Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2016

PHYSICAL SCIENCES P1
FISIESE WETENSKAPPE V1
MEMORANDUM

MARKS/*PUNTE*: **150**

This memorandum consists of 9 pages.
Hierdie memorandum bestaan uit 9 bladsye.

QUESTION/*VRAAG* 1

1.1	**B**	1.2	**C**	1.3	**D**	1.4	**C**	1.5	**A**
1.6	**D**	1.7	**C**	1.8	**C**	1.9	**A**	1.10	**C**

[20]

QUESTION/*VRAAG* 2

2.1 $9{,}8\ m\cdot s^{-2}$ ✓ , downwards/*afwaarts* ✓ (2)

2.2 Yes/*Ja* ✓
Only gravitational force is acting on the ball/*Slegs gravitasiekrag word op die bal uitgeoefen.* ✓ OR/*OF*
The ball is moving under the influence of its weight/*Die bal beweeg onder die invloed van sy gewig.* ✓ (2)

2.3

Upwards +/*Opwaarts* +
OPTION/*OPSIE* 1
$V_f^2 = V_i^2 + 2g\Delta y$ ✓
$= (-8)^2$ ✓ $+ \underline{2(-9{,}8)(-1{,}8)}$ ✓
$V_f = 9{,}96\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 3
$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$
$\underline{1{,}8 = 8\Delta t + \frac{1}{2}(9{,}8)\Delta t^2}$ ✓
$\therefore \Delta t = 0{,}2$ s
✓ Both formulae/ *Beide formules*
$V_f = V_i + g\Delta t$
$= \underline{8 + (9{,}8)(0{,}2)}$ ✓
$= 9{,}96\ m\cdot s^{-1}$ ✓

Downwards +/*Afwaarts* +
OPTION/*OPSIE* 2
$V_f^2 = V_i^2 + 2g\Delta y$ ✓
$= (8)^2$ ✓ $+ \underline{2(9{,}8)(1{,}8)}$ ✓
$V_f = 9{,}96\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 4
$E_{M\ (Top/Bo)} = E_{M\ (Floor/Vloer)}$
$(mgh+\frac{1}{2}mv^2)_{Top} = (mgh+\frac{1}{2}mv^2)_{Floor}$ ✓
$\underline{m(9{,}8)(1{,}8) + \frac{1}{2} m(8)^2}$ ✓$= \underline{0 + \frac{1}{2} mv^2}$ ✓
$17{,}64 + \frac{1}{2}(64) = \frac{1}{2} v^2$
$\therefore v = 9{,}96\ m\cdot s^{-1}$✓

(4)

2.4 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF VRAAG* 2.3**

OPTION/*OPSIE* 1
Downwards +/*Afwaarts* +
$V_f = V_i + g\Delta t$ ✓
$\underline{9{,}96 = 8 + 9{,}8\Delta t}$ ✓
$\Delta t = 0{,}2$ s ✓
Upwards +/*Opwaarts*+
$V_f = V_i + g\Delta t$ ✓
$\underline{-9{,}96 = -8 + (-9{,}8)\Delta t}$ ✓
$\Delta t = 0{,}2$ s ✓

OPTION/*OPSIE* 2
Downwards +/*Afwaarts* +
$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$ ✓
$\underline{1{,}8 = 8\Delta t + \frac{1}{2}(9{,}8)\Delta t^2}$ ✓
$\therefore \Delta t = 0{,}2$ s ✓
Upwards +/*Opwaarts*+
$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$ ✓
$\underline{-1{,}8 = -8\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2}$ ✓
$\therefore \Delta t = 0{,}2$ s ✓

OPTION/*OPSIE* 3
Downwards +/*Afwaarts* +
$\Delta y = \frac{V_f + V_i}{2}\Delta t$ ✓
$1{,}8 = \frac{9{,}96+8}{2}\Delta t$ ✓
$\therefore \Delta t = 0{,}2$ s ✓

