Electrostatics:

Here is some review! Hopefully this will spark some interest in you :)

Notes : -Electrostatics is the study of electric charges that can be held in one place. All charges are due to the presences or absences of electrons. There are three types of charges; positive (less electrons than protons), negative (more electrons than protons, and neutral (equal electrons and protons)

-electrostatic forces are measured using coulombs law $F_e = \frac{Kq_1q_2}{r^2}$

-Electric fields represents an area in space that determine how a charged particle reacts $E = \frac{F}{q}$

- Electric potential describes a region in space that determine how much work is required to move a charged particle $V = \frac{W}{q}$

-Electric field lines move out of a positive charge and into a negative charge

-Magnetic field lines move out of the north pole and into the south pole

Magnetic and electric field lines can never cross

Electrostatics Formulas:

$F_e = \frac{Kq_1q_2}{r^2}$ $E = \frac{F}{q}$ $V = \frac{W}{q}$

Concepts to Watch Out For:

- Conductors allow electrons to flow freely in or through them.
- Insulators *prevent* electrons from moving freely on or through them.
- Like charges *repel.*
- Unlike charges *attract.*
- Touching an object with charges objects is *charging by conduction*; electrons move from *more* to *less (distribute).*
- *Charged* particles always attract *neutral* particles.
- The electric field inside a hollow sphere is zero
- The unit of charge is the Coulomb.
- Coulombs Law defines the forces between two charged spheres.
- Arrow points from North to South when drawing magnetic fields
- The electrostatic constant is $K = 8.99 \times 10^9 \ \mathrm{N \cdot m^2 / C^2}$

EXAMPLES

1. A positive charge of 7.0×10^{-6} C and a negative charge of 5.0×10^{-6} C are 4 x10 $^{-2}$ m apart. What is the force between them?

SOLUTION

Given: **Unknown**

$q_1 = 7.0\times10^{-6}$ C F = ?

$q_2 = 5.0\times10^{-6}$ C

r = 4 x10 $^{-2}$ m

$$F_e = \frac{kq_1q_2}{r^2}$$

$$F_e = \frac{8.99x10^9 \text{ N m}^2/\text{C}^2 \left(7.0\times10^{-6}\text{ C}\right)\left(5.0\times10^{-6}\text{ C}\right)}{(4X10^{-2}m)^2}$$

$$F_e = 196.6\ N$$

2. Determine the work required to move a proton through a potential difference of 5000 V.

SOLUTION

Given: Unknown:

q = 1.6 X 10^{-19} C W = ?

V = 5000V

$$V = \frac{W}{q}$$

$$5000\ V = \frac{W}{1.6\ X\ 10^{-19}C}$$

$$\boldsymbol{V = 8X10^{-16}\ V}$$

3. How strong is the electric field, if a 230N Force is applied to an electron?

SOLUTION

Given: Unknown:

q = 1.6 X 10^{-19} C E= ?

F_e = 230 N

$$E = \frac{F_e}{q}$$

$$E = \frac{230N}{1.6X10^{-19}C}$$

$$\boldsymbol{E = 1.43X10^{21}N/C}$$

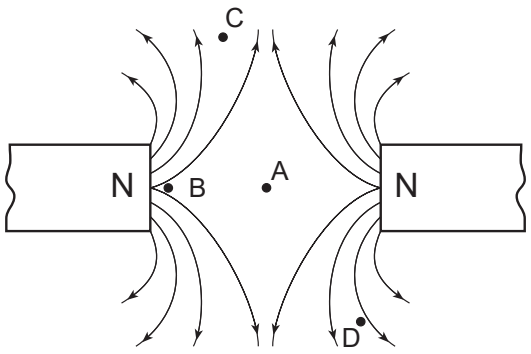
Answer all questions in this part.

Directions (1–16): For *each* statement or question, Circle the correct answer on this sheet.

1 Two positively charged masses are separated by a distance, *r*. Which statement best describes the gravitational and electrostatic forces between the two masses?

(1) Both forces are attractive.
(2) Both forces are repulsive.
(3) The gravitational force is repulsive and the electrostatic force is attractive.
(4) The gravitational force is attractive and the electrostatic force is repulsive.

2 The diagram below shows the lines of magnetic force between two north magnetic poles.



At which point is the magnetic field strength greatest?

