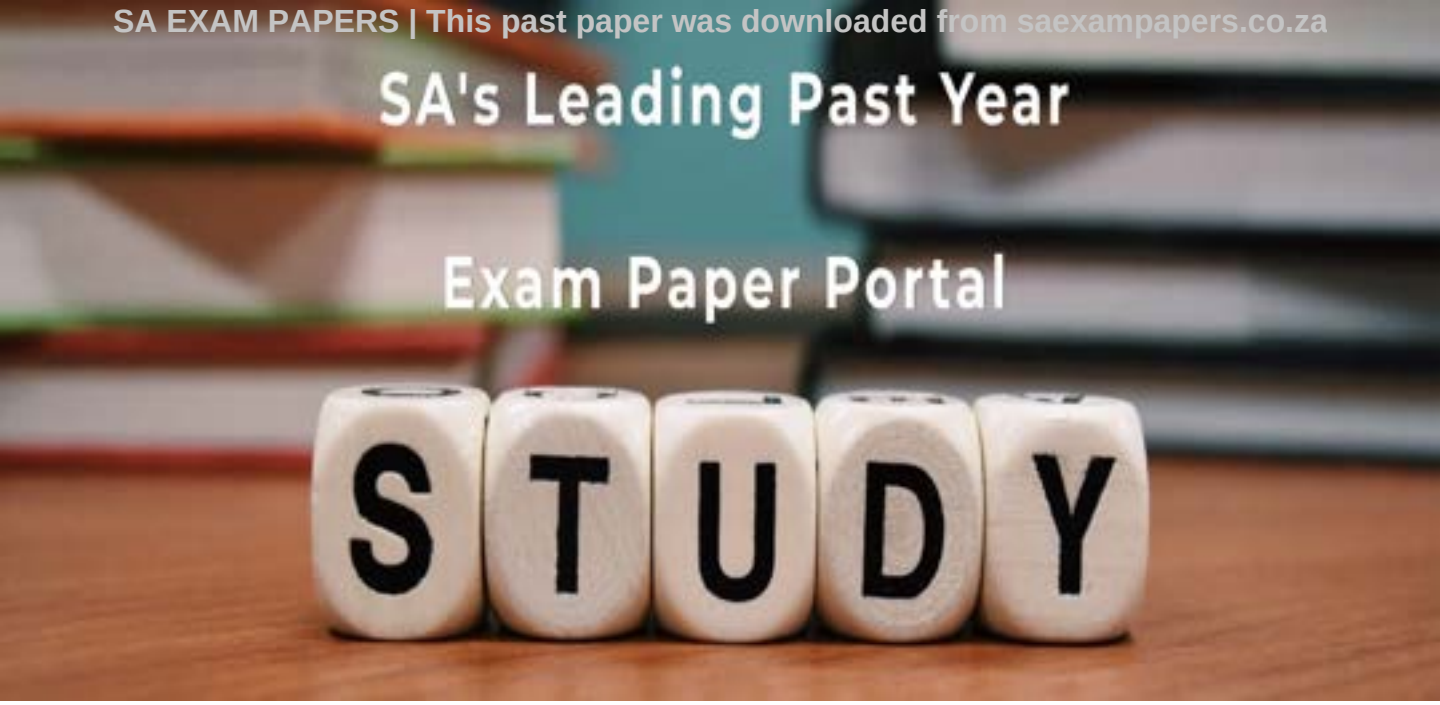

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ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
W = Vq W = VIΔt W= $I^2R\Delta t$ W= $\frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R P = $\frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemid} = V_{wgk}I_{wgk}$
	$P_{ave} = I_{rms}^2R$ / $P_{gemid} = I_{wgk}^2R$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemid} = \frac{V_{wgk}^2}{R}$

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE EKSAMEN

GRADE/*GRAAD* 12

2025

MARKING GUIDELINES/
NASIENRIGLYNE

PHYSICAL SCIENCES/
FISIESE WETENSKAPPE

(PAPER/*VRAESTEL* 1)

