Problem 1

An electric field of 1.50 kV/m and a perpendicular magnetic field of 0.400 T act on a moving electron to produce no net force. What is the electron's speed?

$$F_E = F_B$$

$$qE = qvB$$

$$\Rightarrow v = \frac{E}{B} = \frac{1{,}5 \times 10^3}{0{,}4} =$$

$$E = \frac{F}{q}$$

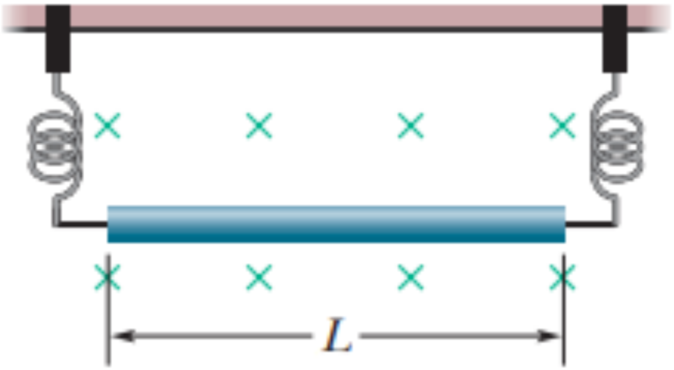
Problem 2

A 13.0 g wire of length L = 62.0 cm is suspended by a pair of flexible leads in a uniform magnetic field of magnitude 0.440 T (Fig. 28-41). What are the magnitude and direction (left or right) of the current required to remove the tension in the supporting leads?

$mg = BIL$

$13 \times 10^{-3} \times \quad = 0{,}44 \times i \times 62 \times 10^{-2}$

$\Rightarrow i =$



Problem 3

62. In Fig. 28-47a, two concentric coils, lying in the same plane, carry currents in opposite directions. The current in the larger coil i is fixed. Current i_2 in coil 2 can be varied. Figure 28-47b gives the net magnetic moment of the two-coil system as a function of i_2. If the current in coil 2 is then reversed, what is the magnitude of the net magnetic moment of the two-coil system when i_2 = 7.0 mA?

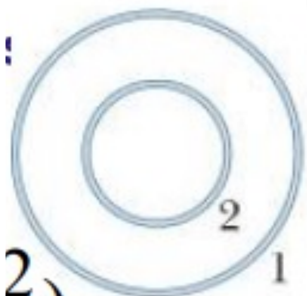
$i_2 = 0$, $\mu_1 = 2\times10^{-5}$ A.m^2

$i_2 = 10$, $\mu_2 = 2\times10^{-5}$ A.m^2

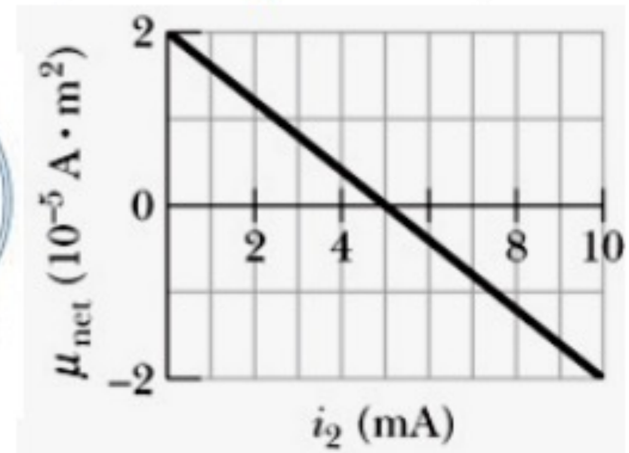
at $i_2 = 10$ A

$\mu_2 = N_2 i_2 A_2$

$N_2 A_2 = \dfrac{2\times10^{-5}}{0{,}005\text{ A}} = 4\times10^{-3}\ m^2$



(a)



(b)

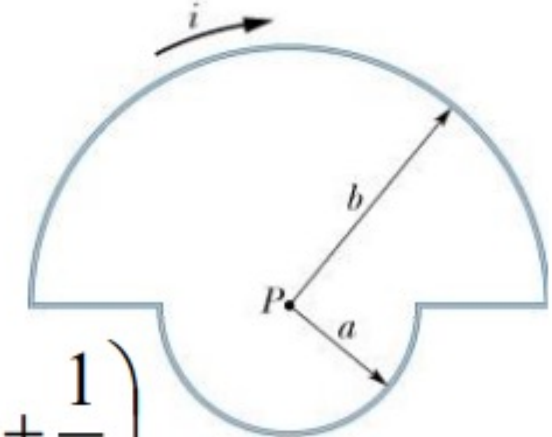
if the current in coil 2 is reversed:

