

# Answers Test 2 2008

$$1. E = \begin{cases} 0, & r < A \\ \frac{Q}{4\pi\epsilon_0 r^2}, & r > A \\ \frac{Q}{4\pi\epsilon_0 r^2} \frac{r^3 - A^3}{(A+T)^3 - A^3}, & A < r < T \end{cases}$$

$$V(0) - V(H) = \frac{Q}{4\pi\epsilon_0} \left( \frac{1}{A+T} - \frac{1}{H} \right) - \frac{Q \cdot (A^2 - (A+T)^2)}{8\pi\epsilon_0 ((A+T)^3 - A^3)} - \frac{Q A^3}{4\pi\epsilon_0 ((A+T)^3 - A^3)} \left( \frac{1}{A} - \frac{1}{A+T} \right)$$

$$2. a) i_1 = \frac{V_1 - V_2}{R_1 + R_2 + R_4}$$

$$b) V_3 = V_1 - i_1 (R_1 + R_2)$$

$$c) Q = C V_3$$

$$3. a) L = 2H, W \text{ is arbitrary}$$

$$b) \vec{E}_1 = \frac{VL}{(L^2 + H^2)} \vec{i}_x = \frac{2}{5} \frac{V}{H} \vec{i}_x$$

$$\vec{E}_2 = \frac{VH}{L^2 + H^2} \vec{i}_x = \frac{1}{5} \frac{V}{H} \vec{i}_x$$

$$c) Q_{\text{encl}} = - \frac{\epsilon_0 VW}{5}$$

$$4. a) r = A+T \quad \sigma = \frac{Q}{2\pi(A+T)L}; \quad r = B \quad \sigma = - \frac{Q}{2\pi BL}; \quad r = B+T \quad \sigma = \frac{Q}{2\pi(B+T)L}$$

$$b) V(A) - V(B+T) = - \frac{Q}{2\pi\epsilon_0 L} \ln \frac{A+T}{B}$$

$$c) C = \frac{Q}{|\Delta V|} = \frac{2\pi\epsilon_0 L}{\ln \frac{B}{A+T}}$$