15 pages/*bladsye*

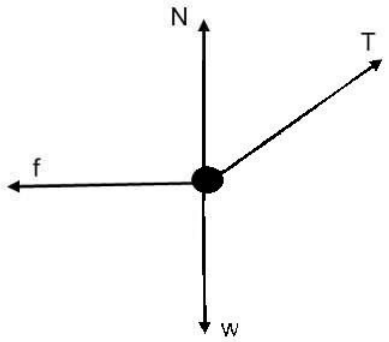
QUESTION 1/*VRAAG 1*

1.1	C ✓✓	(2)
1.2	D ✓✓	(2)
1.3	B ✓✓	(2)
1.4	A ✓✓	(2)
1.5	C✓✓	(2)
1.6	A ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/*VRAAG 2*

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

2.2



No components are accepted

Accepted labels/*Aanvaarde byskrifte*		Marks/*Punte*
w	F_g/F_w/weight/mg/gravitational force Do not accept gravity. *F_g/F_w/gewig/gravitasiekrag* *Moet nie gravitasie aanvaar nie.*	✓
T	F_T/tension *F_T/spanning/spankrag*	✓
F_N	Normal (force)/F_{normal} *Normaal (krag)/$F_{normaal}$*	✓
f	F_k/F_f/Friction *F_k/F_f/Wrywing*	✓
	Deduct 1 mark for any additional force. Mark is given for both arrow and label. If everything is correct, but no arrows, deduct a mark. *Trek 1 punt af vir enige addisionele kragte.* *Punt word toegeken vir pyltjie en byskrif.* *Indien alles korrek, maar geen pyltjies, trek 1 punt af*	

(4)

2.3

Marking criteria/*Nasienkriteria*

- Any one of the correct formulae/*enige een van die korrekte formules* ✓
- Fx substitution/F_x *invervanging* ✓
- Fy substitution/F_y *invervanging* ✓
- Substitution for 0 or equating equation 1 and 2/*Invervanging van 0 of gelykstel van vergelykings 1 en 2* ✓
- Final answer /*Finale antwoord* ✓(Range/*Gebied* 37,59 N – 37,77 N)

OPTION 1/*OPSIE 1*:

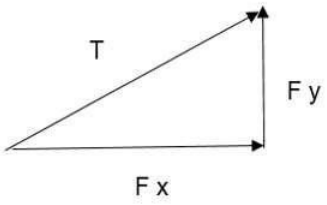
$F_{net} = ma$
$F_{net} = 0$
$T\cos\theta - f_k = ma$
$T\cos 40^o - \mu_k N = ma$

✓ Any one/*Enige een*

$T\cos 40^o$ ✓ $- (0,31)(Fg - T\sin 40^o)$ ✓ $= 0$ ✓
$T\cos 40^o - (0,31)((12 \times 9,8) - T\sin 40^o) = 0$
$T = 37,77$ N ✓

OPTION 2/*OPSIE 2*:

$f_k = \mu_k N$ ✓



$T\cos 40^o = 0,31F_N$

$T = \frac{(0,31F_N)}{\cos 40^o}$ ✓ ..... equation 1/*vergelyking1*

$Fy = Fg - F_N$

$T\sin 40^o = (12x9,8) - F_N$

$T = \frac{117,6 - F_N}{\sin 40^o}$ ✓ ..... equation 2/*vergelyking 2*

$\frac{(0,31F_N)}{\cos 40^o}$ =✓ $\frac{117,6 - F_N}{\sin 40^o}$ (equating the two equations/*gelykstelling van die twee vergelykings*)

$117,6 - F_N = 0,839\ (0,31F_N)$

$F_N = 93,32$ N

$T = \frac{(0,31)(93,32)}{\cos 40^o}$

$T = 37,77$ N ✓

(5)

2.4

2.4.1 **OPTION 1/*OPSIE 1:***

$$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark$$

$$24 = \frac{(10)+(10)}{2}(\Delta t) \checkmark$$

$$\Delta t = 2{,}4 \text{ s} \checkmark$$

OPTION 2/*OPSIE 2:*

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ Accept/*Aanvaar* $\Delta x = v\Delta t$

