QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 B ✓✓ (2)

1.7 B ✓✓ (2)

1.8 B ✓✓ (2)

1.9 D ✓✓ (2)

1.10 D ✓✓ (2)
[20]

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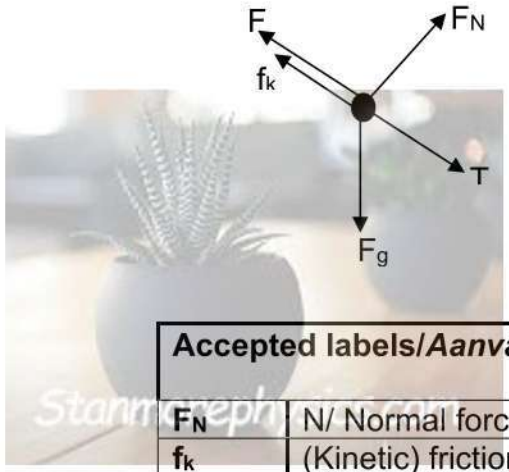


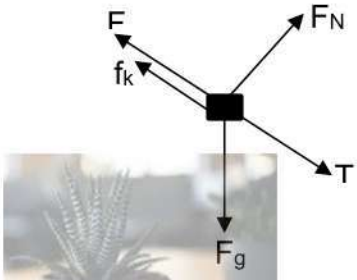
QUESTION 2/*VRAAG 2*

2.1 The force that opposes the motion of a moving object relative to a surface.✓✓
Die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenwerk.
(2 or */of 0*) (2)

2.2 $f_k = \mu_k F_N$] ✓ any one/*enige een*
$f_k = \mu_k mg \cos \theta$]
$f_k = (0,2)(20 \times 9,8 \cos 40^\circ)$ ✓
$f_k = 30,03$ N ✓ (3)

2.3 **ACCEPT/*AANVAAR***





Accepted labels/*Aanvaarde benoemings*:	
F_N	N/ Normal force/ F_{normal}/*Normaalkrag*
f_k	(Kinetic) friction/ F_f /F_k /*Kinetiese wrywing*
w	F_g /mg/ mg/gravitational force/*gravitasiekrag*
F	Applied force/ F_A/*Toegepaste krag*
T	F_T /Tension /*spanning*
Notes/*Aantekeninge*	
• Mark is awarded for label and arrow/*Punt word toegeken vir byskrif en pyltjie.* • Do not penalise for length of arrows/*Moenie vir lengte van pyltjie penaliseer nie.* • If arrows do not touch the dot/*Indien pyle nie die kolletjie raak nie*: Max/*Maks* 4/5 • If additional force(s)/*Enige addisionele kragte*: • Max/*Maks* 4/5 • If everything is correct, but no arrows/*indien alles korrek is, maar geen pyltjies*: Max/Maks 4/5 • If components are drawn/*Indien komponente geteken*: Max/*Maks* 4/5	

(5)

2.4

2.4.1 $f_k = \mu_k F_N$
$f_k = \mu_k mg \cos \theta$
$f_k = (0,2)(10 \times 9,8 \cos 40^\circ)$ ✓
$f_k = 15,01$ N ✓ (2)

2.4.2

OPTION 1/*OPSIE 1*

Block B/*Blok B*

$F_{net} = ma$ ✓ any one/*enige een*
$F_{gll} - f_k - T = ma$

$\underline{(20 \times 9,8 \sin 40) - 30,03 - T}$✓ $= 20a$
$-T = 20a - 125,99 - 30,03$
$T = -20a + 95,96$ ---------- (1)

Block A/*Blok A*

$F_{net} = ma$
$F_{gll} + T - f_k - F_a = ma$
$\underline{(10 \times 9,8 \sin 40) + T - 15,01 - 100}$ ✓$= 10a$ Both / *Beide*✓
$T = 10a + 52,03$ ---------- (2)

Substituting/*Vervanging* (1) in (2)

$\underline{-20a + 95,96 = 10a + 52,03}$✓
$30a = 43,96$
$a = 1,46\ m.s^{-2}$✓
$T = 10a + 52,03$
$T = \underline{10\ (1,46) + 52,03}$ ✓
$T = 66,63\ N$ ✓
Range/*Gebied*: 66,62 N – 66,68 N

(8)

OPTION 2/*OPSIE 2*

Block B/*Blok B*

$F_{net} = ma$ ✓ any one/*enige een*
$F_{gll} - f_k - T = ma$

$\underline{(20 \times 9,8 \sin 40) - 30,03 - T}$✓ $= 20a$
$95,9564 - T = 20a$ ---------- (1)
$95,9564 - T = 2 \times 10a$ ---------- (2)