OPTION/*OPSIE* 4
Upwards +/*Opwaarts*+
$\Delta y = \frac{V_f + V_i}{2}\Delta t$ ✓
$-1{,}8 = \frac{-9{,}96+(-8)}{2}\Delta t$ ✓
$\therefore \Delta t = 0{,}2$ s ✓

(3)

2.5 **POSITIVE MARKING FROM/***POSITIEWE NASIEN VANAF VRAAG* **2.3**

OPTION/*OPSIE* 1

80% of/*van* 9,96 = 7,97 m·s^{-1}

Upwards +/*Opwaarts+*

$V_f^2 = V_i^2 + 2g\Delta y$ ✓

$\underline{0^2 = (7,97)^2}$ ✓ + $\underline{2(-9,8)\ \Delta y}$ ✓

∴ Δy = 3,24 m ✓

No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

Downwards +/*Afwaarts* +

$V_f^2 = V_i^2 + 2g\Delta y$ ✓

$\underline{0^2 = (-7,97)^2}$ ✓+ $\underline{2(-9,8)\ \Delta y}$ ✓

Δy = -3,24 m

∴ Δy = 3,24 m ✓

No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

OPTION/*OPSIE* 2

80% of/*van* 9,96 = 7,97 m·s^{-1}

Upwards +/*Opwaarts+*

$V_f = V_i + g\Delta t$

0 = 7,97 + (-9,8) Δt

Δt = 0,81 s ✓ Both formulae/ *Albei formules*

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

= $\underline{(7,97)(0,81)}$ ✓+$\underline{½\ (-9,8)(0,81)^2}$ ✓

= 3,24 m ✓

No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

Downwards +/*Afwaarts* +

$V_f = V_i + g\Delta t$

0 = -7,97 + (9,8) Δt

Δt = 0,81 s ✓ Both Formulae/ *Albei formules*

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

= $\underline{(-7,97)(0,81)}$ ✓ + $\underline{½\ (-9,8)(0,81)^2}$ ✓

= -3,24 m

∴ Δy = 3,24 m ✓

No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

OPTION/*OPSIE* 3

80% of/*van* 9,96 = 7,97 m·s^{-1}

Upwards +/*Opwaarts+*

$V_f = V_i + g\Delta t$

0 = 7,97 + (-9,8) Δt

Δt = 0,81 s ✓ Both formulae/ *Albei formules*

$\Delta y = \frac{V_f + V_i}{2}\ \Delta t$

$= \frac{0+(7,97)}{2}$ ✓0,81 ✓

∴ Δy = 3,23 m ✓

No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

OPTION/*OPSIE* 4

80% of/*van* 9,96 = 7,97 m·s^{-1}

Downwards +/*Afwaarts* +

$V_f = V_i + g\Delta t$

0 = -7,97 + (9,8) Δt

Δt = 0,81 s ✓ Both formulae/ *Albei formules*

$\Delta y = \frac{V_f + V_i}{2}\ \Delta t$

