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 2017

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 20pages.
Hierdie nasienriglyne bestaan uit 20 bladsye.

QUESTION 1 / *VRAAG 1*

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

[20]

QUESTION 2 / *VRAAG 2*

2.1.1 An object continues in its state of rest or uniform motion (moving with constant velocity) unless it is acted upon by an unbalanced (resultant/net) force.✓✓

OR

A body will remain in its state of rest or motion at constant velocity unless a resultant/net force acts on it.✓✓

OR

A body will remain in its state of rest or of uniform motion in a straight line at constant velocity/speed unless a non-zero resultant/net force acts on it.✓✓

'n Liggaam sal in sy toestand van rus of uniforme beweging (teen konstante snelheid) volhard tensy 'n ongebalanseerde (resulterende/netto) krag daarop inwerk.

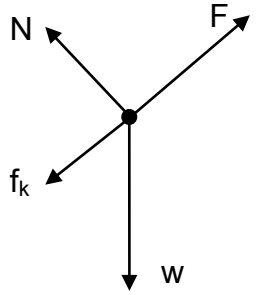
OF

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly tensy 'n resulterende/netto krag daarop inwerk

OF

'n Liggaam sal in sy toestand van rus of uniforme beweging in 'n reguitlyn teen konstante snelheid/spoed volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk. (2)

2.1.3



Accepted Labels/*Aanvaarde benoemings*	
w	F_g / F_w/weight/mg /78,4 N/gravitational force *F_g / F_w /gewig/mg/78,4 N/gravitasiekrag*
F	F_{app}/F_A / applied force (Accept T / tension) $F_{toegepas}$/ F_T / toegepaste krag *(Aanvaar T / spanning)*
f_k	(kinetic) Friction/F_f/f/*(kineties) wrywing*/F_w
N	F_N/Normal (force)/*Normaal(krag)*/ 67,9 N

(4)

2.1.3

$F_{net} = ma$ ✓
$F_{net} = 0$
$F+(-f_k) + (-F_{g||}) = ma$
$F- (f_k + F_{g||}) = ma$
$F - 20,37$✓ $- (8)(9,8)\sin 30^{o}$✓ $= 0$
$F = 59,57$ N ✓ (5)

2.1.4

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$F_{net} = ma$ $(F_{g\|\|} - f_k) = ma$ } ✓ $(8)(9,8)\sin 30^{o} - 20,37$✓ $= 8a$ ✓ ∴magnitude/*grootte:* $a = 2,35\ m\cdot s^{-2}$✓	$F_{net} = ma$ $(f_k - F_{g||}) = ma$ } ✓ $20,37 + [-(8)(9,8)\sin 30^{o}]$✓ $= 8a$ ✓ ∴$a = -2,35\ m\cdot s^{-2}$ ∴ magnitude/*grootte:* $a = 2,35\ m\cdot s^{-2}$✓

(4)

2.2.1

Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte.

OR/*OF*
Every particle in the universe attracts every other particle with a force along a line joining them. The force is directly proportional to the product of the masses ✓ of the particles and inversely proportional to the square of the distance between them. ✓
Elke partikel in die heelal trek elke ander partikel aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle. (2)

2.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$g = \frac{GM}{r^2}$ ✓ ✓ $6 = \frac{(6,67 \times 10^{-11})M}{(700 \times 10^3)^2}$✓ $M = 4,41 \times 10^{22}$ kg ✓	$F = G\frac{m_1 m_2}{r^2}$ $mg = \frac{GmM}{r^2}$ ✓ ✓ $(200)(6) = \frac{(6,67 \times 10^{-11})(200)M}{(700 \times 10^3)^2}$ ✓ $M = 4,41 \times 10^{22}$ kg ✓

(4)
[21]

QUESTION 3 / *VRAAG 3*

3.1

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $v_f = v_i + a\Delta t$✓ $0 = (12) + (-9,8)(\Delta t)$ ✓ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$✓ $0 = (-12) + (9,8)(\Delta t)$ ✓ $\Delta t = 1,22$ s✓

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$✓ $\Delta y = 7,35$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $7,35 = 12\Delta t + ½\ (-9,8)\Delta t^2$ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$✓ $\Delta y = -7,35$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $-7,35 = -12\Delta t + ½\ (9,8)\ \Delta t^2$ $\Delta t = 1,22$ s✓

OPTION 3/*OPSIE 3*	
Upwards positive ***Opwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$✓ $\Delta y = 7,35$ m $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$✓ $\Delta y = -7,35$ m $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-7,35 = \frac{(-12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓

