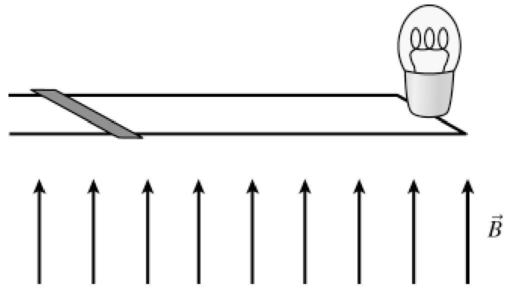
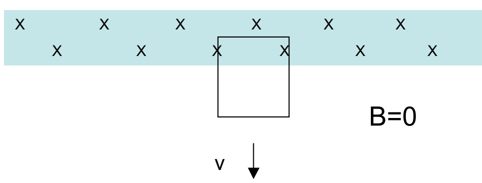


FIG. 1: light bulb problem



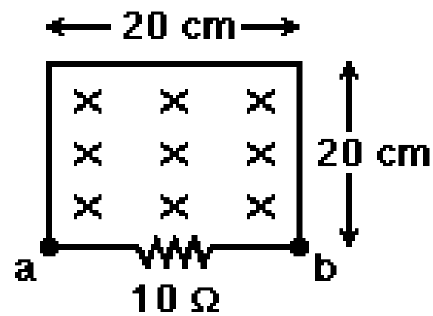


FIG. 2: loop problems

1B quiz 4 version A

1. An R-L circuit has a 60 V battery, a 30 H inductor, a 12 ohm resistor, and a switch S, all in series. Initially, the switch is open, and there is no magnetic flux in the inductor. At time t = 0 s, the switch is closed. When the EMF due to the inductor is 24 V, the time t is closest to:

   - a. 4.7 sec
   - b. 3.3 sec
   - c. 2.1 sec
   - d. 1.2 sec

2. A conducting bar is free to slide horizontally on the rails of a conducting frame, as shown in Figure 1. A light bulb is attached to the right end of the rails. A spatially uniform magnetic field is oriented vertically (perpendicular to the horizontal plane of the rails and bar). Initially the bar is stationary. The strength of the magnetic field begins increasing in time at a constant rate, which induces a current through the bar, frame, and light bulb. The bar begins to move due to the magnetic force exerted on it. Once the bar begins to move, the brightness of the light bulb

   - a. steadily decreases
   - b. stays the same
   - c. steadily increases
   - d. suddenly drops to zero

3. A current loop falls under the influence of gravity and starts to leave a region where there is a magnetic field of magnitude 15T directed into the paper (see Figure 2a). If the loop has a 5 cm side, a mass of .15 kg, and a resistance of 2Ω, find the loop's terminal velocity (i.e. the velocity at which gravity is balanced by the magnetic force)

   - a. cannot be determined from the information given
   - b. .3 m/s
   - c. 5.2 m/s
   - d. 300 m/s

4. A bar magnet is falling through a loop of wire with constant velocity. The north pole enters first. As the south pole leaves the loop of wire, the induced current (as viewed from above) will be:

   - a. clockwise and nonzero
   - b. counterclockwise and nonzero
   - c. zero
   - d. cannot be determined from information given

5. In Figure 2b, a wire and a 10 ohm resistor are used to form a circuit in the shape of a square, 20 cm by 20 cm. A uniform but non-steady magnetic field is directed into the plane of the circuit. The magnitude of the magnetic field is decreased from 0.90 T to 0.30 T in a time interval of 60 ms. The average induced current and its direction through the resistor, in this time interval, are closest to:

   - a. 24 mA, from a to b
   - b. 40 mA, from a to b
   - c. 24 mA, from b to a
   - d. 40 mA, from b to a

6. A battery in a circuit is used to create a 4.0 A current (staring from zero current) in a 0.50-mH coil in a time interval of 5 seconds. How much energy E has been supplied by the battery in this interval?

   - a. $0 < E < 2$ mJ
   - b. 4 mJ $< E < \infty$
   - c. 18 mJ $< E < \infty$
   - d. $0 < E < 40$ mJ

7. A 500-turn circular coil with an area of 0.050 0 m^2 is mounted on a rotating frame, which turns at a rate of 20.0 rad/s in the presence of a 0.050 0-T uniform magnetic field that is perpendicular to the axis of rotation. What is the instantaneous emf in the coil at the moment that the normal to its plane is parallel to the field?

- a. 0. V
- b. 125 V
- c. 216 V
- d. 375 V

8. By what factor is the self-inductance of an air solenoid changed if its cross-sectional area is quadrupled and its length halved?

   - a. 1/8
   - b. 1/4
   - c. 2
   - d. 8