$\mu = \mu_1 + \mu_2 = 2\times10^{-5} + N_2 A_2 i_2$

$= 2\times10^{-5} + 4\times10^{-3} \times 7\times10^{-3} = 4{,}8\times10^{-5}$ A.m^2

Problem 4

62. In Fig. 29-66, current i = 56.2 mA is set up in a loop having two radial lengths and two semicircles of radii a = 5.72 cm and b = 8.57 cm with a common center P. What are the (a) magnitude and (b) direction (into or out of the page) of the magnetic field at P and the (c) magnitude and (d) direction of the loop's magnetic dipole moment?



a) $B = \frac{\mu_0 i \pi}{4\pi\, 8{,}57\times10^{-2}} + \frac{\mu_0 i \pi}{4\pi\, 5{,}72\times10^{-2}}$

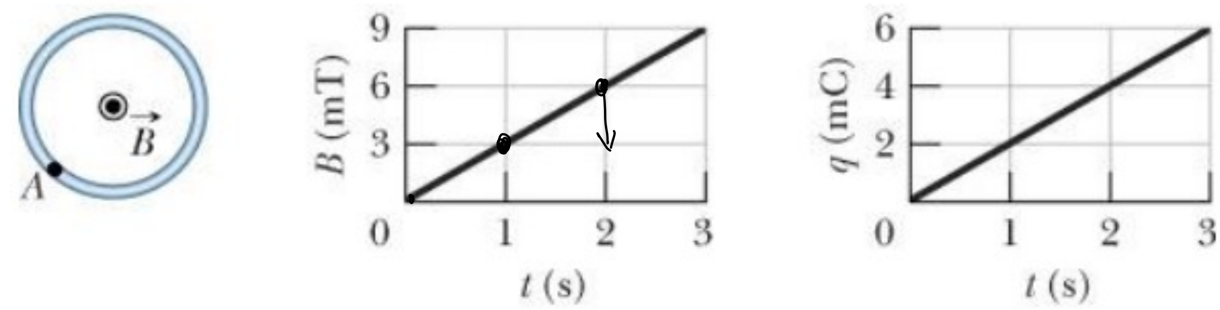
$= \frac{10^{-7}\, 56{,}2\times10^{-3}\,\pi}{8{,}57\times10^{-2}} + \frac{10^{-7}\times 56{,}2\times10^{-3}\,\pi}{5{,}72\times10^{-2}}$

$=$

$\cdot + \frac{1}{b}\Big)$

Problem 5

10. In Fig. 30-41a, a uniform magnetic field B increases in magnitude with time t as given by Fig. 30-41b. A circular conducting loop of area 8.0×10^{-4} m^2 lies in the field, in the plane of the page. The amount of charge q passing point A on the loop is given in Fig. 30-41c as a function of t. What is the loop's resistance?



(a) (b) (c)

$$\mathcal{E} = -\frac{\Delta \Phi}{\Delta t} = \frac{dB}{dt} A$$

$$\frac{dB}{dt} = 3 \text{ mA} (\text{slope}) \Rightarrow \mathcal{E} = 3 \times 10^{-3} \times 8 \times 10^{-4}$$
$$=$$

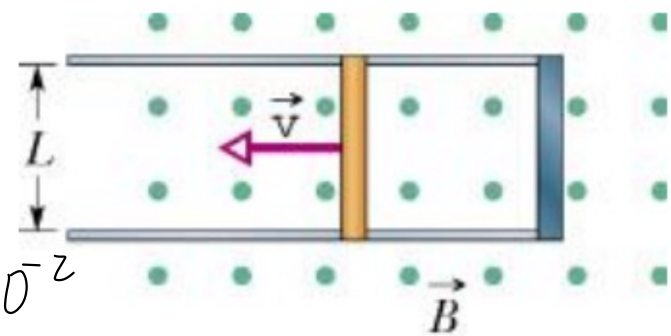
$$i = \frac{dq}{dt} = 2 \text{ mA}$$

$$R = \frac{\mathcal{E}}{i} = \frac{3 \times 10^{-3} \times 8 \times 10^{-4}}{2 \times 10^{-3}} =$$

Problem 6

29. In Fig. 30-52, a metal rod is forced to move with constant velocity v along two parallel metal rails, connected with a strip of metal at one end. A magnetic field of magnitude B = 0.350 T points out of the page. (a) If the rails are separated by L = 25.0 cm and the speed of the rod is 55.0 cm/s, what emf is generated? (b) If the rod has a resistance of 18.0 Ω and the rails and connector have negligible resistance, what is the current in the rod? (c) At what rate is energy being transferred to thermal energy?

