

10. ELECTROSTATICS: Work in the electrostatic field and the Gauss' law - answers

10.1. a) $W = Eqx$; b) $W = 0$; c) $W = Eqx \cos\alpha$

10.2. $W = \frac{kq(\sqrt{2}-2)}{2a}(|Q_1| - |Q_2|)$

10.3. $W = k \left(\frac{|q_B||q_C|}{|BC|} + \frac{|q_C||q_A|}{|CA|} - \frac{|q_A||q_B|}{|AB|} \right)$

10.4. in non-relativistic case: $v = \sqrt{\frac{1}{4\pi\epsilon_0} \frac{e^2}{m_e R}}$; $E_p = -\frac{ke^2}{R}$; $E_c = -\frac{1}{2} \frac{ke^2}{R}$

10.5. $v = \sqrt{\frac{2ke^2}{rm_e}}$

10.6.* $W = \frac{kQ^2}{2R}$

10.7. $W = \frac{\epsilon_0 SV^2}{2d}$; $W' = \epsilon W$

10.8. mass will decrease

10.9. If R – sphere, ball radius and r – distance from center then:

a) sphere:	outside $E = \frac{kQ}{r^2}$; $V = \frac{kQ}{r}$;	inside $E = 0$; $V = \frac{kQ}{R}$;
b) conducting ball:	outside $E = \frac{kQ}{r^2}$; $V = \frac{kQ}{r}$;	inside $E = 0$; $V = \frac{kQ}{R}$ (prove it!);
c) non-conducting ball:	outside $E = \frac{kQ}{r^2}$; $V = \frac{kQ}{r}$;	inside $E = \frac{kQ}{R^3}r$; $V = \frac{kQ}{2R}(3 - r^2)$;

10.10. a) $E = 0$; b) $E = \frac{kQ(r^3 - R_w^3)}{(R_z^3 - R_w^3)r^2}$; c) $E = \frac{kQ}{r^2}$

10.11. a) $E = \frac{\rho}{2\epsilon_0}r$; b) $E = \frac{\rho}{2\epsilon_0} \frac{R^2}{r}$

10.12. a) $E = 0$; b) $E = \frac{\rho(r^2 - R_w^2)}{2\epsilon_0} \frac{1}{r}$; c) $E = \frac{\rho(R_z^2 - R_w^2)}{2\epsilon_0} \frac{1}{r}$

10.13. $E = \frac{\sigma}{2\epsilon\epsilon_0}$;

10.14. $\sigma = \frac{2\epsilon\epsilon_0 mg \tan\theta}{q}$

10.15. from left to right: $E_A = \frac{1}{2\epsilon\epsilon_0}(-|\sigma_1| + |\sigma_2| - |\sigma_3|)$; $E_B = \frac{1}{2\epsilon\epsilon_0}(|\sigma_1| + |\sigma_2| - |\sigma_3|) = 0$;

$E_C = \frac{1}{2\epsilon\epsilon_0}(|\sigma_1| - |\sigma_2| - |\sigma_3|)$; $E_D = \frac{1}{2\epsilon\epsilon_0}(|\sigma_1| - |\sigma_2| + |\sigma_3|)$

10.16.* $E = \frac{\rho_0}{2\epsilon_0} = \text{const}$; using vectors: $\vec{E} = \frac{\rho_0}{2\epsilon_0} \hat{r}$