1) Sketch the electron $\boldsymbol{v}$, the $\boldsymbol{B}$, $\boldsymbol{F_B}$, and the current $\boldsymbol{I}$ that causes the $\boldsymbol{B}$. Where is Ampere's Law and Lorentz Force applied here?

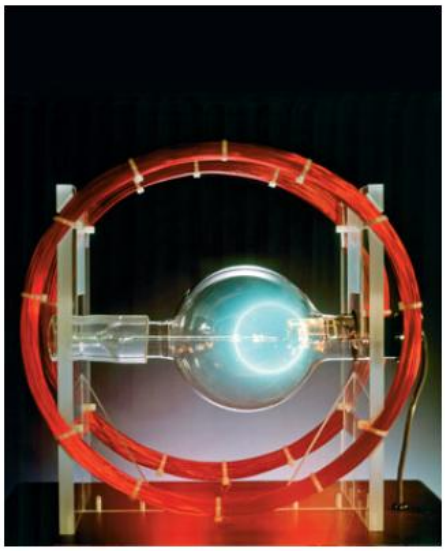


FIGURE 20–18 The white ring inside the glass tube is the glow of a beam of electrons that ionize the gas molecules. The red coils of current carrying wire produce a nearly uniform magnetic field, illustrating the circular path of charged particles in a uniform magnetic field.

2) Explain how the doorbell works. Hint: Ampere's Law.

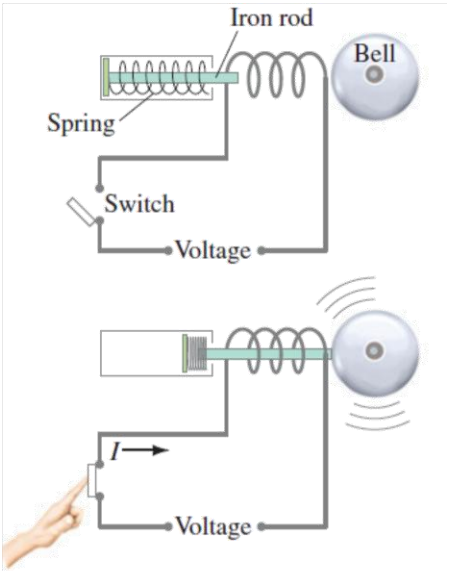


FIGURE 20–29 Solenoid used as a doorbell.

PHYSICS APPLIED

The mass spectrometer

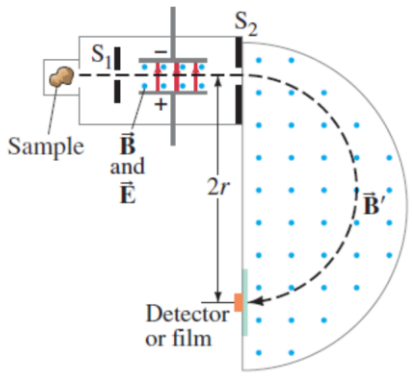
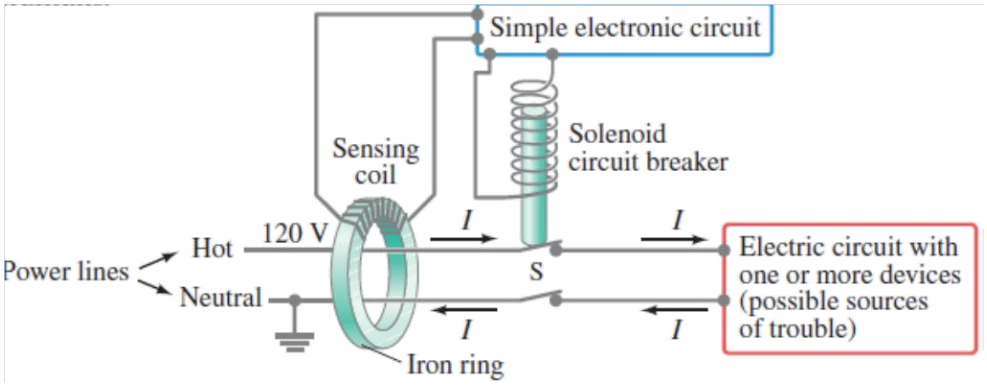


FIGURE 20–41 Bainbridge-type mass spectrometer. The magnetic fields B and B' point out of the paper (indicated by the dots).

3) Ions of mass *m* pass through slit S_1 and enter a region (before S_2) where there are perpendicular electric and magnetic fields. This is called a velocity selector because ions follow a straight-line path in this region only if the electric force is just balanced by the magnetic force. Only ions with this speed will go straight and pass through slit S_2. After passing S_2, there is only a magnetic field B', so ions will go in a circle. Measuring the radius of the circle, we can find the mass of the ion. Question: Derive an expression for the mass m of the ion in terms of q, r, B, B', E.

4) A ground fault circuit interrupter (GFCI) is a switch that protects humans. When the net current going through the sensing coil is not 0, the switch will open. a) Explain why a nonzero net current indicates a problem. A GFCI can sense a current difference of 5 mA and react in 1 ms, which can save lives. b) Apply Ampere's Law, domains, Faraday's Law, and Ampere's Law again to explain how the device works. Hint: Remember the mains uses alternating current. The "simple electronic circuit" amplifies current in the sensing coil so that the current in the solenoid is a bigger version of that current.

Figure 21-34



Source: Giancoli

5) Alternating Current Practice The mains is 110 V ac, 60 Hz.

a) Write a sinusoidal function $v(t)$ = _____. Sketch $v(t)$ vs. time with labeled axes.

b) Sketch $v^2(t)$ vs. time with labeled axes. Use the graph to explain where the relationship between V_{rms} and V_{max} come from.

c) A hair dryer designed for use in Taiwan connected to a 110-V ac line has an average power of 1500 W. What's the average power if you take the hair dryer to Britain and plug it into their 240-V ac line? Is this a good idea?

6) Transformers

a) Apply conservation of energy/power and resistance as a function of length of the wire to conceptually explain how a step-up transformer works.

b) How are transformers related to why Westinghouses's ac won over Edison's dc in the 'War of Currents'?

c) Clearly explain with net force = 0 why V_1 = back emf, and how this gets you to the relation between ratio of coil turns and ratio of voltages.

7~11) Hewitt's Next Time Questions for Magnetism (total: 5 questions)

Try to answer these questions without looking at the solutions first! For full credit, label the title of the question and show your work by writing down your initial guess and your reasoning, even if it is wrong. *Only after this*, check your answer, and then write the correct explanation in <u>your own words</u>.

- Magnetic Force
- Loop
- Iron Bars
- Galvanometer Reading
- Overheating Motor