1. MacGyver's loop of radius 0.1m with 500 turns is placed in the earth's nearly uniform magnetic field of 50µT oriented in the figure to the right.

   a) What is the magnetic flux through the loop? Include units [2pt]
   
   \[ \Phi_1 = AB \cos \theta = \pi (0.1)^2 \times (50\mu) \times \cos(0) = 1.57 \mu \text{Wb} \]

   b) The loop is rotated from 0 (left diagram) to slanted downward at 45 degrees (right diagram) over 2 seconds. What is the induced emf? Include units [4pts]

   \[ \text{emf} = -N \frac{\Delta \Phi}{\Delta t} = -500 \frac{1.57 \mu \text{Wb} (1 - \cos(45))}{2} = 114 \mu \text{V} \]

2. Lenz’s law states (choose one) [2pt]:

   a) A steady current can create a steady induced magnetic field.

   b) **An induced magnetic field always attempts to restore the original magnetic field.**

   c) Induced emf is always positive.

   d) Magnetic flux is always positive.
3. You find MacGyver's coil of wire (from 1) and bring a bar magnet near its center.

   a) In what direction does the current flow in the coil if the magnet's 'south' side is facing the coil and is brought near the center? (clockwise or counterclockwise from the magnet). [2pt]

   **Clockwise**

   b) If the magnet is turned parallel to the coil before it is brought near the center (as the figure) will more or less current flow than before? [2pt]

   *Much less to zero. Only the slight fringing fields can contribute, and then only if the magnet is off-center.*

4. Which of the following statements is NOT true. Explain why. [3pts]

   a) A changing magnetic field can induce a current in nearby circuits.

   b) A changing current can induce a magnetic field in neighboring circuits.

   c) A changing angle between a magnetic fields and a coil can induce current in the coil.

   **d) Changing magnetic fields always produce a positive induced emf.**

   *Induced emf may be positive or negative depending on the changing flux that created it. induced emf always generates a B field which attempts to restore the change in magnetic field.*