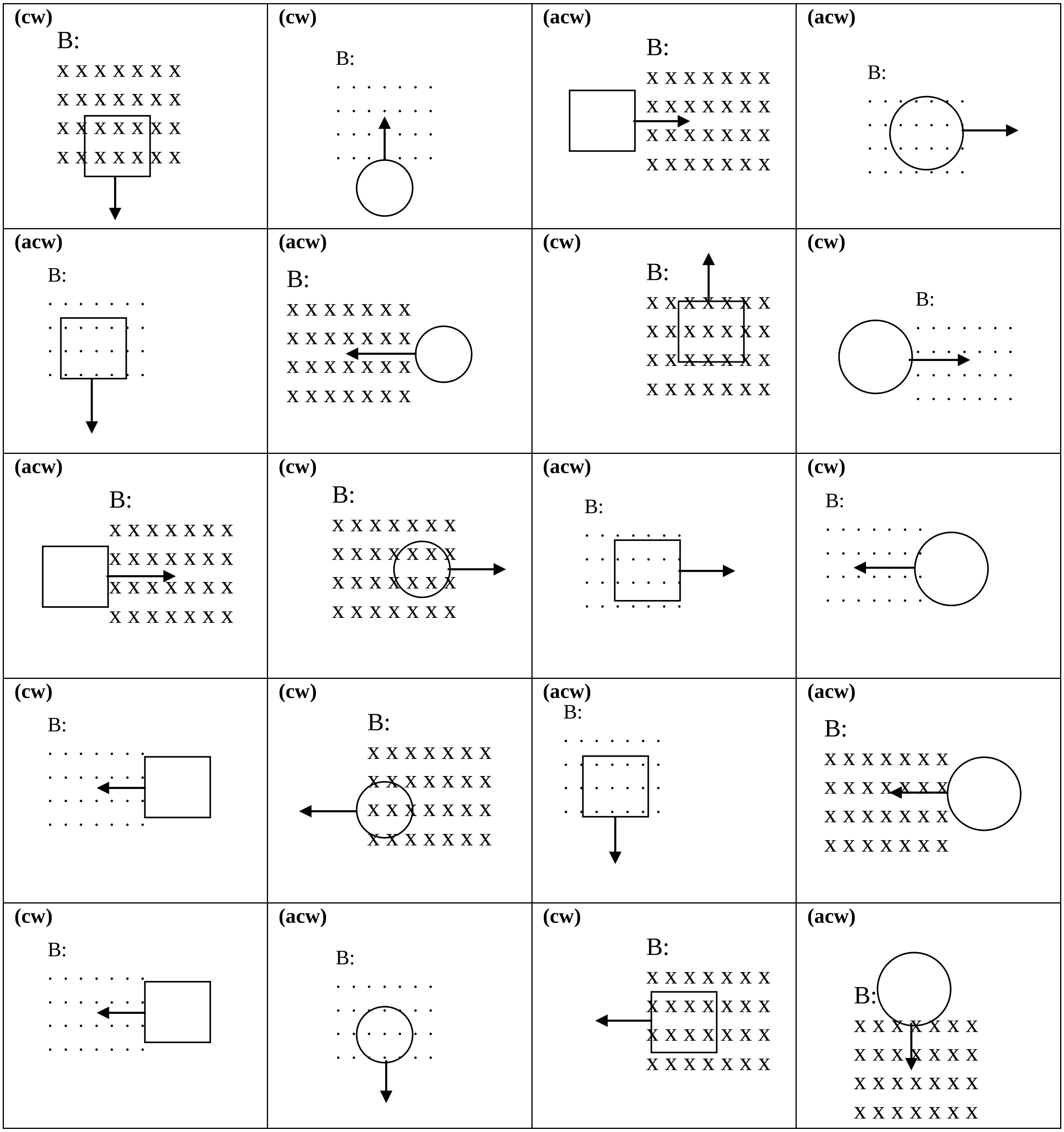
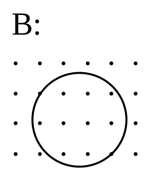
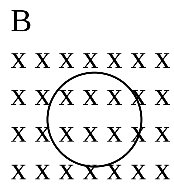
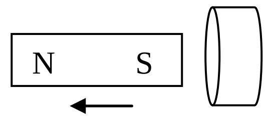
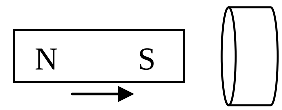
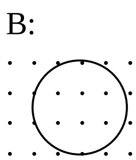
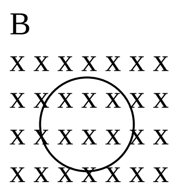
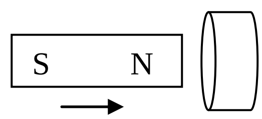
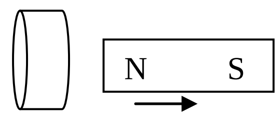
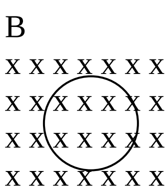
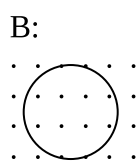
