education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GRADE 12

PHYSICAL SCIENCES MONTHLY TEST

APRIL 2020

TOPIC: ELECTROSTATICS

QUESTION PAPER

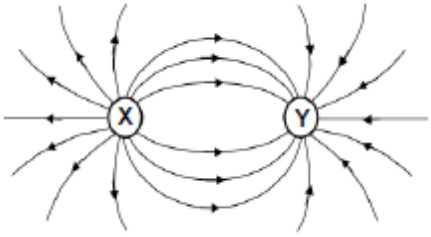
MARKS: 60

TIME: 1:15 HOURS

This question paper consists of 6 pages

QUESTION 1

1.1. The diagram below shows the electric field pattern due to two point charges **X** and **Y**.

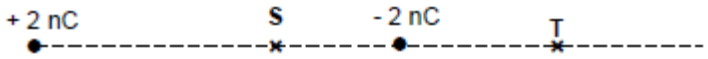


Which ONE of the following represents the charge on **X** and **Y** respectively?

	POINT CHARGE X	**POINT CHARGE Y**
A	Negative	Negative
B	Positive	Positive
C	Positive	Negative
D	Negative	Positive

(2)

1.2. Two charges of + 2 nC and - 2 nC are located on a straight line. **S** and **T** are two points that lie on the same straight line as shown in the diagram below.



Which ONE of the following correctly represents the directions of the RESULTANT electric fields at **S** and at **T**?

	direction of the resultant electric field at point s	**direction of the resultant electric field at point t**
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

1.3. The magnitude of an electric field, a distance *r* from a point charge is ***E***. The magnitude of an electric field, a distance 2*r* from the same point charge will be …

A $\frac{1}{4}E$
B $\frac{1}{2}E$
C 2E
D 4E (2)

1.4. Two charged spheres of magnitudes 2Q and Q respectively are placed a distance r apart on insulating stands.

If the sphere of charge Q experiences a force **F** to the east, then the sphere of charge 2Q will experience a force …

A F to the west
B F to the east
C 2F to the west
D 2F to the east (2)

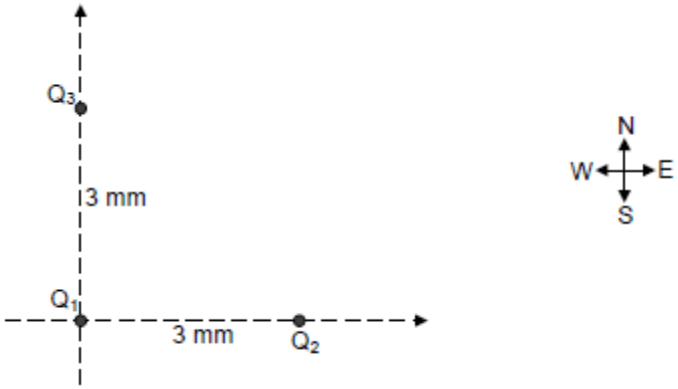
1.5. P, Q and R are three charged spheres. When P and Q are brought near each other, they experience an attractive force. When Q and R are brought near each other, they experience a repulsive force.

Which ONE of the following is TRUE?

A P and R have charges with the same sign.
B P and R have charges with opposite signs.
C P, Q and R have charges with the same sign.
D P, Q and R have equal charges. (2)

QUESTION 2

Three small, identical metal spheres, Q_1, Q_2 and Q_3, are placed in a vacuum. Each sphere carries a charge of – 4 µC. The spheres are arranged such that Q_2 and Q_3 are each 3 mm from Q_1 as shown in the diagram below.



2.1. State Coulomb's law in words. (2)

2.2. Draw a force diagram showing the electrostatic forces exerted on Q_1 by Q_2 and Q_3. (2)

2.3. Calculate the net force exerted on Q_1 by Q_2 and Q_3. (8)

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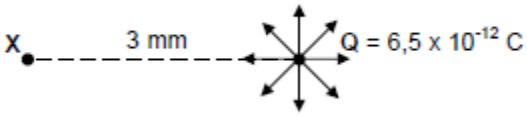
QUESTION 3

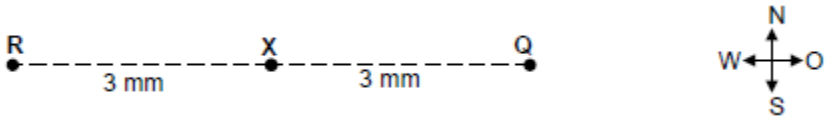
An isolated point charge **Q** is located in space as shown in the diagram below. Point charge **Q** contributes to an electric field as shown. Point **X** is located 3 mm away from point charge **Q**.



