CLASS EXERCISE #6 - June 21, 2005

(1) When two charges are separated by 4.0 m, their electric potential energy is $+12$ J. What can you tell, if anything, about the signs of these two charges?

Since the electric potential energy is positive, the two charges must have the same sign: they are both positive or both negative. If one were positive and the other negative, the electric potential energy would be negative.

(2) What is their electric potential energy when they are moved to a separation of 3.0 m?

The electric potential energy is proportional to $1/r$. since $r = 3.0$ m is 0.75 times as large as $r = 4.0$ m, the electric potential energy at $r = 3.0$ m must be $1/0.75 = 4/3$ as large as it is at $r = 4.0$ m. That means the electric potential energy at $r = 3.0$ m is $(4/3)(+12\text{ J}) = +16$ J.

(3) If the charges had 11 J of total kinetic energy when they were 4.0 m apart, what would be their total kinetic energy when they are 3.0 m apart?

Use conservation of total energy: $(\text{KE})_i + (\text{PE})_i = (\text{KE})_f + (\text{PE})_f$.

Subsituting in the values we know: $11\text{ J} + 12\text{ J} = (\text{KE})_f + 16$ J, so

$(\text{KE})_f = 11\text{ J} + 12\text{ J} - 16\text{ J} = 7$ J.

(4) Determine the changes in kinetic energy and in potential energy, and show how they are related.

As the charge moves from $r = 4.0$ m to $r = 3.0$ m and the electric potential energy increases by 4 J, the kinetic energy must decrease by 4 J, from 11 J to 7 J.