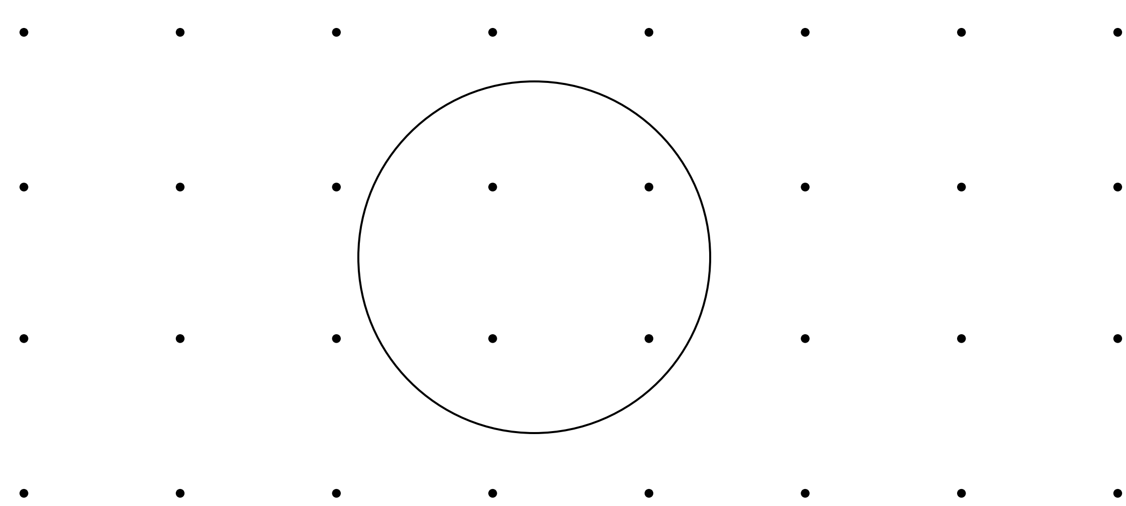
Magnetic Induction

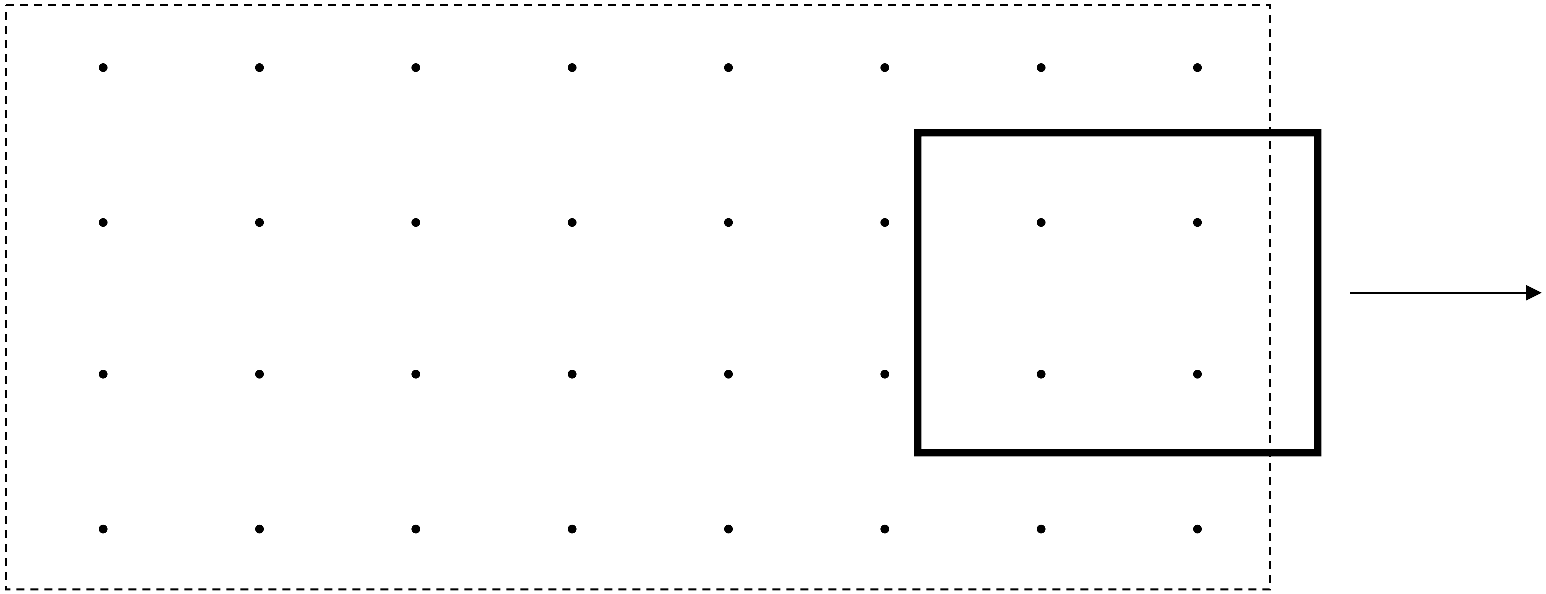
Practice Problems

A circular coil of radius 10.0 cm and resistance 0.50 Ω is placed in a spatially uniform magnetic field given by $B = 3t - 2t^2$, B in teslas, t in seconds. (a) Find expressions for the induced emf and current; sketch the graphs. (b) Find the emf at $t = 0.5$ s. (c) Find the current at $t = 1.5$ s