OPTION 4/*OPSIE 4*	
$(E_{mech})_A = (E_{mech})_{top}$ $(½\ mv^2 + mgh)_A = (½\ mv^2 + mgh)_{top}$ $\underline{½m(12)^2} + \underline{0 = 0 + m(9,8)(h)}$ ✓ $\therefore h = \Delta y = 7,35$ m	
OR/OF $W_{net} = \Delta E_k$ $F_{net}\Delta y\cos\theta = ½\ m(v_f^2 - v_i^2)$ $\underline{m(9,8)\Delta y\cos 180^o} = \underline{½\ m(0^2 - (12)^2)}$✓ $\Delta y = 7,35$ m	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓
OR/*OF* $\Delta E_p + \Delta E_k = 0$ $mg(h_f - h_i) + ½\ m(v_f^2 - v_i^2) = 0$ $\underline{m(9,8)(h - 0)} + \underline{½(m)(0 - 12^2)} = 0$✓ $\therefore h = \Delta y = 7,35$ m	

OPTION 5/*OPSIE 5*	
Upwards positive ***Opwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(-9,8)\Delta t = (0 - 12)$ ✓ $\Delta t = 1,2245$ s ✓	**Downwards positive** ***Afwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(9,8)\Delta t = (0 - (-12))$ ✓ $\Delta t = 1,2245$ s ✓

OPTION 6/*OPSIE 6*	
Upwards positive ***Opwaarts positief:*** $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $0 = 12\Delta t + ½ (-9,8)\Delta t^2$ $\Delta t = 2,4490$ s $\Delta t = ½ (2,4490)$✓ $= 1,2245$ s ✓	**Downwards positive** ***Afwaarts positief:*** $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $0 = -12\Delta t + ½ (9,8)\Delta t^2$ $\Delta t = 2,4490$ s $\Delta t = ½ (2,4490)$ ✓ $= 1,2245$ s ✓

(3)

3.2

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $v_f = v_i + a\Delta t$✓ $\underline{-3v = -v}$✓ + $\underline{(-9,8)(1,22)}$ ✓ $v = 5,98$ m·s^{-1}✓(5,978 – 6,03 m·s^{-1})	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$✓ $\underline{3v = v}$✓ + $\underline{(9,8)(1,22)}$ ✓ $v = 5,98$ m·s^{-1}✓(5,978 – 6,03 m·s^{-1})

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(-9,8)(1,2245)$✓ = $\underline{-3v - (-v)}$✓ $v = 6,00$ m·s^{-1} ✓	**Downwards positive** ***Afwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(9,8)(1,2245)$✓ = $3v - v$✓ $v = 6,00$ m·s^{-1} ✓

(4)

3.3

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $\Delta y = v_i\Delta t + ½a\Delta t^2$✓ = $\underline{(-5,98)(2,44) + ½(-9,8)(2,44)^2}$✓ = - 43,764 $\therefore h = 43,76$ m✓ (43,764 – 44,08 m)	Downwards positive *Afwaarts positief:* $\Delta y = v_i\Delta t + ½a\Delta t^2$✓ = $\underline{(5,98)(2,44) + ½(9,8)(2,44)^2}$ ✓ = 43,764 $\therefore h = 43,76$ m✓(43,764 – 44,08)

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief*** $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-29,892)^2 = (-5,98)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -43,763$ m $\therefore h = 43,76$ m ✓(43,764 – 44,08)	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(29,892)^2 = (5,98)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 43,76$ m $\therefore h = 43,76$ m ✓(43,764 – 44,08)

OPTION 3/*OPSIE 3*	
Upwards positive ***Opwaarts positief*** $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892\ m\cdot s^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\left(\frac{-30 + (-6,00)}{2}\right)(2,4490)\right)$ ✓ $\Delta x = -44,082$ m h = 44,082 m ✓	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892\ m\cdot s^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\left(\frac{30 + 6,00}{2}\right)(2,4490)\right)$ ✓ $\Delta x = 44,082$ m h = 44,082 m ✓

OPTION 4/*OPSIE 4*	
Upwards positive ***Opwaarts positief*** **For A/ *Vir A*** $v_f = v_i + a\Delta t$ $-12 = 12 + (-9,8)\Delta t$ $\Delta t = 2,45$ s **For B/ *Vir B*** $\Delta x = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= (-5,98)(2,45) + ½\ (-9,8)(2,45)^2$ ✓ $= -44,06$ m h = 44,06 m ✓	**Downwards positive** ***Afwaarts positief:*** **For A/ *Vir A*** $v_f = v_i + a\Delta t$ $12 = -12 + (9,8)\Delta t$ $\Delta t = 2,45$ s **For B/ *Vir B*** $\Delta x = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= (5,98)(2,45) + ½\ (9,8)(2,45)^2$ ✓ $= 44,06$ m h = 44,06 m ✓

(3)

OPTION 5/*OPSIE 5*	
Upwards positive ***Opwaarts positief*** $\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓ $\Delta y_A = 12\Delta t + ½\ a\Delta t^2$ $\Delta y_B = -6\Delta t + ½\ a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = 18\Delta t$ ✓ $= 18(2,44)$ $= 43,92$ m h = 43,92 m ✓	**Downwards positive** ***Afwaarts positief:*** $\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓ $\Delta y_A = -12\Delta t + ½\ a\Delta t^2$ $\Delta y_B = 6\Delta t + ½\ a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = -18\Delta t$ ✓ $= -18(2,44)$ $= 43,92$ m h = 43,92 m ✓

