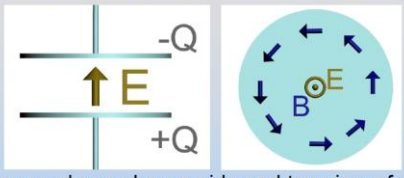
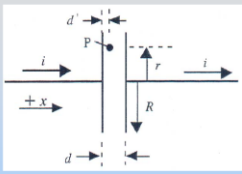
Concept Question: Capacitor



The figures above show a side and top view of a capacitor with charge Q and electric and magnetic fields E and B at time *t*. At this time the charge Q is:

1. Increasing in time
2. Constant in time.
3. Decreasing in time.

Problem: Capacitor

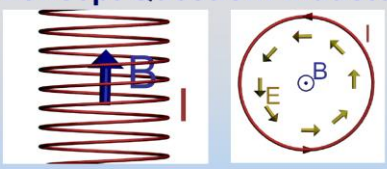


A circular capacitor of spacing *d* and radius *R* is in a circuit carrying the steady current *i* shown.

At time t=0 it is uncharged

1. Find the electric field **E**(t) at P vs. time t (mag. & dir.)
2. Find the magnetic field **B**(t) at P
3. Find the Poynting vector **S**(t) at P
4. What is the total power flux into/out of the capacitor?
5. Does this make sense? How? (Hint: What's U?)

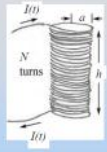
Concept Question: Inductor



The figures above show a side and top view of a solenoid carrying current I with electric and magnetic fields E and B at time t. In the solenoid, the current I is:

1. Increasing in time
2. Constant in time.
3. Decreasing in time.

Problem: Inductor



A solenoid of radius a and length h has an increasing current $I(t)$ as pictured.
Consider a point P at radius r ($r < a$).

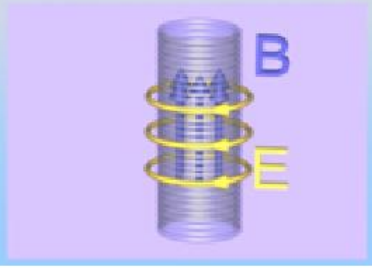
We assume that I(t) is linear proportional to the time, i.e. ~αt

1. Find the magnetic field **B**(t) at P vs. time t
2. Find the electric field **E**(t) at P
3. Find the Poynting vector **S**(t) at P
4. What is the total power flux into/out of the inductor?
5. Does this make sense? How? (Hint: What's U?)

Energy Flow: Inductor

$\vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_0}$

Determine the direction of S on the surface of the cyldindrical inductor assuming the current is increasing through the inductor.



Energy Flow: Inductor

$\vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_0}$

Determine the direction of S on the surface of the cylindrical inductor assuming the current is decreasing through the inductor.

Using the Poynting vector demonstrate energy transport in a circuit that contains a function-generator (sine wave) connected to and inductor. Assume that the function generator provides a sinusoidal current to the inductor. You might need to review the I-V relation of an inductor. Use the paper of Galili and Goihbarg and draw figures similar to fig.3 for different moment in times.

Adapted from MIT OPEN COURSEWARE: http://ocw.mit.edu/courses/physics/8-02sc-physics-ii-electricity-and-magnetism-fall-2010/electromagnetic-waves/energy-and-momentum-in-electromagnetic-waves/