$24 = (10)\Delta t + \frac{1}{2}(0)\Delta t^2$ ✓

$\Delta t = 2{,}4$ s ✓ (3)

2.4.2 REMAINS THE SAME/*BLY DIESELFDE* ✓ (1)

2.5.1 DECREASE/*VERLAAG* ✓ (1)

2.5.2 As θ increases, the F_y will increase/*Soos θ toeneem, sal die F_y toeneem* ✓
$F_N = F_g - F_y$ / N α f / normal force decreases / *normaalkrag verminder*✓
and μ_k is constant/*en μ_k is konstant* ✓ (3)
[19]

QUESTION 3/*VRAAG 3*

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

3.2

3.2.1

OPTION 1/ *OPSIE 1*	**OPTION 2/ *OPSIE 2***
$F_g = mg$ $w = ma$ $5{,}38 \times 10^6 = m(9{,}8)$ ✓ $m = 548\,979{,}59$ kg✓ (5,49 x 10^5 kg)	$F = G\frac{m_1 m_2}{r^2}$ $5{,}38 \times 10^6 = \frac{(6{,}67x10^{-11})(5{,}98x10^{24})(m)}{(6{,}38x10^6)^2}$ ✓ $m = 548\,979{,}59$ kg✓ (5,49 x 10^5 kg)

(2)

3.2.2

$F = G\frac{m_1 m_2}{r^2}$ ✓

$5{,}04 \times 10^6$ ✓ $= \frac{(6{,}67x10^{-11})(5{,}98x10^{24})(m)}{(9\,000+6{,}38x10^6)^2}$ ✓

$m = 515\,785{,}7$ kg ✓ (5,16 x 10^5 kg) (5)

3.2.3 **POSITIVE MARKING FROM 3.2.1 AND 3.2.2/*POSITIEWE NASIEN VANAF 3.2.1 en 3.2.2***

Fuel mass = Total mass – mass of rocket (at 9000m)

Brandstofmassa = Totale massa – massa van vuurpyl (op 9000m)

= 548 979,59 – 515 785,70 ✓

= 33 193,89 kg ✓ (3,32 x 10^4 kg)

range/*gebied* 33 000 – 33 193,89 (2)

3.3 INCREASE/*VERHOOG* ✓✓ (2)

[13]

QUESTION 4/*VRAAG 4*

4.1 The block **B**/*die blok **B***✓

Only gravitational force is acting on the block./*Slegs gravitasiekrag werk op die blok in.* ✓ (2)

4.2.1

Take down as negative/*Neem af as negatief*:	Take down as positive/*Neem af as positief*:
$v_f = v_i + a\Delta t$ ✓ $0 = 5 + (-9{,}8)\Delta t$ ✓ $\Delta t = 0{,}51$ s ✓	$v_f = v_i + a\Delta t$ ✓ $0 = -5 + (9{,}8)\Delta t$ ✓ $\Delta t = 0{,}51$ s ✓

(3)

4.2.2

Take down as negative/*Neem af as negatief*:	Take down as positive/*Neem af as positief*:
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $= 5^2 + 2(-9{,}8)(-50)$ ✓ $v_f = 31{,}7$ m.s^{-1} (downwards) ✓	$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $= (-5)^2 + 2(9{,}8)(50)$ ✓ $v_f = 31{,}7$ m.s^{-1} (downwards) ✓

(3)