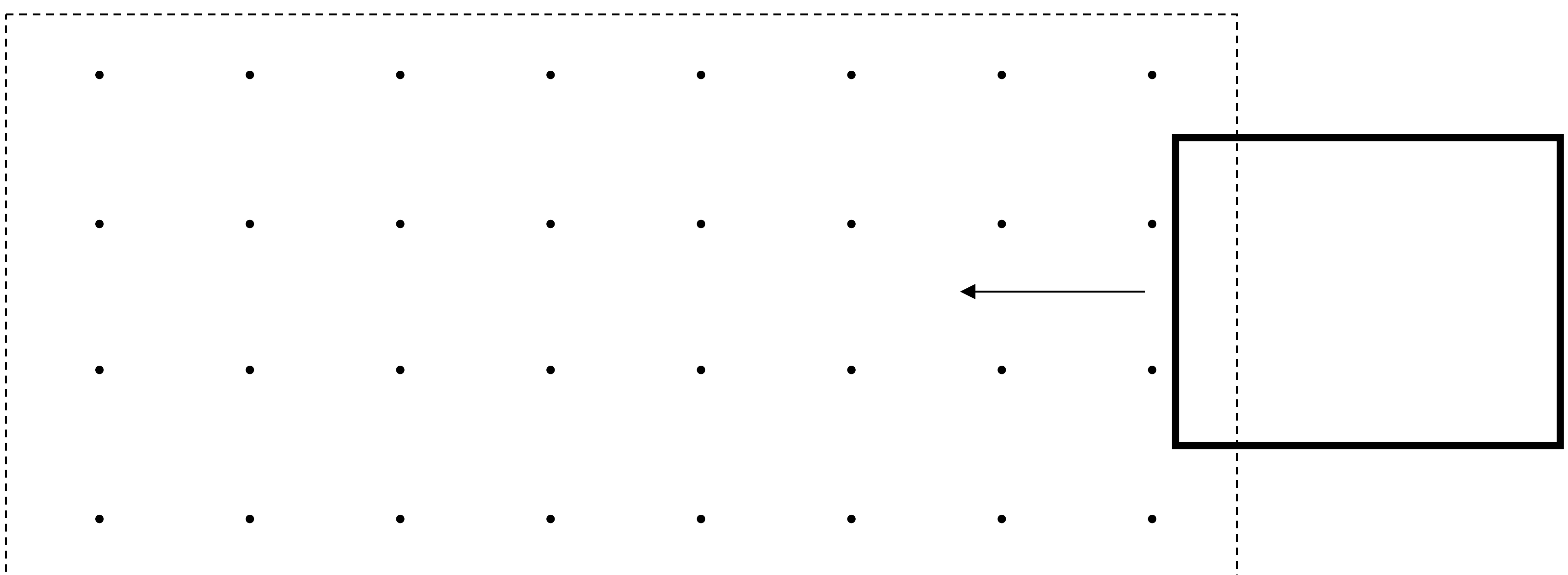


B

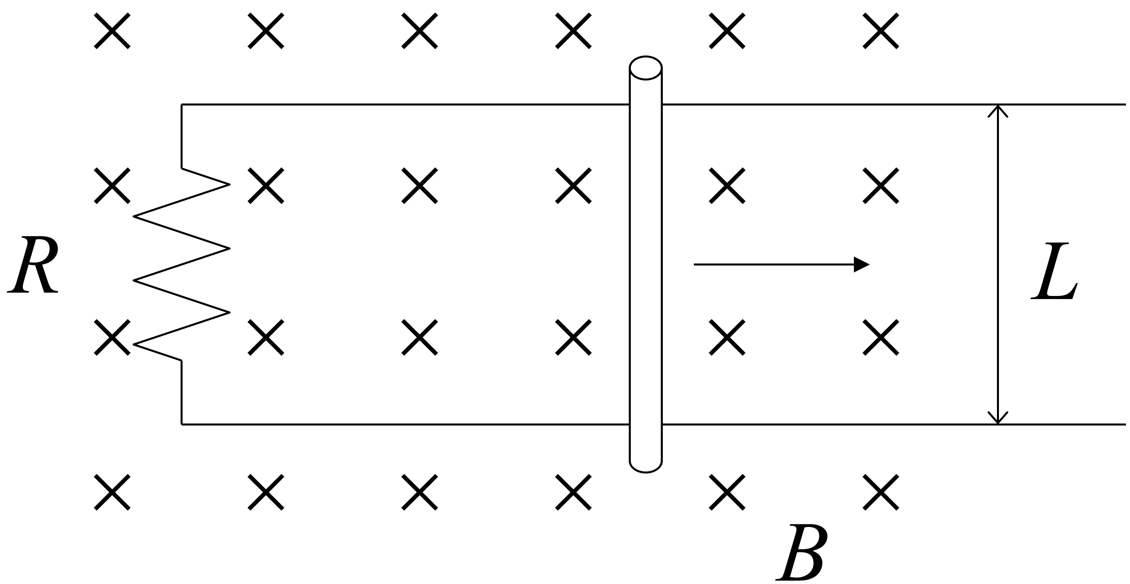
A rectangular coil of height 5.00 cm and width 8.00 cm has constant velocity 10.0 m/s, 0.0° as it exits a uniform magnetic field of 0.40 T out of the page. Find the induced current if the coil has 50.0 turns and resistance 2.5 Ω.



