positief:***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = v_i^2 + 2(-9,8)(0,9)$ ✓
$v_i = 4,2\ m\cdot s^{-1}$ ✓ upwards/*opwaarts* ✓

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = v_i^2 + 2(9,8)(0,9)$ ✓
$v_i = 4,2\ m\cdot s^{-1}$ ✓ upwards/*opwaarts* ✓ (4)

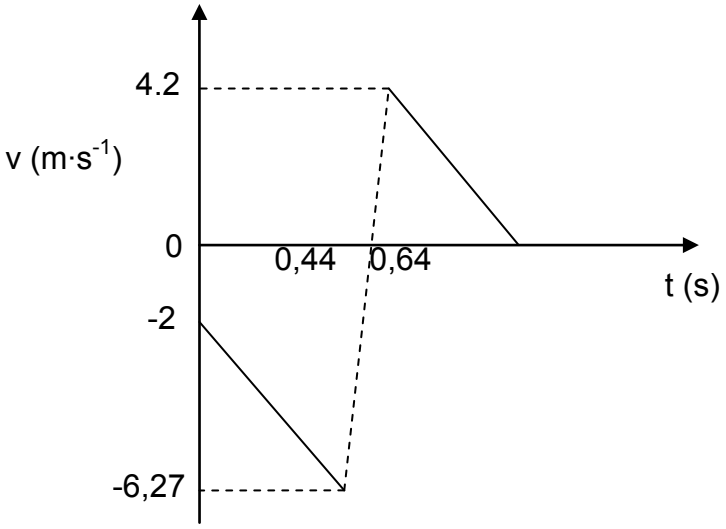
3.4 **Upwards positive/*Opwaarts positief:***

$F_{net}\Delta t = m\Delta v$ ✓
F_{net} (0,2) ✓= (0,5)[(4,2 – (-6,27)] ✓
F_{net} = 26,175 N ✓

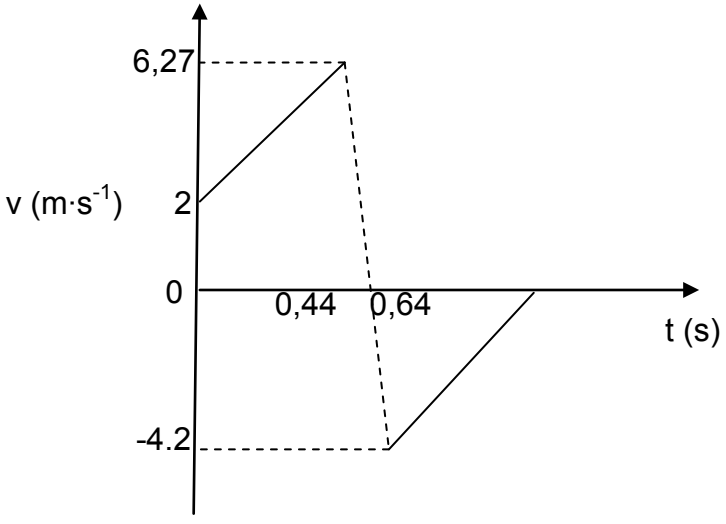
Downwards positive/*Afwaarts positief:*

$F_{net}\Delta t = m\Delta v$ ✓
F_{net} (0,2) ✓ = (0,5)[(-4,2 – (6,27)] ✓
F_{net} = -26,175 N
F_{net} = 26,175 N ✓ (4)

3.5 **Upwards positive/*Opwaarts positief:***



Downwards positive/*Afwaarts positief:*



(3)

Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
First part of the graph starts at v = 2 m·s^{-1} at t = 0 s and extends until v = 6,27 m·s^{-1} at t = 0,44 s. *Eerste deel van die grafiek begin by v = 2 m·s^{-1} by t = 0 s en verleng tot* v = 6,27 m·s^{-1} by *t = 0,44 s.*	✓
Graph is discontinuous and object changes direction at 0,64 s. *Grafiek is nie kontinu nie en voorwerp verander van rigting by 0,64 s.*	✓
Second part of graph starts at v = 4,2 m·s^{-1} at t = 0,64 s until v = 0 m·s^{-1}. *Tweede deel van grafiek begin by v = 4,2 m·s^{-1} by t = 0,64 s tot* v = 0 m·s^{-1}.	✓

[17]

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum in a closed system ✓ remains constant. / is conserved. ✓
Die totale lineêre momentum in 'n geslote sisteem bly konstant / bly behoue.