(1) *A*
(2) *B*
(3) *C*
(4) *D*

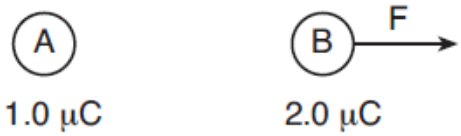
3 A positively charged glass rod attracts object *X*. The net charge of object *X*

(1) may be zero or negative
(2) may be zero or positive
(3) must be negative
(4) must be positive

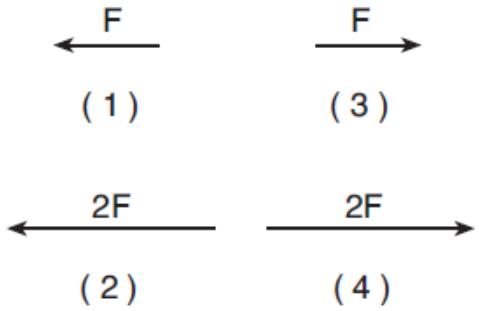
4 What is the total amount of work required to move a proton through a potential difference of 100. volts?

(1) 1.60×10^{-21} J
(2) 1.60×10^{-17} J
(3) 1.00×10^{2} J
(4) 6.25×10^{20} J

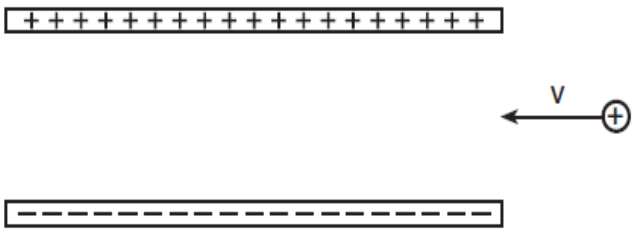
5 Two metal spheres, *A* and *B*, possess charges of 1.0 microcoulomb and 2.0 microcoulombs, respectively. In the diagram below, arrow *F* represents the electrostatic force exerted on sphere *B* by sphere *A*.



Which arrow represents the magnitude and direction of the electrostatic force exerted on sphere *A* by sphere *B*?



6 The diagram below represents a positively charged particle about to enter the electric field between two oppositely charged parallel plates.



The electric field will deflect the particle

(1) into the page
(2) out of the page
(3) toward the top of the page
(4) toward the bottom of the page

7 Two electrons are separated by a distance of 3.00×10^{-6} meter. What are the magnitude and direction of the electrostatic forces each exerts on the other?

(1) 2.56×10^{-17} N away from each other
(2) 2.56×10^{-17} N toward each other
(3) 7.67×10^{-23} N away from each other
(4) 7.67×10^{-23} N toward each other

8 How much work is required to move an electron through a potential difference of 3.00 volts?

(1) 5.33×10^{-20} J
(2) 4.80×10^{-19} J
(3) 3.00 J
(4) 1.88×10^{19} J

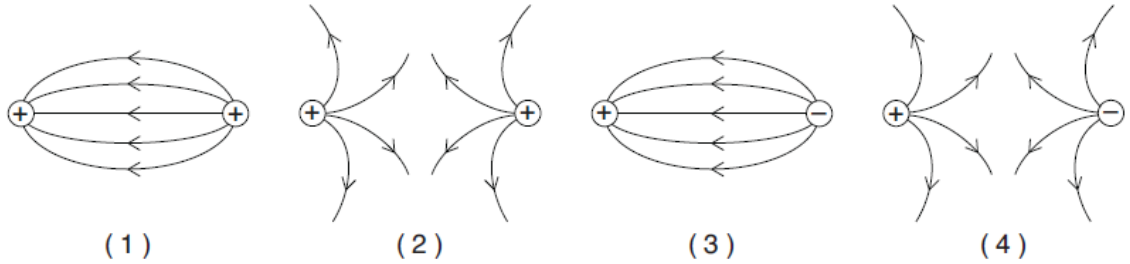
9 An electron is located in an electric field of magnitude 600. newtons per coulomb. What is the magnitude of the electrostatic force acting on the electron?

(1) 3.75×10^{21} N
(2) 6.00×10^{2} N
(3) 9.60×10^{-17} N
(4) 2.67×10^{-22} N

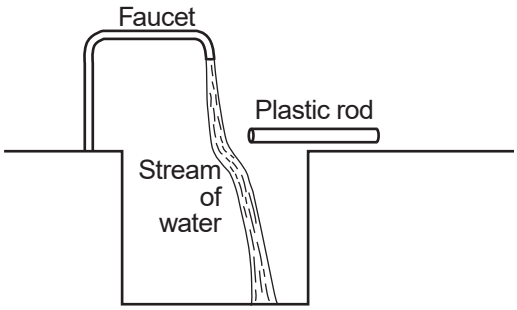
10 Moving 4.0 coulombs of charge through a circuit requires 48 joules of electric energy. What is the potential difference across this circuit?