$= \frac{0+(-7,97)}{2}$ ✓0,81 ✓

= -3,23 m

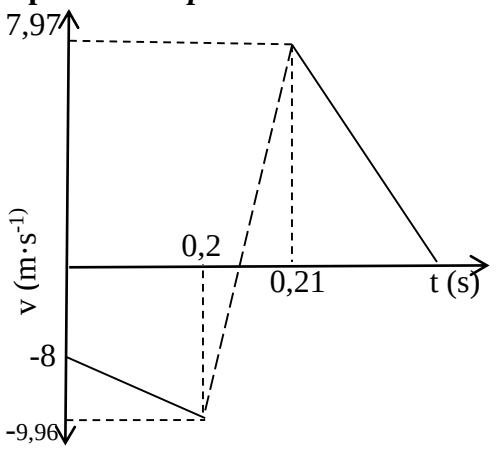
∴ Δy = 3,23 m ✓

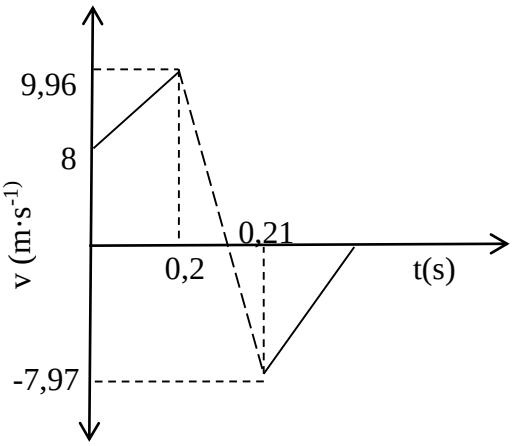
No, the ball will not reach the ceiling/ *Nee, die bal sal nie die plafon bereik nie.* ✓

(5)

2.6

Upwards +/*Opwaarts+*





Upwards as positive/*Opwaarts as positief*

Marking guidelines/*Nasienriglyne*	Marks/*Punte*
Initial v at -8 m.s-1/*Beginsnelheid by -8m.s^{-1}*	✓
Positive marking from/*Positiewe nasien vanaf* 2.3 & 2.4 Time and velocity shown with which ball hits the floor/ Velocity (-9,96 m.s^{-1}) and time (0,2 s) with which ball hits the floor. Snelheid (-9,96 m.s^{-1}) en tyd (0,2 s) waarmee die bal die vloer tref.	✓
Positive marking from/*Positiewe nasien vanaf* 2.3 & 2.4 Time and velocity shown with which ball leaves the floor/ Velocity (7,97 m.s^{-1}) and time (0,21 s) with which ball leaves the floor./*Snelheid (7,97 m.s^{-1}) en tyd (0,21 s) waarmee die bal die verlaat.*	✓
Two parallel lines ending at v = 0 m.s^{-1} on t-axis./ *Twee parallel lyne wat eindig by v = 0 m.s^{-1} op t-as.*	✓

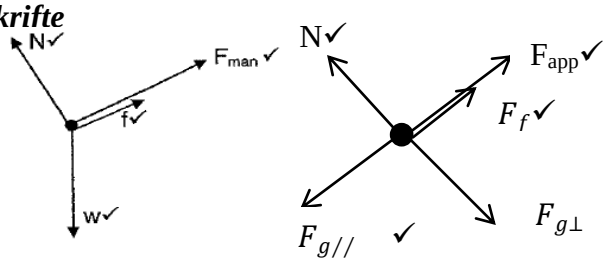
Upwards as positive/*Opwaarts as positief*

Marking guidelines/*Nasienriglyne*	Marks/*Punte*
Initial v at 8 m.s-1/*Beginsnelheid by 8m.s^{-1}*	✓
Positive marking from/*Positiewe nasien vanaf* 2.3 & 2.4 Time and velocity shown with which ball hits the floor/ Velocity (9,96 m.s^{-1}) and time (0,2 s) with which ball hits the floor. *Snelheid* (9,96 m.s^{-1}) *en tyd (0,2 s) waarmee die bal die vloer tref.*	✓
Positive marking from/*Positiewe nasien vanaf* 2.3 & 2.4 Time and velocity shown with which ball leaves the floor/ Velocity (-7,97 m.s^{-1}) and time (0,21 s) with which ball leaves the floor. *Snelheid* (-7,97 m.s^{-1}) *en tyd* (0,21 s)*waarmee die bal die verlaat.*	✓
Two parallel lines ending at v = 0 m.s^{-1} on t-axis./ *Twee parallel lyne wat eindig by v = 0 m.s^{-1} op t-as.*	✓

(4)

[20]