Block A/*Blok A*

$F_{net} = ma$
$F_{gll} + T - f_k - F_a = ma$
$\underline{(10 \times 9,8 \sin 40) + T - 15,01 - 100}$ ✓$= 10a$ Both / *Beide*✓
$T - 52,0168 = 10a$ ---------- (3)

Substituting/*Vervanging* (3) in (2)

$\underline{95,9564 - T = 2\ (T - 52,0168)}$ ✓
$95,9564 - T = 2T - 104,0336$
$T = 66,66\ N$ ✓
Range/*Gebied*: 66,62 N – 66,68 N

2.5 Increase/*Verhoog* (1)

[21]

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QUESTION 3/*VRAAG 3*

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

3.1 Everybody 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 direk eweredig aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

3.2 The sensation experienced when all contact forces are removed. ✓✓ (2)
Die sensasie wat ervaar word indien alle kragte verwyder word.

3.3 $F = G \frac{m_1 m_2}{r^2}$ ✓

$1\,539,23$ ✓$= 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(3800)}{r^2}$ ✓

$r^2 = 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(3800)}{1\,539,23}$

$r = 3,14 \times 10^{7}$ m ✓ (4)

3.4 Greater than/*Groter as* ✓

The mass is greater / *Die massa is groter*✓
Same force, ✓must have the same mass as planet earth ✓/ *Vir dieselfde krag moet die afstand ook groter wees.* (4)
[12]

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QUESTION 4 /*VRAAG 4*

4.1 Object which has been given an initial velocity and then it moves under the influence of the gravitational force only.✓✓
'n Voorwerp waaraan 'n beginsnelheid gegee is *en wat dan slegs onder die invloed van die gravitasiekrag beweeg*.
(2 or/ *of 0*) (2)

4.2

4.2.1

OPTION 1/*OPSIE 1* (Upwards as positive/*Opwaarts as positief*)	**OPTION 2/<u>OPSIE 2</u> (Downwards as positive/*Afwaarts as positief*)**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $= (17,5)(5) + \frac{1}{2}(-9,8)(5)^2$✓ $= 35$ m ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $= (-17,5)(5) + \frac{1}{2}(9,8)(5)^2$✓ $= -35$ m $= 35$ m ✓

(3)

4.2.2

OPTION 1/*OPSIE 1* (Upwards as positive/*Opwaarts as positief*)	**(Downwards as positive/*Afwaarts as positief*)**
$v_f = v_i + a\Delta t$ ✓ $= 17,5 + (-9,8)(5)$ ✓ $= 31,5$ m·s^{-1} ✓	$v_f = v_i + a\Delta t$ ✓ $= -17,5 + (9,8)(5)$ ✓ $= 31,5$ m·s^{-1} ✓

OPTION 2/*OPSIE 2* (Upwards as positive/*Opwaarts as positief*)	**(Downwards as positive/*Afwaarts as positief*)**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (17,5)^2 + (-9,8)(-35)$ ✓ $v_f^2 = 992,25$ $= 31,5$ m·s^{-1} ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (-17,5)^2 + (9,8)(35)$ ✓ $v_f^2 = 992,25$ $= 31,5$ m·s^{-1} ✓

(3)

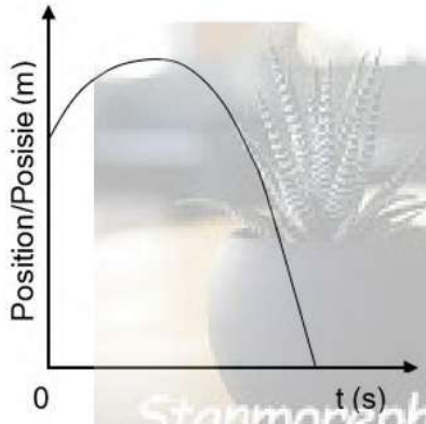
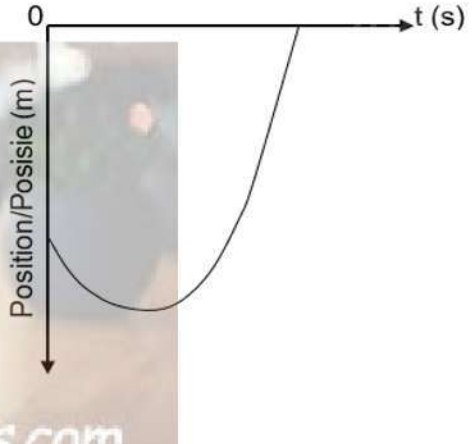
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4.3 **Positive marking from Question 4.2.1 and 4.2.2 /*Positiewe nasien vanaf VRAAG 4.2.1 en 4.2.2***

