Week 7 Quiz

Thursday, May 13, 2021 9:15 AM

Three point charges (**A** , **B** , and **C**) are fixed in place laced in a triangular pattern. These three charges create an electric potential (in volts) which is plotted in the region around these charges. **k** = 8.99 x 10^9 N·m^2/C^2

0.47	0.35	0.15	-0.18	-0.64	-1.18	-1.64	-1.83	-1.64	-1.18	-0.64	-0.18	0.15	0.35	0.47
0.64	0.54	0.31	-0.14	-0.88	-1.91	-2.95	-3.43	-2.95	-1.91	-0.88	-0.14	0.31	0.54	0.64
0.90	0.87	0.69	0.16	-0.99	-3.01	-5.67	-7.20	-5.67	-3.01	-0.99	0.16	0.69	0.87	0.90
1.25	1.41	1.45	1.07	-0.42	-4.10	-11.77	-20.31	-11.77	-4.10	-0.42	1.07	1.45	1.41	1.25
1.68	2.14	2.79	3.32	2.25	-3.01	-18.41	Point Charge C	-18.41	-3.01	2.25	3.32	2.79	2.14	1.68
2.08	2.95	4.63	8.29	11.85	3.38	-7.95	-17.42	-7.95	3.38	11.85	8.29	4.63	2.95	2.08
2.34	3.45	5.90	14.13	Point Charge A	11.42	0.62	-2.40	0.62	11.42	Point Charge B	14.13	5.90	3.45	2.34
2.38	3.39	5.34	9.51	14.17	8.27	3.31	1.78	3.31	8.27	14.17	9.51	5.34	3.39	2.38
2.22	2.95	4.05	5.43	6.09	4.95	3.40	2.78	3.40	4.95	6.09	5.43	4.05	2.95	2.22
1.98	2.45	3.03	3.56	3.74	3.43	2.94	2.73	2.94	3.43	3.74	3.56	3.03	2.45	1.98
1.73	2.03	2.35	2.60	2.70	2.62	2.47	2.40	2.47	2.62	2.70	2.60	2.35	2.03	1.73
1.51	1.71	1.90	2.05	2.12	2.12	2.08	2.06	2.08	2.12	2.12	2.05	1.90	1.71	1.51
1.33	1.47	1.59	1.69	1.75	1.77	1.77	1.77	1.77	1.77	1.75	1.69	1.59	1.47	1.33
1.18	1.28	1.37	1.44	1.49	1.51	1.52	1.53	1.52	1.51	1.49	1.44	1.37	1.28	1.18
1.06	1.13	1.20	1.25	1.29	1.32	1.33	1.33	1.33	1.32	1.29	1.25	1.20	1.13	1.06

Rubric

~ Part (a) ~
1 pt - answer
1 pt - Explanation

~ Part (b) ~
1 pt - Correct ranking
1 pt - Explanation

~ Part (c) ~
0.5 pt - Direction answer
0.5 pt - Electric P.E. answer
1.5 pts - Explanation

~ Part (d) ~
0.5 pt - delta_U = q*delta_V eq.
0.5 pts - delta_U = - delta_K eq.
0.5 pts - correct delta_V
1.5 pts - Application
0.5 pts - Answer and units

(a) Use the table below to fill in the signs of each point charge (positive, negative, or neutral). Explain. Note: This three charge distribution has the same convention as a point charge where the electric potential very far away is zero.

Point Charge	Sign
A	+
B	+
C	-

The equation for a point charge's electric potential is k*q/r. For positive charges that means the E.P. is becomes more positive the closer to the charge you get. For a negative charge that means the E.P. becomes more negative the closer to the charge you get. Both points A and B have positive voltages near them while point C has negative voltages.

(b) Rank the magnitudes of each point charge. Explain.

$|Q_C| > |Q_A| = |Q_B|$

The larger the magnitude of the charge, the larger the magnitude of electric potential near the charge.

(c) If a 4th test charge, an electron, is placed at rest halfway between point charges **A** and **B** at the –2.40 volt location, what direction would the electron move and what would happen to the electric potential energy of the electron (increase, decrease, stay the same)? Explain. Note: At all times the original three charges (**A**, **B**, and **C**) are fixed in place and do not move.

Downward because electrons experience a force towards increased electric potential. This has the effect of lowering the electric potential energy because of the minus sign from the electron in the equation U=qV.

(d) What is the speed of the electron from part (c) after is has moved 1 square in the direction you determined. Note: Each square has side lengths of 1.00 meters. The charge of an electron is -1.60×10^{-19} C and the mass is 9.11×10^{-31} kg.

$$\Sigma E_i + W_{nc}^{0} = \Sigma E_f \Rightarrow \Delta U = -\Delta KE \Rightarrow -e\Delta V = -\tfrac{1}{2}m(v_f^2 - v_i^{2\,0})$$

$$\text{w/ } \Delta V = 4.18\text{ v} \Rightarrow v_f = \sqrt{\frac{2e\Delta V}{m}} = 1.21 \times 10^{6}\ \text{m/s}$$