QUESTION/*VRAAG* 3

3.1	A force for which the net work done in any closed path is dependent on the path the object travelled/*Die krag waarvoor die arbeid verrig word om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word*. ✓✓	(2)
3.2	$F_k = \mu_k N = 0,22 \times 86 \times 9,8 \text{ Cos } 25°$✓ = 168,04 N ✓	(2)
3.3	The net work done on the object is equal ✓to the change in the object's kinetic energy/*Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in die kinetiese energie van die voowerp.* ✓ 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 energie van 'n voorwerp deur 'n resulterende/ netto krag is gelyk aan die verandering in die kinetiese krag van die voorwerp.* ✓	(2)
3.4	**Accepted labels/*Aanvaarde byskrifte*** 	(4)
3.5	**OPTION/*OPSIE* 1 *Downwards as +/Afwaarts as +*** $V^2_f = v^2_i + 2a\Delta x$ $V^2_f - v^2_i = 2(1,54)(0,9)$ ✓ $= 2,772$ $W_{net} = E_k$✓ $W_{man} + W_{grav} + W_f = 1/2m(v^2_f - v^2_i)$ $W_{man} + (86 \times 9,8) \sin 25° (0,9) \cos 0° + 168,04(0,9) \text{ Cos } 180°$ ✓$= 1/2 (86)(2,772)$ ✓ $W_{man} = -50,13$ J ✓	
	OPTION/*OPSIE* 2 *Downwards as +/Afwaarts as +* $F_{net} = ma$ $-F_{man} + F_g \sin\theta + f = ma$ $-F_{man} + 86 \times 9,8 \sin 25° - 168,04 = 86(1,54)$ ✓ $F_{man} = -356,18 + 168\ 04 + 132,44$ $F_{man} = -55,7$N $W_{man} = F_{man} \times \cos\theta$ ✓ $W_{man} = (55,7)$ ✓ (0,9) cos 180° ✓ $W_{man} = -50,13$ J ✓	

w	F_g/F_w/Weight/Gravity/Gravitational force/$F_{g\parallel}$ and $F_{g\perp}$ *F_g/F_w/Gewig/Gravitasie/Gravitasiekrag*/$F_{g\parallel}$ en $F_{g\perp}$
N	Normal/*Normaa*l
f	F_f/frictional force/*F_f/wrywingskrag*
F	Applied force/ $F_A/F_{applied}$ *Toegepaste krag/$F_a/F_{toegepas}$*

	OPTION/*OPSIE* 3 *Upwards as +/Opwaarts as +* F_{net}= ma F_{man} - Fgsin+ f =ma F_{man} - 86x9,8sin25 + 168,04=86(-1,54) ✓ F_{man} = 356,18 -168 04 -132,44 F_{man} =55,7 N $W_{man} = F_{man} \times \cos\theta$✓ W_{man} =(55,7) ✓ (0,9) cos 180✓ W_{man} = -50,13 J ✓	(5)

[15]

QUESTION/*VRAAG* 4

4.1	The total Mechanical Energy is conserved/ remains constant ✓ in an isolated system / in absence of external forces/ non-conservative forces/*Die totale meganiese energie bly behoue/bly konstant in 'n geslote sisteem/in afwesigheid van eksterne kragte/nie-konserwatiewe kragte*. ✓ OR/*OF* The sum of gravitational potential energy and kinetic energy of an object remains constant ✓ in an isolated system/*Die som van die potensiële gravitasie energie en die kinetiese energie van 'n voorwerp in 'n geslote houer bly konstant*. ✓	(2)
4.2	**OPTION/*OPSIE* 1** $E_{m\ at\ A} = E_{m\ at\ B}$ $(mgh+½mv^2)_A = (mgh+½mv^2)_B$ ✓ $[(5)(9,8)(5)+½(5)(0)^2]$✓$=[(5)(9,8)(1)+½(5)v^2]$✓ ∴ v = 8,85 m·s^{-1}✓ **OPTION/*OPSIE* 2 When B is taken as ground surface/*As B die grond is*** $E_{m\ at\ A} = E_{m\ at\ B}$ $(mgh + ½\ mv^2)_A = (mgh + ½\ mv^2)_B$ ✓ $[(5)(9,8)(4)+½(5)(0)^2]$✓$=[(5)(9,8)(0)+½(5)v^2]$ ✓ ∴ v = 8,85 m·s^{-1}✓	(4)
4.3	Weight / force of gravity (*Gewig/Gravitasiekrag*) ✓ Normal force/*Normale krag* ✓	(2)
4.4	C to/*na* B ✓	(1)
4.5	Equal to/*Gelyk aan* ✓	(1)

