29-7. Note: we calculated the flux in this situation in class 8-5.

(a) Right hand rule gives direction of $\vec{\mathbf{B}}$: into page.

$$B = \frac{\mu_0 I}{2\pi r}$$

(b) In order to have a positive flux, $\vec{\mathbf{B}} \| \vec{\mathbf{A}}$ which requires a clockwise loop.

$$d\Phi_B = B \cdot dA = \frac{\mu_0 I}{2\pi r} \, Ldr$$

(c)

$$\Phi_B = \int B \cdot dA = \int_a^b \frac{\mu_0 I}{2\pi r} \, Ldr = \frac{\mu_0 IL}{2\pi} \int_a^b \frac{dr}{r} = \frac{\mu_0 IL}{2\pi} \ln(b/a)$$

(d)

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -\frac{\mu_0 \frac{dI}{dt} L}{2\pi} \ln(b/a)$$

(e) The negative value for $\mathcal{E}$ indicates current will flow counterclockwise. Lenz's Law produces the same result.

$$\mathcal{E} = -\frac{\mu_0 \frac{dI}{dt} L}{2\pi} \ln(b/a) = -\frac{4\pi \times 10^{-7} \cdot 9.6 \cdot 0.24}{2\pi} \ln(36/12) = -5.06 \times 10^{-7} \text{ V}$$

29-10. In both cases (a) and (c) there is no changing flux so zero emf.

(b) We can calculate either the motional emf due to the one wire still in the field: $\mathcal{E} = vBL$, or recognize that the area of the loop experiencing a magnetic field is decreasing at a rate: $dA/dt = -Lv$ so the flux is decreasing $d\Phi_B/dt = -BLv$. Either way the induced emf is:

$$\mathcal{E} = vBL = 0.02 \cdot 1.25 \cdot 0.4 = 0.0100 \text{ V}$$

This emf will produce a clockwise current.

29-17. For each case we need to know $\Delta\vec{\mathbf{B}}$ at the location of coil B.

(a) Initially $\vec{\mathbf{B}}$ is to right, when the switch is opened the field will be reduced; $\Delta\vec{\mathbf{B}}$ is to left. In order to fight that change the current through the resistor must flow from a to b.

(b) Initially $\vec{\mathbf{B}}$ is to right, as coil B moves left the field will strengthen; $\Delta\vec{\mathbf{B}}$ is to right. In order to fight that change the current through the resistor must flow from b to a.

(c) Initially $\vec{\mathbf{B}}$ is to right, reducing R will increase the current through coil A and the field will strengthen; $\Delta\vec{\mathbf{B}}$ is to right. In order to fight that change the current through the resistor must flow from b to a.

29-24. $\mathcal{E} = vBL$; 0.5 G=0.5×10^{-4} T

(a) too small

$$\mathcal{E} = vBL = 180 \text{ mi/hr} \cdot \frac{0.4470 \text{ m/s}}{1 \text{ mi/hr}} \cdot 0.5 \times 10^{-4} \cdot 1.5 = 6.03 \times 10^{-3} \text{ V}$$

(b) still pretty small

$$\mathcal{E} = vBL = 565 \text{ mi/hr} \cdot \frac{0.4470 \text{ m/s}}{1 \text{ mi/hr}} \cdot 0.5 \times 10^{-4} \cdot 64.4 = 0.813 \text{ V}$$

old exam #8 A,D