Chapter **25** (Benson)

E01 (**a**) Energy $= q\Delta V = (30)(10^8) = 3.0\times10^9$ (J) =,1.88×10^{28} (eV); (**b**) 5×10^7 s .

E10 $V = Ed = (3\times10^6)(1\times10^{-3}) = 3$ (kV) .

E16 $d = 3$ cm & $\mathcal{E} = 120$ V: (**a**) $E = \Delta V/d = 4$ kV/m; (**b**) $W = -q\Delta V = 1.92\times10^{-17}$ J; (**c**) $\Delta V = 120$ V; (**d**) $\Delta U = -1.92\times10^{-7}$ J .

E23 (**a**) $\Delta V = 12$ kV; (**b**) $\Delta K = -q\Delta V = 0.06$ J, find $v = 2$ km/s .

E34 (**a**) $V(x) = -\int_{x_0}^{x} E_x dx = \sigma(x_0 - x)/2\epsilon_0$; (**b**) $\sigma = 7$ nC/m^2, $\Delta x = 2\epsilon_0\Delta V/\sigma = -5.06$ cm .

E35 (**a**) $V_B - V_A = -Es\cos\theta = (400)(0.03)\cos 37^0 = -9.58$ (V);
(**b**) $V_B - V_C = -(400)(0.03)\cos 53^0 = -7.22$ (V) .

E36 $v_f = 3\times10^6$ m/s, $v_i = 8\times10^6$ m/s & $\Delta x = 3$ mm: (**a**) $\Delta K = -(-e)(\Delta V)$, $\Delta V = -157$ V;
(**b**) $E_x = -\Delta V/\Delta x = 5.23\times10^4$ V/m .

E37 (**a**) $V(x) = 2kq[1/x - 1/(x^2 + a^2)^{1/2}]$. $V(x) \approx kqa^2/x^3$, as $x \gg a$;
(**b**) $V(y) = 2kq[1/y - y/(y^2 - a^2)]$; $V(y) \approx -2kqa^2/y^3$, as $y \gg a$.

E42 Q: $(0,\ a)$ & Q: $(0,\ -a)$: (**a**) $V(x) = 2kQ/(x^2 + a^2)^{1/2}$;
(**b**) $E_x = -dV/dx = 2kQx/(x^2 + a^2)^{3/2}$.

E44 Q: $(a,\ 0)$ & $-Q$: $(-a,\ 0)$: (**a**) $V(x) = 2kQa/(x^2 + a^2)$;
(**b**) $E_x = -dV/dx = 4kQax/(x^2 + a^2)^2$.

E45 $V(r) = kQ(3R^2 - r^2)/2R^3 \Rightarrow E_r = -dV/dr = kQr/R^3$.

E47 $E_y = -dV/dy = 2\pi k\sigma[1 - y/(a^2 + y^2)^{1/2}]$.

E50 (**a**) $V(y) = kQ/(y^2 + a^2)^{1/2}$; (**b**) $E_y = -dV/dy = kQy/(y^2 + a^2)^{3/2}$.

E53 ① $r > b$: $V = -kQ/r$ & $E = -kQ/r^2$; ② $a < r < b$: $V = kQ(1/r - 2/b)$ & $E = kQ/r^2$; ③ $r < a$: $V = kQ(1/a - 2/b)$ & $E = 0$.

E65 $V_0 = Q_0/R_0 = 1000$ V, Volume and charge conserved: $R^3 = 2R_0^3$ & $Q = 2Q_0$; $V = 2Q_0/R = 2Q_0/(2^{1/3}R_0) = 1590$ V . (Teacher: Jyh-Shinn Yang, 90.05.02)

P03 $d = 2.82\times10^{-10}$ m: (**a**) $U_1 = -6ke^2/d = -30.6$ eV; (**b**) $U_2 = U_1 + 6ke^2/\sqrt{2}d = 12.7$ eV .

P11 $q(r) = Q\,r^3/R^3$, $V(r) = kq(r)/r = kQ\,r^2/R^3$, $dU = V(r)dq = (3kQ^2/R^6)\,r^4dr$.
Find $U = \int dU = (3kQ^2/R^6)\int_o^R r^4dr = 3kQ^2/5R$.

P05 (**a**) $V_1 = k(Q_1/R_1 - Q_2/R_2)$; (**b**) $V_2 = k(Q_1 - Q_2)/R_2$; (**c**) $V_1 - V_2 = kQ_1(1/R_1 - 1/R_2)$; (**d**) $Q_1 = 0$.