[10]

QUESTION/*VRAAG* 5

5.1.1	The apparent change in the detected frequency (pitch) or (wavelength) ✓as a result of the relative motion between a source and an observer (listener) ✓ *Die verandering in die frekwensie (toonhoogte) van die klank waargeneem deur 'n luisteraar is omdat die klankbron en die luisteraar veskillende snelhede relatief tot die medium waarin klank voortgeplant word, het*	(2)
5.1.2	Away/*Weg van* (from submarine/*vanaf duikboot*) ✓ The detected /observed frequency is lower than the actual frequency/ *Die waargenome frekwensie is laer as die werklike frekwensie* ✓	(2)
5.1.3	**OPTION/*OPSIE* 1** $F_L = \frac{v \pm V_l}{v \pm v_S} F_s$✓ 0,985 F_s✓ = $\frac{1470}{1470+ v_S}$ ✓ × F_s✓ v_S = 22,39 m·s^{-1}✓ **OPTION/*OPSIE* 2** $F_L = (0,985)F_s$ 437 = (0,985) F_s F_s = 443,655 Hz $F_L = \frac{v \pm V_l}{v \pm v_S} F_s$✓ 437✓ = $\frac{1470}{1470+ v_S}$ ✓ × 443,655✓ v_S = 22,39 m·s^{-1}✓	(5)

5.2	Red shift implies that light emitted by stars shows a shift towards the lower frequencies of the spectrum/*Rooi verskuiwing van lig vrygestel deur die sterre wys 'n verskuiwing na die laer frekwensie van die spektrum.* ✓✓	(2)
5.3	Blue shift/*Blou verskuiwing* ✓	(1)

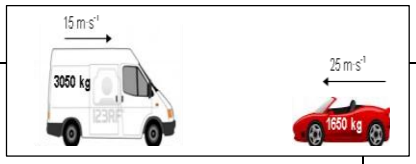
[12]