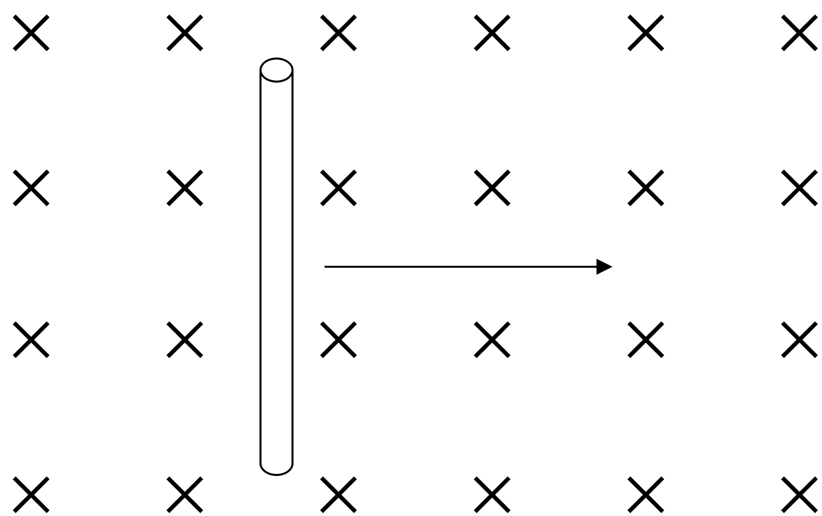
The same coil from previous problem has constant acceleration 6.0 m/s^2, 180.0° as it enters the field. Find the maximum current in the coil if it starts at rest at the edge of the field as shown.



A metallic bar slides along conducting rails at a constant speed v, as shown below. Find the current in terms of B, L, R, and v. Show that the power required to move the bar is equal to the power dissipated in the circuit.

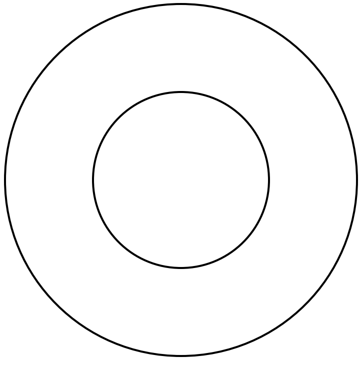


A metallic bar moves at speed v through a uniform magnetic field, B. Determine the potential difference from one end of the rod to the other in terms of its length, L.



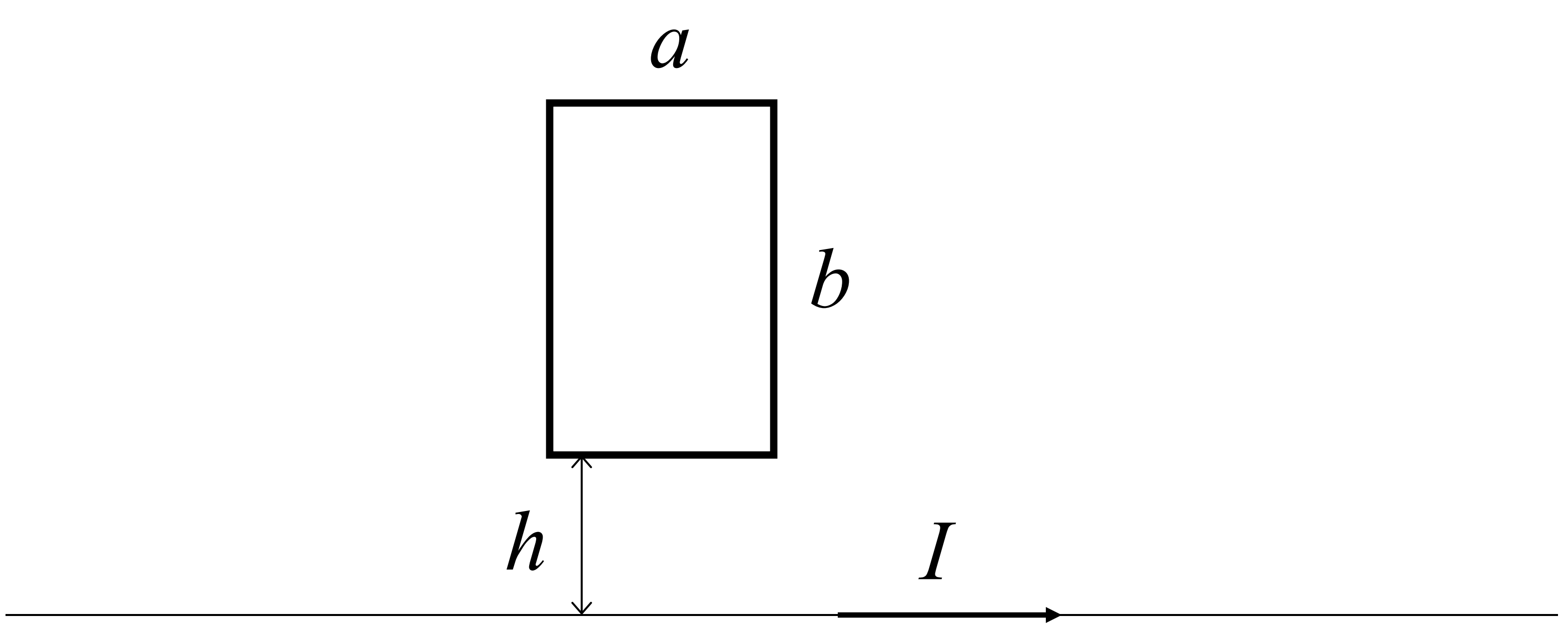
A metallic bar of length 2.0 m is held horizontally at a height of 1.5 m and dropped. The axis of the bar is aligned east and west. The Earth's magnetic field has components of 22 μT north and 47 μT down. (a) Find the maximum voltage induced in the rod. (b) In order to induce a voltage of 1.00 V, what minimum speed of the bar is required and in what direction should it move?

