Education and Sport Development

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NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE 12/ *GRAAD 12*

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

SEPTEMBER 2015

MARKS/*PUNTE*: 150

This memorandum consists of 13 pages. /
Hierdie memorandum bestaan uit 13 bladsye.

QUESTION 1 / *VRAAG 1*

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

[20]

QUESTION 2 / *VRAAG 2*

2.1 When a resultant force acts on an object, the object accelerates in the direction of the force. This acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

OR

The resultant/net force acting on an object is equal to ✓ the rate of change of momentum of the object in the direction of the resultant/net force ✓.

Indien 'n resulterende krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die resultante krag ✓ *en omgekeerd eweredig aan die massa* van die voorwerp. ✓

OF

Die resultante/netto krag wat op 'n voorwerp inwerk is gelyk aan ✓ *die tempo van verandering van momentum van die voorwerp, in die rigting van die resultante/netto krag.* ✓ (2)

2.2.1 $F_{net} = m \cdot a$ ✓

For 2 kg object / *Vir 2 kg voorwerp*

Subst. (2) into (1):
$2 \times 9,8 - T$ ✓ $= 2 \times a$ ✓-----(1)

$2 \times 9,8 = 5a + 2a$

$a = 2,8\ m \cdot s^{-2}$ ✓

For 5 kg object
Vir 5 kg voorwerp

✓ $T = 5 \times a$ -----(2)

(5)

2.2.2 $T = 5 \times 2,8$ ✓

$T = 14\ N$ ✓

OR/*OF*

$2 \times 9,8 - T = 2 \times 2,8$ ✓

$T = 14\ N$ ✓

(2)

2.3 For the 2 kg mass
/Vir die 2 kg massa:

$2 \times 9,8 - T = 2 \times 2$ ✓

$19,6 - 4 = T$ .....(1)

Subst. (1) into (2):
$f = 5,6\ N$ ✓

For the 5 kg mass
/Vir die 5 kg massa:

$T - f$ ✓$= 5 \times 2$ ✓

$T = 10 + f$ .....(2)

(4)

2.4 $F_{net} = 0$ ✓

Horizontal forces on the incline/
Horisontale kragte op die helling

$T = F_{//}$ → Both equations ✓ ← *Albei vergelykings*

$19,6$ ✓ $= 5 \times 9,8 \times \sin\theta$ ✓

Vertical forces/ *Vertikale kragte*

$T = m \times g$

$= 2 \times 9,8$

$= 19,6\ N$

$\theta = 23,58^{\circ}$ ✓

(5)

[18]

QUESTION 3 / *VRAAG 3*

3.1 0 (J)✓ (1)

3.2 The total mechanical energy✓ (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant.✓ /
Die totale meganiese energie✓ *(som van gravitasie potensiële en kinetiese energie) in 'n geslote sisteem bly konstant*✓ (2)

3.3 **OPTION 1/ *OPSIE 1***

$E_{mech\ (at\ C)} = E_{mech\ (at\ A)}$ / $E_{meg\ (by\ C)} = E_{meg\ (by\ A)}$

$(mgh + ½\ mv^2)_C = (mgh + ½\ mv^2)_A$

$m(gh + ½\ v^2)_C = m(gh + ½\ v^2)_A$

any equation✓/ *enige vergelyking*

$9,8 \times 1,5$ ✓$+ 0 = 9,8 \times 1$✓ $+ ½\ v^2$ ✓

OR write the equation using the mass as m/
OF gebruik m as die massa wanneer die vergelyking geskryf word

$v^2 = 9,8$ $v = \underline{3,13\ m{\cdot}s^{-1}}$ ✓ (5)

OPTION 2/ *OPSIE 2*

$E_{mech\ (at\ C)} = E_{mech\ (at\ B)}$ / $E_{meg\ (by\ C)} = E_{meg\ (by\ A)}$

$(mgh + ½\ mv^2)_C = (mgh + ½\ mv^2)_B$

$m(gh + ½\ v^2)_C = m(gh + ½\ v^2)_B$ ✓

any equation✓/ *enige vergelyking*

$\underline{m \times 9,8 \times 1,5 = ½ \times m \times v^2}$ ✓

$v = 5,42218$

$E_{mech\ (at\ B)} = E_{mech\ (at\ A)}$ / $E_{meg\ (by\ B)} = E_{meg\ (by\ A)}$

$\underline{½ \times m \times (5,42218)^2}$ ✓ $= \underline{½\ m \times v^2 + m \times 9,8 \times 1}$ ✓

