$\boxed{\text{Q3}}$ Coil 1 would afterward be unable to produce *any* flux through Coil 2, so it could never change. M = 0.

$\boxed{\text{Q13}}$ $\frac{dI}{dt} = \infty \Rightarrow \mathcal{E}_{\text{inductor}} = \infty$. Well, it won't be infinite, but as large as necessary to get the job done (of sending the inductor's formerly stored energy elsewhere). No! Infinities are unattainable.

$\boxed{9}$ $|\mathcal{E}| = |L(dI/dt)| = (0.26H)(0.018A/s) = 4.7mV$. (b) It becomes a battery trying to keep the dying current from dying. Trying to keep current flowing to left, *a* is higher potential.

$\boxed{18}$ $u = B^2/2\mu_o \rightarrow (3.6\times10^6 J)/\text{Volume} = (0.6T)^2/2\cdot(4\pi\times10^{-7}T\cdot m/A) \Rightarrow \text{volume} = 25.1m^3$. Pretty big.
$(3.6\times10^6 J)/(0.4m)^3 = B^2/2\cdot(4\pi\times10^{-7}T\cdot m/A) \Rightarrow B = 11.9T$. Rather large.

$\boxed{19}$ The inductor prevents current from jumping, so initially it must be the same voltage as the battery.
$|\mathcal{E}| = |L(dI/dt)| \rightarrow 6V = (2.5H)\,|dI/dt| \Rightarrow |dI/dt| = 2.4A/s$. (b) There are several ways to do this. The voltage across the resistor is $(0.5A)(8\Omega) = 4V$, so the voltage across the inductor is $6V-4V = 2V$.
$2V = (2.5H)\,|dI/dt| \Rightarrow |dI/dt| = 0.8A/s$. The long way is to find the time when this occurs:
$I = \frac{\mathcal{E}}{R}(1 - e^{-(R/L)t}) \rightarrow 0.5A = \frac{6V}{8\Omega}(1 - e^{-(8\Omega/2.5H)t}) \Rightarrow t = 0.343s$. Then take the derivative of I.
$\frac{dI}{dt} = \frac{\mathcal{E}}{L}e^{-(R/L)t} = \frac{6V}{2.5H}e^{-(8\Omega/0.115H)(0.343s)} = 0.8A/s$. First way is certainly easier.
$I = \frac{6V}{8\Omega}(1 - e^{-(8\Omega/2.5H)(0.25s)}) = 0.413A$. Note that this occurs slightly before the 0.343s found above. The current is still building, and doesn't reach 0.5A till 0.343s. (d) $\mathcal{E}/R = 0.75A$

$\boxed{27}$ (a) $\mathcal{E} I = \mathcal{E}\left(\frac{\mathcal{E}}{R}(1-e^{-(R/L)t})\right) = \frac{\mathcal{E}^2}{R}(1 - e^{-(R/L)t})$. (b) $I^2 R = \left(\frac{\mathcal{E}}{R}(1-e^{-(R/L)t})\right)^2 R = \frac{\mathcal{E}^2}{R}\left((1-e^{-(R/L)t})\right)^2$
(c) $|\text{Power}| = |\mathcal{E}_{\text{across inductor}}| \cdot I = L\,|dI/dt| \cdot I = L\left(\frac{\mathcal{E}}{L}e^{-(R/L)t}\right)\left(\frac{\mathcal{E}}{R}(1-e^{-(R/L)t})\right) =$
$\frac{\mathcal{E}^2}{R}\left(e^{-(R/L)t} - e^{-2(R/L)t}\right)$. It is positive, for the inductor is opposing the increasing current, so the current is going into its positive terminal. The inductor is storing energy. (d) Let's add the power lost in resistance to the power stored in the field in the inductance. $\frac{\mathcal{E}^2}{R}\left((1-e^{-(R/L)t})\right)^2 + \frac{\mathcal{E}^2}{R}\left(e^{-(R/L)t} - e^{-2(R/L)t}\right)$
$= \frac{\mathcal{E}^2}{R}\left(1 - 2e^{-(R/L)t} + e^{-2(R/L)t} + e^{-(R/L)t} - e^{-2(R/L)t}\right) = \frac{\mathcal{E}^2}{R}(1 - e^{-(R/L)t})$ = power provided by battery!

$\boxed{32}$ $\omega = \sqrt{\frac{1}{LC}} \rightarrow 2\pi(1600\times10^3)s^{-1} = \sqrt{\frac{1}{L(4.18\times10^{-12}F)}} \Rightarrow L = 2.37mH$.

(b) $2\pi(540\times10^3)s^{-1} = \sqrt{\frac{1}{(0.00237H)C}} \Rightarrow C = 36.7pF$

$\boxed{\text{Q4}}$ Strong electromagnetic fields, which one can certainly have near radio transmitters, can excite the gases just as the usual circuitry does.