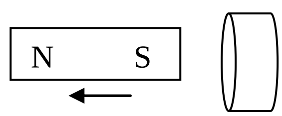
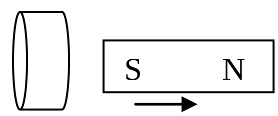
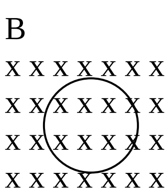
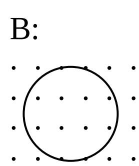
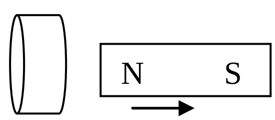
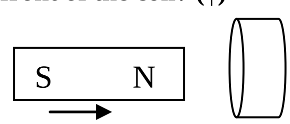
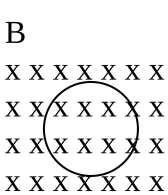
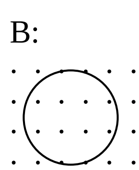
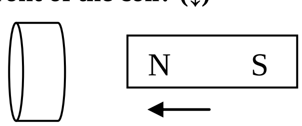
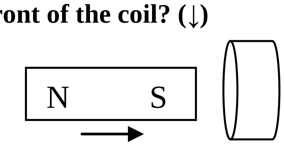
Practice for 21.1 - Lenz's Law