4.2.3 **POSITIVE MARKING FROM 4.2.1 AND 4.2.2/**
POSITIEWE NASIEN VANAF 4.2.1 EN 4.2.2

OPTION 1/*OPSIE 1*: Take down as negative/*Neem af as negatief*: $\Delta y = v_i\ \Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-50 = 5\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓ $\Delta t = 3{,}745\ s$ ✓	**OPTION 1/*OPSIE 1:*** Take down as positive/*Neem af as positief*: $\Delta y = v_i\ \Delta t + \frac{1}{2}a\Delta t^2$ ✓ $50 = -5\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓ $\Delta t = 3{,}745\ s$ ✓
OPTION 2/*OPSIE 2*: Take down as negative/*Neem af as negatief*: $\Delta y = v_i\ \Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-50 = 0 + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓ $\Delta t = 3{,}19\ s$ $t = 3{,}19 + 0{,}51$ $= 3{,}7\ s$ ✓	**OPTION 2/*OPSIE 2*:** Take down as positive/*Neem af as positief*: $\Delta y = v_i\ \Delta t + \frac{1}{2}a\Delta t^2$ ✓ $50 = 0 + \frac{1}{2}(9{,}8)\Delta t^2$ ✓ $\Delta t = 3{,}19\ s$ $T = 3{,}19 + 0{,}51$ $= 3{,}7\ s$ ✓
OPTION 3/OPSIE 3: Take down as negative/*Neem af as negatief*: $v_f = v_i + a\Delta t$ ✓ $-31{,}70 = 5 + (-9{,}8)\Delta t$ ✓ $\Delta t = 3{,}745\ s$ ✓	**OPTION 3/*OPSIE 3*:** Take down as positive/*Neem af as positief*: $v_f = v_i + a\Delta t$ ✓ $-31{,}70 = 5 + (-9{,}8)\Delta t$ ✓ $\Delta t = 3{,}745\ s$ ✓

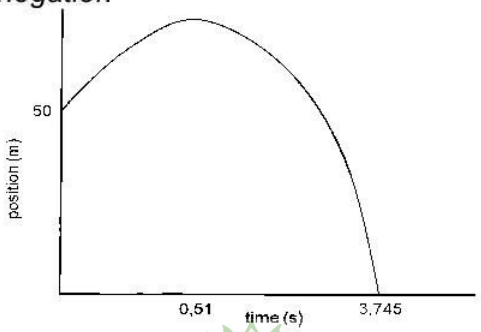
(3)

4.3 **POSITIVE MARKING FROM 4.2/*POSITIEWE NASIEN VANAF 4.2***

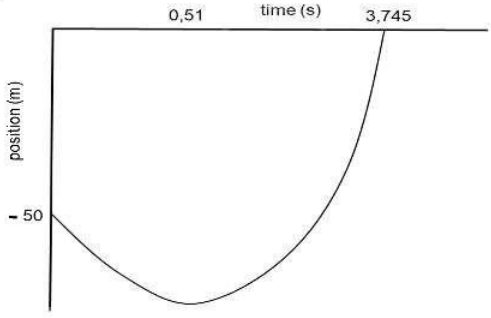
Marking criteria/*Nasienriglyne*:

- ✓ initial height/*aanvanklike hoogte* (50 m)
- ✓ time at maximum height/*tyd by maksimum hoogte* (4.2.1)
- ✓ time reaching the ground/*tyd om grond te bereik* (4.2.3)
- ✓ ground as zero reference point/*grond as nulverwysingspunt*
- ✓ correct shape of graph/*korrekte vorm van grafiek*

Take down as negative/*Neem af as negatief*:



Take down as positive/*Neem af as positief*:



(5)
[16]

QUESTION 5 /*VRAAG 5*

5.1

5.1.1 The TOTAL linear momentum of an isolated system remains constant (is conserved). ✓✓ do not accept closed system (2 or zero)

Die TOTALE lineêre momentum van 'n geïsoleerde sisteem bly konstant (behoue).
Moet nie geslote sisteem aanvaar nie. (2 of nul) (2)

5.2.1 $p = mv$
$30\ 000 = (2\ 000)v$ ✓
$v = 15\ m\cdot s^{-1}$ ✓ right/*regs* ✓ (3)

5.2.2 **POSITIVE MARKING FROM Q5.2.1 / *POSTIEWE NASIEN VANAF V5.2.1***
OPTION 1/ *OPSIE 1*

$$\Sigma p_i = \Sigma p_f$$
$$p_{i(car\ A)} + p_{i(car\ B)} = p_{f(car\ A)} + p_{f(car\ B)}$$
$$mv_{i(car\ A)} + mv_{i(car\ B)} = mv_{f(car\ A)} + mv_{f(car\ B)}$$
$$(2\ 000)(15) + m(0) = (2\ 000)(5) + m(20)$$
$$\underline{(30\ 000) + 0} \checkmark = \underline{(10\ 000) + m(20)} \checkmark$$
$$m = 1\ 000\ kg \checkmark$$