(3)

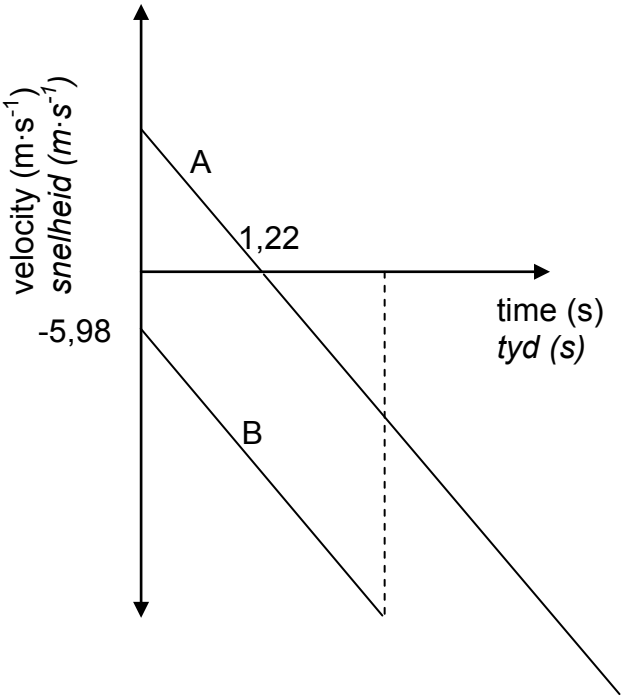
OPTION 6/*OPSIE 6*	
Upwards positive ***Opwaarts positief*** $W_{net} = \Delta E_k$ ✓ $mg\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$ $\underline{(-9,8)h\cos 0^o} = \underline{½ (-20)^2} - \underline{½ (-6)^2}$ ✓ h = 44,082 m ✓	**Downwards positive** ***Afwaarts positief:*** $W_{net} = \Delta E_k$ ✓ $mg\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$ $\underline{(9,8)h\cos 0^o} = \underline{½ (20)^2} - \underline{½ (6)^2}$ ✓ h = 44,082 m ✓

OPTION 7/*OPSIE 7*
$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bottom/onder}$ $mgh_i + ½ mv_i^2 = mgh_f + ½ mv_f^2$ ✓ $\underline{(9,8)h} + \underline{½ (6)^2} = (9,8)(0) + ½ (30)^2$ ✓ h = 44,082 m ✓

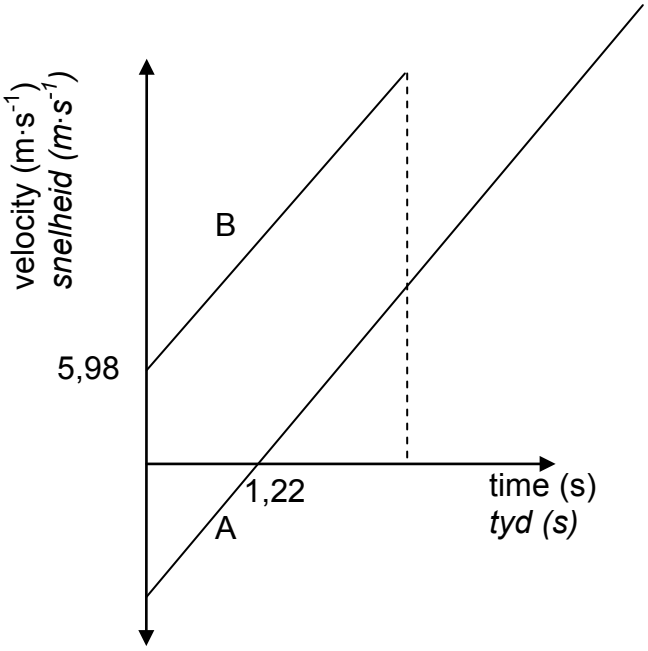
(3)

3.4

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*



DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*



Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Time 1,22 s shown **correctly**/*Tyd 1,22 s **korrek** getoon*	✓
Initial velocity for stone B at time t = 0 correctly shown with correct signs / *Aanvanklike snelheid vir klip B korrek met korrekte tekens getoon*	✓
Two sloping parallel lines with A **crossing** the time axis /*Twee skuins parallelle lyne met A wat die tyd-as **kruis***	✓
Straight line graph for A parallel to graph B, extending beyond the time when B hits the ground/ *Reguitlyn grafiek A parallel aan grafiek B verleng verby die tyd wanneer B die grond tref*	✓

(4)
[14]

QUESTION 4 /*VRAAG 4*

4.1 The <u>total</u> linear momentum in an <u>isolated</u>/<u>closed</u> system is constant.✓✓
Die <u>totale</u> liniêre momentum in 'n <u>geïsoleerde</u> <u>(geslote)</u> sisteem is konstant