OR/*OF*
In a closed system ✓ the total linear momentum before collision is equal to the total linear momentum after collision. ✓
In 'n geslote sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing. (2)

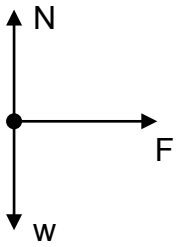
4.2 $\sum p_i = \sum p_f$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$ } ✓ Any one/*Enige een*
$(2m + 4m)(0)$ ✓ $= 2m(2) + 4m(v_{2f})$ ✓
$-4m = 4mv_f$
$\therefore v_f = -1$ m·s^{-1}
$\therefore v_f = 1$ m·s^{-1} ✓ in the opposite direction to that of the boys ✓
in die teenoorgestelde rigting as dié van die seuns (5)

4.3 Greater than / *Groter as* ✓ (1)
[8]

QUESTION 5/*VRAAG 5*

5.1 Frictional force / *Wrywingkrag* ✓ (1)

5.2 F_N / Normal force / *Normaalkrag* ✓
F_g / Gravitational force / Weight / *Gravitasiekrag* / *Gewig* ✓
F_{app}/ 10 N / Horizontal applied force / *Horisontale toegepaste krag* ✓



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N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / *normaalkrag*
F	F_{app} / applied force / 10 N F_{toeg} / *toegepaste krag/ 10 N*

(3)

5.3 The net work done ✓on an object is equal to the change in kinetic energy ✓of the object.
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

5.4 $W_{net} = \Delta E_K$ ✓
$W_F + W_w + W_{FN} = ½ m(v_f^2 – v_i^2)$
$(10)(2,5)\cos 0^o + 0 + 0$ ✓$= ½ (3)(v_f^2 – 0^2)$ ✓
$v_f = 4,08 \text{ m·s}^{-1}$ ✓ (4)

5.5 **OPTION 1/*OPSIE 1***
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta = (mgh_f – mgh^i) + (½ mv_f^2 – ½ mv_i^2)$
$(2)(10)\cos 180^o$ ✓$= (3)(9,8)h_f – 0$ ✓ $+ 0 – ½ (3)(4,08)^2$ ✓
$\therefore h = 0,17$ m ✓

OPTION 2/*OPSIE 2*
$W_{net} = \Delta E_K$ ✓
$W_f + W_w = ½ m(v_f^2 – v_i^2)$
$(2)(10)\cos 180^o$ ✓$+ (3)(9,8)h\cos 180^o$ ✓$= ½ (3)(0^2 – 4,08^2)$ ✓
$\therefore h = 0,17$ m ✓

OPTION 3/*OPSIE 3*
$W_{net} = \Delta E_k$ ✓
$mg\sin\alpha\ \Delta x\cos\theta + f\Delta x\cos\theta = ½ m(v_f^2 – v_i^2)$
$(3)(9,8)(\frac{h}{10})(10)\cos 180^o$ ✓$+ (2)(10)\cos 180^o$ ✓$= ½ (3)(0^2 – 4,08^2)$ ✓
$\therefore h = 0,17$ m ✓ (5)
[15]

QUESTION 6/*VRAAG 6*

6.1 Smaller than */ Kleiner as* ✓ (1)

6.2 Doppler effect / *Doppler-effek* ✓ (1)

6.3 $v = f\lambda$ ✓
$345 = f(0,55)$ ✓
$\therefore f = 627,27$ Hz

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \textbf{ OR/}\textit{OF}\textbf{ } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$= \frac{345}{345 \checkmark 33,33 \checkmark}(627,27) \checkmark$$

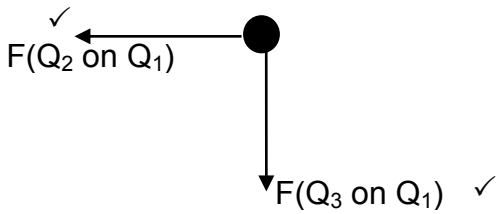
= 694,35 Hz ✓ (7)