3.1. Define the term electric field at a point. (2)

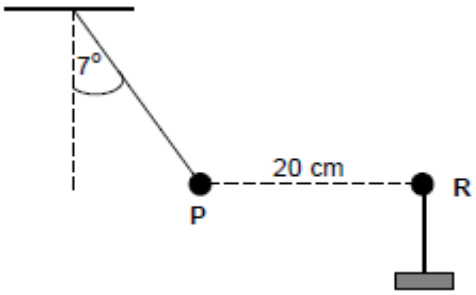
3.2. Calculate the magnitude of the electric field at point X. (3)

3.3. Point charge R carrying a charge of + 6,5 x 10^{-12} C is placed 3 mm away from point **X** as shown in the diagram below.



Calculate the net electric field at point X. (5)

3.4 Another sphere **p** with a charge of +0, 5 µC is suspended from a light, inextensible string. Sphere **R** is now placed on an insulated stand and brought close to sphere **P**. As a result sphere **P** moves to a position where it is 20 cm from sphere **R**, as shown below. The system is in equilibrium and the angle between the string and the vertical is 7^{o}.



3.4.1 Draw a labelled free-body diagram showing ALL the forces acting on sphere **P**. (3)

3.4.2 Calculate the magnitude of the tension in the string. (5)

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QUESTION 4

The diagram below shows two small identical metal spheres, **R** and **S**, each placed on a wooden stand. Spheres **R** and **S** carry charges of + 8 μC and - 4 μC respectively. Ignore the effects of air.

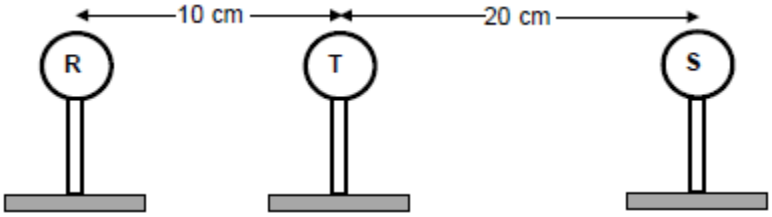
4.1. Explain why the spheres were placed on wooden stands. (1)

Spheres **R** and **S** are brought into contact for a while and then separated by a small distance.

4.2. Calculate the net charge on each of the spheres. (2)

4.3. Draw the electric field pattern due to the two spheres **R** and **S**. (3)

After **R** and **S** have been in contact and separated, a third sphere, **T**, of charge + 1 μC is now placed between them as shown in the diagram below.



4.4. Draw a free-body diagram showing the electrostatic forces experienced by sphere **T** due to spheres **R** and **S**. (2)

4.5. Calculate the net electrostatic force experienced by **T** due to **R** and **S**. (6)

4.6. Define the term *electric field* (2)

4.7. Calculate the magnitude of the net electric field at the location of **T** due to **R** and **S**. (Treat the spheres as if they were point charges.) (4)

[20]

TOTAL:60

DATA FOR PHYSICAL SCIENCES P1 GRADE 12 CAPS

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m \cdot s^{-2}$
Speed of light in a vacuum	c	3,0 x 10^{8} $m \cdot s^{-1}$
Planck's constant	h	6,63 x 10^{-34} $J \cdot s$
Gravitational constant	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Coulombs constant	k	9,0 x 10^{9} $N \cdot m^2 \cdot C^{-2}$
Charge on electron	e/q_e	-1,6 x 10^{-19} C
Electron mass	m_e	9,11 x 10^{-31} kg

TABLE 2: ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or $n = \frac{Q}{q_e}$	$F_{net} = ma$