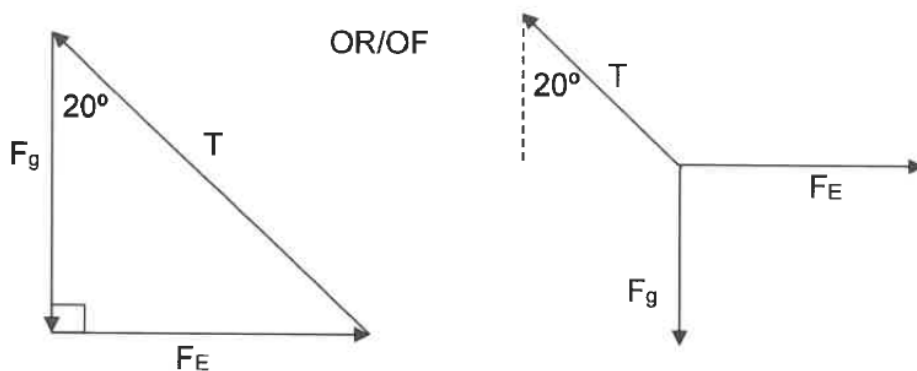


QUESTION 9/VRAAG 9

9.1 The magnitude of the electrostatic force exerted by two point charges on each other is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance between them. ✓
 Die grootte van die elektrostatiese krag wat deur twee puntladings op mekaar uitgeoefen word, is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.
 [Penalise -1 if key words/phrase is omitted/
 Penaliseer -1 indien sleutelwoorde/frase is uitgelaat]
 NOTE: If learners refers to masses, no marks awarded
 NOTA: Indien leerder na massa verwys, geen punte

(2)

9.2



Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
w	weight/ F_G/F_g gewig/gravitasiekrag/swaartekrag	✓
T	Tension/ F_T Spanning/ F_T	✓
F_E	Electrostatic force Elektrostatiese krag	✓
	One angle indicated Een hoek aangedui	✓

(4)

9.3 **OPTION 1/OPSIE 1**

If F_A and F_B were used/Indien F_A en F_B gebruik word

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(8 \times 10^{-9})(7 \times 10^{-9})}{0,03^2} \checkmark$$

$$= 5,60 \times 10^{-4} \text{ N} \checkmark$$

NOTE/NOTA:

Due to information given in the question, accept all possible options

As gevolg van die inligting in die vraag gegee, aanvaar alle moontlike opsies

OPTION 2/OPSIE 2

If F_g and F_E were used/Indien F_g en F_E gebruik word

$$F_g = mg$$

$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} \text{ N} \checkmark$$

$$F_E = (1,96 \times 10^{-3}) \tan 70^\circ \checkmark$$

$$= 7,13 \times 10^{-4} \text{ N} \checkmark$$

OPTION 3/OPSIE 3

If F_g and F_E were used/Indien F_g en F_E gebruik word

$$F_g = mg$$

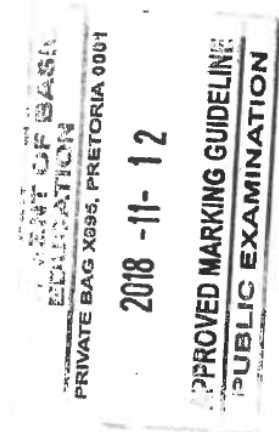
$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} \text{ N} \checkmark$$

$$\frac{F_E}{\sin 20^\circ} = \frac{F_g}{\sin 70^\circ}$$

$$\checkmark \frac{F_E}{\sin 20^\circ} = \frac{(1,96 \times 10^{-3})}{\sin 70^\circ} \checkmark$$

$$F_E = 7,13 \times 10^{-4} \text{ N} \checkmark$$



(4)