OPTION 1/*OPSIE 1*	
(Upwards as positive/*Opwaarts as positief*)	**(Downwards as positive/*Afwaarts as positief*)**
$v_f^2 = v_i^2 + 2a\Delta y$✓ $(-\frac{6}{7}v)^2$✓ $= (V_y)^2 + 2(-9,8)(-35)$✓ $\frac{36}{49}v^2 = V_y^2 + 686$ $\frac{36}{49}(31,5)^2$✓ $= V_y^2 + 686$ $729 = V_y^2 + 686$ $Vy^2 = 43$ $V_y = 6,56\ m.s^{-1}$✓	$v_f^2 = v_i^2 + 2a\Delta y$✓ $(\frac{6}{7}v)^2$ ✓$= (-V_y)^2 + 2(9,8)(35)$✓ $\frac{36}{49}v^2 = V_y^2 + 686$ $\frac{36}{49}(31,5)^2 = V_y^2 + 686$ $729 = V_y^2 + 686$ $Vy^2 = 43$ $V_y = 6,56\ m.s^{-1}$✓
OPTION 2/*OPSIE 2*	
(Upwards as positive/*Opwaarts as positief*)	**(Downwards as positive/*Afwaarts as positief*)**
$\frac{6}{7}v$ ✓ $= \frac{6}{7}(31,5)$✓ $\frac{6}{7}v = 27\ m.s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$✓ $(27)^2 = (V_y)^2 + 2(-9,8)(-35)$✓ $V_y = 6,56\ m.s^{-1}$✓	$\frac{6}{7}v$ ✓ $= \frac{6}{7}(31,5)$✓ $\frac{6}{7}v = 27\ m.s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$✓ $(-27)^2 = (V_y)^2 + 2(9,8)(35)$✓ $V_y = 6,56\ m.s^{-1}$✓

(5)

4.4

Upwards as positive/*Opwaarts as positief*	**Downwards as positive/*Afwaarts as positief***
	
Marking Criteria/*Nasienkriteria*: Shape/*Vorm*: max/*Maks* 2/2	

(2)
[15]

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QUESTION 5

5.1 The total linear momentum of an isolated system remains constant. ✓✓
Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant (behoue).
(2 or/*of 0*) (2)

5.2
$$E_{mech/meg\ B} = E_{mech/meg\ A}$$
$$(E_p + E_k)_B = (E_p + E_k)_A$$ ✓ any one/*enige een*
$$(mgh + \tfrac{1}{2}mv^2)_B = (mgh + \tfrac{1}{2}mv^2)_A$$
$$((0,4)(9,8)(0,2) + (0))_B \checkmark = (0 + \tfrac{1}{2}(0,4)v^2)_A \checkmark$$
$$V^2 = 3,92$$
$$V = \underline{1,98\ m.s^{-1}\ to\ the\ right}\ \checkmark$$ (4)

POSITIVE MARKING FROM 5.2/*POSITIEWE NASIEN VANAF VRAAG 5.2*

5.3
$$\Sigma p_i = \Sigma p_f$$ ✓ any one/*enige een*
$$m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$$
$$\underline{(0,4)(1,98) + (0,6)(0)}\ \checkmark = (0,4 + 0,6)\ v_{fAB}\ \checkmark$$
$$v_{fAB} = \underline{0,792\ m.s^{-1}\ to\ the\ right}\ \checkmark$$ (4)

5.4 Inelastic/*onelasties* ✓ (1)
[11]

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QUESTION 6/*VRAAG 6*

6.1 The product of the resultant/ net force acting on an object and the time the net force acts on an object. ✓✓
Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk. (2)
(2 or/*of 0*)

6.2

OPTION 1/*OPSIE 1*		
$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{20 - 10}{10 - 5}$ ✓✓ $=2$ N.s ✓	$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{10 - 4}{5 - 2}$ ✓✓ $=2$ N.s✓	$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{20 - 4}{10 - 2}$ ✓✓ $=2$ N.s✓

(3)

OPTION 2/*OPSIE 2*		
$F_{net} = \Delta p \cdot \frac{1}{\Delta t}$ ✓ $20 = \Delta p \cdot 10$ ✓ $\Delta p = 2$ N.s✓	$F_{net} = \Delta p \cdot \frac{1}{\Delta t}$ ✓ $10 = \Delta p \cdot 5$ ✓ $\Delta p = 2$ N.s✓	$F_{net} = \Delta p \cdot \frac{1}{\Delta t}$ ✓ $4 = \Delta p \cdot 2$ ✓ $\Delta p = 2$ N.s✓

