Chapter 23 Solutions – Problems 1, 3, 6, 7, 9, 13, 17, 19, 23, 25, 27, 30

1. The angle of importance is between a vector perpendicular to the plane of the board (called the normal to the plane of the board) and a vector parallel to the magnetic field, as shown in Fig. 23.5 of the text. As you can see from the picture, the perpendicular component of **B** is *B*cos(theta). This is exactly the angle given in the problem. a) When theta is 0^o, the flux is its maximum value BA = (0.150 T)(0.06 m^2) = 0.009 Wb. b) When theta is 90^o , there is no flux because the field "sees" the board edgewise. c) When theta is 40^o, the flux is less than its maximum value by the factor cos(40^o). Flux = (0.009 Wb)cos(40^o) = 0.0069 Wb.

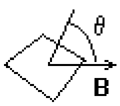
3. Notice that the angle 67^o given in the problem is with respect to the surface of the tabletop and is called the dip angle. The angle that corresponds to the theta of problem 1 is not 67^o, but rather its complement, 23^o. Therefore

   flux = (3.14 x 0.2^2) (0.58 x 10^{-4} T)cos(23^o) = 6.7 x 10^{-6} Wb.

6. The picture shows the setup for the question. The field is along the *x* axis, and the orientation of the loop is defined by the line perpendicular to the plane of the loop (the normal). The angle between this normal and the magnetic field vector is theta. Notice that when the angle theta is 0^o the flux is its maximum value of BA. As theta increases from 0^o, the flux is reduced until it reaches zero at theta = 90^o.

   a. For an angle shift of 0^o to 60^o:
   flux change is (0.020 T)(0.0040 m^2)(cos 60^o – cos 0^o) = – 4 x 10^{-5} Wb.

   b. For an angle shift of 30^o to 40^o:
   flux change is (0.020 T)(0.0040 m^2)(cos 40^o – cos 30^o) = – 8.0 x 10^{-6} Wb.

7. This question is an application of Faraday's Law, E_{ind} = – N(change in flux)/(time interval). The negative sign has to do with the direction of the induced voltage and as a result the direction of the induced current. **<u>I recommend that you forget about the negatve sign in Faraday's law and just use Lenz's law to determine the direction of the induced current!</u>** This means to regard the Faraday law to find the magnitude of the induced voltage.

   a. Assuming N = 1 and a 0.5 s time interval in case a) of the previous problem, the magnitude of the induced emf is
   E_{ind} = (4 x 10^{-5} Wb)/(0.5 s) = 8 x 10^{-5} V.
   b. For the case b) in the previous problem, the magnitude of the induced emf is
   E_{ind} = (8 x 10^{-6} Wb)/(0.5 s) = 1.6 x 10^{-5} V.