OR write the equation without mass /*OF skryf die vergelyking sonder massa*

$v = \underline{3,13\ m.s^{-1}}$ ✓

3.4 **OPTION 1/ *OPSIE 1***

(+)

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

$\underline{1}$ ✓ $= \underline{3,13\ t + ½\ 9,8\ t^2}$✓

$t = 0,2338$ s ✓

OPTION 2 / *OPSIE 2*

$v_f^2 = v_i^2 + 2a\Delta x$

$\underline{v_f^2 = 9,8 + 2 \times 9,8 \times 1}$✓

$= 5,42218\ m.s^{-1}$

$v_f = v_i + g\ \Delta t$

both equations 1 mark ✓

$\underline{5,42218 = 3,13 + 9,8\ t}$ ✓

$t = 0,2336$ s ✓ (4)

3.5 Equal to C / *Gelyk aan C* (1)

[13]

QUESTION 4 / *VRAAG 4*

4.1.1 $F_{m1} = F_{m2}$ ✓ (1)

4.1.2 Newton's 3rd law ✓OR (state it in words)/
Newton se 3de wet ✓ *OF (stel in woorde)* (1)

4.2.1 $v_{m1} > v_{m2}$✓ (1)

4.2.2 Newton's 2nd law ✓ OR (state it in words)/
Newton se 2de wet ✓ *OF (stel in woorde)* (1)

4.3

Momentum is conserved/ *Momentum word behou*	Energy is conserved/ *Energie word behou*
$\sum p_i = \sum p_f$ or/*of*	$\frac{1}{2} mv^2_{\text{before/voor}} = \frac{1}{2} mv^2_{\text{after / na}}$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$ ✓	
both equations 1 mark/ *albei vergelykings 1 punt*	
let velocity of $m_1 = x$ and $m_2 = y$ *laat snelheid van* $m_1 = x$ *en* $m_2 = y$	
✓ $0 = 0,4x + 1,2(-y)$ ✓	✓ $0,225 = \frac{1}{2}0,4x^2 + \frac{1}{2}1,2y^2$ ✓
$x = 3y$	
$y = 0,306\ m{\cdot}s^{-1}$	$0,225 = \frac{1}{2}0,4(3y)^2 + \frac{1}{2}1,2y^2$ ✓

(6)

[10]

QUESTION 5 / *VRAAG 5*

5.1 Normal force✓ / *Normaalkrag*✓ (1)

5.2 X OR force of gravity OR weight✓ / *X OF gravitasiekrag OF gewig*✓ (1)

5.3 0✓ (1)

5.4 Z OR frictional force✓ / *Z OF wrywingskrag*✓ (1)

5.5 The net/total work done on an object is equal to ✓ the change in the object's kinetic energy ✓OR the work done on an object by a resultant/net force is equal to the change in the object's kinetic energy./
Die netto/totale werk wat op die voorwerp gedoen word, is gelyk aan ✓ *die verandering in die voorwerp se kinetiese energie.* ✓
OF
Die werk gedoen op 'n voorwerp deur 'n resultante/netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

5.6 $f_k = \mu_k N$✓
$= 0,42 \times 800 \times 9,8$✓
$= 3292,8\ N$✓ (3)

5.7 $W_{net} = \Delta K$ ✓ OR/*OF* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ OR/*OF* $\Delta E_k = E_{kf} - E_{ki}$

$3292,8 \times 88 \times \cos 180^\circ$ ✓ $= 0 - ½\ 800 \times v^2$ ✓ OR/*OF*

$3292,8 \times 88 \times -1 = 0 - ½\ 800 \times v^2$

$v = 26,915\ m.s^{-1}$ ✓ (4)

[13]

QUESTION 6 / *VRAAG 6*

6.1 Change in frequency (or pitch) of the sound detected by a listener ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation✓/
Die verandering in frekwensie (of toonhoogte) van die klank wat die luisteraar waarneem, ✓ *want die klankbron en die luisteraar het verskillende snelhede relatief tot die medium of klankvoortplanting*✓ (2)

6.2 180 Hz ✓ (1)

6.3 There is no relative motion between the source ✓and the listener✓/.
Daar is geen relatiewe beweging tussen die bron✓ *en die luisteraar nie*. ✓ (2)

6.4 Increases✓ *toeneem* (1)

6.5 For constant velocity /speed of sound ✓
If the frequency decreases λ increases✓/
Vir 'n konstante snelheid/ spoed van klank ✓
As die frekwensie afneem , neem λ toe ✓ (2)
OR/OF
The wave length inversely proportional to the wavelength when v is constant/
Die golflengte is omgekeerd eweredig aan die frekwensie indien v konstant bly.