$\mathcal{E} = \dfrac{\Delta \Phi}{\Delta t} = \dfrac{B \Delta A \cos\theta}{\Delta t}$



$d = v \Delta t$

$= B \; L \times v$

$= 0{,}35 \times 25 \times 10^{-2} \times 55 \times 10^{-2}$

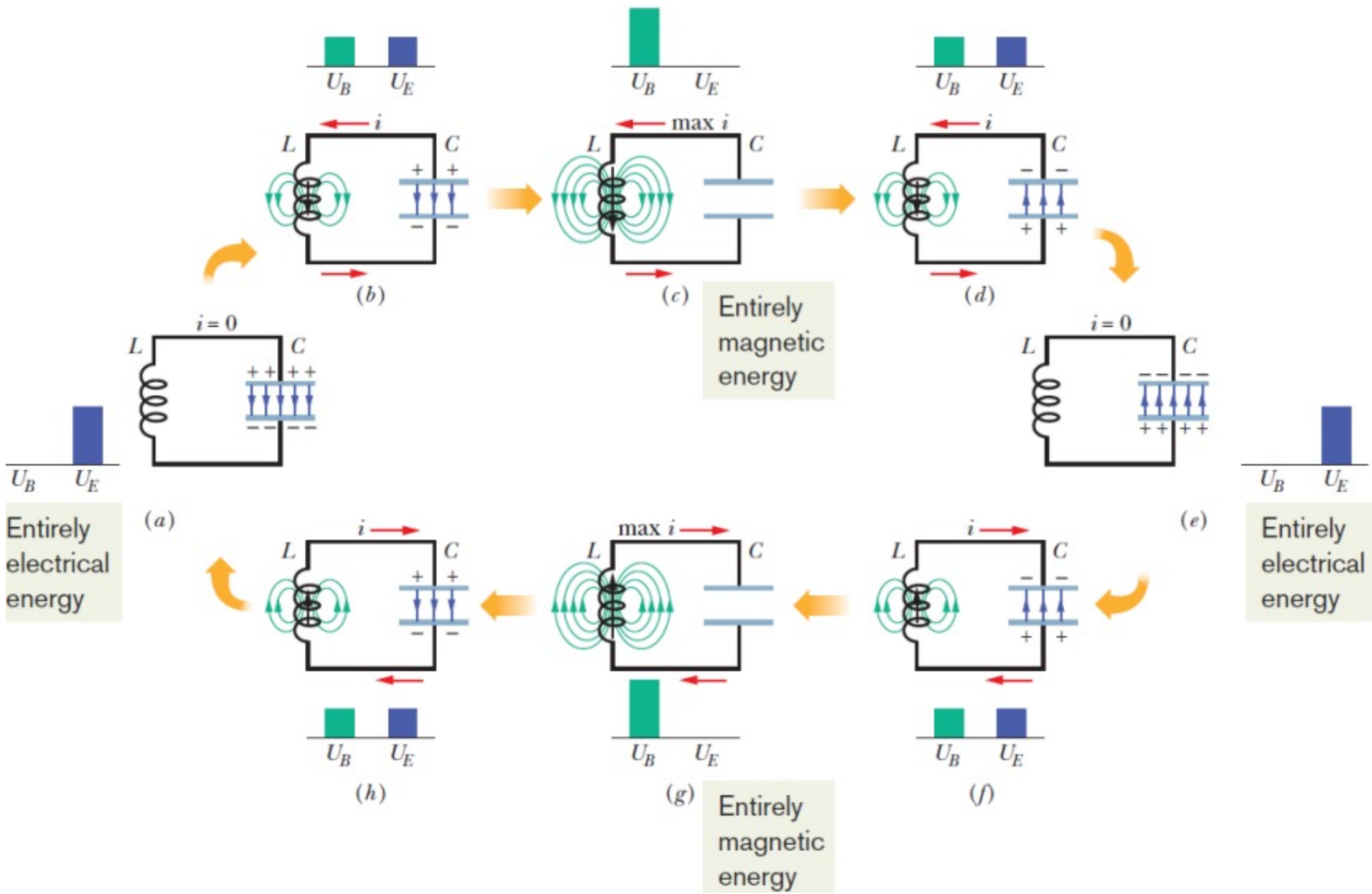
$=$

c)

b) $I = \dfrac{\mathcal{E}}{R} =$

clockwise

$P = \mathcal{E} I =$



(a)
i = 0
L
C
U_B
U_E
Entirely electrical energy
(b)
i
(c)
max i
Entirely magnetic energy
(d)
(e)
Entirely electrical energy
(f)
(g)
Entirely magnetic energy
(h)