(1) 190 V
(2) 48 V
(3) 12 V
(4) 4.0 V

11 Which diagram represents the electric field lines between two small electrically charged spheres?



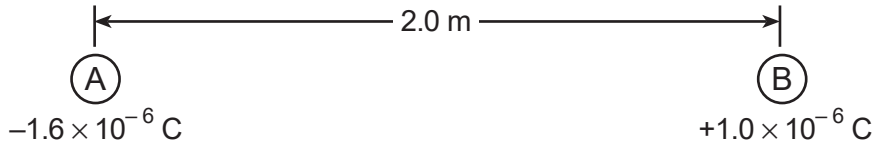
12 A dry plastic rod is rubbed with wool cloth and then held near a thin stream of water from a faucet. The path of the stream of water is changed, as represented in the diagram below.



Which force causes the path of the stream of water to change due to the plastic rod?

(1) nuclear
(2) magnetic
(3) electrostatic
(4) gravitational

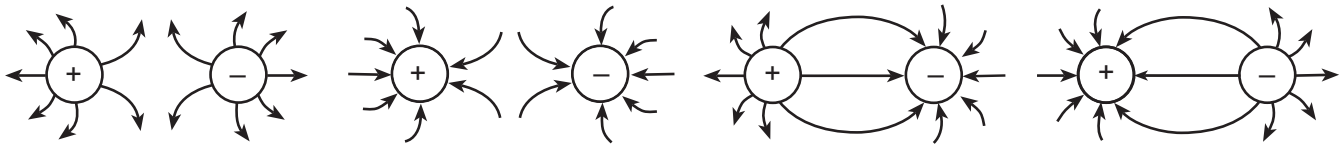
Base your answers to questions 13 on the diagram below and on your knowledge of physics. The diagram represents two small, charged, identical metal spheres, *A* and *B* that are separated by a distance of 2.0 meters.



13 What is the magnitude of the electrostatic force exerted by sphere *A* on sphere *B*?

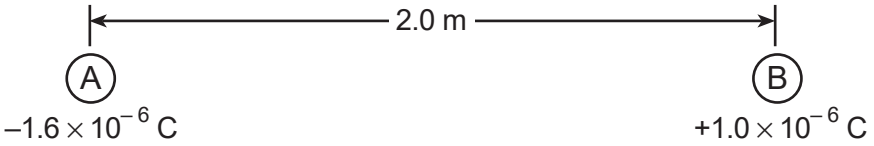
(1) 7.2×10^{-3} N
(2) 3.6×10^{-3} N
(3) 8.0×10^{-13} N
(4) 4.0×10^{-13} N

14 Which diagram represents the electric field between two oppositely charged conducting spheres?



(1) (2) (3) (4)

Base your answers to questions 15 on the diagram below and on your knowledge of physics. The diagram represents two small, charged, identical metal spheres, *A* and *B* that are separated by a distance of 2.0 meters.



15 What is the magnitude of the electrostatic force exerted by sphere *A* on sphere *B*?

(1) 7.2×10^{-3} N
(2) 3.6×10^{-3} N
(3) 8.0×10^{-13} N
(4) 4.0×10^{-13} N

16 The diagram below shows the magnetic field lines between two magnetic poles, *A* and *B*.

Which statement describes the polarity of magnetic poles *A* and *B*?

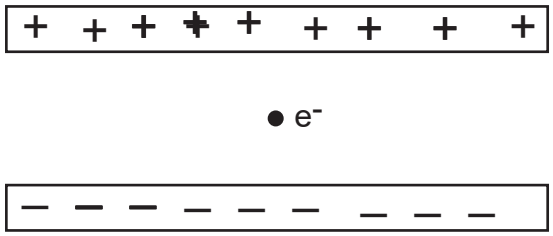
(1) *A* is a north pole and *B* is a south pole.
(2) *A* is a south pole and *B* is a north pole.
(3) Both *A* and *B* are north poles.
(4) Both *A* and *B* are south poles.

In this section for free response question 17, read the questions , write down the givens and unknowns , write an approprite equation to solve the problem including substitution with units and the answers with units. Please box your answer.

17 An electron is accelerated through a potential difference of 2.5 × 104 volts in the cathode ray tube of a computer monitor. Calculate the work, in joules, done on the electron. [Show all work, including the equation and substitution with units.]

Base your answers to question 18 and 19 on the diagram below and your knowledge of physics

Two conducting parallel plates 5.0×10^{-3} meter apart are charged with a 12-volt potential difference. An electron is located midway between the plates. The magnitude of the electrostatic force on the electron is 3.8×10^{-16} newton.



18 draw *at least three* field lines to represent the direction of the electric field in the space between the charged plates.

19 Identify the direction of the electrostatic force that the electric field exerts on the electron.

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