OR/*OF*
In an <u>isolated</u>/<u>closed</u> system, <u>total</u> linear momentum before collision is equal to <u>total</u> linear momentum after collision. ✓✓
In 'n <u>geïsoleerde (geslote)</u> sisteem is die <u>totale</u> liniêre momentum voor die botsing gelyk aan die <u>totale</u> momentum na die botsing. (2)

4.2 $\Sigma p_i = \Sigma p_f$ ✓

$m_B v_{Bi} + m_b v_{bi} = m_B v_{Bf} + m_b v_{bf}$

$\Delta p_{bullet} = -\Delta p_{block}$

$\underline{(0,015)(400)}$✓ + 0 = $(0,015)v_{Bf}$ + $\underline{2(0,7)}$✓

V_{Bf} = 306,67 (306,666)$m \cdot s^{-1}$✓ (4)

4.3

OPTION 1/*OPSIE 1*

$F_{net}\Delta t = \Delta p$
$\Delta p = mv_f - mv_i$ ✓

For bullet / *Vir koeël*
$\Delta p = (0,015)(306,666 - 400)$✓
$= -1,4\ kg\cdot m\cdot s^{-1}$
$F_{net}(0,002) = -1,4$
$F_{net} = -700\ N$

For block / *Vir blok*
$\Delta p = (2)(0,7 - 0)$✓
$= 1,4\ kg\cdot m\cdot s^{-1}$
$F_{net}(0,002) = 1,4$
$F_{net} = 700\ N$

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$
$(700)\Delta x\cos 180^o$ ✓$= ½\ (0,015)(306,67^2 - 400^2)$✓
$\Delta x = 0,71\ m$ ✓

$F_{net} = ma$
$-700 = (0,015)a$
OR/*OF*
$F_{met} = ma$
$700 = (0,015)a$

$a = -46\ 666,67$
or/*of* $46\ 665\ m\cdot s^{-2}$

$\Delta x = v_i\Delta t + ½\ a\Delta t^2$
$= (400)(0,002)$✓ $+ ½(-46\ 666,67)(0,002)^2$✓
$= 0,71\ m\ (0,70667)\ m$✓

OR/OF
$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta x$
$(306,67)^2$ ✓$= (400)^2 + 2(-46\ 666,67)\Delta x$✓
$\Delta x = 0,71\ m\ (0,70667\ m)$ ✓

OPTION 2/*OPSIE 2*

$v_f = v_i + a\Delta t$✓
$306,666 = 400 + a\ (0,002)$ ✓
$a = -46\ 667\ m\cdot s^{-2}$

$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta x$
$(306,666)^2$ ✓$= 400^2 + 2(-4667)\ \Delta x$✓
$\Delta x = 0,71\ m\ (0,706\ m)$ ✓

OPTION 3/*OPSIE 3*

$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{400 + 306,666}{2}\right)(0,002)$ ✓
$= 0,71\ m\ (0,707)\ m$ ✓

OPTION 4/*OPSIE 4* $W_{net} = \Delta K/\Delta E_k$ ✓ $F_{net}\Delta x\cos\theta = ma\Delta x\cos\theta = \Delta K/\Delta E_k$ $v_f = v_i + a\Delta t$ $306,666 = 400 + a\,(0,002)$ ✓ $a = -46\ 667\ m\cdot s^{-2}$
$W_{net} = \Delta K/\Delta E_k$ $F_{net}\Delta x\cos\theta = ma\Delta x\cos\theta = \Delta K/\Delta E_k$ $(0,015)(46\ 667)\Delta x\cos180^o$✓ $= ½(0,015)(306,666^2 - 400^2)$✓ $\Delta x = 0,71$ m (0,707) ✓
OR/*OF* $W_{nc} = \Delta E_p + \Delta E_k$ $(0,015)(46\ 667)\Delta x\cos180^o$✓ $= ½(0,015)(306,666^2 - 400^2)$✓ $\Delta x = 0,71$ m (0,707) ✓

(5)
[11]

QUESTION 5/*VRAAG 5*

5.1 The net/total work done (on an object) is equal to the change in the object's kinetic energy.✓✓
Die netto/totale arbeid wat (op 'n voorwerp) verrig is is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/*OF*
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.✓✓
Die arbeid verrig op in voorwerp deur die resultante/netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

5.2

Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w / weight / mg/ 58,8N / gravitational force / $F_{\text{earth on block}}$ *F_g / F_w / gewig / mg /58,8 N/ gravitasiekrag* / $F_{\text{aarde op blok}}$
T	F_T/ Tension/ *spanning*

5.3

$W_w = w\Delta x\cos\theta$✓ $= mg\Delta x\cos\theta$ $= (6)(9,8)(1,6)\cos0^o$✓ $\therefore W = 94,08$ J ✓	$W_w = -\Delta E_P$ ✓ $= -mg(h_f - h_i)$ $= -(6)(9,8)(0 - 1,6)$ ✓ $= 94,08$ J✓