QUESTION/*VRAAG* 6

6.1	F ✓ ⟵● ⟶ T✓	(2)
6.2	**OPTION/*OPSIE* 1** Fnet = ma ***At/by A:4 kg block/blok*** *In x-direction./In rigting x* $T - f_f = m_Aa$ $T - \mu N = m_Aa$✓ $T - \mu m_Ag = m_Aa$ (equation/*vergelyk* 1) ***At/by A:4 kg block/blok*** In *y* direction (up/ $N - F_g = 0$ $N = F_g = mg$ ***At/by B:8 kg block/blok*** **In the *x* direction/*In die x-rigting*** $-T + F_g = m_Ba$✓ $-T + m_Bg = m_Ba$ (equation/*vgl* 2) Solving the system of equations/ *Los op die sisteem van vgl* $T - \mu m_Ag - T + m_Bg = m_Aa + m_Ba$✓ Removing T and isolating a:/ *Verwyder T en isoleer a:* $-\mu m_Ag + m_Bg = (m_A + m_B)a$✓ $-(0,6)(4)(9,8) +(8)(9,8)$✓ $= (4+8)a$✓ $54,88 = 12a$ $a = 4,57\ m\cdot s^{-2}$ ✓	**OPTION/*OPSIE* 2** Fnet = ma ***At/by A:4 kg block/blok*** $T - \mu N = m_Aa$✓ $T - \mu m_Ag = m_Aa$ $T - 0,6(4)(9,8)$ ✓ $= 4a$ $T = 4a + 23,52$ …… equation/*vgl* 1 Any/*Enige* ✓ ***At/by B:8 kg block/blok*** $-T + F_g = m_Ba$✓ $-T + m_Bg = m_Ba$ $-T + 8(9,8)$ ✓$= 8a$ $-T = 8a - 78,4$ …. equation/*vgl* 2 Adding Eq 1 & Eq 2/*Tel Vgl 1 & 2* $4a +23,52 + 8a - 78,4 = 0$✓ $12a = 54,88$ $\therefore a = 4,57\ m\cdot s^{-2}$✓	(7)
6.3	**<u>OPTION 1</u>** $T - f_f = m_Aa$ $T - \mu m_Ag = m_Aa$ $T -23,52$ ✓$= 4(4,57)$ ✓ $T = 41,8$ N ✓	**<u>OPTION 2</u>** $-T + m_Bg = m_Ba$ $-T+ (8)(9,8)$ ✓ $= (8)(4,57)$ ✓ $T = 41,84$ N✓	(3)
6.4	**OPTION/*OPSIE* 1** $F_F = \mu N$✓ $N = mg$ $F_F = \mu mg = (0,6)(4)$✓ $(9,8)$ ✓$=23,52$N✓	**OPTION/*OPSIE* 2** $T - F_F = m_Aa$ ✓ $41,8 - F_F$✓ $= 4(4,57)$ ✓ $F_F = 23,52$ N✓	(4)

[16]

QUESTION/*VRAAG* 7



7.1	Choose RIGHT as positive/ Kies REGS as positief. $(m_{mb}\ v_{imb} + m_c v_{ic}) = (m_{mb}\ v_{fmb} + m_c v_{fc})$ ✓ (3050)(15) ✓ + (1650)(-25) ✓ = v_f (3050 + 1650) ✓ v_f = 0,96 m.s^{-1} to the right/*na regs*✓	(5)
7.2	$\sum K_i = ½\ m_{MB}\ v^2_{iMB} + ½\ m_C\ v^2_{iC}$ ✓ $= ½(3\ 050)(15)^2 + ½(1\ 650)(-25)^2$✓ = 85 8750 J✓ $\sum K_f = ½ m_{MB}\ v^2_{fMB} + ½\ m_C\ v^2_{fC}$ ✓ $= ½(3\ 050)(0,96)^2$✓ + $½(1\ 650)(0,96)^2$✓ = 2 165,76 J ✓ Since/*Aangesien* $\sum K_i \neq \sum K_f$ ✓, ∴ the collision was inelastic/*was die botsing onelasties*✓	(9)
7.3	Crumple zones in a car ensure that the car comes to rest over a longer period of time✓, (Δt), during an accident / stopping time is increased./ *Frommelsone in 'n motor verseker dat 'n motor tot stilstand kom oor 'n langer tydsverloop./Δt neem toe/tyd om te stop neem toe* From $F_{NET} \propto \frac{1}{\Delta t}$, it follows that F_{NET} decreases with an increase in Δt. ✓ *Van* $F_{net} \propto \frac{1}{\Delta t}$, F_{net} *neem af met toename in* Δ*t* ∴ The magnitude of F_{NET} determines the extent of passenger's injuries. ✓ *Die grootte van* F_{net} *bepaal die mate van passasier se beserings*	(3)

[17]

