Practice for 21.2 - Faraday's Law

1. a. The approach of the South pole of a magnet from above the page changes the magnetic field from 0.125 T out of the page, to 1.60 T out of the page in 0.0260 s inside this 0.450x0.450 m square. What current flows in what direction (CW or ACW) if the loop has a resistance of 0.850 Ω? (EMF = 11.5 V, I = 13.5 A, CW)
b. A loop of wire with a radius of 0.430 m starts at an angle of 75.0^o with the page, and is rotated to the plane of the page. If there is a 6.95 T magnetic field into the page, and the rotation takes 0.00500 s, what is the average EMF generated? Which way does it flow? (598 V, ACW)
c. A vertical wire in the plane of the page traveling to the right is moving at 1.05 m/s through a 7.24 T magnetic field out of the page. What is its length if there exists a potential of 4.72 V from one end to the other? Which end is positive, the top or the bottom? (0.621 m, bottom)
d. A transformer has 3800. primary windings, and 550. secondary windings. What is the voltage in the primary if there is a voltage of 72.6 V (AC) in the secondary? What is the secondary current if the primary is 120. mA? (502 V, 829 mA or 0.829 A)
e. If you transmit 1500. W of power at 800. VAC, how much power is lost if the lines have a resistance of 4.10 Ω? (14.4 W)

2. a. The motion of the North pole of a magnet from above the page changes the magnetic field in 0.0340 s inside this 0.630x0.630 m square. A current of 3.40 A flows CW in the loop with a resistance of 0.530 Ω, so how large was the change in magnetic field, and did the magnet approach the page, or recede? (0.154 T, magnet receded)
b. A loop of wire with a radius of 0.900 m is in the plane of this page, and is rotated so that the loop forms a 42.0^o angle with the page. If there is a 5.73 T magnetic field into the page, and this generates an EMF of 16.7 V, in what time did the loop undergo the rotation, and which way did the current flow? (CW or ACW) (0.224 s, CW)
c. A vertical wire in the plane of the page is 2.86 m long, and is traveling to the left at 16.0 m/s through a magnetic field perpendicular to the page. There exists a potential of 19.2 V between one end and the other. The top is positive. What is the magnitude of the magnetic field, and is it into or out of the page? (0.420 T out of page)
d. You want to step 120. VAC down to 24.0 VAC with a transformer. What should be the number of primary windings if you have 1300. secondary windings? What is the secondary current if the primary is 180. mA? (6500 windings, 900. mA or 0.900 A)
e. If you wanted to transmit 1400. W of power over 4.20 Ω power lines, what voltage would you need to use to waste only 1.70 W? (2.20×10^3 V)

3. a. The motion of the North pole of a magnet from above the page changes the magnetic field by 4.20 T in 0.0210 s inside this square. A current of 8.60 A flows ACW in the loop with a resistance of 0.930 Ω, so what is the area of the loop in m^2, and did the magnet approach or recede? (0.0400 m^2, or 20 cm on a side, magnet approached)
b. A loop of wire is in the plane of this page, and is rotated so that the loop forms a 78.0^o angle with the page. If there is a 4.92 T magnetic field into the page, and the rotation takes 0.0180 s, and there is an EMF of 56.2 V generated, what is the radius of the loop, and what is the direction of the current flow, CW or ACW? (0.287 m, CW)
c. A horizontal wire in the plane of the page wire is 6.05 m long and is traveling down the page through a 2.64 T magnetic field out of the page. What is its speed if there exists a potential of 21.7 V from one end to the other? Which end is positive, the right, or left? (1.36 m/s, left side)
d. A transformer has 340. primary windings, and 8900. secondary windings. What is the voltage in the primary if there is a voltage of 343 V (AC) in the secondary? What is the primary current if the secondary is 130. mA? (13.1 V, 3.40 A or 3403 mA)
e. You transmit 18,000. W of power at 12,300 VAC and waste only 2.30 W. What is the resistance of your transmission lines? (1.07 Ω)

4. a. The motion of the South pole of a magnet from above the page changes the magnetic field by 5.20 T inside this 0.420x0.420 square. A current of 5.10 A flows CW in the loop with a resistance of 0.530 Ω, so how much time did the magnet take to move, and did it approach or recede? (0.339 s, magnet approached)
b. A loop of wire with a radius of 0.320 m starts at an angle of 60.0^o with the page, and is rotated to the plane of the page. If there is a voltage of 23.1 V making current go clockwise, and the rotation takes 0.0520 s, what is the magnetic field (assume it is perpendicular to the page), and which way is it, into or out of the page? (7.47 T, out of the page)
c. A horizontal wire in the plane of the page is traveling up the page at 5.29 m/s through a 3.03 T magnetic field into the page. What is its length if there exists a potential of 9.00 V from one end to the other? Which end is positive, the right or the left? (0.561 m. left side)
d. You want to step 120. VAC down to 5.00 VAC with a transformer. What should be the number of secondary windings if you have 5600. primary windings? What is the primary current if the secondary is 170. mA? (233 windings, 3403 mA or 3.40 A)
e. You are wasting 1.10 W of power, when you transmit at 13,400 VAC on 1.60 Ω transmission lines. What is your transmitted power? (11,100 W)

5. a. The recession of the North pole of a magnet from above the page changes the magnetic field from 7.30 T into the page, to 1.60 T into the page in 0.0160 s inside this 0.530x0.530 m square. What current flows in what direction (CW or ACW) if the loop has a resistance of 0.150 Ω? (667 A, CW)
b. A loop of wire with a radius of 0.310 m starts at an angle of 57.0^o with the page, and is rotated to the plane of the page. If there is a 2.74 T magnetic field into the page, and the rotation takes 0.0540 s, what is the average EMF generated? Which way does it flow? (6.98 V, ACW)
c. A vertical wire in the plane of the page is 6.19 m long, and is traveling to the left at 67.1 m/s through a magnetic field perpendicular to the page. There exists a potential of 12.7 V between one end and the other. The top is positive. What is the magnitude of the magnetic field, and is it into or out of the page? (0.0306 T, out of the page)
d. A transformer has 170. primary windings, and 4500. secondary windings. What is the voltage in the primary if there is a voltage of 645 V (AC) in the secondary? What is the primary current if the secondary is 190. mA? (24.4 V, 5029 mA or 5.03 A)
e. If you transmit 1800. W of power at 10,200. VAC, how much power is lost if the lines have a resistance of 2.10 Ω? (0.0654 W)