✓ Any one/*Enige een*

OPTION 2 / *OPSIE 2*

$$\Delta p_A = -\Delta p_B$$
$$mv_{i(car\ A)} - mv_{f(car\ A)} = -(mv_{f(car\ B)} - mv_{i(car\ B)})$$
$$\underline{(2\ 000)(15) - (2\ 000)(5)} \checkmark = \underline{m(20) - m(0)} \checkmark$$
$$m = 1\ 000\ kg \checkmark$$

✓ Any one/*Enige een*

If the negative in the formula is omitted (0/4)
Indien die negatief in formule uitgelaat word (0/4)

(4)

5.3

$\Delta p = 20\ 000\ kg\cdot m\cdot s^{-1}$ ✓

Arrow to the left/*pyl na links* ✓

(2)

(Do not penalise length of arrow/*Moet nie lengte van pyltjie penaliseer nie*)

5.4

OPTION 1/ *OPSIE 1*

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = \Delta p$
✓ Any one/ *Enige een*

$F_{net}(0,5) = 2000(5 - 15)$ ✓
OR / *OF*
$F_{net}(0,5) = (10\ 000 - 30\ 000)$
$F_{net} = -\ 40\ 000$

$F_{net} = 40\ 000$ N ✓

OPTION 2/ *OPSIE 2*

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = \Delta p$
✓ Any one/ *Enige een*

$F_{net}(0,5) = 1000(20 - 0)$ ✓

$F_{net}(0,5) = 20\ 000$

$F_{net} = 40\ 000$ N ✓

(3)

5.5 For the same change in momentum/*Vir dieselfde verandering in momentum*✓
During impact, the airbag increases the contact time/*Tydens impak verhoog die lugsak die kontaktyd*. ✓ ($F_{net} \propto \frac{1}{t}$)
The net force will decrease./*Die netto krag sal afneem.* ✓ (3)
[17]

QUESTION 6/*VRAAG 6*

6.1 A force for which the work done in moving an object between two points depends on the path taken. ✓✓ (2 or zero)

'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te laat beweeg, afhanklik is van die roete wat gevolg word. (2 of nul) (2)

6.2 (Kinetic) frictional force ✓ and pulling force / applied force ✓
(Kinetiese) wrywingskrag en trekkrag / toegepaste krag. (2)

6.3

OPTION 1/*OPSIE 1*

$W_{nc} = \Delta Ek + \Delta Ep$
$W_{FA} + W_{fk} = Ekf - Eki + 0$
✓ Any one/*Enige een*

$F\Delta x\cos\theta + f_k\Delta x\cos\theta = \frac{1}{2}(20)v_f^2$✓ $- \frac{1}{2}(20)(0)^2$

$(100)(4)\cos0^o$ ✓$+ (65)(4)\cos180^o$✓ $= 10v_f^2$

$v_f = 3,74\ m\cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta E_k$
$W_{FA} + Wf_k = E_{kf} - E_{ki}$ ✓ Any one/*Enige een*

$F\Delta x\cos\theta + f_k\Delta x\cos\theta = \frac{1}{2}(20)v_f^2$ ✓ $- \frac{1}{2}(20)(0)^2$

$(100)(4)\cos 0^o$ ✓ $+ (65)(4)\cos 180^o$ ✓ $= 10v_f^2$

$v_f = 3{,}74\ m\cdot s^{-1}$ ✓ (5)

6.4 **POSITIVE MARKING FROM 6.3/*POSITIEWE NASIEN VANAF 6.3***

OPTION 1/ *OPSIE 1*

$P_{ave} = Fv_{ave}$ ✓

$= (100)\left(\frac{3{,}74+0}{2}\right)$ ✓

$= 187\ W$ ✓

(Range/*Gebied* 187 – 187, 08 W)