(3)

5.4

OPTION 1/*OPSIE 1*

$W_{net} = \Delta E_K / \Delta K$✓ $= ½m(v_f^{\ 2} - v_i^{\ 2})$
$W_{net} = F_{net}\Delta x\cos\theta$
$W_{net} = W_f + W_g + W_N$
$= \mu_k N\Delta x\cos\theta + W_g + W_N$

$W_{net} = \underline{(0,4)(4)(9,8)(1,6)\cos180^o}$ ✓ + 94,08 + 0
$= 68,992$ J
$W_{net} = ½m(v_f^{\ 2} - v_i^{\ 2})$
$\underline{68,992}$✓$= \underline{½(4)(v_f^{\ 2} - 0)} + \underline{½(6)(v_f^2 - 0)}$✓
$v_f = 3,71\ m\cdot s^{-1}$✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta = (m_1gh_f - m_1gh_i) + (½m_1v_f^2 - ½m_1v_i^2) + (½m_2v_f^2 - ½m_2v_i^2)$
$\underline{(0,4)(4)(9,8)\ (1,6)\cos 180^o}$ ✓$= [0 - (6)(9,8)(1,6)]$✓$+ (½(6)v_f^2 + ½(4)v_f^2 - 0)$✓
$68,992 = 5v_f^2$
$v_f = 3,71\ m\cdot s^{-1}$✓

OPTION 3/*OPSIE 3*

$f_k = \mu_k N = (0,4)(4)(9,8) = 15,68$ N
$T - f_k = ma$
$w - T = ma$
$T - 15,68 = 4a$ … .(i)
$(6)(9,8) - T = 6a$ ……..(ii)
$\therefore a = 4,312\ m\cdot s^{-2}$
$\therefore T = 32,928$ N

$F_{net} = ma$
$= (6)(4,312)$
$= 25,872$

$W_{net} = F_{net}\Delta x\cos\theta$
$= (25,872)(1,6)\cos0^o$✓
$= 41,3952$ J

$W_{net} = \Delta E_k$✓
$41,3952 = ½\ m(v_f^2 - v_i^2$
$\underline{41,3952 = ½\ (6)(v_f^2 - 0)}$✓
$v_f = 3,7146\ m\cdot s^{-1}$✓

Above calculations can be done with 4 kg or 10 kg / *Bostaande berekeninge kan met 4 kg of 10 kg gedoen word*

<u>4 kg block</u>
$W_{net} = \Delta E_K / \Delta K$✓
$W_f + W_T = ½m(v_f^2 - v_i^2)$

$f\Delta x\cos180^o + T\Delta x\cos0^o = ½(4)(v_f^2 - 0)$
$(15,68)(1,6)(-1)$✓ $+ (32,928)(1,6)(1)$✓ $= 2v_f^2$
$v_f = 3,72\ m\cdot s^{-1}$✓

<u>6 kg block</u>
$W_{net} = \Delta E_K / \Delta K$✓
$W_w + W_T = ½m(v_f^2 - v_i^2)$

$mg\Delta x\cos0^o + T\Delta x\cos180^o = ½(6)(v_f^2 - 0)$
$(6)(9,8)(1,6)(1)$✓$+ (32,928)(1,6)(-1)$✓$= 3v_f^2$
$v_f = 3,72\ m\cdot s^{-1}$✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_K / \Delta K$ ✓

For the 4 kg mass / *Vir die 4 kg massa*

$T(1,6)\cos 0^o + [(0,4)(9,8)(4)](1,6)\cos 180^o$ ✓ $= ½(4)v^2 - 0)$

For the 6 kg mass/*Vir die 6 kg massa*

$(6)(9,8)(1,6)]\cos 0^o + T(1,6)\cos 180^o$ ✓ $= ½(6)(v^2 - 0)$

Adding the two equations / *Optel van twee vergelykings*

$68,992 = ½(4)v^2 + ½(6)v^2$ ✓

$5v^2 = 68,992$

$v = 3,71\ m\cdot s^{-1}$ ✓

OPTION 5/*OPSIE 5*

$W_{net} = \Delta E_k$ ✓

$F_{net}\ \Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$

$(F_g - f)\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$

$[(6)(9,8) - (0,4)(4)(9,8)]$ ✓ $(1,6)\cos 0^o$ ✓ $= ½(10)(v_f^2 - 0)$ ✓

$v_f = 3,71 m.s^{-1}$ ✓ (5)

[12]

QUESTION 6 / *VRAAG 6*

6.1 It is the (apparent) 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. ✓

Dit is die verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het.

