1a. Kirchhoff: $\frac{Q}{C} - L\frac{dI}{dt} - IR = 0$

b. Op t = 0 geldt I(0) = 0, zodat: $\frac{dI}{dt}\Big|_0 = \frac{Q}{C}\frac{1}{L} = \frac{V_0}{L}$

c. $I = -\frac{dQ}{dt}$

d. $\frac{dE}{dt} = \frac{d}{dt}[\frac{1}{2}\frac{Q^2}{C} + \frac{1}{2}LI^2] = \frac{Q}{C}\frac{dQ}{dt} + LI\frac{dI}{dt} = -\frac{Q}{C}I + I(\frac{Q}{C} - IR) = -I^2R$

2a. $\sigma = \varepsilon_0 E$ ; E staat loodrecht op de plaat

b. $V = \frac{Q}{4\pi\varepsilon_0 r_1} - \frac{Q}{4\pi\varepsilon_0 r_2} = \frac{Q}{4\pi\varepsilon_0}[\frac{1}{\sqrt{y^2 + (a-x)^2}} - \frac{1}{\sqrt{y^2 + (a+x)^2}}]$

c. ? 1e methode: $E = -2.\frac{Q}{4\pi\varepsilon_0 r^2}\cos\theta = -\frac{Q}{2\pi\varepsilon_0(a^2+y^2)}.\frac{a}{\sqrt{a^2+y^2}} = -\frac{Q}{2\pi\varepsilon_0}.\frac{a}{(a^2+y^2)^{3/2}}$

2e methode: $\vec{E} = -\vec{\nabla}V$

de loodrechte component is: $E_x = -\frac{\partial V}{\partial x} = -\frac{Q}{4\pi\varepsilon_0}[\frac{(a-x)}{(y^2+(a-x)^2)^{3/2}} + \frac{(a+x)}{(y^2+(a+x)^2)^{3/2}}]$

Op de plaat (x = 0) volgt nu: $E_x(0,y) = -\frac{Q}{2\pi\varepsilon_0}.\frac{a}{(a^2+y^2)^{3/2}}$

d. De ladingsdichtheid op een ring met straal r in het yz-vlak wordt gegeven door:

$\sigma(r) = -\frac{Q}{2\pi}.\frac{a}{(a^2+r^2)^{3/2}}$ De totale lading op de plaat is dan:

$$q = \int \sigma 2\pi r dr = -\frac{Qa}{2\pi}.\int\frac{2\pi r dr}{(a^2+r^2)^{3/2}} = Qa[\frac{1}{(a^2+r^2)^{1/2}}]\Big|_0^\infty = -Q$$

3a. $B_r = \frac{\mu_0 m}{2\pi r^3}\cos\theta$ en $B_\theta = \frac{\mu_0 m}{4\pi r^3}\sin\theta$

b. $B_x = B_r\cos\theta - B_\theta\sin\theta = \frac{\mu_0 m}{4\pi r^3}(3\cos^2\theta - 1)$

c. $d\Phi = B_x 2\pi y dy = \frac{\mu_0 m}{2r^3}(3\cos^2\theta - 1)y dy$

met $\frac{x}{r} = \cos\theta$ en $\frac{y}{x} = \tan\theta$ zodat $dy = \frac{x}{\cos^2\theta}d\theta$

volgt: $d\Phi = \frac{\mu_0 m}{2x}(3\cos^2\theta - 1)\sin\theta\, d\theta$

d. $$\Phi = \int_0^{\theta_0} d\Phi = \frac{\mu_0 m}{2x}\int_0^{\theta_0}(3\cos^2\theta - 1)\sin\theta\, d\theta = \frac{\mu_0 m}{2x}[\cos\theta - \cos^3\theta]\Big|_0^{\theta_0}$$

met $\cos\theta_0 = \frac{x}{\sqrt{x^2+R^2}}$ volgt: $\Phi = \frac{\mu_0 m R^2}{2(x^2+R^2)^{3/2}}$

e. $\mathcal{E} = -\dfrac{d\Phi}{dt} = \dfrac{3\mu_0 m R^2 x}{2(x^2+R^2)^{5/2}} . v_0$

$$\boxed{\mathcal{E} = -\frac{d\Phi}{dt}} = -\frac{d\Phi}{dx}\,\frac{dx}{dt} \Rightarrow \mathcal{E} = \frac{3\mu_0 m R^2 x}{2(x^2+R^2)^{5/2}}\, V_0$$