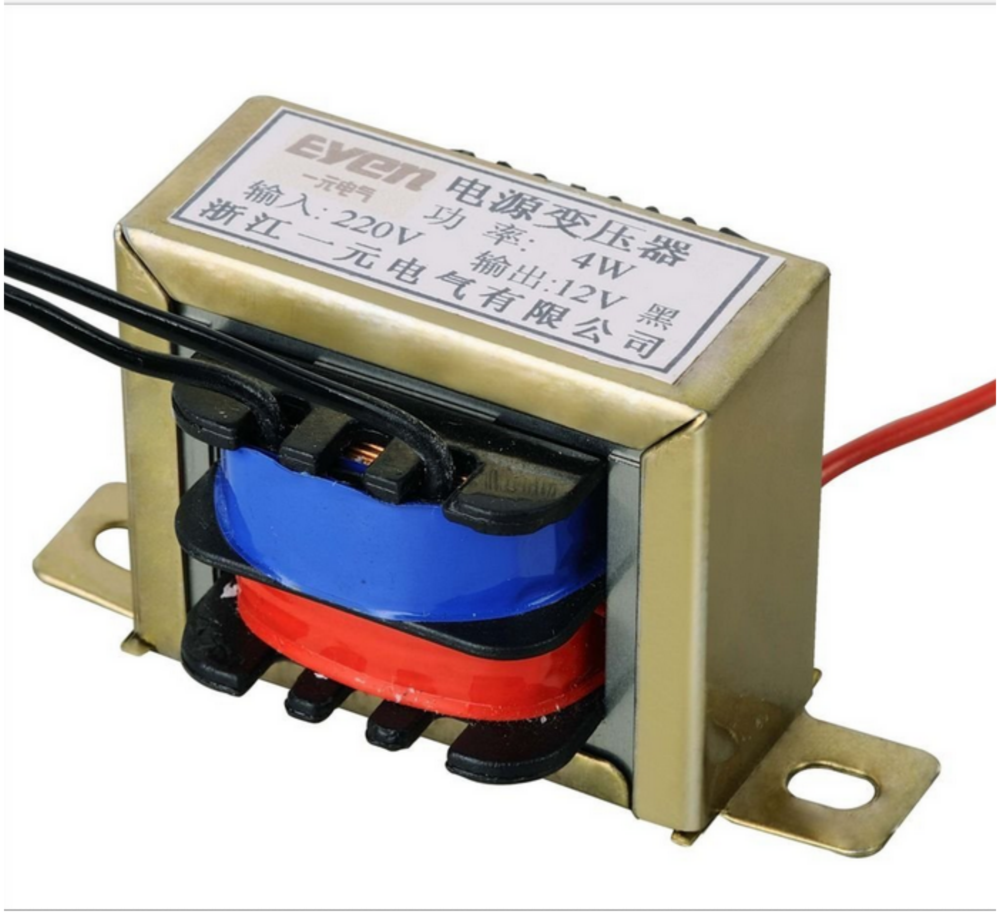
A long solenoid of radius 5.00 cm and 555 turns per meter shares an axis with a circular coil of radius 10.0 cm and 100 turns. Determine the emf of the coil if the current in the solenoid is: (a) CW and increasing at 25 A/s. (b) CCW and decreasing at 4.0 A/s. (c) constant 5.0 A, CCW.



A long solenoid of radius R carries a current given by $I = I_0 \sin(\omega t)$. Find the induced electric field for regions inside and outside of the coil. Find maximum electric field strength given values: $I_0 = 2.00$ A, $\omega = 377$ rad/s,
$n = 313\ \text{m}^{-1}$, $R = 3.0$ cm.

A rectangular coil of wire is placed near a current carrying wire. The current in the wire varies according to $I(t) = I_0(1 - e^{-kt})$. Find the emf for the coil.