OR/OF

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) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer / luisteraar. (2)

6.2.1 170 Hz✓ (1)

6.2.2 130 Hz✓ (1)

6.3 **POSITIVE MARKING FROM QUESTIONS 6.2.1 and 6.2.2/**
POSITIEWE NASIEN VANAF VRAAG 6.2.1 en 6.2.2

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

$$170 \overset{\checkmark}{=} \frac{(340 + 0)}{(340 - v_s)} \overset{\checkmark}{\times} f_s \text{ ---------- } (1)$$

$$130 \overset{\checkmark}{=} \frac{(340 - 0)}{340 + v_s} \overset{\checkmark}{\times} f_s \text{ ---------- } (2)$$

$v_s = 45,33\ m\cdot s^{-1}$ ✓ $(45,33 - 45,45\ m\cdot s^{-1})$ (6)

[10]

QUESTION 7 / *VRAAG 7*

7.1 The magnitude of the electrostatic force exerted by one point charge on another point charge 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 uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.
OR/*OF*
The force of attraction or repulsion between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓
Die aantrekkings- of afstotingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

7.2

OPTION 1/ *OPSIE 1*

$F = k\frac{Q_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^{9})(6\times10^{-6})(8\times10^{-6})}{(0,2)^2}$ ✓ ✓

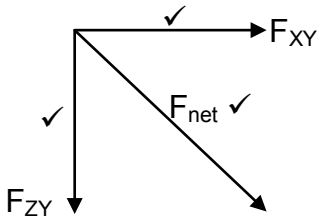
= 10,8 N✓

OPTION 2/ *OPSIE 2*

$E = \frac{kQ}{r^2} = \frac{(9\times10^{9})(8\times10^{-6})}{(0,2)^2}$ ✓ = 1,8 x 10^4 N·C^{-1}

F = Eq = (1,8 x 10^4)(6 x 10^{-6})✓ = 10,8 N✓ (4)

7.3



(3)

7.4

OPTION 1 /*OPSIE 1*

$F_{net}^2 = F_{XY}^2 + F_{ZY}^2$

$15{,}20^2 = 10{,}8^2 + F_{ZY}^2$

F_{ZY} = 10,696 N

$F_{ZY} = k\frac{Q_Z Q_Y}{r^2}$

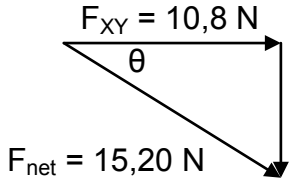
$10{,}696\checkmark = 9\times10^9 \times \frac{8\times10^{-6}\times Q_Z}{(0{,}30)^2}\checkmark$

Q_Z = 1,34 x 10^{-5} C✓

OPTION 2 /*OPSIE 2*

$\cos\theta = \frac{10{,}8}{15{,}2}$

$\theta = 44{,}72^o$



$\sin 44{,}72 = \frac{F_{ZY}}{15{,}2}\checkmark$ **OR/*OF*** $\tan 44{,}72 = \frac{F_{ZY}}{F_{XY}}$

F_{ZY} = 10,696 N

$F_{ZY} = k\frac{Q_Z Q_Y}{r^2}$

$10{,}696\checkmark = 9\times10^9 \times \frac{8\times10^{-6}\times Q_Z}{(0{,}30)^2}\checkmark$

Q_Z = 1,34 x 10^{-5} C✓

(4)
[13]

QUESTION 8 / *VRAAG 8*

8.1 Electric field at a point is the force per <u>unit</u> <u>positive</u> charge placed at that point. ✓✓
Elektriese veld by 'n punt is die krag per <u>eenheids</u> <u>positiewe</u> lading geplaas by daardie punt. (2)

8.2

$E = \frac{kQ}{r^2}\checkmark$

$E_{net} = (E_A + E_B)$

$= 9\times10^9 \frac{(1{,}5\times10^{-6})\checkmark}{(0{,}4)^2} + 9\times10^9 \frac{(2{,}0\times10^{-6})}{(0{,}3)^2}\checkmark$

= 2,84 x 10^5 N·C^{-1} ✓ (4)

8.3

OPTION 1/*OPSIE 1*

$F_E = qE$ ✓

= (3,0 x 10^{-9})(2,84 x 10^5) ✓

= 8,52 x 10^{-4} N ✓

OPTION 2/*OPSIE 2*

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$F_{net} = (F_A + F_B)$

$= \left(\frac{(9\times10^9)(3\times10^{-6})(1{,}5\times10^{-6})}{(0{,}4)^2} + \frac{(9\times10^9)(3\times10^{-6})(2{,}0\times10^{-6})}{(0{,}3)^2} \right)$ ✓

$= 8{,}53 \times 10^{-4}$ N ✓ (3)

[9]

QUESTION 9 / *VRAAG 9*

9.1.1 The potential difference (voltage) across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓
Die potensiaalverskil (spanning) oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.
OR/*OF*
The current in a conductor is directly proportional to the potential difference (voltage) across the conductor if temperature is constant✓✓
Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil (spanning) oor die geleier indien die temperatuur konstant is. (2)

