Example Problems – electrostatics & electric field

1. What is the electric force on a Na 1+ ion from an O 2- ion when the ions are 2 X 10 -10 m apart?

U

P

3 X 10 -2 m

2. Object P has a mass of 2 kg and a charge of +0.3 μC.

Object U is 3 X 10 -2 m above object P.

What minimum charge must object U have to pick up object P?

3. Three charged objects are arranged in a straight line. Object A is on the left and object C is on the right, leaving object B between A and C. Object A has a charge of +40 μC, object B has a charge

of +20 μC, and object C has a charge of -10 μC. Object B is 1.2 m from object A and 2 m from

object C.

●

*A*

*+40 µC*

1.2 m

2 m

●

*B*

*+20 µC*

●

*C*

*-10 µC*

(a) What is the size and direction of the electric force object A applies to object B?

(b) What is the size and direction of the electric force object A applies to object C?

(c) What is the size and direction of the electric force object C applies to object B?

(d) What is the size and direction of the net electric force on object A?

(e) What is the size and direction of the net electric force on object B?

4. A charge, *q*, of +1 X 10 -9 C is in the electric field of charged object P. Object P has a charge

of - 4 X 10 --6 C. Charge *q* experiences a force of 1.41 X 10 -5 N.

(a) What is the size and direction of the electric field strength at the present location of charge *q*?

(b) What is the size and direction of the electric field strength at a point that is 3 m from object P?

(c) If charge *q* is placed at the point in part b, what is the size and direction of the force on charge *q*?

5. A uniform electric field exists between the two charged plates, *A* & *B*,

***A***

***B***

***60 cm***

***●***

***X***

***●***

***Y***

which are 60 cm apart. Two charges, *X* and *Y*, are held

motionless at a position which is midway between the two plates.

The charge on *X* is +3 X 10 -4 C and the charge on *Y* is -2 X 10 -4 C.

The mass of charge *X* is 0.2 kg and the mass of charge *Y* is 0.1 kg.

The electric field between the plates exerts a force of 1.6 N toward

plate A on charge *Y*.

(a) Identify which plate is positively charged and draw the electric field

lines of force between the plates.

(b) What is the size and direction of the electric field strength?

(c) What is the size and direction of the electric force on charge *X*?

(d) What is the electrical potential difference across the plates?

(e) The two charges are released and allowed to move. Toward which plate will each charge move?

(f) How much work does the electric field do in moving each charge from its midpoint position to

a plate?

(g) How much kinetic energy does each charge gain during the move in part f?

(h) What is the speed of each charge when the charge reaches a plate?

6. Through what potential difference must a proton (initially at rest) move to reach a speed of 0.1***c***?

The mass of a proton is 1.67 X 10 -27 kg.