QUESTION/*VRAAG* 8

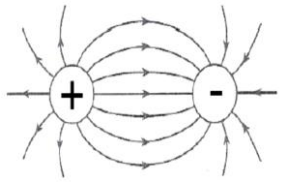
8.1	Every object in the universe attracts every other object with a force ✓that is directly proportional to the product of the masses and inversely proportional to the square of the distance between their centers. ✓ *Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag direk eweredig aan die produk van hul massas en omekeerde eweredig aan die kwadraat van die afstand tussen hul middelpunte*	(2)
8.2	Data: M_E (Mass of the earth/*Massa van aarde*) = 5,98 × 10^{24} kg M_S (mass of the spaceship/*massa van ruimteskip*) = 3 500 kg r = 8,53 × 10^6 m G = 6,67 × 10^{-11} N·m^2·kg^{-2} $F = \frac{G\ M_E \cdot M_S}{r^2}$✓ = $\frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(3500)}{(8,53 \times 10^6)^2}$✓ = 19 186,55 N✓	(4)
8.3	Equal to/*Gelyk aan* ✓	(1)
8.4	Newton's third law of motion/ *Newton se derde bewegingwet* ✓ When object A exerts a force on object B, object B simultaneously exerts an equal force✓ on object A in an opposite direction✓. *Wanneer een liggaam 'n krag op 'n tweede liggaam uitoefen, oefen die tweede liggaam 'n gelyk in grootte*✓ *en teenoorgesteld van rigting van eerste liggaam uit.*✓	(3)
8.5	$F = \frac{G\ M_E \cdot M_S}{r^2}$✓ 4 × 19 186,55 ✓ = $\frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(3500)}{r^2}$✓ $r^2 = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(3\ 500)}{76\ 746,2}$ r^2 = 1,82 × 10^{13} m^2 r = 4 265 000,54 m✓ = 4,27 × 10^6 m	(4)

[14]

QUESTION/*VRAAG* 9

9.1	Impulse/*Impuls* = Area under graph/*Area onder grafiek* ✓ Any ONE/*Enige EEN* = ½ bh + ½ bh + lb = ½(2)(10) ✓ + ½ (2)(-10) ✓ + 6(-10) ✓ = - 60 N.s in opposite direction/ *in teenoorgestelde rigting*✓	(5)
9.2	Greater than/*Groter as* ✓✓	(2)
9.3	East positive/*Oos positief* *Impulse/Impuls* = $mv_f - mv_i$ ✓ -60 ✓= $10v_f - (10)(5,5)$ ✓ $V_f = 0,5\ m\cdot s^{-1}$✓	(4)
		[11]

QUESTION/*VRAAG* 10

10.1	 **CRITERIA TO MARK THE PATTERN** Shape of the pattern/*Korrekte patroon* ✓ Direction (arrows from positive to negative)/ *Rigting (pyltjies vanaf positief na negatief* ✓ Angle of contact / field lines not touching each other/*Hoek van kontak / veldlyne moet nie kruis nie* ✓	(3)
10.2	$E_A = \frac{K\,Q_A}{r^2}$✓ $= \frac{(9\times10^9)(4\times10^{-9})}{(20\times10^{-3})^2}$✓ = 90 000 $N\cdot C^{-1}$, to the right/*na regs* $E_C = \frac{K\,Q_C}{r^2} = \frac{(9\times10^9)(6\times10^{-9})}{(22\times10^{-3})^2}$ ✓ = 86 400 $N\cdot C^{-1}$, to the right/*na regs* ∴ $E_{NET} = E_A + E_C$ = 90 000 + 86 400✓ (for adding E_A and E_C) (*tel* E_A *en* E_C *op)* = 176 400 NC^{-1} = $1,76\times10^5$ $N\cdot C^{-1}$✓, to the right/*na regs* ✓	(7)
10.3	$F = \frac{K\,Q_A Q_C}{r^2}$✓ $= \frac{(9\times10^9)(4\times10^{-9})✓(6\times10^{-9})✓}{(30\times10^{-3})^2✓}$ = $7,2\times10^{-3}$ N, (attraction/ *aantrekkend*)✓	(5)
		[15]
		TOTAL/*TOTAAL*: 150