6.3

OPTION 1/*OPSIE 1* **(DOWN POSITIVE/*AFWAARTS AS POSITIEF*)**	**OPTION 2 /*OPSIE 2*** **(UP POSITIVE/OPWAARTS AS POSITIEF)**
$\Delta p = mv_f - mv_i$ ✓ $-2 = 0{,}06 \times v_f - 0{,}06 \times 10.84$ ✓ $v_f = 22{,}42$ m·s^{-1}upwards✓	$\Delta p = mv_f - mv_i$ ✓ $2 = 0{,}06 \times v_f - 0{,}06 \times -10.84$ ✓ $v_f = 22.42$ m·s^{-1}upwards✓

OPTION 3/*OPSIE 3* **(DOWN POSITIVE/*AFWAARTS AS POSITIEF*)**
$F_{net} = \frac{\Delta p}{\Delta t}$✓ $20 = \frac{0{,}6\ (vf-(-10{,}8))}{0{,}1}$ ✓ Vf = 22,49 m.s^{-1} upwards

(3)

6.4 Decreases/*Verlaag* ✓ (1)

6.5 Rubber mat increases contact time/*Rubber matjie verlengkontak tyd*.

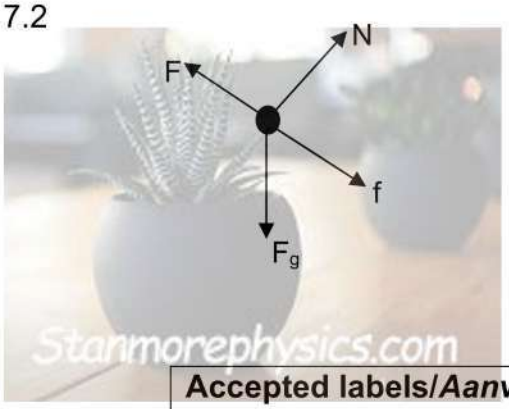
$F_{net} \propto \frac{1}{\Delta t}$ ✓ (1)

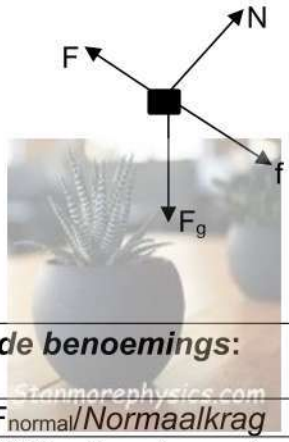
[10]

QUESTION 7 /*VRAAG 7*

7.1 There is no change in the kinetic energy of the car, therefore the net work done on the car is zero. ✓ or $W_{net} = 0$ (J) ✓
Daar is geen verandering in die kinetiese energie van die kar nie, daarom is die netto werk verrig op die kar nul. Of W = 0 (J) (1)

7.2 **ACCEPT/*AANVAAR***





Accepted labels/*Aanvaarde benoemings*:	
F_N	N/ Normal force/ F_{normal}/*Normaalkrag*
f_k	(Kinetic) friction/ f /*(Kinetiese) wrywing/F_w*
F_g	w /F_w /weight / mg/gravitational force/ gravitasiekrag
F	Applied force/Fapplied/ Fa/*Toegepaste krag*

Notes

- Mark is awarded for label and arrow/*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows/*Moenie vir die lengte van die pyltjies penaliseer nie.*
- If arrows do not touch the dot/*Indien pyle nie die kolletjie raak nie*: Max/*Maks* 3/4
- If additional force(s)/*Enige addisionele kragt(te)*:
  : Max/*Maks* 3/4
- If everything is correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/Maks 3/4
- If components are drawn/*Indien komponente geteken*: Max/*Maks* 3/4

(4)

7.3

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

7.3.2 **REMOVED/*VERWYDER*** **[7]**

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QUESTION 8/*VRAAG 8*

8.1 The rate at which work is done or energy is expended.✓✓ (2 or 0)
Die tempo waarteen arbeid verrig word. (2)

8.2.1 $W_{Fg\ (create/krat)} = F_g \Delta x \cos\theta$ ✓
$= (180)(9,8)(4,5)\cos 180^o$ ✓
$= -7\ 938$ J ✓ (3)