6.4 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

188 ✓ $= \frac{340 + v_L}{340}$ ✓ 180 ✓

$v_L = 15,11\ m.s^{-1}$ ✓ (5)

[13]

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 uitgeoefen word deur een puntlading (Q_1) op 'n ander puntlading (Q_2) is direk eweredig aan die produk van die groottes van hul lading✓en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle✓

(2)

7.2 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$F = \frac{9\times10^9 \times 12\times10^{-9} \times 2\times10^{-9}}{(10\times10^{-3})^2}$ ✓ ✓

$= 2{,}16 \times 10^{-3}$ N✓

(4)

7.3 $F_{net} = 0$ OR/*OF* $F_1 + (-F_2) = 0$ OR /*OF* $F_1 = F_2$ ✓

ANY ONE EQUATION / *ENIGE EEN VERGELYKING* 1 mark/*punt*

$F_1 = \frac{9\times10^9 \times 12\times10^{-9} \times 1\times10^{-9}}{(x)^2}$ $F_2 = \frac{9\times10^9 \times 1\times10^{-9} \times 2\times10^{-9}}{(10\times10^{-3} - x)^2}$

4 marks allocated for substitution/ *4 punte toegeken vir vervanging*

$\frac{9\times10^9 \times 12\times10^{-9} \times 1\times10^{-9}}{(x)^2}$ ✓ ✓ $= \frac{9\times10^9 \times 1\times10^{-9} \times 2\times10^{-9}}{(10\times10^{-3} - x)^2}$ ✓ ✓

$x = 7.1 \times 10^{-3}$ m ✓

(6)

[12]

QUESTION 8 / *VRAAG 8*

8.1 6 V✓ (1)

8.2 $R=\frac{V}{I}$ ✓ $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$ ✓

$1=\frac{6}{I}$ ✓ $\frac{1}{R}=\frac{1}{2}+\frac{1}{2}$ ✓

I = 6 A✓ R = 1 Ω (5)

8.3 $R=\frac{V}{I}$ $\varepsilon = I\,(R+r)$ ✓

✓$2=\frac{6}{I}$ ✓ ✓6 = 3(1 + r) ✓

I = 3 A r = 1Ω ✓ (6)

8.4 Smaller than / *kleiner as*✓ (1)

8.5 With both S_1 and S_2 closed the total resistance decreases, the current increases,✓ ϵ (emf) remain the same✓ and I*r* (lost volts)increases ✓
Met beide S_1 en S_2 gesluit, neem die totale weerstand af/ die stroom verhoog ✓, ε (emk) bly dieselfde ✓ en Ir (verloor volts) verhoog ✓ (3)

[16]

QUESTION 9 / *VRAAG 9*

9.1 clockwise✓/ *kloksgewys* ✓ (1)

9.2 Reverse the direction of the current ✓ OR
Reverse the polarity of the magnet/
Draai die stroomrigting om ✓ OF
Draai die pole van die magneet om (1)

9.3 W = VIΔ t ✓ W = F Δx cos θ✓

= 6 x I x 2 ✓ = 3 x 0,8 x 1✓

= 12 I

$\frac{80}{100}\times 12\times I = 3\times 0{,}8\times 1$✓

I = 0,25 A✓ (6)

[8]

QUESTION 10 / *VRAAG 10*

10.1 B_1✓ (1)

10.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$

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

V_{rms} value in AC is less than the V value in DC✓

Power of bulb B_1 or $\left(\frac{V^2}{R}\right)$ > Power in bulb B_2 ✓

V_{wgk} waarde in AC is minder as die V-waarde in DC ✓

Drywing van gloeilamp B_1 of $\left(\frac{V^2}{R}\right)$ > Drywing in gloeilamp B_2 ✓ (3)

