Instituto de Física

FAP 2292

Gabarito – Lista de Exercícios 2
Lei de Gauss e condutores

Exercícios Sugeridos (02/03/2010) A numeração corresponde ao Livros Textos A e B.

A19.32 (b) $\Phi_6 = \dfrac{Q}{\epsilon_0} = 1{,}92\times10^7\ \mathrm{Nm^2/C}$ (a) $\Phi_1 = \dfrac{1}{6}\Phi_6 = 3{,}2\times10^6\ \mathrm{Nm^2/C}$
(c) Φ_6 só depende de a carga se encontrar no interior do cubo; se a carga não estiver no centro os fluxos através de cada face podem ser diferentes, mas somam sempre Φ_6.

A19.34 $\mathbf{E}(r) = \dfrac{Q_r}{4\pi\epsilon_0 r^2}\,\hat{r}$; (a) $E(r=0)=0$; (b) $E(r=10\ \mathrm{cm}) = 3{,}65\times10^5\ \mathrm{N/C}$;
(c) $E(r=40\ \mathrm{cm}) = 1{,}46\times10^6\ \mathrm{N/C}$; (d) $E(r=60\ \mathrm{cm}) = 6{,}49\times10^5\ \mathrm{N/C}$.

A19.35 $\mathbf{E}(r) = \dfrac{Q_r}{4\pi\epsilon_0 r^2}\,\hat{r}$ (a) $E(r=10\ \mathrm{cm}) = 0$; (b) $E(r=20\ \mathrm{cm}) = 7{,}19\times10^6\ \mathrm{N/C}$

A19.36 $E(r>r_0) = \dfrac{\lambda}{2\pi\epsilon_0 r}$; (a) $Q = \lambda L = 0{,}913\ \mu\mathrm{C}$; (b) $E=0$.

A19.38 $\sigma = 2\epsilon_0 mg/q = -2{,}53\ \mu\mathrm{C/m^2}$.

A19.40 $E(r<R)=0$; $E(r>R) = \dfrac{\lambda}{2\pi\epsilon_0 r}$;
(a) $E(r=3\ \mathrm{cm}) = 0$; (b) $E(r=10\ \mathrm{cm}) = 5{,}39\ \mathrm{kN/C}$; (c) $E(r=100\ \mathrm{cm}) = 0{,}539\ \mathrm{kN/C}$.

A19.42 $\sigma = \epsilon_0 E$; (a) $\sigma(r_{\max}) = \epsilon_0 E_{\min} = 0{,}248\ \mu\mathrm{C/m^2}$; (b) $\sigma(r_{\min}) = \epsilon_0 E_{\max} = 0{,}496\ \mu\mathrm{C/m^2}$.

A19.43 (a) $\sigma = Q/A = 1{,}6\times10^{-7}\ \mathrm{C/m^2}$, $E_0 = \sigma/2\epsilon_0 = 9{,}0\ \mathrm{kN/C}$; (b) $\mathbf{E} = E_0\,\hat{z}$; (c) $\mathbf{E} = -E_0\,\hat{z}$.

P1.2 (a) $\mathbf{E}(0{,}0{,}Z) = \dfrac{Q}{\pi^2\epsilon_0}\dfrac{a}{(Z^2+a^2)^{3/2}}\,\hat{y}$; (b) $\Phi = 0$.

P1.3 (a) $\rho<a$: $\mathbf{E}(\mathbf{r}) = \dfrac{Q}{4\pi\epsilon_0}\dfrac{\rho}{La^2}\,\hat{\rho}$; (b) $a<\rho<b$: $\mathbf{E}(\mathbf{r}) = \dfrac{Q}{4\pi\epsilon_0 L}\dfrac{1}{\rho}\,\hat{\rho}$;
(c) $b<\rho<c$: $\mathbf{E}(\mathbf{r}) = \mathbf{0}$; (d) $\rho>c$: $\mathbf{E}(\mathbf{r}) = \dfrac{Q}{4\pi\epsilon_0 L}\dfrac{1}{\rho}\,\hat{\rho}$;
(e) $\sigma_b = -\dfrac{Q}{2\pi bL}$; $\sigma_c = +\dfrac{Q}{2\pi cL}$.