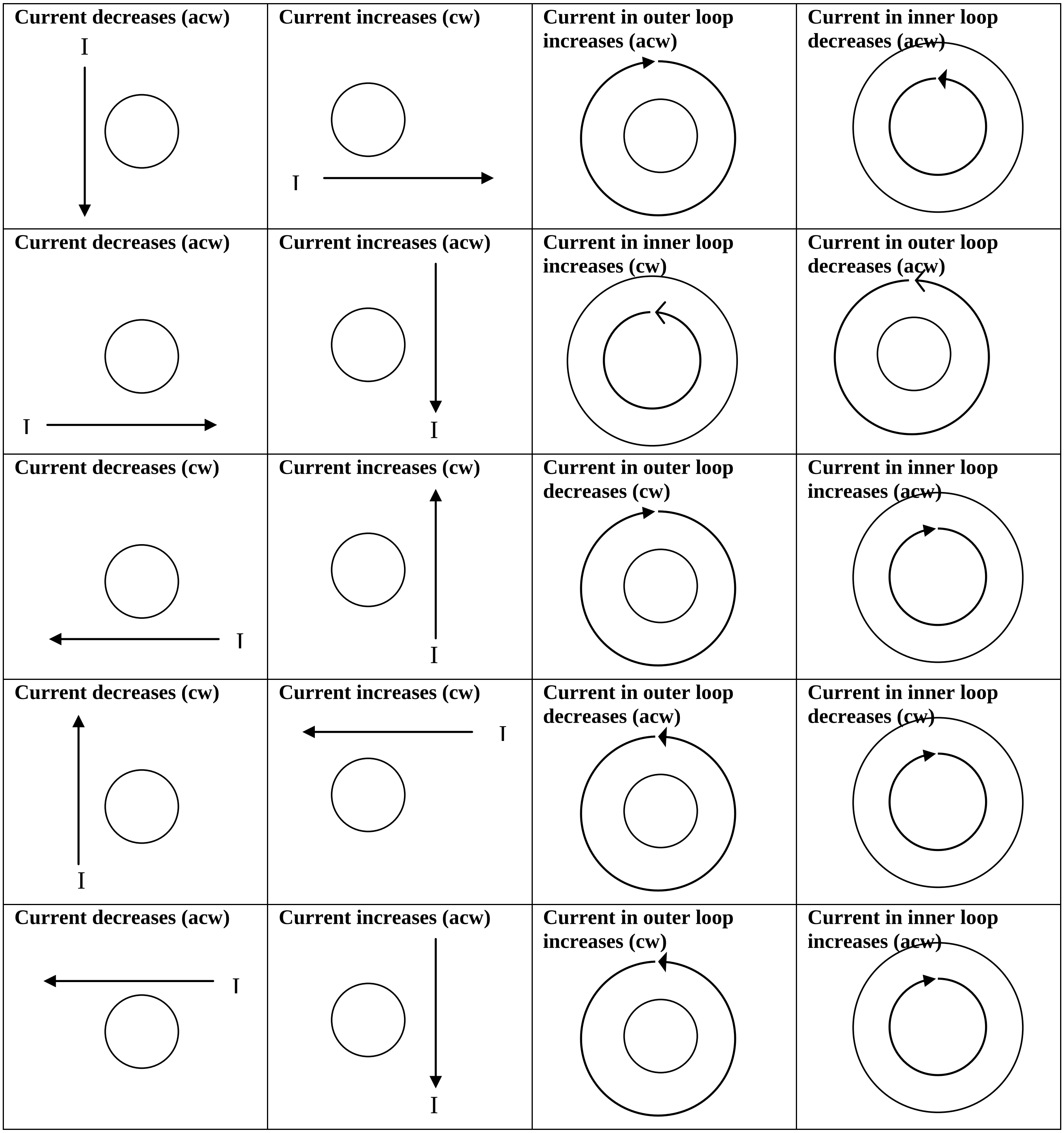
1. These are loops being put into or pulled out of a magnetic field. Lenz's law says that the current induced flows in a direction so as to oppose the change in flux. So if flux **goes away**, you **replace** it, and if flux **increases**, you **oppose** it. Remember, that CW (clockwise) current creates flux into the page inside a loop. (Rt-hand rule for magnets and loops), and ACW (anti-clockwise) current creates flux out of the page inside a loop.