9.1.2 (Equivalent) resistance/ (*Ekwivalente) weerstand*✓ (1)

9.1.3 Gradient/*Helling* = $\frac{\Delta V}{\Delta I}$

$= \frac{2-0}{0{,}5-0}$ ✓ = 4 (Ω)✓ (2)

9.1.4 **OPTION 1/*OPSIE 1***

In series $R_1 + R_2 = 4\ \Omega$ ✓.....(1)

In parallel $\frac{R_1R_2}{R_1+R_2} = 1\ \Omega$ ✓✓.....(2)

$R_1R_2 = 4\ \Omega$

$\therefore R_1 = R_2 = 2\ \Omega$ ✓

OPTION 2/*OPSIE 2*

For graph X/*Vir grafiek X*:

$R_1 + R_2 = 4$……(1) ✓

For graph Y/*Vir grafiek Y*

$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\left\{ \left(\frac{1}{R_1} + \frac{1}{R_2} \right) = \left(\frac{1}{1} \right) \right\}$ ✓✓.....(2)

$R_1^2 - 4R_1 + 4 = 0$

$R_1 = 2\ \Omega$✓ (4)

9.2.1

$$I = \frac{V}{R}$$

$$= \frac{5}{(R_M + R_N)}$$

$$= \frac{5}{(6)} \checkmark$$

$$= 0{,}83 \text{ A} \checkmark$$

(3)

9.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\mathcal{E} = I(R + r)$ ✓ $= 0{,}83[(6 + 1{,}5)$ ✓$+ 0{,}9$✓$]$ $= 6{,}997$ V $= 7(,00)$ V✓ (6,972 – 7,00 V)	$\mathcal{E} = (V_s + V_{//} + V_r)$✓ / $V_{ext/eks} + V_{int}$ $= [5 + (0{,}833 \times 1{,}5)$ ✓$+ (0{,}9 \times 0{,}833)]$ ✓ $= 6{,}999$ V $= 7(,00)$ V✓ (6,972 – 7,00 V)

9.2.3 The resistance R_N will be 3 Ω ✓
The voltage divides (proportionately) in a series circuit. Since the voltage across **M** is half the total voltage, it means the resistances of **M** and **N** are equal.✓

Die weerstand R_N sal 3 Ω wees.
*Die potensiaalverskil verdeel (eweredig) in 'n serie stroombaan. Aangesien die potensiaalverskil oor **M** die helfte is van die totale potensiaalverskil, beteken dit dat die weerstande van **M** en **N** gelyk is.* (2)

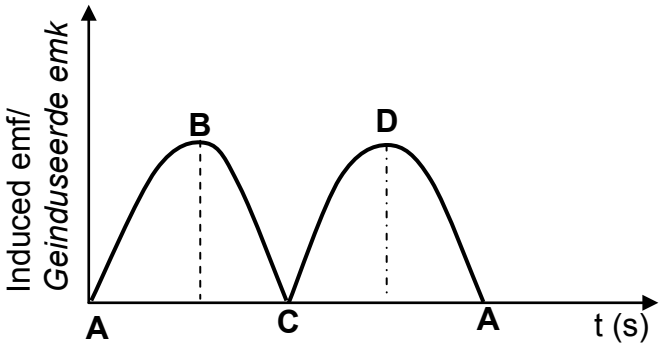
[18]

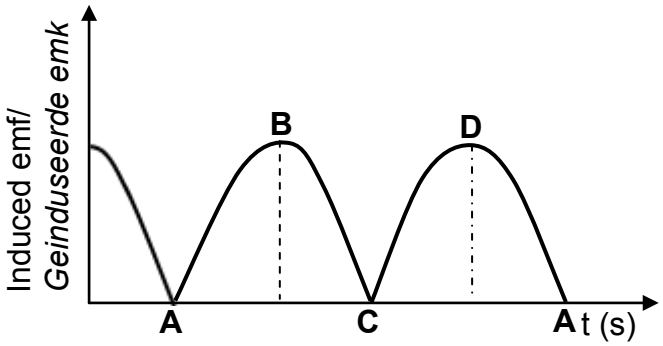
QUESTION 10 / *VRAAG10*

10.1

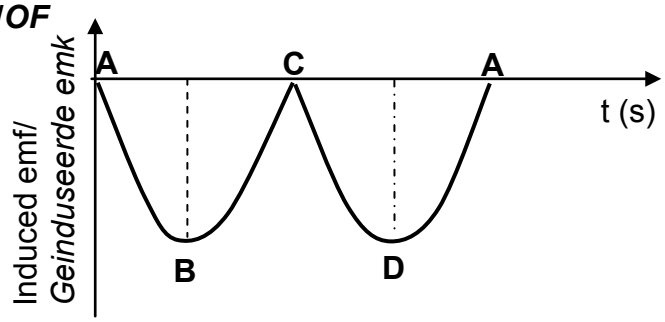
10.1.1 Mechanical to electrical / Meganies na elektries ✓ (1)

