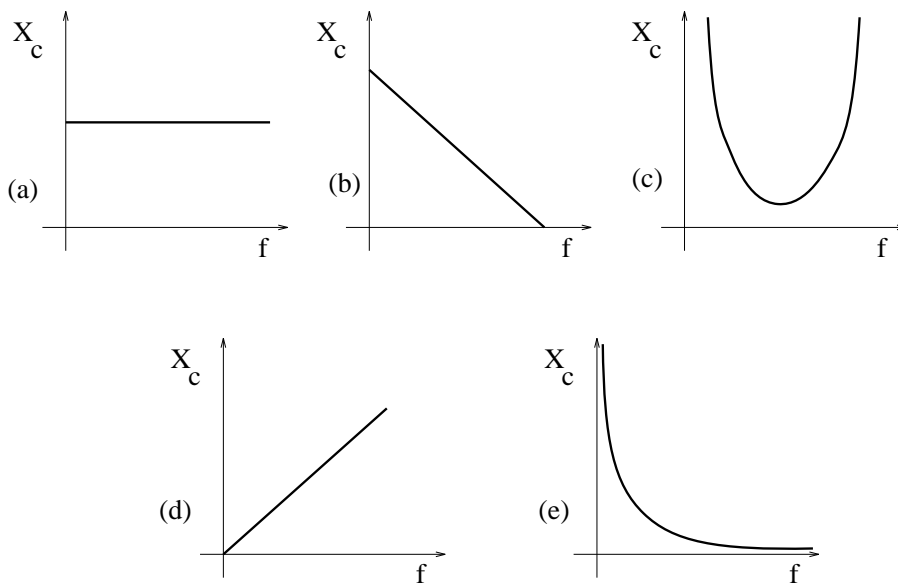


1. An RLC circuit has a sinusoidal source of emf. The average rate at which the source supplies energy is 5 W. This must also be: (Circle **all** that apply)

- (a) the average rate at which energy is stored in the capacitor
- (b) the average rate which energy is stored in the inductor
- (c) the average rate at which energy is dissipated in the resistor
- (d) all of these
- (e) none of these

2. Which one of the following graphs illustrates the way in which capacitive reactance varies with frequency.



3. When the frequency of a particular AC circuit is decreased, the current is seen to increase. For which combination of elements comprising the circuit is this statement ALWAYS true?
- (a) resistors only
  - (b) capacitors only
  - (c) inductors only
  - (d) inductors and capacitors (no resistors)
  - (e) none of these

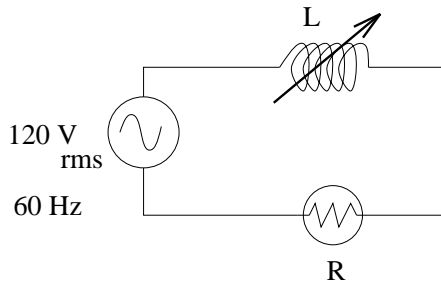
4. The emf that appears in Faraday's law exists:
- (a) at all points inside the closed loop C
  - (b) around the circumference of the closed loop C
  - (c) throughout the open surface S
  - (d) perpendicular to the open surface S
  - (e) none of the above

5. Suppose that this page is perpendicular to a uniform magnetic field and that the magnetic flux through it is 5 Wb. If the page is turned by  $30^\circ$  around an edge, the new flux through it will be:
- (a) 2.5 Wb
  - (b) 4.3 Wb
  - (c) 5 Wb
  - (d) 5.8 Wb
  - (e) 10 Wb
6. Which of the following would induce the emf with the largest peak value in the square loop? Which the least? (There may be ties.) Spinning the loop at a constant angular speed about
- (a) an edge
  - (b) an axis through the center parallel to an edge
  - (c) a diagonal
  - (d) an axis through the center perpendicular to the square

**Partial Credit Section** (40 points)

A typical AC light dimmer consists of a variable inductor whose inductance is adjustable between zero and  $L_{\max}$ , connected in series with a light bulb rated at 120 V, 900 watts. That is, when the bulb alone is connected across 120 volts, the power it consumes is 900 watts.

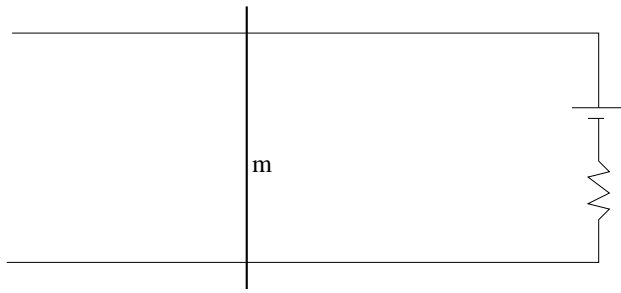
The electric supply voltage is 120 V<sub>rms</sub> at 60 Hz.



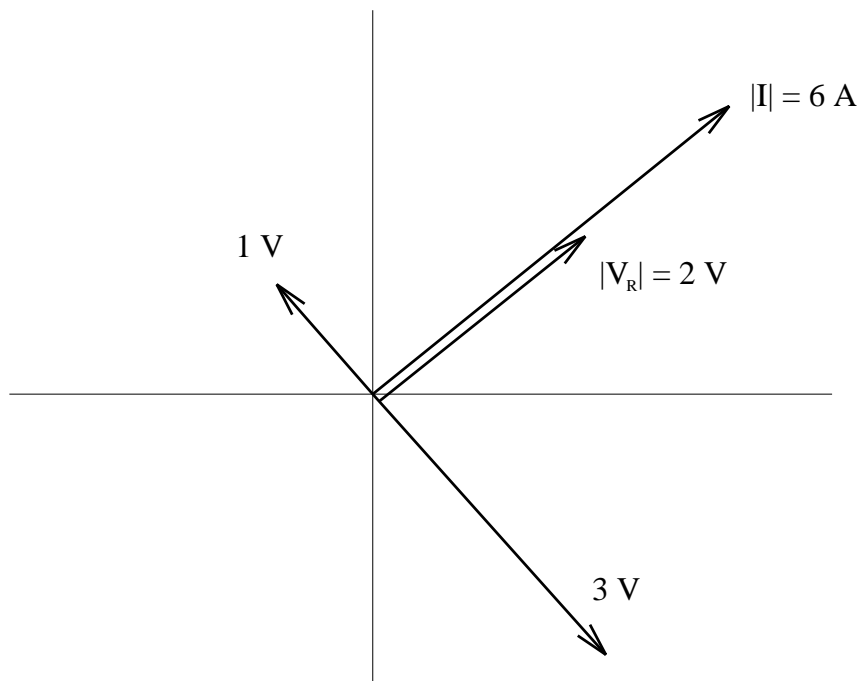
What is the resistance of the bulb?

What  $L_{\max}$  is required if the power dissipation in the bulb is to be varied by a factor of 3? (That is, the bulb at its brightest is three times brighter than the bulb at its dimmest.)

A metal bar of mass  $m$  can slide without friction along two horizontal rails spaced a distance  $d$  apart. The track lies in a uniform magnetic field  $\vec{B}$  directed out of the page. A constant current  $i$  flows out of the battery, along one rail, through the bar, along the other rail and back to the battery (the resistor is there to limit the current). Describe the subsequent motion of the bar (does it accelerate? ; which way? ; what is the velocity magnitude and direction? ; etc.)



Consider the following phasor diagram for an alternating current RLC circuit.



Label  $V_L$  and  $V_C$  on the diagram.  
Is the circuit inductive or capacitive?

What is the magnitude of the source voltage?

What is the angle between the source voltage and the current?

What is the impedance of the circuit?