10.3

OPTION 1/ *OPSIE 1*

$P_1 = \frac{V^2}{R} = \frac{12^2}{R}$

$P_2 = \frac{8,485^2}{R}$

$P_1 : P_2 = ✓\frac{12^2}{R} \div \frac{(8,485)^2}{R}$ ✓

= 2 ✓ OR / *OF* 2: 1

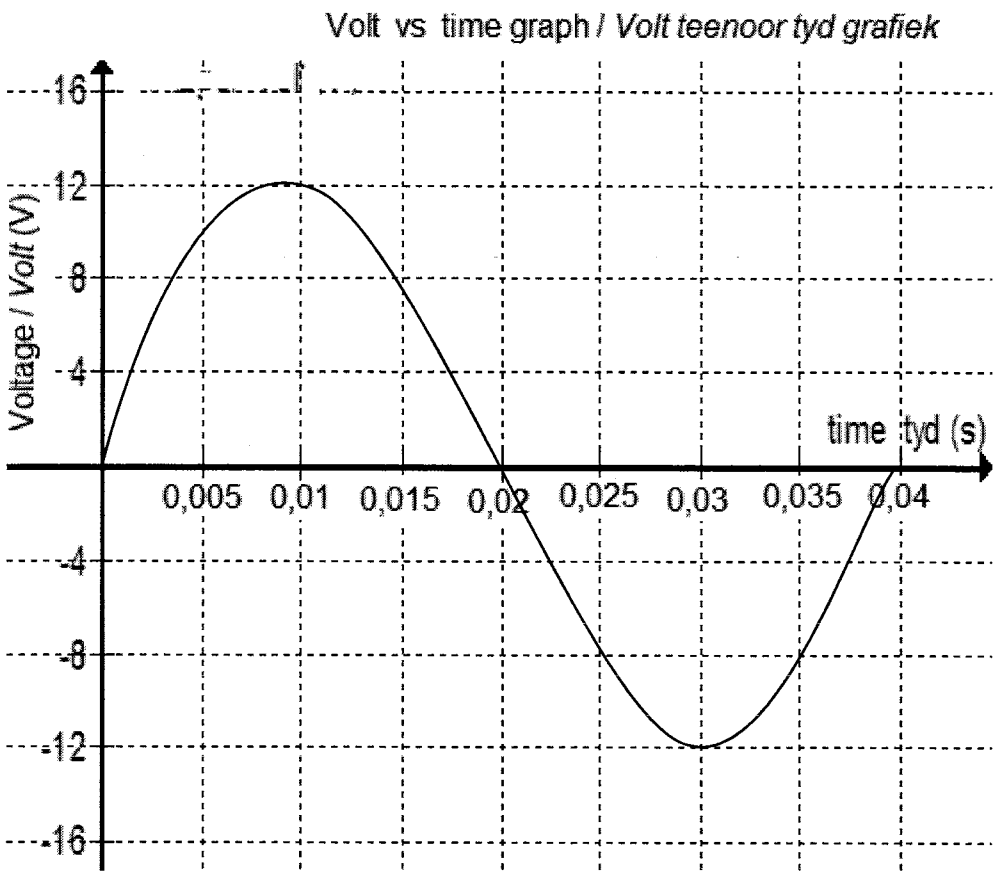
OPTION 2 / *OPSIE 2*

$P_1 : P_2 = \frac{12^2}{R}$ ✓ $\div \frac{\left(\frac{12}{\sqrt{2}}\right)^2}{R}$ ✓

= 2✓ OR / *OF* 2: 1

(3)

10.4



Sinusoidal curve/ *Sinuskurwe*	Axes marked/ *Asse gemerk*	Peak at 12 &- 12 *Piek by 12 & -12*	Graph changes direction at 0,02/ *Grafiek verander rigting by 0,02*	Ends at 0,04 *Eindig by 0,04*
1	1	1	1	1

(5)

[12]

QUESTION 11 / *VRAAG 11*

11.1 Photoelectric effect / *Fotoëlektriese effek* (1)

11.2 Minimum frequency of light ✓needed to emit electrons from the surface of the metal✓/
Minimum frekwensie van lig ✓wat nodig is om elektrone uit te straal uit die oppervlak van 'n metaal✓ (2)

11.3 $1,2 \times 10^{15}$ Hz ✓ (1)

11.4 Planck's constant OR (h) OR $6,63 \times 10^{-34}$ J·s ✓
Planck se konstante OF (h) OF $6,63 \times 10^{-34}$ J·s (1)

11.5 $E = hf$ OR/*OF* $W_0 = h f_0$✓

$= 6,63 \times 10^{-34} \times 0,68 \times 10^{15}$✓

$= \underline{4,5084 \times 10^{-19}\ J}$✓ (3)

