



education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GRADE 12

PHYSICAL SCIENCES MONTHLY TEST

APRIL 2020

TOPIC: ELECTROSTATICS

MEMORANDUM

MARKS: 60

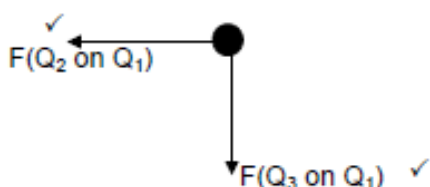
This Memorandum consists of 5 pages

QUESTION 1

- 1.1. C ✓✓
 1.2. A ✓✓
 1.3. A ✓✓
 1.4. A ✓✓
 1.5. B ✓✓

QUESTION 2

- 2.1. The (magnitude) of the electrostatic force exerted by one charge on another is directly proportional to the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance between their centres. ✓ (2)



- 2.2. (2)

- 2.3. $F = \frac{kQ_1Q_2}{r^2}$ ✓
 $F_{Q2 \text{ on } Q1} = \frac{(9 \times 10^9)(4 \times 10^{-6})(4 \times 10^{-6})}{(3 \times 10^{-3})^2}$ ✓
 $F_{Q2 \text{ on } Q1} = 1,6 \times 10^4 \text{ N left, links}$
 $F_{Q3 \text{ on } Q1} = \frac{(9 \times 10^9)(4 \times 10^{-6})(4 \times 10^{-6})}{(3 \times 10^{-3})^2}$ ✓
 $F_{Q3 \text{ on } Q1} = 1,6 \times 10^4 \text{ N downwards}$
 $F_{net} = \sqrt{(F_{Q2 \text{ on } Q1})^2 + (F_{Q3 \text{ on } Q1})^2}$
 $F_{net} = \sqrt{(1,6 \times 10^4)^2 + (1,6 \times 10^4)^2}$ ✓
 $F_{net} = 2,26 \times 10^4$
 $\tan\theta = \left(\frac{F_{Q3 \text{ on } Q1}}{F_{Q2 \text{ on } Q1}}\right)$
 $\tan\theta = \left(\frac{1,6 \times 10^4}{1,6 \times 10^4}\right)$ ✓
 $\therefore \theta = 45^\circ$
 $F_{net} = 2,26 \times 10^4 \text{ N } \checkmark 45^\circ \text{ south of west / } 225^\circ \checkmark$

(8)
[12]

QUESTION 3

3.1. The force ✓ per unit charge ✓ at that point. (2)

3.2. $E = \frac{kQ}{r^2}$ ✓
 $E = \frac{(9 \times 10^9)(6,5 \times 10^{-12})}{(0.003)^2}$ ✓

$E = 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1}$ ✓ (3)

3.3. **At point X**

$E_Q = 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1} \text{ West}$ ✓

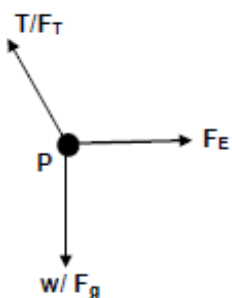
$E_R = \frac{kQ}{r^2}$
 $E_R = \frac{(9 \times 10^9)(6,5 \times 10^{-12})}{(0.003)^2}$ ✓

$E_R = 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1} \text{ East}$ ✓

$E_{\text{net}} = E_Q + E_R$ ✓

$E_{\text{net}} = 6,5 \times 10^3 + (-6,5 \times 10^3)$
 $E_{\text{net}} = 0 \text{ N} \cdot \text{C}^{-1}$ ✓ (5)

3.4.1



Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag
T	F_T / tension F_T / spanning
F_E	Electrostatic force/ F_C / Coulombic force/ F_Q / F_{RRPR} Elektrostatiese krag / Coulombkrag / F_Q / F_{RRPR}

(3)

3.4.2 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$$F = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(6,5 \times 10^{-12})}{(0,2)^2} \checkmark$$

$$F/T_X = 7,31 \times 10^{-7} \text{ N}$$

$$\tan 7^\circ = \frac{T_X}{T_Y} = \frac{7,31 \times 10^{-7}}{T_Y} \checkmark$$

$$T_Y = 5,95 \times 10^{-6} \text{ N}$$

$$T = \sqrt{T_X^2 + T_Y^2}$$

$$\sqrt{(7,31 \times 10^{-7})^2 + (5,95 \times 10^{-6})^2}$$

$$T = 5,99 \times 10^{-6} \text{ N} \checkmark$$

OPTION 2

$$\sin 7^\circ = \frac{T_X}{T}$$

$$= \frac{7,31 \times 10^{-7}}{T} \checkmark$$

$$T = 5,99 \times 10^{-6} \text{ N} \checkmark$$

(5)

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QUESTION 4

4.1. To ensure that charge does not leak to the ground/insulated. ✓ (1)

4.2. Net charge = $\frac{Q_R + Q_S}{2}$

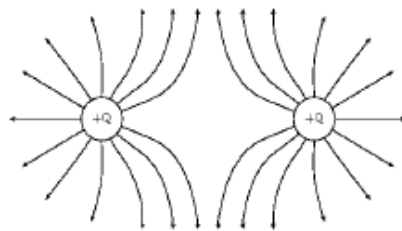
$$Q_{net} = \frac{+8 + (-4)}{2} \checkmark$$

$$Q_{net} = 2 \mu\text{C}$$

(2)

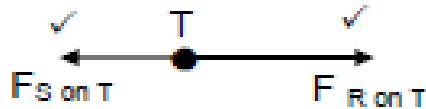
$$Q_{net} = 2 \times 10^{-6} \text{ C} \checkmark$$

4.3



(3)

Criteria	Marks
Correct direction of field lines	✓
Shape of the electric field	✓
No field line crossing each other	✓



4.4 (2)

4.5 $F = \frac{kQ_1Q_2}{r^2} \checkmark$
 $F_{ST} = \frac{(9 \times 10^9)(1 \times 10^{-6})(2 \times 10^{-6})}{(0,2)^2} \checkmark$
 $F_{ST} = 0,45 \text{ N left}$

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

$$F_{RT} = 1,8 \text{ N right}$$

$$F_{net} = F_{ST} + F_{RT}$$

$$F_{net} = 1,8 + (-0,45) \checkmark$$

$$F_{net} = 1,35 \text{ N right or towards sphere S} \checkmark \quad (6)$$

4.6 A region of space $\checkmark$ in which an electric charge experiences a force. $\checkmark$ (2)

4.7 **OPTION 1**

$$E = \frac{F}{q} \checkmark$$

$$E = \frac{1,35 \checkmark}{1 \times 10^{-6}} \checkmark$$

$$E = 1,35 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

OPTION 2

$$E = \frac{F}{q} \checkmark$$

$$E = \frac{1,8}{1 \times 10^{-6}} \checkmark$$

$$E = 1,8 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

$$E = \frac{0,45}{1 \times 10^{-6}} \checkmark$$

$$E = 4,5 \times 10^5 \text{ N} \cdot \text{C}^{-1}$$

$$E_{net} = 1,8 \times 10^6 - 4,5 \times 10^5$$

$$E_{net} = 1,35 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

(4)
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TOTAL: 60