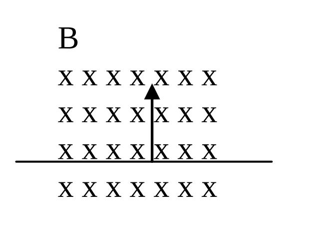
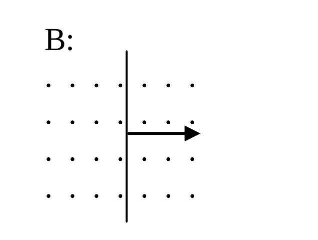
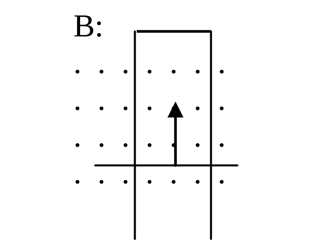
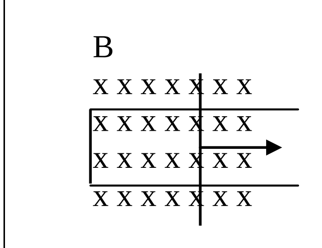
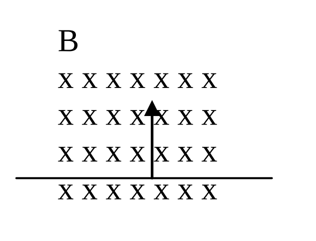
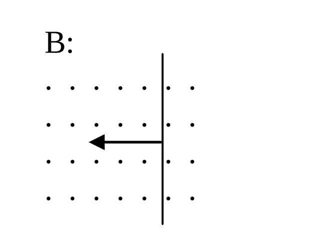
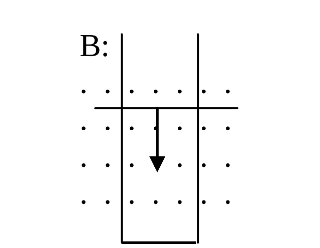
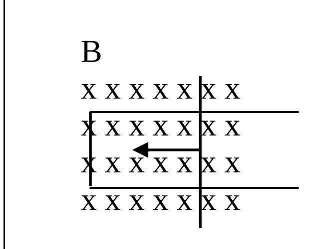
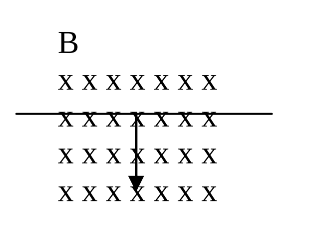
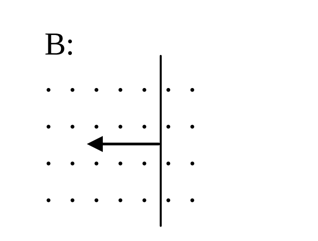
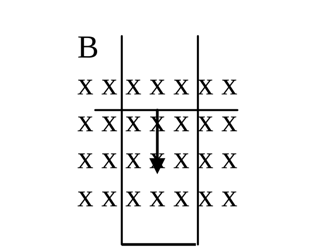
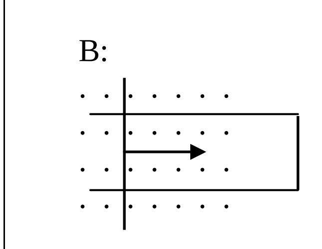
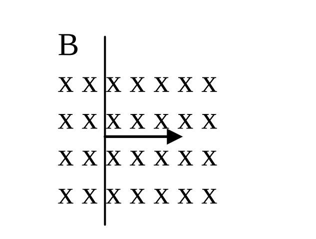
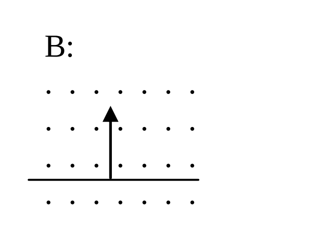
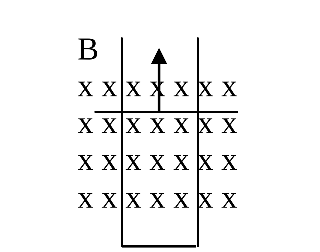
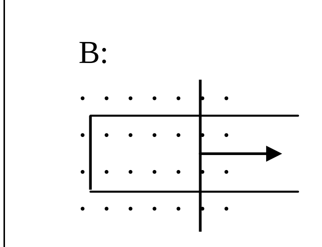
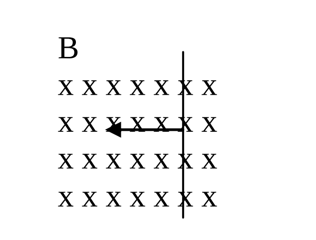
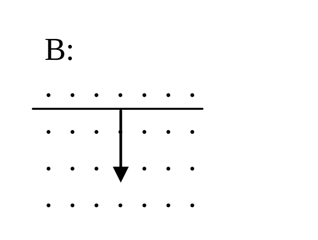
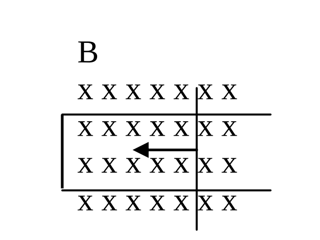
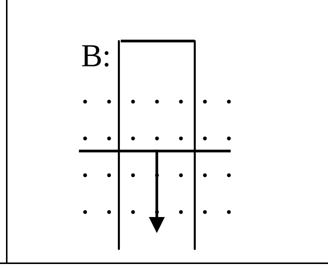
2. The first two are loops where we change magnetic field. Lenz's law says that the current induced flows in a direction so as to oppose the change in flux. So if flux **decreases**, you **replace** it, and if flux **increases**, you **oppose** it. Remember, that CW current creates flux into the page. (Rt-hand rule for magnets and loops), and ACW current creates flux out of the page. The second two have to do with the current induced in a solenoid (or coil) flowing in such a way as to also oppose the motion of the magnet. (i.e. the work the magnet does becomes electrical energy) So as the magnet approaches, the current will flow in the coil in such a way as to make the coil a magnet that either **repels** an **incoming** magnet, or **attracts** a **receding** magnet.