6.4 Decreases / *Verlaag* ✓ (1)
[10]

QUESTION 7/*VRAAG 7*

7.1 The (magnitude) of the electrostatic force exerted by one charge on another is directly proportional to the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance between their centres. ✓
Die (grootte) van die elektrostatiese krag wat een lading op 'n ander uitoefen, is direk eweredig aan die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

7.2



(2)

7.3 $F = k\frac{Q_1Q_2}{r^2}$ ✓

$F(Q_2 \text{ on } Q_1) = (9 \times 10^9)\frac{(4\times10^{-6})(4\times10^{-6})}{(3\times10^{-3})^2}$ ✓ ✓ $= 1{,}6 \times 10^4$ N (to left/*na links*)

$F(Q_3 \text{ on } Q_1) = (9 \times 10^9)\frac{(4\times10^{-6})(4\times10^{-6})}{(3\times10^{-3})^2}$ ✓ $= 1{,}6 \times 10^4$ N

(downwards/*afwaarts*)

$F_{net} = \sqrt{(F_{Q2 \text{ on } Q1})^2 + (F_{Q3 \text{ on } Q1})^2}$

$= \sqrt{(1{,}6 \times 10^4)^2 + (1{,}6\times10^4)^2}$ ✓

$= 2{,}26 \times 10^4$ N

$\tan\theta = \left(\frac{F_{Q3 \text{ on } Q1}}{F_{Q2 \text{ on } Q1}}\right)$

$\tan\theta = \left(\frac{1{,}6\times10^4}{1{,}6\times10^4}\right)$ ✓

$\therefore \theta = 45°$

$F_{net} = 2{,}26 \times 10^3$ N ✓ SW / 225° / 45° south of west / *suid van wes* ✓ (8)

[12]

QUESTION 8/*VRAAG 8*

8.1 The force ✓per unit charge ✓ at that point.
Die krag per eenheidslading by daardie punt. (2)

8.2 $E = \frac{kQ}{r^2}$ ✓

$= \frac{(9\times10^9)(6{,}5\times10^{-12})}{(0{,}003)^2}$ ✓

$= 6{,}5 \times 10^3$ N·C^{-1} ✓ (3)

8.3 **At point X/*By punt X***

$E_Q = 6{,}5 \times 10^3$ N·C^{-1} west/*wes* ✓

$E_R = \frac{kQ}{r^2}$

$= \frac{(9\times10^9)(6{,}5\times10^{-12})}{(0{,}003)^2}$

$= 6{,}5 \times 10^3$ N·C^{-1} east/*oos* ✓

$E_{net} = E_Q + E_R$ ✓

$= 6{,}5 \times 10^3 + (-6{,}5 \times 10^3)$

$= 0$ N·C^{-1} ✓ (4)

[9]

QUESTION 9/*VRAAG 9*

9.1

9.1.1 From graph/*Van grafiek:* $\frac{R}{V}$ ✓

OR/*OF*

From equation/*Van vergelyking*: $\frac{r}{E}$ (1)

9.1.2 $\frac{1}{E} = 0,65$ ✓

$\therefore E = 1,54$ V✓ (2)

9.1.3 $\frac{r}{E} = \frac{2-1}{4-1}$ ✓✓

$\therefore r = 0,51\ \Omega$ ✓

(Any set of values from the graph can be used to calculate the gradient./*Enige stel waardes van die grafiek kan gebruik word om die gradiënt te bereken.)* (3)

9.2

9.2.1 Emf/*emk* = $I(R + r)$ ✓

$6 = I(9 + 1)$ ✓

$\therefore I = 0,6$ A ✓ (3)

9.2.2 $P = I^2R$ ✓

$1,8 = (0,6)^2R_1$ ✓

$R_1 = 5\ \Omega$

$R_p = 9 - 5 = 4\ \Omega$ ✓

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

$$\frac{1}{4} = \frac{1}{R_2} + \frac{1}{4R_2}$$ ✓

$\therefore R_2 = 5\ \Omega$ ✓ (5)