B22.4 (a) $S_1 = \int_0^L \mathrm{d}x \int_0^L \mathrm{d}z\,[-E_y(y=0)] = 0$; $S_2 = \int_0^L \mathrm{d}x \int_0^L \mathrm{d}y\,[E_z(z=L)] = +0{,}081\ \mathrm{Nm^2/C}$;
$S_3 = \int_0^L \mathrm{d}x \int_0^L \mathrm{d}z\,[E_y(y=L)] = 0$; $S_4 = \int_0^L \mathrm{d}x \int_0^L \mathrm{d}y\,[-E_z(z=0)) = 0$;
$S_5 = \int_0^L \mathrm{d}y \int_0^L \mathrm{d}z\,[E_x(x=L)] = -0{,}135\ \mathrm{Nm^2/C}$; $S_6 = \int_0^L \mathrm{d}y \int_0^L \mathrm{d}z\,[-E_x(x=0)] = 0$.
$S = -0{,}054\ \mathrm{Nm^2/C}$.

B22.30 Nos três pontos o campo elétrico é perpendicular às placas e aponta para a esquerda na figura. Os módulos são:
$E_A = (+\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4)/2\epsilon_0 = 2.82\times10^5$ N/C,
$E_B = (-\sigma_1 - \sigma_2 + \sigma_3 + \sigma_4)/2\epsilon_0 = 3.95\times10^5$ N/C e
$E_C = (-\sigma_1 - \sigma_2 - \sigma_3 + \sigma_4)/2\epsilon_0 = 1.69\times10^5$ N/C.

B22.33 (a) $\Phi_{\rm I} = E_x(x=0)A = 750\ {\rm Nm^2/C}$. (b) $\Phi_{\rm II} = 0$.
(c) $\Phi_{\rm total} = Q/\epsilon_0 = \Phi_{\rm I} + \Phi_{\rm I'} \Rightarrow \Phi_{\rm I'} = -3461\ {\rm Nm^2/C}$.

B22.40 (a) $E(r<R) = \rho r/2\epsilon_0$; (b) $E(r>R) = \rho R^2/2\epsilon_0 r = \lambda/2\pi\epsilon_0 r$.

B22.45 (a) $\mathbf{E}(\mathbf{r}) = E(r)\,\hat{r}$: $E(r) = \begin{cases} 0, & \text{para } r<b \\ 2q/4\pi\epsilon_0 r^2, & \text{para } b<r<c \\ 0 & \text{para } c<a<d \\ 6q/4\pi\epsilon_0 r^2, & \text{para } r>d \end{cases}$
(b) $Q_a = 0$; $Q_B = +2q$; $Q_c = -2q$; $Q_d = +6q$.

B22.61 $E(\mathbf{r}) = (\rho/3\epsilon_0)\,[(\mathbf{r}-\mathbf{0}) - (\mathbf{r}-\mathbf{b})] = \rho\mathbf{b}/3\epsilon_0$.

B22.66 (a) $\alpha = \frac{8Q}{5\pi R^3}$; (b) $E(r) = \begin{cases} \frac{8Q}{15\pi\epsilon_0}\frac{r}{R^3} & \text{para } r \le R/2 \\ \frac{Q}{5\pi\epsilon_0}\left(-\frac{1}{12r^2} + \frac{16r}{3R^3} - \frac{4r^2}{R^4}\right) & \text{para } R/2 \le r \le R \\ \frac{Q}{4\pi\epsilon_0}\frac{1}{r^2} & \text{para } r > R. \end{cases}$ (c) $4/15$.
(d) $F = -kx = -\frac{e\alpha}{3\epsilon_0}x$; (e) $T = 2\pi\sqrt{\frac{3m\epsilon_0}{e\alpha}}$.