B decreases (acw) 	**B increases (acw)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↓)** 
B increases (cw) 	**B increases (acw)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 
B increases (acw) 	**B decreases (acw)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↓)** 
B decreases (cw) 	**B decreases (acw)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↑)** 
B decreases (cw) 	**B increases (cw)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↓)** 	**The magnet moves as shown. Which way does the current flow on the front of the coil? (↓)** 

3. For the first two, the loops with no arrow are in the magnetic field of a wire, so use the wire right hand rule to figure out the direction of that field. For the second two, current in the loop with no arrow is responding to the B-field created by the arrowed loop. Inner and outer work pretty much the same way. Lenz's law says that the current induced flows in a direction so as to oppose the change in flux. So if flux **goes away**, you **replace** it, and if flux **increases**, you **oppose** it. Remember, that CW current creates flux into the page, and ACW current creates flux out of the page.



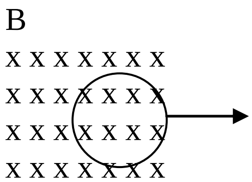
4. These are moving conductor questions. Use the right hand rule for particles for the first two. (Figure out the force on a positive charge riding the wire - Index finger in the direction it is moving, middle in the direction of B, and thumb is the direction of the + end, or the direction + charge would move) For the second two the bar slides, and the "u" shaped conductor is understood to remain stationary. For these, you can use the same rule, or you can use increasing flux is opposed, and decreasing is replaced.

Which end of the wire is +? (left) 	**Which end of the wire is +? (bottom)** 	**CW or ACW? (acw)** 	**CW or ACW? (acw)** 
Which end of the wire is +? (left) 	**Which end of the wire is +? (top)** 	**CW or ACW? (acw)** 	**CW or ACW? (cw)** 
Which end of the wire is +? (right) 	**Which end of the wire is +? (top)** 	**CW or ACW? (cw)** 	**CW or ACW? (acw)** 
Which end of the wire is +? (top) 	**Which end of the wire is +? (right)** 	**CW or ACW? (acw)** 	**CW or ACW? (cw)** 
Which end of the wire is +? (bottom) 	**Which end of the wire is +? (left)** 	**CW or ACW? (cw)** 	**CW or ACW? (cw)** 

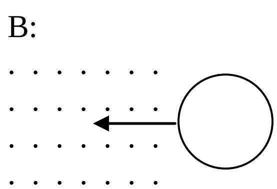
P 21.1

5. These are the Faraday's Law questions on the bottom of the page on SA 21.1
Use emf = $N\Delta BA/t$.

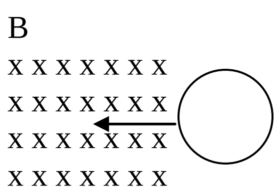
a. The 13.0 cm diameter loop below has 13 windings and is pulled from the 4.10 T magnetic field in 0.0170 s. What is the average EMF, and what direction does the current flow ? (41.6 V, CW)



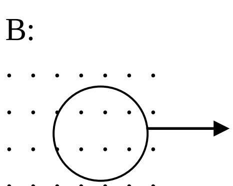
b. The 11.0 cm diameter loop below has 27 windings and is put into the magnetic field in 0.0110 s. The average EMF is 5.20 V. What is the magnitude of the magnetic field, and which way does the current flow? (0.223 T, CW)



c. The loop below is put into the 6.30 T magnetic field in 0.0120 s generating an average EMF of 93.0 V. What is the diameter of the 67 winding loop and which direction does the current flow? (5.80 cm, ACW)



d. The 15.0 cm diameter loop below has 12 windings is pulled from the 7.20 T magnetic field generating an average EMF of 67.0 V. What time did this take, and which direction did the current flow? (0.0228 s, ACW)



e. The 16.0 cm diameter loop below has 42 windings is pushed into the 8.70 T magnetic field in 0.0140 s. What is the average EMF, and what direction does the current flow? (525 V, ACW)