Electric Potential Energy Practice Name:_____

1. A positive charge is brought closer to another positive charge.

    a. Does its electric potential energy increase or decrease?

Increase

    b. Is the work done to it positive or negative?

Positive, the charge doesn't want to go that way

2. A negative charge is brought closer to a positive charge.

    a. Does its electric potential energy increase or decrease?

Decrease

    b. Is the work done to it positive or negative?

Negative, the charge will move that way on its own

3. Give an example of a situation where a charge would have positive electric potential energy.

A negative charge near a negative charge
or A positive charge near a positive charge

4. Give an example of a situation where a charge would have negative electric potential energy.

A positive charge near a negative charge

5. When would a charge have zero electric potential energy?

When it is infinitely far from a charge

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6. If there was a force that was always repulse would the potential energy associated with that force be always positive or always negative?

Always positive, the energy would decrease until they were infinitely far away

7. Positive work is done to bring two charges closer together. Circle any of the following which are possible.

Both charges are positive

Both charges are negative

One charge is positive and one charge is negative

8. A 1.0 μC charge is brought near a 5.0 μC charge. What is the electric potential energy of the 1.0 μC charge relative to infinity when the charges are

a. 5.0 metres apart?

$$E_p = \frac{kq_1q_2}{r} = \frac{8.988\times10^9 \frac{N\cdot m^2}{C^2} \times (1.0\times10^{-6}C)\times(5.0\times10^{-6}C)}{5.0m}$$

$$= 0.0090J$$

b. 2.0 metres apart?

$$0.02247 \simeq 0.022J$$

c. 0.50 metres apart?

0.090J

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$m = 0.022kg$

9. A $-5.0\mu C$ charge is 0.15 metres away from a $-24\mu C$ charge. If it is allowed to move freely with no other forces affecting it how fast will it be moving when it is infinitely far away from the $-24\ \mu C$ charge?

$$\Delta E_p = E_{pf} - E_{pi} = 0 - \frac{k\cdot(-5\times10^{-6})(-24\times10^{-6})}{0.15} = -7.19J$$

E_p lost is E_k gained so $E_{k\,final} = 7.19\,J$

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{2\times7.19}{0.022}} = 26m/s$$

$m = 0.19kg$

10. A 2.5 μC charge is 26 metres away from a $-65\ \mu C$ charge. If it is allowed to move freely with no other forces affecting it how fast will it be moving when it is 0.25 metres away from the $-65\ \mu C$ charge?

$$\Delta E_p = E_{pf} - E_{pi} = \frac{k(2.5\times10^{-6})(-65\times10^{-6})}{0.25} - \frac{k(2.5\times10^{-6})(-65\times10^{-6})}{26}$$

$$= -5.8422 - (-0.05618) = -5.786J$$

E_p lost $= E_k$ gained so $E_k = 5.786J$

$$v = \sqrt{\frac{2(5.786)}{0.19}} = 7.8m/s$$

11. The electric potential energy of a 56 μC charge is 52.6 J when it is 2.0 metres from a second charge. What is the second charge?

$$E_p = \frac{kq_1q_2}{r} \rightarrow \frac{E_p r}{kq_1} = q_2$$

$$\frac{52.6J\times2.0m}{8.988\times10^4\ \frac{N\cdot m^2}{C^2}\times56\times10^{-6}C} = 2.1\times10^{-4}C$$

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12. The electric potential energy of a $-25\ \mu C$ charge is -2.35 J when it is a certain distance from a $56\ \mu C$ charge. What is the distance between the charges?

$$E_p = \frac{k q_1 q_2}{r} \rightarrow r = \frac{k q_1 q_2}{E_p} = \frac{8.988\times10^9 \times (-25\times10^{-6})(56\times10^{-6})}{-2.35}$$

$$= 5.354\text{m}$$

$$\approx \boxed{5.4\text{m}}$$

13. A positive charge is brought from infinitely far away to a point between a positive and a negative charge. Does this take more or less energy than if it was brought to the same point but there was only a positive charge?

Less, the negative charge will pull it in

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14. A positive charge of $2.5\ \mu C$ is brought from infinitely far away to a point 1.0 metres from a $+25\ \mu C$ charge and 0.50 metres from a $-5.0\ \mu C$ charge. How much work is needed to do this?

Work to bring a $2.5\mu C$ charge 1.0 metres from a $25\mu C$ charge

$$W = \Delta E = E_{pf} - E_{pi} = \frac{k(2.5\times10^{-6})(25\times10^{-6})}{1} - 0$$

$$= \boxed{0.56175\,J}$$

Work to bring a $2.5\mu C$ charge 0.5 metres from a $-5.0\mu C$ charge

$$W = \Delta E = E_{pf} - E_{pi} = \frac{k(2.5\times10^{-6})(-5\times10^{-6})}{0.5} - 0$$

$$= -0.2247\,J$$

Total work $= 0.56175\,J + -0.2247\,J$

$$= \boxed{0.34\,J}$$