8.2.2 $W_{Fg\ (counterweight/teenwig)} = F_g \Delta x \cos\theta$
$= (140)(9,8)(4,5)\cos 0^o$ ✓
$= 6\ 174$ J ✓ (2)

8.3 **Positive marking from Question 8.2.1 and 8.2.2/*Positiewe nasien vanaf VRAAG 8.2.1 en 8.2.2***

OPTION 1/ *OPSIE 1*

$W_{net} = \Delta E_k$
$W_{net} = 0$
$W_{motor} + W_{counterweight/teenwig} + W_{crate\ /krat} = 0$
$W_{motor} + 6\ 174 - 7\ 938$ ✓ $= 0$ ✓
$W_{motor} = 1\ 764$ J ✓

$P = \frac{W}{\Delta t}$ ✓
$= \frac{1\ 764}{3}$ ✓
$= 588$ W ✓

Note: If the calculation of W_{motor} = 1 764 J is not shown mark 3/6

OPTION 2/ *OPSIE 2*

$F_{net} = ma$
$F_{motor} + F_{cw} - F_c = ma$
$F_{motor} + (140 \times 9,8) - (180 \times 9,8)$✓ $= 0$ ✓
$F_{motor} + (1372) - (1764) = 0$
$F_{motor} - 392 = 0$
$F_{motor} = 392$ N✓

$V = \frac{\Delta x}{\Delta t} = \frac{4,5}{3} = 1,5\ m.s^{-1}$

$P_{ave} = Fv_{ave}$✓
$= 392 \times 1,5$✓
$= 588$ W✓ (6)

[13]

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QUESTION 9/*VRAAG 9*

9.1 $f = \frac{v}{\lambda}$ ✓
$= \frac{330}{0,2}$ ✓
$= 1\,650$ Hz ✓ (3)

9.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓
factor/*faktor* = $\frac{330 + 0}{330 - 2,78}$ ✓✓
$f_L = 1,0085\, f_s$ ✓ (4)

9.3 **POSITIVE MARKING FROM 9.1/*Positiewe nasien vanaf 9.1***
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓
$= \frac{330-0}{330+2,78}$ ✓ x 1 650 ✓
$= 1\,632,22$ Hz ✓ (4)

9.4 9.4.1 Y✓ (1)

9.4.2 X and Z are moving towards the earth/ *X en Z beweeg na die Aarde.*✓
Y is moving away from the earth/*Y beweeg weg van die Aarde.*✓ (2)

9.4.3 If a moving light source moves away from an observer (e.g. on earth). Light with longer wavelength✓ (to the red side of the spectrum) is observed as a result of doppler effect.✓/ The longer the wavelength, the higher the frequency.✓
Indien die ligbron weg van die waarnemer beweeg (bv. op Aarde). Lig met langer golflengte (na die rooi kant van die spektrum) word waargeneem as gevolg van die Doppler effek. (2)

[16]

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QUESTION 10/*VRAAG 10*

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

10.1 The magnitude of the electrostatic forces exerted by two-point charges on each other is directly proportional to the product of their charges ✓and inversely proportional to the square of the distance between them.✓
Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

10.2 $F_{AB} = \frac{k\,Q_A Q_B}{r^2}$ ✓
$= \frac{(9 \times 10^9)(45 \times 10^{-6})(20 \times 10^{-6})}{(0{,}09)^2}$ ✓✓
= 1000 N to right/*na regs* ✓ (4)

10.3 **Positive marking from question 10.2./*Positiewe nasien vanaf vraag 10.2.***

Rx = 10000 N to the right/*na regs*
Ry = 1500 N upwards/*opwaarts*

$R^2 = R_x^2 + R_y^2$ ✓
$= 1000^2 + 1500^2$ ✓
R = 1 802, 78 N ✓ (3)

10.4

10.4.1 The electrostatic force experienced per unit positive charge placed at that point.✓✓
Die elektrostatiese krag wat per eenheidspositiewe-lading wat by daardie punt geplaas is, ondervind word. (2)
(2 or/*of 0*)

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10.4.2 $E_{CA} = \frac{k\,Q_A}{r^2}$ ✓

$= \frac{(9 \times 10^9)(45 \times 10^{-6})}{(0,03)^2}$ ✓✓

$= 45 \times 10^7$ N.C^{-1} to the right/*na regs*

$E_{net} = E_{CB} + E_{CA}$

$= 5 \times 10^7 + 45 \times 10^7$ ✓

$= 5 \times 10^8$ N.C^{-1} ✓to the right/*na regs* ✓ (6)

[17]

TOTAL/TOTAAL: 143

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