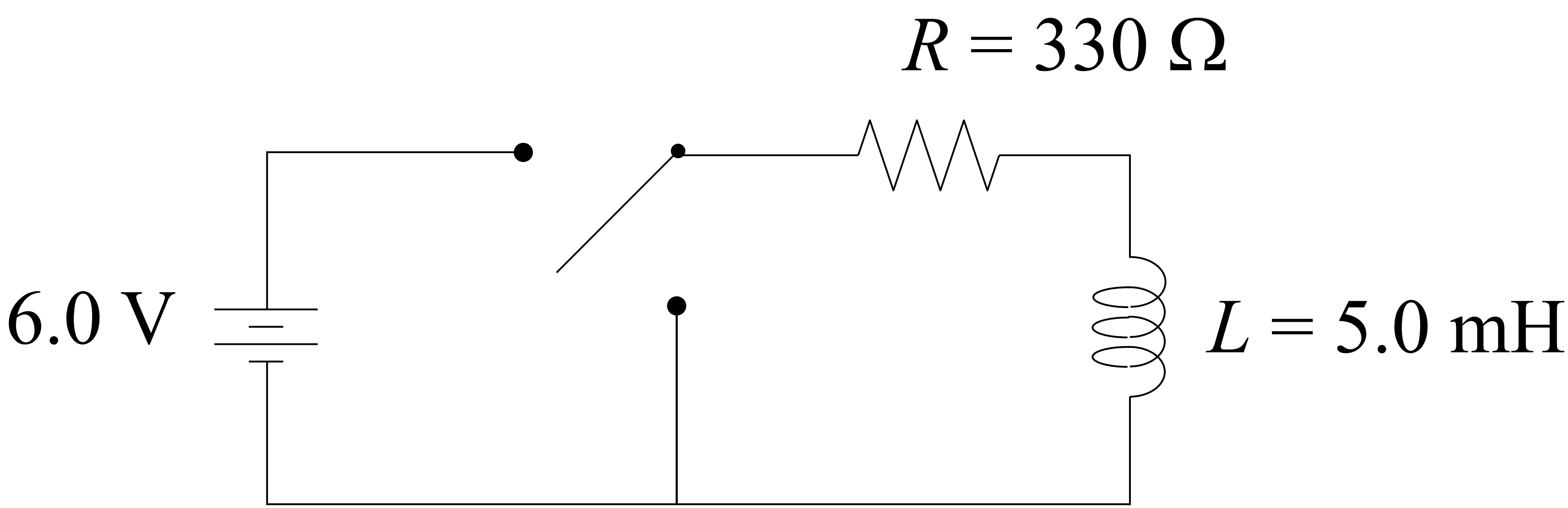
Eyen
一元电气
电源变压器
输入:220V 功 率: 4W
输出:12V 黑
浙江一元电气有限公司

A square coil that is 2.5 cm on a side and has 20.0 turns is rotated in a uniform magnetic field of 50.0 mT. (a) In order to produce a peak emf of 2.00 V, what must be the rotation rate in rpm? (b) Suppose the coil has resistance 5.0 Ω and the coil is rotated at 30.0 rpm. Make a careful sketch of the current vs. time graph if the ends of the coil are connected.

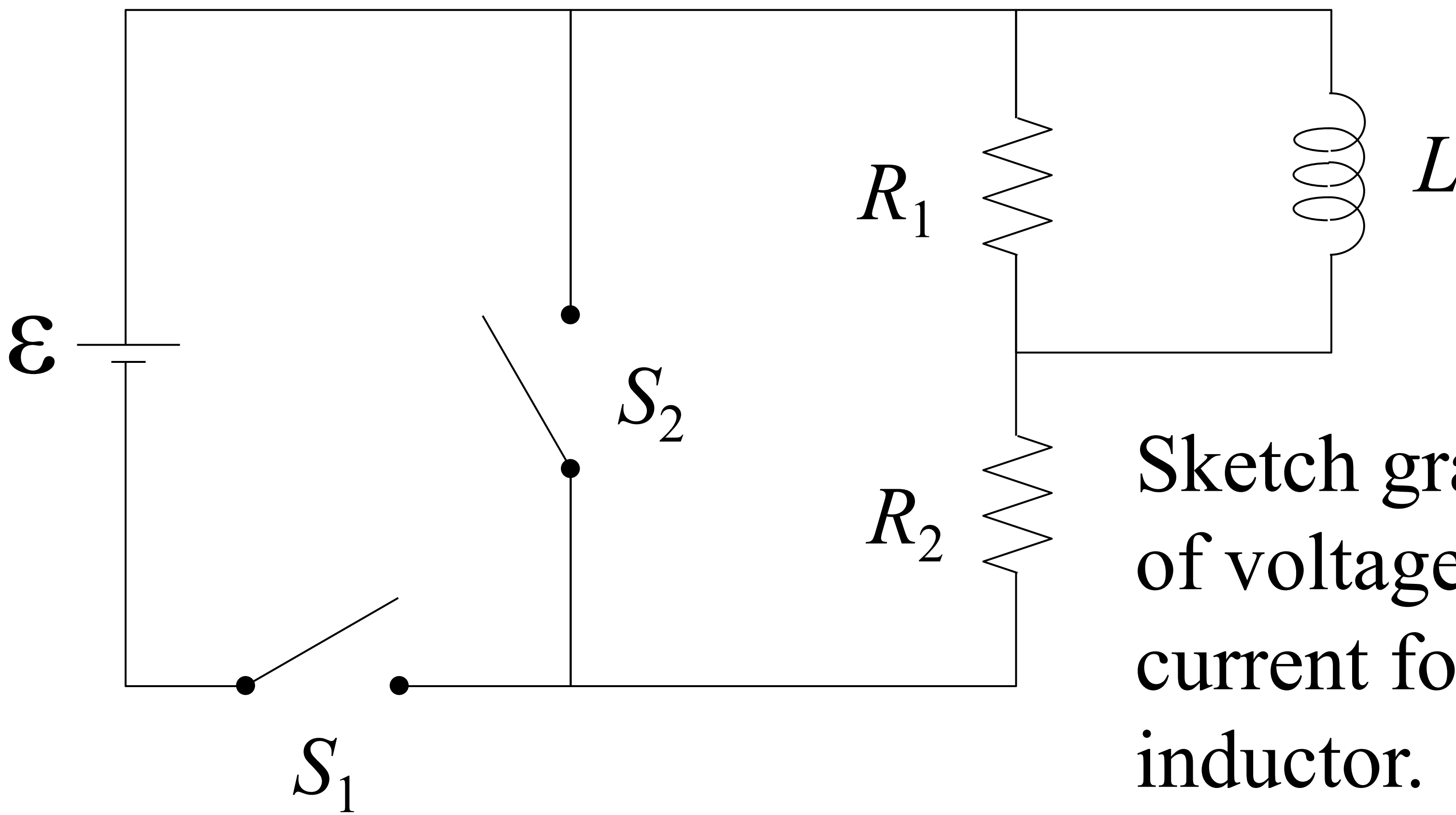
Household voltage varies sinusoidally with frequency 60.0 Hz. The peak voltage is 170 V (the RMS or “mean” value is 120 V). Suppose a generator is intended to produce such an emf. Let the armature consist of a circular coil of radius 5.00 cm rotating in a uniform magnetic field of 0.100 T. (a) Solve for the required number of turns in the coil. (b) If the wire used is 30 gauge, which has resistance per length 0.338 Ω/m, what is the maximum current output? (c) Ignoring friction, what torque and power is required to turn it?

