Chapter-24

1. Two point charges Q1 = +5.00 nC and Q2 = 23.00 nC are separated by 35.0 cm. (a) What is the electric potential at a point midway between the charges? (b) What is the potential energy of the pair of charges? What is the ignificance of the algebraic sign of your answer?

Ans: (a) From Equation 24.12, the electric potential due to the two charges is

 

 (b) The potential energy of the pair of charges is

 

 The negative sign means that  to separate the charges by an infinite distance (that is, to bring them to a state of zero potential energy).

1. **Review.** Two insulating spheres have radii *r*1 and *r*2, masses *m1* and *m*2, and uniformly distributed charges -*q*1 and *q*2. They are released from rest when their centers are separated by a distance *d.* (a) How fast is each moving when they collide? (b) **What If?** If the spheres were conductors, would their speeds be greater or less than those calculated in part (a)? Explain.

Ans: Consider the two spheres as a system.

 (a) Conservation of momentum:

 

 or 

 By conservation of energy,

 

 and 



 (b) If the spheres are metal, electrons will move around on them with negligible energy loss to place the centers of excess charge on the insides of the spheres. Then just before they touch, the effective distance between charges will be less than r1 + r2 and the spheres will really be moving .

1. A spherical conductor has a radius of 14.0 cm and a charge of 26.0 *µ*C. Calculate the electric field and the electric potential at (a) *r* = 10.0 cm, (b) *r* = 20.0 cm, and (c) *r* = 14.0 cm from the center.

Ans: For points on the surface and outside, the sphere of charge behaves like a charged particle at its center, both for creating field and potential.

 (a) Inside a conductor when charges are not moving, the electric field is zero and the potential is uniform, the same as on the surface, and .

 

 (b) 

 

 (c) 

 