OPTION 2/*OPSIE 2*

$\Delta x = \frac{v_f+v_i}{2}\Delta t$

$4 = \frac{0+3{,}74}{2}\Delta t$

$\Delta t = 2{,}139s$

$P = \frac{W}{\Delta t}$
$= \frac{F\Delta x\cos\theta}{\Delta t}$ ✓ Any one/ *enige een*

$= \frac{(100)(4)\cos 0}{2{,}139}$ ✓

$= 187\ W$ ✓ (3)

6.5

6.5.1

Fg ✓✓ Accept w / mg *Aanvaar w / mg* (2)

6.5.2 No✓ , The F_{net} will be less (decrease) ✓/ the w will do negative work and remove energy from the system.

Nee, die F_{net} sal minder wees (afneem) / die gewig sal negatiewe arbeid verrig en die energie uit die sisteem verwyder. (2)

[16]

QUESTION 7/*VRAAG 7*

7.1

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 sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The (apparent) change in frequency (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓✓

Die (skynbare) verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/*OF*
An (apparent) change in observed/detected frequency/pitch as a result of the relative motion between a source and an observer/listener.

'n (Skynbare) verandering in waargenome frekwensie/toonhoogte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

7.2 Away/*Weg van* ✓ (1)

7.3 $f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓

$88 ✓ = \frac{340}{340 + v_S} ✓ 90 ✓$

do not accept any other formula/*moet geen ander formule aanvaar nie*

$v_S = 7{,}73\ m.s^{-1}$ ✓ (5)

[8]

QUESTION 8/*VRAAG 8*

8.1

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 sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

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. ✓✓
If masses in place of charge – **zero** marks

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.
Indien massa in plek van ladings – geen punte. (2)

8.2

Marking criteria/*Nasienriglyne*
- correct formula for Coulomb's Law/*korrekte formule vir Coulomb se wet* ✓
- substitution of 0,866 in Fnet/*vervanging van 0,866 in Fnet* ✓
- Substitution for C on A/*vervanging vir C op A* ✓
- Substitution for B on A/*vervanging vir B op A* ✓
- Correct final answer/*Korrekte finale Antwoord* ✓

$$F_{net}^2 = F_{ConA}^2 + F_{BonA}^2$$

$$F_{net}^2 = \left(\frac{kQ_CQ_A}{r^2}\right)^2 + \left(\frac{kQ_BQ_A}{r^2}\right)^2 ✓$$

$$0{,}866^2 ✓ = \left(\frac{9x10^9(7x10^{-6})(5x10^{-6})}{d^2}\right)^2 ✓ + \left(\frac{9x10^9(5x10^{-6})(2x10^{-6})}{0{,}5^2}\right)^2 ✓$$

$$d = 0{,}63\ m\ ✓$$ (5)

8.3

8.3.1

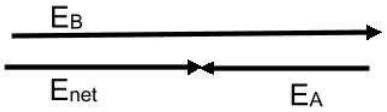
Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct
1 mark./*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die elektrostatiese krag wat per eenheid positiewe-lading wat by daardie punt geplaas is, ondervind word. (2)

8.3.2 ✓✓

OR/*OF*



OR/*OF*

(2)

8.3.3

Marking criteria/*Nasienriglyne*
- correct formula /*korrekte formule* ✓
- substitution for both Q_A and Q_B/ *vervanging van beide Q_A en Q_B* ✓
- Subtraction/*aftrek* ✓
- Correct final answer/*Korrekte finale Antwoord* ✓

$$E_{net} = \frac{kQ_A}{r^2} - \frac{kQ_B}{r^2} \quad ✓$$

$$= \frac{9\times10^9(2\times10^{-6})}{0{,}2^2} - ✓ \frac{9\times10^9(5\times10^{-6})}{0{,}7^2} \quad ✓$$

= 358 163,27 N·C^{-1} ✓ OR 3,58 x 10^5 N·C^{-1} (4)

8.3.4 The statement is true ✓

The net electric field will always be the sum of E_B and E_A. The two electric fields will always be in the same direction. ✓

Die stelling is waar.