A certain motor has a coil rotating in a uniform magnetic field and is powered by 12 VAC. The windings in the motor have a resistance of 20.0 Ω and the peak current is 75 mA. (a) Find the peak level of the back emf. (b) If the frequency of rotation is halved what will be the effect on the current?

The switch is moved to the top position, and then a long time later moved *instantaneously* to the bottom position. (a) Find the current and voltages just before and just after each event. (b) Find the rate of change in current just after each event.

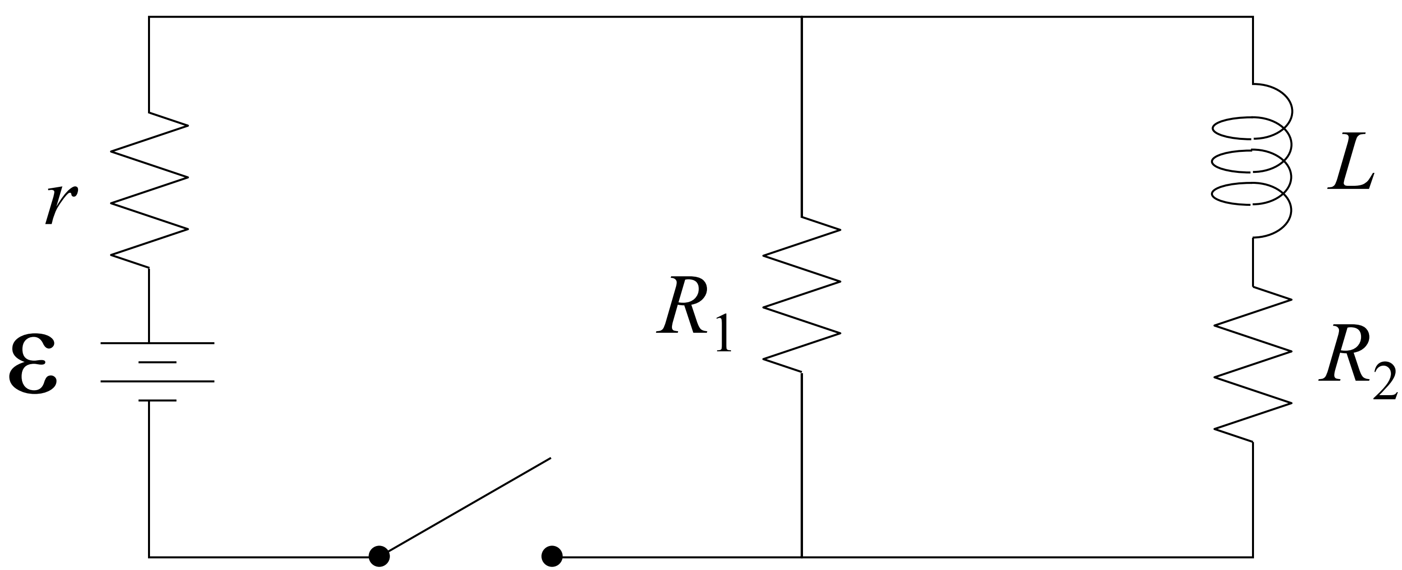


Analyze the steady state behavior of the circuit as the switch S_1 is closed and later when S_1 is opened at the exact same time S_2 is closed.



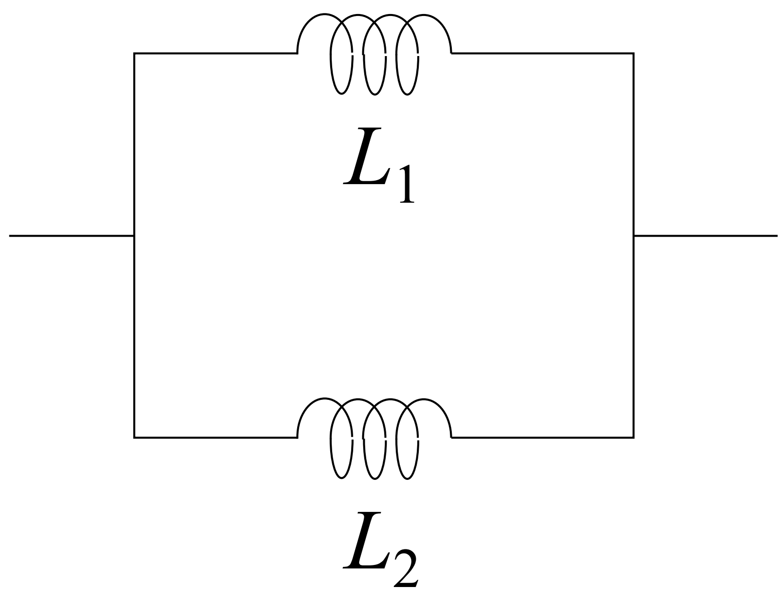
Sketch graphs of voltage and current for the inductor.