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$\boxed{9}$ Note: There is a typo in the problem's statement. The angular frequency is $2.65\times10^{12}$rad/s (not 12.65)
The argument of the sinusoidal function tells the direction of travel, just as in Physics 9B, Chapter 15.
$\sin[(k\,y - 2.65\times10^{12}\text{rad/s})\,t\,]$ is something that moves in the +y direction ($ky + \omega\,t$ would move in the −y).
(b) $v = f\,\lambda = \omega/k$ and $\omega$ is given to be $2.65\times10^{12}$rad/s, while v is of course $3\times10^{8}$m/s.
$k = \omega/v = 2.65\times10^{12}\text{rad/s}/3\times10^{8}\text{m/s} = 8.83\times10^{3}\text{m}^{-1}$. But $k = {}^{2\pi}/_{\lambda}$, so $\lambda = 2\pi/(8.83\times10^{3}\text{m}^{-1}) = 0.711\text{mm}$.
$\vec{B}$ is in phase with $\vec{E}$, so it will have the same $\sin[(k\,y - 2.65\times10^{12}\text{rad/s})\,t\,]$ as $\vec{E}$. But it is perpendicular, with $\vec{E}\times\vec{B}$ being the direction of $\vec{v}$, so if $\vec{E}$ is in the $-\hat{k}$ direction, $\vec{B}$ must be in the $-\hat{\imath}$ direction $[(-\hat{k})\times(-\hat{\imath}) = +\hat{\jmath}]$.
All that's left is the magnitude of $\vec{B}$. It is $E/c = (3.1\times10^{5}\text{V/m})/(3\times10^{8}\text{m/s}) = 1.03\times10^{-3}\text{T}$.
Altogether, then, $\vec{B} = (-\hat{\imath})\ 1.03\times10^{-3}\text{T}\ \sin[(8.83\times10^{3}\text{m}^{-1})\ y - (2.65\times10^{12}\text{rad/s})\ t]$

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$\boxed{29\text{–}36}$ Using the term "displacement current" can sometimes deflect one from the really important idea: that changing electric flux (which isn't a real current) creates a $\vec{B}$. So, here's the quick answer: The displacement current is the same as the real current. The current density is thus I/area
$= \dfrac{0.28\text{A}}{\pi(0.04\text{m})^2} = 55.7\text{A/m}^2$ (b) $E = \Delta V/\ d = \dfrac{Q}{C}/d = \dfrac{Q}{\epsilon_o A/d}\ /d = \dfrac{1}{\epsilon_o A}Q$. Thus, $\dfrac{dE}{dt} = \dfrac{1}{\epsilon_o A}\dfrac{dQ}{dt} = \dfrac{1}{\epsilon_o A}I$
$= \dfrac{1}{(8.85\times10^{-12}\text{C}^2/\text{N}\cdot\text{m}^2)\pi(0.04\text{m})^2}(0.28\text{A}) = 6.29\times10^{12}\text{N/C/s}$. (c) $\oint \vec{B}\cdot d\vec{\ell} = \mu_o\, I_{\text{encl}} + \mu_o\epsilon_o \dfrac{d}{dt}\Phi_E$. If we're inside the capacitor, $I_{\text{encl}} = 0$. The only thing enclosed by our Amperian loop is a changing electric flux. If we choose our loop to be at a radius r that doesn't enclose all the area A, nor therefore all the flux, then $\vec{B}\cdot d\vec{\ell}$ would be just $B\ 2\pi r$, while on the other side of the equation we would have $\mu_o\epsilon_o\dfrac{d}{dt}\Phi_E = \mu_o\epsilon_o\dfrac{d}{dt}EA_{\text{encl}}$
$= \mu_o\epsilon_o\ A_{\text{encl}}\dfrac{d}{dt}E$. We have $\dfrac{dE}{dt}$, and our loop encloses an area of $\pi r^2$. So Ampere's Law becomes
$B\ 2\pi r = \mu_o\ \epsilon_o\ \pi r^2\ \dfrac{1}{\epsilon_o A}I$, or $B = \dfrac{\mu_o I}{2\pi r}\ \dfrac{\pi r^2}{A}$. Note that this is just like the field for a long straight wire except having a $\dfrac{\pi r^2}{A}$, i.e., a fraction equal to the fraction of the total flux/area the loop encloses. OK, plug in r = 2cm.
$B = \dfrac{(4\pi\times10^{-7}\text{T}\cdot\text{m/A})(0.28\text{A})}{2\pi(0.02\text{m})}\ \dfrac{\pi(0.02\text{m})^2}{\pi(0.04\text{m})^2} = 7\times10^{-7}\text{T}$. (d) $\dfrac{(4\pi\times10^{-7}\text{T}\cdot\text{m/A})(0.28\text{A})}{2\pi(0.01\text{m})}\ \dfrac{\pi(0.01\text{m})^2}{\pi(0.04\text{m})^2}\ 3.5\times10^{-7}\text{T}$
It gets weaker, being proportional to $r^1$, as r gets smaller––less flux enclosed.