9.4 **POSITIVE MARKING FROM QUESTION 9.3**

POSITIEWE NASIEN VANAF VRAAG 9.3

<p>OPTION 1/OPSIE 1 Using F_g and F_E/Gebruik F_g en F_E</p> $F_g = mg$ $= (0,2 \times 10^{-3})(9,8) \checkmark$ $= 1,96 \times 10^{-3} \text{ N}$ $T^2 = (1,96 \times 10^{-3})^2 + (5,6 \times 10^{-4})^2 \checkmark$ $T = 2,04 \times 10^{-3} \text{ N} \checkmark$	<p>OPTION 2/OPSIE 2 Using F_g and angle/Gebruik F_g en hoek</p> $T = \frac{F_g}{\sin 70^\circ}$ $T = \frac{1,96 \times 10^{-3}}{\sin 70^\circ} \checkmark$ $T = 2,09 \times 10^{-3} \text{ N} \checkmark$
<p>OPTION 3/OPSIE 3 Using F_E and angle/Gebruik F_E en hoek</p> $T = \frac{F_E}{\cos 70^\circ}$ $T = \frac{5,6 \times 10^{-4}}{\cos 70^\circ} \checkmark$ $T = 1,64 \times 10^{-3} \text{ N} \checkmark$	<p>NOTE/NOTA: Due to information given in the question, accept all possible options As gevolg van die inligting in die vraag gegee, aanvaar alle moontlike opsies</p>

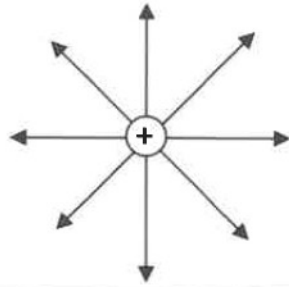
(3)
[13]

Elektrostatika Memo

November 2018/3

QUESTION 10/VRAAG 10

10.1



Criteria for marking/Nasienkriteria	
Shape of the field (minimum of 4 field lines) <i>Vorm van veld (minimum van 4 veldlyne)</i>	✓
Direction of the field <i>Rigting van veld</i>	✓
Lines don't touch charge/lines cross etc. (maximum ½) <i>Lyne raak nie lading/lyne kruis ens. (maksimum ½)</i>	

(2)

10.2.1 16 : 1 ✓

(1)

10.2.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$E_P : E_T$ $16 : 1 \checkmark$	$E_p = \frac{kQ}{r^2} \checkmark$
Because/Omdat	$4 \times 10^6 = \frac{9 \times 10^9 Q}{r^2} \checkmark$
$E \propto \frac{1}{r^2} \checkmark$	$9 \times 10^9 Q = (4 \times 10^6) r^2 \dots (1)$
$r_P : r_T$ $1 : 4 \checkmark$	$E_T = \frac{kQ}{r^2}$
$r : r + 3 \text{ mm}$ $r = 1 \text{ mm} \checkmark (0,001 \text{ m})$	$2,5 \times 10^5 = \frac{9 \times 10^9 Q}{(r + 0,003)^2} \checkmark$
	$9 \times 10^9 Q = (2,5 \times 10^5)(r + 0,003)^2 \dots (2)$
	Equation/Vergelyking (1) = (2)
	$(4 \times 10^6) r^2 = (2,5 \times 10^5)(r + 0,003)^2$ $16r^2 = r^2 + 0,006r + 9 \times 10^{-6}$
	$r = 1 \text{ mm} \checkmark (0,001 \text{ m})$

(4)

10.2.3 POSITIVE MARKING FROM QUESTION 10.2.2
 POSITIEWE NASIEN VANAF VRAAG 10.2.2

$$E_p = \frac{kQ}{r^2}$$

$$4 \times 10^6 = \frac{9 \times 10^9 Q}{(0,001)^2} \checkmark$$

$$Q = 4,44 \times 10^{-10} \text{ C} \checkmark$$

OR/OF $E_T = \frac{kQ}{r^2}$

$$2,5 \times 10^5 = \frac{9 \times 10^9 Q}{(0,004)^2} \checkmark$$

$$Q = 4,44 \times 10^{-10} \text{ C} \checkmark$$

(2)
 [9]