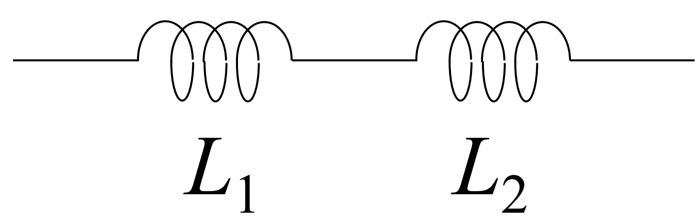
Analyze the steady state behavior of the circuit as the switch is closed and then opened. Can simplify by assuming *r* is negligible.



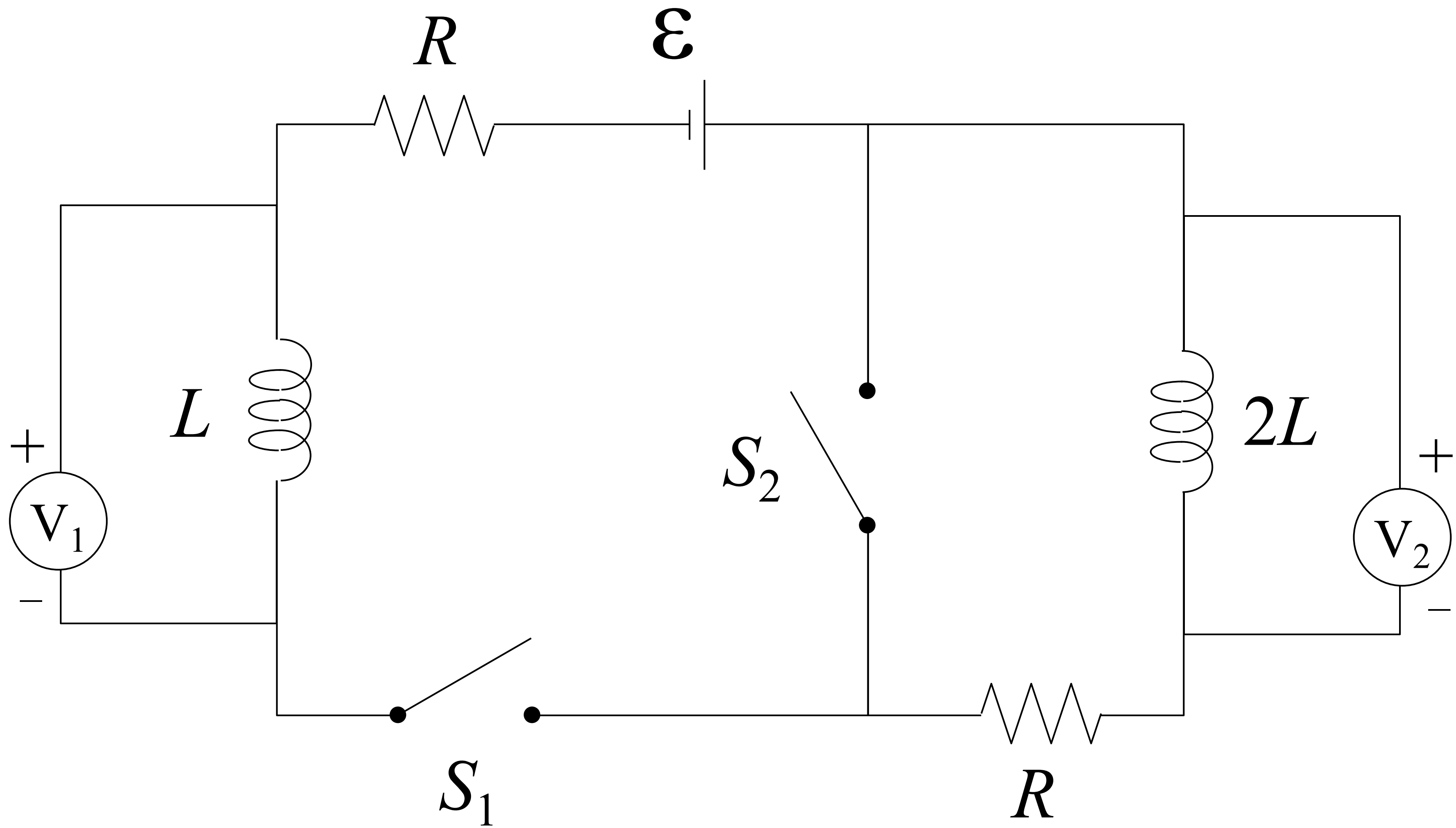
Note: this is essentially the same circuit that will be used to demonstrate inductance – what does R_2 represent in the demos?