Problem 7

9. In an oscillating LC circuit with L = 50 mH and C = 4.0 μF, the current is initially a maximum. How long will it take before the capacitor is fully charged for the first time?

$$q = Q\cos(\omega t + \phi)$$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{50\times10^{-3}\times4\times10^{-6}}} =$$

$$T = 2\pi\sqrt{LC} = 2\pi\sqrt{\ldots}$$

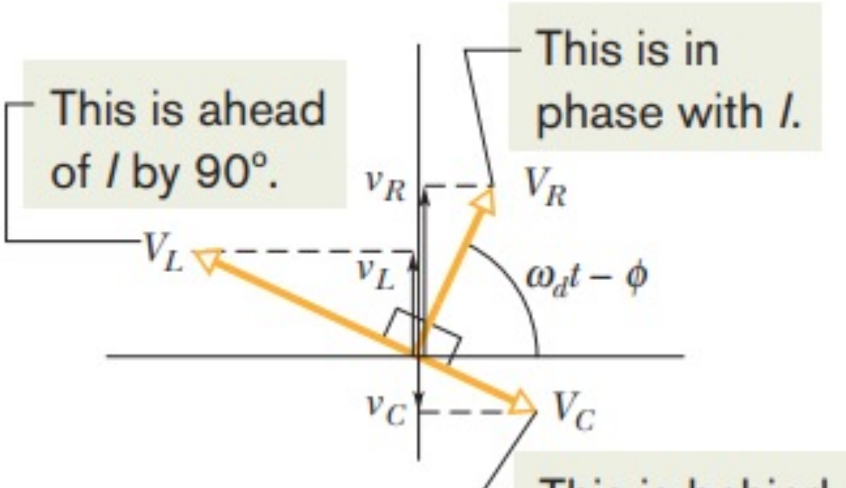
Problem 8

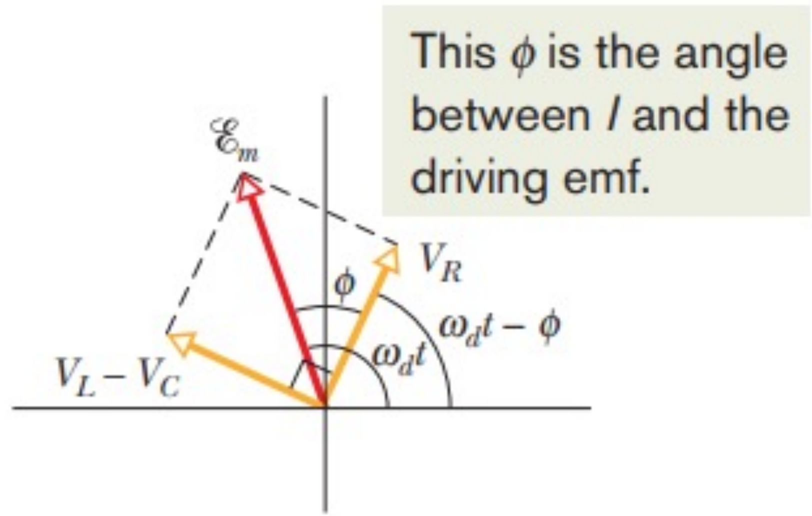
A solenoid has an inductance of 53 mH and a resistance of 0.37Ω. If the solenoid is connected to a battery, how long will the current take to reach **half its final equilibrium value**?

$$i = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau_L}\right) = \frac{1}{2}\frac{\mathcal{E}}{R} \qquad \tau_L = \frac{L}{R} = \frac{53\times10^{-6}}{0{,}37}$$

$$= \left(1 - e^{-t/}\right) = 0{,}5$$

$$\Rightarrow t =$$


This is ahead of I by 90°.
This is in phase with I.
This is behind I by 90°.
V_L
v_L
v_R
V_R
$\omega_d t - \phi$
v_C
V_C
(b)


This ϕ is the angle between I and the driving emf.
$\mathscr{E}_m$
V_R
ϕ
$\omega_d t - \phi$
$\omega_d t$
$V_L - V_C$
(d)

Problem 9

A generator of frequency 3000 Hz drives a series RLC circuit with an emf amplitude of 120 V. The resistance is 40.0 Ω, the capacitance is 1.60 mF, and the inductance is 850 mH. What are (a) the phase constant in radians and (b) the current amplitude? (c) Is the circuit capacitive, inductive, or in resonance?

Problem 10

An alternating source drives a series RLC circuit with an emf amplitude of 6.00 V, at a phase angle of +30.0°.When the potential difference across the capacitor reaches its maximum positive value of 5.00 V, what is the potential difference across the inductor (sign included)?