9.3 $W = VI\Delta t$ ✓

$= (240)(9,5)(12)(60)$ ✓

$= 1,64 \times 10^6$ J

Cost/*Koste* = $\frac{1,64 \times 10^6}{3,6 \times 10^6} \times 1,47$ ✓

= R0,67 or/*of* 67 cents/*sent* ✓ (4)

[18]

QUESTION 10/*VRAAG10*

10.1 Increase the speed of rotation. / *Verhoog spoed van rotasie.* ✓

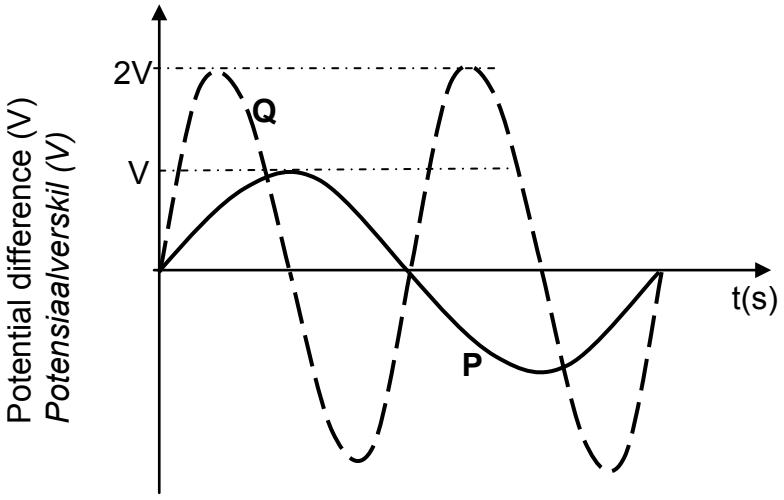
OR/*OF*
Increase the number of coils. / *Verhoog getal windings/spoele.*

OR/*OF*
Increase the strength of the magnetic field. / *Verhoog magetiese veldsterkte.* (1)

10.2 Commutators replaced by slip rings./ *Kommutators vervang met sleepringe.* ✓

OR/*OF*
Slip rings were used. /*Sleepringe is gebruik.* ✓ (1)

10.3



Criteria for graph/*Kriteria vir grafiek:*	**Marks** ***Punte***
Correct shape with higher amplitude as shown (accept more than one cycle) *Korrekte vorm met hoër amplitude soos aangetoon (aanvaar meer as een siklus)*	✓
Correct shape with higher frequency as shown (accept more than one cycle) *Korrekte vorm met hoër frekwensie soos aangetoon (aanvaar meer as een siklus)*	✓

(2)

10.4

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark = \frac{\left(\frac{V_{max}}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$120 = \frac{\left(\frac{340}{\sqrt{2}}\right)^2}{R} \checkmark$$

$R = 481{,}67\ \Omega$ ✓ (4)

[8]

QUESTION 11/*VRAAG 11*

11.1 The minimum energy needed to remove an electron ✓
from the surface of a metal. ✓
Die minimum energie benodig om 'n elektron
vanaf die oppervlak van 'n metaal te verwyder. (2)

11.2
11.2.1 $W_0 = hf_0$ ✓
$= (6{,}63 \times 10^{-34})(4 \times 10^{14})$ ✓
$= 2{,}65 \times 10^{-19}$ J ✓ (3)

11.2.2 $E = W_0 + E_k$
$hf = hf_0 + \frac{1}{2}mv^2$
} ✓ Any one/*Enige een*

$(6{,}63 \times 10^{-34})(8 \times 10^{14})$ ✓ $= 2{,}65 \times 10^{-19}$ ✓ $+ \frac{1}{2}(9{,}11 \times 10^{-31})v^2$ ✓

$\therefore v = 7{,}63 \times 10^{5}$ m·s^{-1} ✓ (5)

11.3
11.3.1 Equal to /*Gelyk aan* ✓
The gradient is Planck's constant./ *Die gradiënt is Planck se konstante.* ✓ (2)

11.3.2 8×10^{14} Hz ✓
f_0 is directly proportional to W_0. / *f_0 is direk eweredig aan W_0.* ✓ (2)
[14]

TOTAL/*TOTAAL*: 150