Given $L_1 = 2.5$ mH and $L_2 = 4.0$ mH, find the equivalent inductance of each combination:

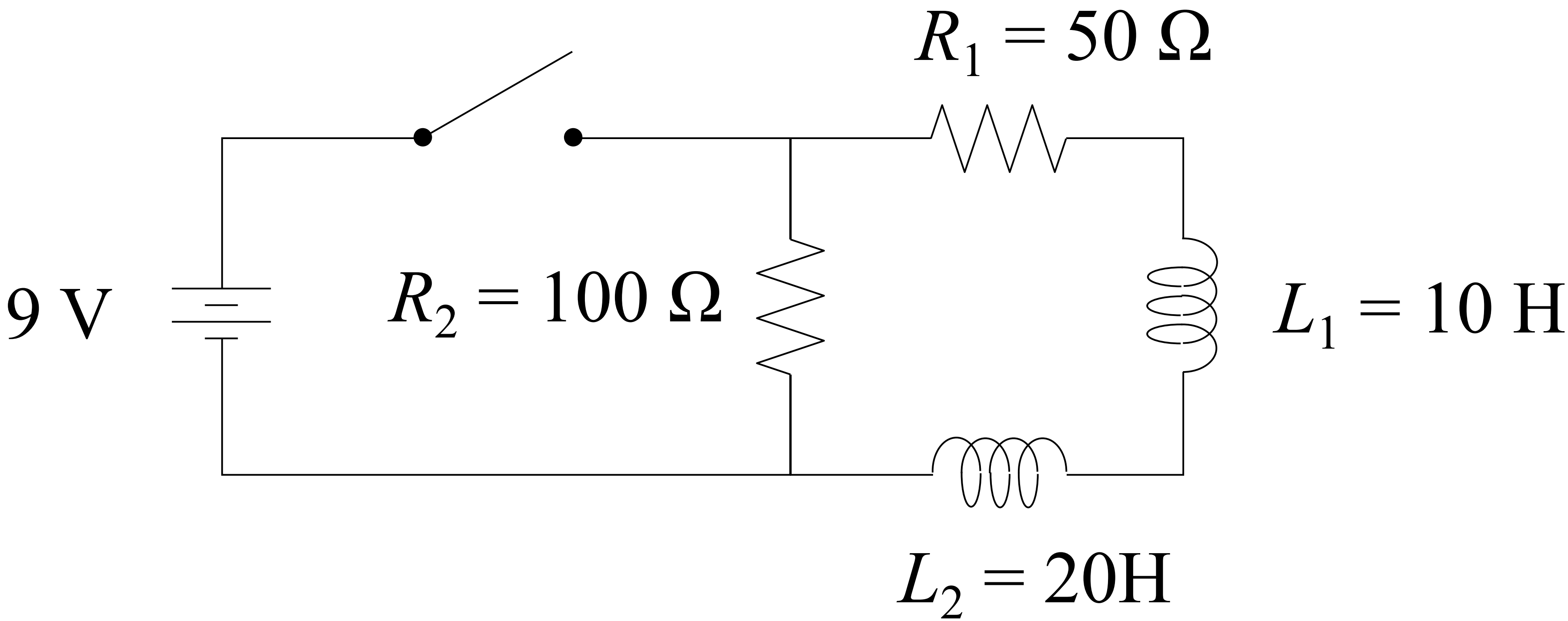




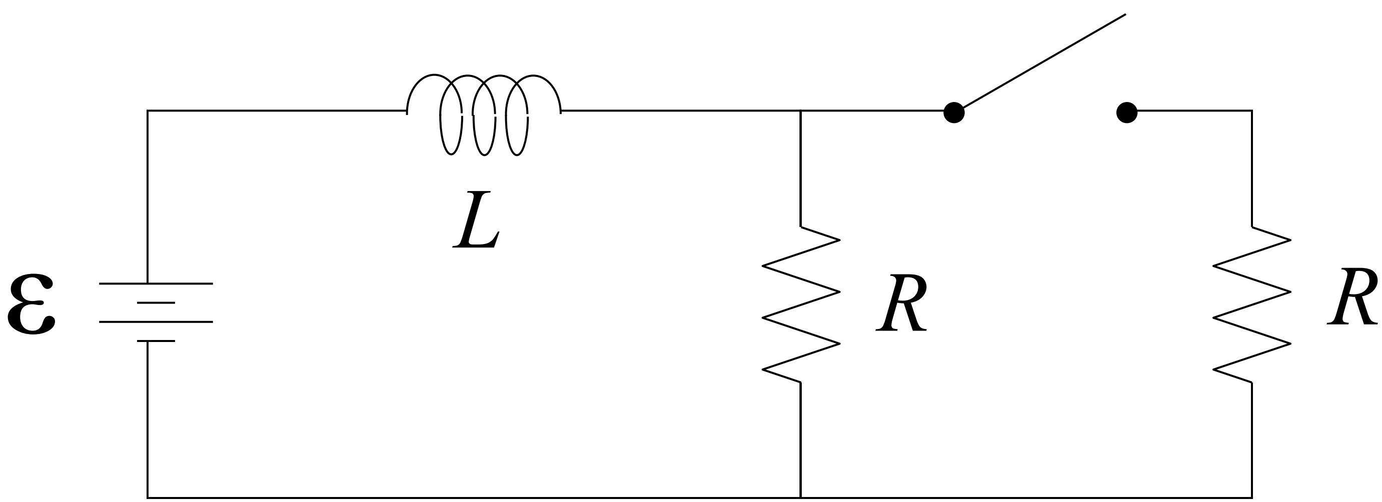
Make a careful graph of voltage vs. time illustrating V_1 and V_2 as first S_1 and then later S_2 are closed.



Determine the time constants for the current through the resistor R_1 with switch open or closed.



Make a careful sketch of the inductor's voltage illustrating closing and opening the switch.



Analyze the transient and steady state behavior of the circuit as switch is closed and then opened.