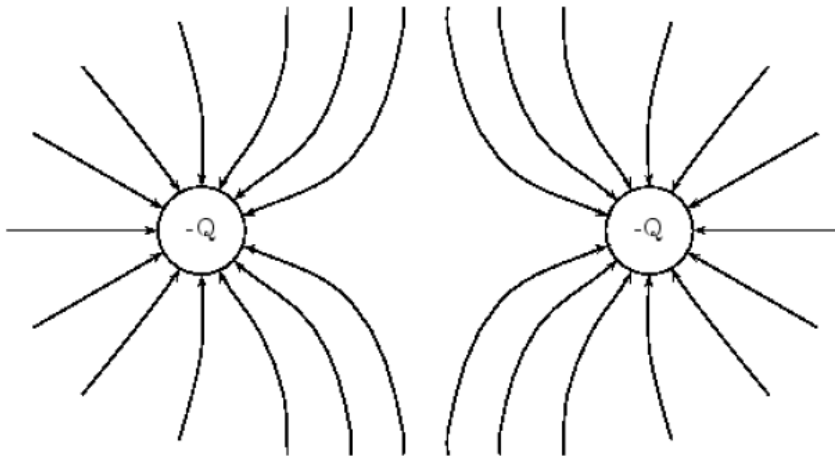
Elektrostatika Memo
November 2017

QUESTION/VRAAG 8

8.1 The electrostatic force experienced per unit positive charge (placed at that point) ✓✓
 Die elektrostatiese krag wat per eenheid positiewe lading (ondervind word by daardie punt) ✓✓ (2)

8.2 Negative ✓
 Negatief ✓ (1)

8.3 **POSITIVE MARKING FROM QUESTION 8.2**
POSITIEWE NASIEN VANAF VRAAG 8.2



Criteria for marking/Nasienkriteria	
Shape of the field Vorm van veld	✓
Direction of the field Rigting van veld	✓
Lines touch charge/line don't cross etc. Lyne raak lading/lyne kruis nie ens.	✓

NOTE: If only one charge is drawn, no marks
 NOTA: Indien slegs een lading geteken word, geen punte

(3)

8.4 $E = \frac{kQ}{r^2}$
 $E_{net} = \frac{kQ}{r^2} + \frac{kQ}{r^2}$ } ✓ Any one/enige een

$5,44 \times 10^6 \checkmark = \frac{9 \times 10^9 Q}{(5 \times 10^{-3})^2} \checkmark + \frac{9 \times 10^9 Q}{(3 \times 10^{-3})^2} \checkmark$

$Q = 4 \times 10^{-9} \text{ C } \checkmark$ (5)

8.5 Net electric field DECREASES ✓
 The positive charge on X will have a field in the opposite direction. The electric field (strength) being a vector will decrease because of opposite directions. ✓

Netto elektriese veld NEEM AF ✓

Die positiewe lading op X het 'n veld in die teenoorgestelde rigting. Die elektriese veld (sterkte) is 'n vektor en dit sal die veld laat afneem as die rigtings van die twee ladings se velde teenoorgesteld is. ✓

(2)

[13]

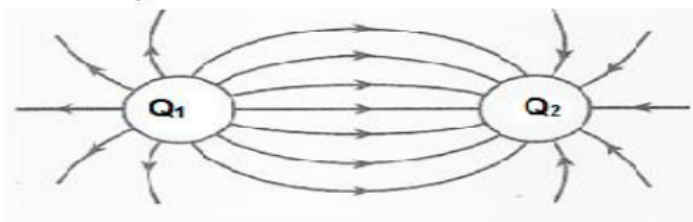
QUESTION/VRAAG 8

8.1 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 (magnitude of the) charges ✓ and inversely proportional to the square of the distance between them. ✓

Die grootte van die elektrostatiese krag wat deur een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen word, is direk eweredig aan die produk van die (grootte van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

8.2



Criteria for sketch/Kriteria vir skets.	Marks/Punte
Correct shape Korrekte vorm.	✓
Direction from positive to negative. Rigting van positief na negatief.	✓
Field lines start on spheres and do not cross. Veldlyne begin op sferie en kruis nie.	✓

(3)

8.3.1

$$F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$F = \frac{(9,0 \times 10^9)(6 \times 10^{-6}) \checkmark (4 \times 10^{-6}) \checkmark}{(3)^2 \checkmark}$$

$$F = 2,4 \times 10^{-2} \text{ N right/regs } \checkmark$$

(no direction/geen rigting- 4/5)

(5)

8.3.2

$$E_1 = \frac{kQ_1}{r^2} \checkmark = \frac{(9,0 \times 10^9)(6 \times 10^{-6}) \checkmark}{(4,2)^2 \checkmark} = 3\,061,22 \text{ N.C}^{-1}$$

$$E_2 = \frac{kQ_2}{r^2} = \frac{(9,0 \times 10^9)(4 \times 10^{-6}) \checkmark}{(1,2)^2} = 25\,000 \text{ N.C}^{-1}$$

$$E_{\text{net}} = E_1 + (-E_2) \checkmark$$

$$= 3\,061,22 + (-25\,000) \checkmark$$

$$= -2,19 \times 10^4$$

$$= 2,19 \times 10^4 \text{ N.C}^{-1} \text{ left/links } \checkmark$$

(7)