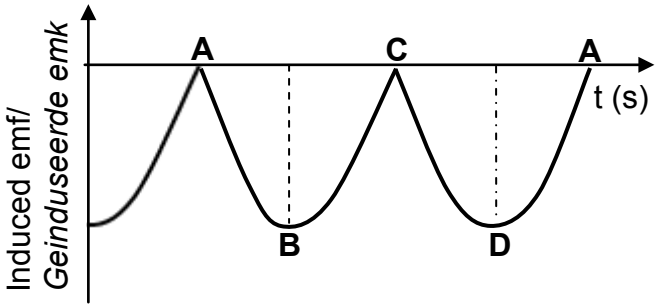
10.1.2





OR/*OF*





Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Correct DC shape, starting from zero/*Korrekte GS vorm wat by nul begin*	✓
Positions ABCDA correctly indicated on the graph/*Posisies ABCDA of grafiek aangedui*	✓

(2)

10.2.1 20,5 Ω✓ (1)

10.2.2

OPTION 1/*OPSIE 1*

$I_{rms} = \frac{V_{rms}}{R}$✓ $= \frac{25}{20,5}$✓
$= 1,22\ (1,2195)\ A$

$P_{ave} = I_{rms}^2 R$ $=(1,22)^2(0,5)$ $= 0,74\ W$ $P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $P_{ave} = \frac{(25)^2}{20,5}$✓ $P_{ave} = 30,49\ W$ Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)* $= (30,49 – 0,74)$ $= 29,75\ W$✓	$P_{ave} = I_{rms}^2 R$✓ $= (1,22)^2(20)$ ✓ $= 29,77\ W$✓ **OR/OF** $V_{rms/wgk\ device/toestel} = \frac{20}{20,5}$✓$\times 25 = 24,39\ V$ $P_{ave} = V_{rms} I_{rms}$ ✓ $= (24,39)(1,22)$ $= 29,76\ W$ ✓	$W = I^2_{rms} R\Delta t$ $= (1,22)^2\ (0,5)(1)$ $= 0,74\ J$ $P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $P_{ave} = \frac{(25)^2}{20,5}$ ✓ $P_{ave} = 30,49\ W$ Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)* $= (30,49 – 0,74)$ $= 29,75\ W$✓

OPTION 2/*OPSIE 2*

$V_{rms/wgk\ device/toestel} = \frac{20}{20,5}$✓$\times 25 = 24,39\ V$

$P_{ave} = \frac{V_{rms}^2}{R}$✓ $= \frac{(24,39)^2}{20}$✓$= 29,74\ W$✓

(5)
[9]

QUESTION 11 / *VRAAG 11*

11.1.1 (Line) emission (spectrum) / *(Lyn) emissiespektrum* ✓ (1)

11.1.2 (Line) absorption (spectrum) / *(Lyn) absorpsiespektrum* ✓ (1)

11.2.1 Emission ✓/ *Emissie* (1)

11.2.2

Energy released in the transition from E_4 to $E_2 = E_4 – E_2$
Energie vrygestel in die oorgang vanaf E_4 na $E_2 = E_4 – E_2$
$E_4 – E_2 = (2,044 \times 10^{-18} – 1,635 \times 10^{-18})$✓ $= 4,09 \times 10^{-19} J$

$E = hf$✓
$4,09 \times 10^{-19} = (6,63 \times 10^{-34})f$✓
$f = 6,17 \times 10^{14}\ Hz$✓

(4)

11.2.3

$E = W_0 + E_{k(max)}$
$hf = hf_0 + E_{k(max)}$
$hf = hf_0 + ½ m v^2_{max}$
$E = W_0 + ½ m v^2_{max}$
✓ Any one/*Enige een*

$4,09 \times 10^{-19}$ ✓ = $\underline{(6,63 \times 10^{-34})(4,4 \times 10^{14})}$✓ + $E_{k(max)}$

$E_{k(max)} = 1,17 \times 10^{-19}$ J✓

OR/OF

$E_{k(max)} = E_{light/lig} - W_o$
$= hf_{light/lig} - hf_o$
✓ Any one/*Enige een*

$= \underline{(6,63 \times 10^{-34})(6,17 \times 10^{14})}$ ✓- $\underline{(6,63 \times 10^{-34})(4,4 \times 10^{14})}$✓
$= 1,17 \times 10^{-19}$ J ✓ (4)

11.2.4

No✓ / *Nee*
The threshold frequency is greater than the frequency of the photon. ✓
Die drumpelfrekwensie is groter as die frekwensie van die foton
OR/*OF*
The frequency of the photon is less than the threshold frequency✓
Die frekwensie van die foton is minder as die drumpelfrekwensie
OR/*OF*
Energy of the photon is less than the work function of the metal✓
Energie van foton is minder as die van die arbeidsfunksie van die metaal (2)

[13]

TOTAL/*TOTAAL*: 150