11.6 $E = W_0 + E_k$ ✓

$$6,63\times10^{-34}\ \frac{3\times10^{8}}{187\times10^{-9}} \quad \begin{matrix}\checkmark\\ \checkmark\end{matrix} \quad = W_0 + 4\times10^{-19}\ \checkmark$$

$W_0 = 6,63636 \times 10^{-19}$✓

$W_0 = h f_0$

$f_0 = 1,0009 \times 10^{15}$ Hz✓

Al✓ (7)

[15]

GRAND TOTAL / *GROOTTOTAAL*: 150

ANALYSIS GRID PHYSICAL SCIENCE PAPER 1 2015

Question No.	Taxonomy														Knowledge area					
		Knowledge,Recall, Low Demand			COMPREHENSION, Basic Questions			APPLICATION, ANALYSIS, Problem Solving			SYNTHESIS, EVALUATION,Higher Abilities, Hard new problems, Challenge Level			TOTAL	MECHANICS	WAVES, SOUND & LIGHT	ELECTRICITY & MAGNETISM	MATTER & MATERIALS	TOTAL MARKS	Question Totals
	Content	E	M	D	E	M	D	E	M	D	E	M	D		Marks					
1.1	projectile	2												2	2				2	
1.2	projectile		2											2	2				2	
1.3	newton law					2								2	2				2	
1.4	momentum						2							2	2				2	
1.5	energy		2											2	2				2	
1.6	doppler			2										2		2			2	
1.7	electrostatics	2												2			2		2	
1.8	electrodymamics	2												2			2		2	
1.9	circuits									2				2			2		2	
1.10	matter and materials					2								2				2	2	20
2.1	newton law	2												2	2				2	
2.2.1	newton law									5				5	5				5	
2.2.2	newton law							2						2	2				2	
2.3	newton law									4				4	4				4	
2.4	newton law											5		5	5				5	18
3.1	projectile	1												1	1				1	
3.2	projectile	2												2	2				2	
3.3	projectile								5					5	5				5	
3.4	projectile								4					4	4				4	
3.5	projectile				1									1	1				1	13
4.1.1	newton law				1									1	1				1	
4.1.2	newton law		1											1	1				1	
4.2.1	newton law					1								1	1				1	
4.2.2	newton law		1											1	1				1	
4.3	momentum												6	6	6				6	10
5.1	forces	1												1	1				1	
5.2	forces		1											1	1				1	
5.3	forces		1											1	1				1	
5.4	work		1											1	1				1	
5.5	work	2												2	2				2	
5.6	work								3					3	3				3	
5.7	work								4					4	4				4	13
6.1	doppler		2											2		2			2	
6.2	doppler	1												1		1			1	
6.3	doppler						2							2		2			2	

6.4	doppler	1												1						
6.5	doppler					2								2		2			2	
6.6	doppler								5					5		5			5	13
7.1	electrostatics		2											2			2		2	
7.2	electrostatics								4					4			4		4	
7.3	electrostatics												6	6			6		6	12
8.1	circuits	1												1			1		1	
8.2	circuits							5						5			5		5	
8.3	circuits								6					6			6		6	
8.4	circuits					1								1			1		1	
8.5	circuits								3					3			3		3	16
9.1	electrodynamics				1									1			1		1	
9.2	electrodynamics				1									1			1		1	
9.3	electrodynamics												6	6			6		6	8
10.1	electrodynamics						1							1			1		1	
10.2	electrodynamics								3					3			3		3	
10.3	electrodynamics								3					3			3		3	
10.4	electrodynamics										5			5			5		5	12
11.1	photoelectric	1												1				1	1	
11.2	photoelectric	2												2				2	2	
11.3	photoelectric					1								1				1	1	
11.4	photoelectric					1								1				1	1	
11.5	photoelectric							3						3				3	3	
11.6	photoelectric											7		7				7	7	15
		20	**13**	**2**	**4**	**10**	**5**	**10**	**40**	**11**	**5**	**12**	**18**	**150**	**64**	**15**	**49**	**17**	**150**	
		35			19			61			35			150	64	15	49	17		
		15.3%			34.7%			40.0%			10.0%				46%	10.0%	32.7%	11,3%		
		15			35			40			10				45%	8%	36%	10%		

Overall

E	M	D
35	80	35
23%	53%	23 %
30	40	30

150