8.3.3

$$n_{e^-} = \frac{Q_2}{Q_e} = \frac{(4 \times 10^{-6})}{(1,6 \times 10^{-19})} \checkmark = 2,5 \times 10^{13} \text{ electrons } \checkmark / \text{elektrone}$$

(2)

QUESTION/VRAAG 11

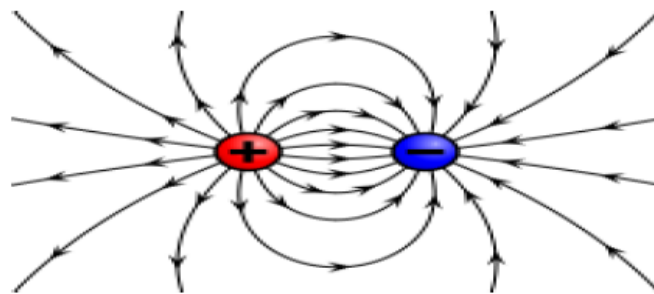
- 11.1 Force experienced per unit charge at a point in the field. ✓✓
Krag ondervind per eenheidslading by 'n punt in die veld. ✓✓

OR/OF

It is the force experienced by a unit positive charge placed at that point. ✓✓
 Dit is die krag wat deur 'n eenheids positiewe lading geplaas by daardie punt ondervind word. ✓✓

(2)

11.2



CRITERIA FOR SKETCH/KRITERIA VIR SKETS	MARKS/PUNTE
Correct shape / Korrekte vorm	✓
Direction from positive to negative <i>Rigting van positief na negatief</i>	✓
Fieldlines start on sphere and do not cross <i>Veldlyne begin op elke sfeer en kruis nie</i>	✓

(3)

11.3

Any ONE / Enige EEN

$$E_p = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(4 \times 10^{-9})}{(0,10)^2} = 3\,600 \text{ N.C}^{-1} \text{ to the right/na regs}$$

$$E_Q = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-9})}{(0,02)^2} = 45\,000 \text{ N.C}^{-1} \text{ to the left/na links}$$

$$E_{\text{net}} = 3\,600 - 45\,000 = 41\,400 \text{ N.C}^{-1} \text{ to the left/na links}$$

11.4

POSITIVE MARKING FROM QUESTION 11.3
POSITIEWE NASIEN VAN VRAAG 11.3

$$E = \frac{F}{Q}$$

$$41\,400 = \frac{F}{1,6 \times 10^{-19}}$$

$$F = 6,62 \times 10^{-15} \text{ N}$$

(3)

[15]

Elektrostatika Memo

November 2014

1.7 B✓✓ (2)

1.8 D✓✓ (2)

QUESTION 9/VRAAG 9

9.1 Electric field at a point is defined as the force acting per unit charge. ✓✓
Elektriese veld by 'n punt word gedefinieer as die krag wat inwerk per eenheidslading.

OR/OF

It is the force experienced by a unit positive charge placed at that point.

Dit is die krag wat deur 'n eenheid positiewe lading geplaas by daardie punt ondervind word.

(2)

9.2 $E_{\text{net}} = 0$

OR/OF

$$E_1 + E_2 = 0$$

$$\frac{kQ_1}{r_1^2} + \frac{kQ_2}{r_2^2} = 0 \checkmark$$

$$\frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,2 - x)^2} - \frac{(9 \times 10^9)(3 \times 10^{-6})}{x^2} = 0$$

$$\frac{2}{(0,2 - x)^2} = \frac{3}{x^2}$$

Taking square root/Neem vierkantswortel

$$\frac{1,414}{(0,2 - x)^2} = \frac{1,732}{x^2}$$

$$x = 0,11 \text{ m} \checkmark$$

(7)

9.3 $F = \frac{kQ_1Q_2}{r^2} \checkmark$

Force experienced by the $+3 \mu\text{C}$ charge due to the $+2 \mu\text{C}$ charge = $F_{3,2}$

Krag ondervind deur die $+3 \mu\text{C}$ -ading as gevolg van die $+2 \mu\text{C}$ -lading = $F_{3,2}$

$$F_{3,2} = 9 \times 10^9 \frac{(2 \times 10^{-6})(3 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$= 1,35 \text{ N to the right (east) / na regs (oos)}$$