Die netto elektriese veld sal altyd die som van E_B en E_A wees, die twee elektriese velde sal altyd in die selfde rigting wees. (2)

8.4.1 Directly proportional/*direk eweredig*. ✓ (1)

8.4.2

OPTION 1/*OPSIE 1*

$$E = \frac{F}{q} \quad ✓$$

$$= \frac{0{,}005}{1\text{ x }10^{-6}} \quad ✓$$

$$= 5\,000\ N \cdot C^{-1} \quad ✓$$

OPTION 2/*OPSIE 2*

$$\text{gradient/*gradiënt*} = \frac{\Delta F}{\Delta q} \quad ✓$$

$$= \frac{0{,}005 - 0}{1{,}0\text{ x }10^{-6} - 0} \quad ✓$$

$$= 5\,000\ N \cdot C^{-1} \quad ✓$$

(3)
[21]

QUESTION 9/*VRAAG 9*

9.1 The rate at which work is done ✓✓ (2 or zero)

Die tempo waarteen arbeid verrig word. (2 of 0) (2)

9.2.1 $1{,}2\ \text{A}$ ✓✓ (2)

9.2.2 **OPTION 1/*OPSIE 1*:**

$P = VI$ ✓
$P = 3{,}6(2{,}4)$ ✓
$= 8{,}64\ \text{W}$ ✓

OPTION 2/*OPSIE 2*:

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{3} + \frac{1}{3}$
$R = 1{,}5\ \Omega$

$P = \frac{V^2}{R}$ ✓
$= \frac{3{,}6^2}{1{,}5}$ ✓
$= 8{,}64\ \text{W}$ ✓

OPTION 3/*OPSIE 3*:

$P = I^2R$ ✓
$= 2{,}4^2(1{,}5)$ ✓
$= 8{,}64\ \text{W}$ ✓

OPTION 4/*OPSIE 4:*

$P_{R_2} = I^2R$ ✓
$= (1{,}2)^2(3)$ ✓
$= 4{,}32\ \text{W}$
$P_{total} = P_{R2} + P_{R3}$
$= 4{,}32 + 4{,}32$
$= 8{,}64\ \text{W}$ ✓

(3)

9.3.1 **OPTION 1/*OPSIE 1*:**

$W = I^2Rt$ ✓
$= 1{,}26^2(3)(600)$ ✓
$= 2857{,}68\ \text{J}$ ✓

OPTION 3/*OPSIE 3*:

$W = VIt$ ✓
$= 3{,}78(1{,}26)(600)$ ✓
$= 2857{,}68\ \text{J}$ ✓

OPTION 2/*OPSIE 2*:

$W = \frac{V^2t}{R}$ ✓
$= \frac{3{,}78^2(600)}{3}$ ✓
$= 2857{,}68\ \text{J}$ ✓

(3)

9.3.2 DECREASE ✓
No current will go through the circuit. Voltmeter has a very high resistance and will not let current pass through. ✓

VERLAAG
Geen stroom sal deur die stroombaan beweeg nie. Die voltmeter het 'n baie hoë weerstand en sal nie die stroom deurlaat nie (2)

9.4 The maximum energy provided/work done by a battery per unit charge passing through it. ✓✓ (2 or zero)

Die maksimum energie wat 'n battery lewer/arbeid verrig per eenheidslading wat daardeur vloei. (2 of nul) (2)

9.5

CIRCUIT A/*STROOMBAAN A*:	**CIRCUIT B/*STROOMBAAN B*:**
$\varepsilon = I(R + r)$ ✓	$\varepsilon = I(R + r)$
$\varepsilon = 2{,}4(3 + 1{,}5 + r)$ ✓ .....(1)	$\varepsilon = 1{,}26(3 + 3 + 3 + r)$ ✓ .....(2)

(1) = (2) ✓

2,4(4,5 + r) = 1,26(9 + r)

r = 0,47 Ω ✓

$\varepsilon = 11{,}94\ V$ ✓

(6)

[20]

TOTAL/*TOTAAL:* 150