Chapter **24** (Benson)

E**03** Projected area is πR^2, so $\phi = \pi R^2 E$.

E**11** $E = kQ/R^2 = k(4\pi R^2\sigma)/R^2 = 4\pi k\sigma = \sigma/\epsilon_0$.

E**13** (**a**) Zero; (**b**) σ/ϵ_0.

E**14** (**a**) $2\sigma/\epsilon_0$; (**b**) σ/ϵ_0.

E**17** By Gauss's law, $(2\pi rL)E = (2\pi RL)\sigma/\epsilon_0$, thus $E = R\sigma/(\epsilon_0 r)$. For net field $E = 0$, need $a\sigma_1 + b\sigma_2 = 0$, i.e. $\sigma_2 = -a\sigma_1/b$.

E**21** (**a**) kQ/r^2; (**b**) zero.

E**29** $\phi = Q_t/\epsilon_0 = \lambda H/\epsilon_0$.

E**24** (**a**) To ensure that the electric field is zero within the metal shell, the total charges at the inner and outer surfaces of shell should be $+Q$ and $-Q$, respectively. Thus $\sigma_1 = -Q/4\pi R_1^2$, $\sigma_2 = +Q/4\pi R_2^2$; (**b**) kQ/r^2; (**c**) kQ/r^2; (**d**) Yes, σ_2 is still uniform.

E**31** Zero for xy, xz and yz planes, $Q/(24\epsilon_0)$ for each of the other three .

E**32** (**a**) $E = 2kQ/r^2$; (**b**) $E = k(2Q - 3Q)/r^2 = -kQ/r^2$.

P**01** $4\pi r^2 E = Q/\epsilon_0$: (**a**) $Q = 4\pi\rho r^3/3$, so $E = \rho r/3\epsilon_0$; (**b**) $Q = 4\pi\rho R^3/3$, so $E = \rho R^3/3\epsilon_0 r^2$.

P**03** (**a**) $Q_{net} = Q + (4\pi R_1^2)\sigma = 0$, $Q = -4\pi\sigma R_1^2$; (**b**) $Q_{net} = 4\pi(R_1^2 - R_2^2)\sigma_1$; (**c**) $4\pi r^2 E = -(4\pi R_2^2)\sigma/\epsilon_0$, thus $E = -\sigma R_2^2/\epsilon_0 r^2$.

P**05** (**a**) $(2\pi rL)E = (\pi r^2 L\rho)/\epsilon_0$, thus $E = \rho r/2\epsilon_0$; (**b**) $(2\pi rL)E = (\pi R^2 L\rho)/\epsilon_0$, thus $E = \rho R^2/2\epsilon_0 r$; $E = \rho R/2\epsilon_0$ at $r = R$. (Teacher: Jyh-Shinn Yang, 90.04.06)

P**09** (**a**) kQ/r^2; (**b**) kQ/r^2 .