Force experienced by the $+3 \mu\text{C}$ charge due to the presence of the $-4 \mu\text{C}$ charge = $F_{3,4}$

Krag ondervind deur die $+3 \mu\text{C}$ -lading as gevolg van die $-4 \mu\text{C}$ -lading = $F_{3,4}$

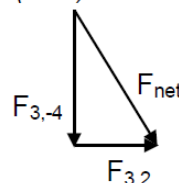
$$F_{3,4} = 9 \times 10^9 \frac{(4 \times 10^{-6})(3 \times 10^{-6})}{(0,1)^2}$$

$$= 10,8 \text{ N downwards (southwards)/afwaarts (suid)}$$

$$F_{\text{net}} = \sqrt{F_1^2 + F_2^2}$$

$$= \sqrt{(10,8)^2 + (1,35)^2} \checkmark$$

$$= 10,88 \text{ N} \checkmark$$



(5)

[14]

Elektrostatika Memo

November 2013

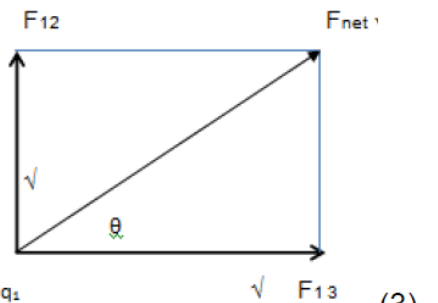
2.7 C

(2)

2.9 A

(2)

QUESTION/VRAAG 9

<p>9.1</p>	 <p>(3)</p>	<p>9.2</p> $F_{12} = \frac{k q_1 q_2}{r^2} \checkmark$ $= \frac{9 \times 10^9 (4 \times 10^{-6})(6 \times 10^{-6})}{(0,15)^2} \checkmark$ $= 9,6 \text{ N} \checkmark$	<p>(4)</p>
<p>9.3</p>	$F_{13} = \frac{9 \times 10^9 (4 \times 10^{-6})(5 \times 10^{-6})}{(0,1)^2} \checkmark$ $= 18 \text{ N} \checkmark$ $F_{\text{net}} = \sqrt{9,6^2 + 18^2} \checkmark$ $= 20,4 \text{ N} \checkmark$ $\tan \theta = \frac{9,6}{18} \checkmark$ $\theta = 28,07^\circ \checkmark$ <p>(anticlockwise from positive x-axis) (antikloksgewys vanaf die positiewe x-as)</p> <p>(clockwise from the positive y-axis) (kloksgewys vanaf die positiewe y-as)</p>	<p>(7)</p>	

[14]

Elektrostatika Memo
Modelvraestel 2013

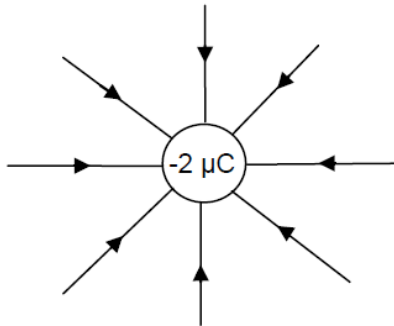
1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

QUESTION 10/VRAAG 10

10.1 The force per unit charge./Die krag per eenheid lading. ✓✓ (2)

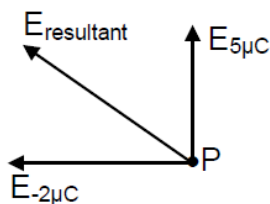
10.2



Marking criteria for electric field lines Kriteria vir nasien van elektriese veldlyne	
Shape of field lines./Vorm van veldlyne.	✓
Direction of field lines (towards charge). Rigting van veldlyne (na lading toe).	✓

(2)

10.3



$$E_{2\mu\text{C}} = \frac{kQ}{r^2} \checkmark = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,1)^2} \checkmark$$

$$= 1,8 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ towards the } 2 \mu\text{C} \text{ charge (as shown)}$$

na 2 μC lading (soos aangedui)

$$E_{5\mu\text{C}} = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(5 \times 10^{-6})}{(0,15)^2} \checkmark$$

$$= 2 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ away from the } 5 \mu\text{C} \text{ charge (as shown)}$$

weg vanaf 5 μC lading (soos aangedui)

$$E_{\text{resultant}} = \sqrt{(1,8 \times 10^6)^2 + (2 \times 10^6)^2} \checkmark = 2,69 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

(7)
[11]