PHY 102   Homework Answers 9

Lecture 7

1.   The wingspan (tip to tip) of a Boeing 747 jetliner is 59 m. The plane is flying
        horizontally at a speed of 220 m/s. The vertical component of the earth's magnetic
        field is 5.0 x 10^{-6} T. Find the emf induced between the wing tips.

This is a motional emf problem
Emf = vBL = 220 m/s x 5.0 x 10^{-6} T x 59 m
Emf = 0.0649 volts

2.   A magnetic field has magnitude of 0.078 T and is uniform over a circular surface
        whose radius is 0.10 m. The field is oriented at an angle of ▯ = 25^0 with respect to
        the normal to the surface. What is the magnetic flux through the surface?

Flux = BAcosθ
Flux = 0.078 x πr^2 x cos25
Flux = 0.078 x π(0.10)^2 x cos25
Flux = 0.00222 Weber

3.   In 1996, NASA performed an experiment called the Tethered Satellite experiment.
        In this experiment a 2.0 x 10^4 m length of wire was let out by the space shuttle
        Atlantis to generate a motional emf. The shuttle had an orbital sped of 7.6 x 10^3
        m/s. The magnitude of the earth's magnetic field at the location of the wire was
        5.1 x 10^{-5} T. If the wire had moved perpendicular to the earth's magnetic field,
        what would have been the motional emf generated between the ends of the wire?

emf = vBL = 7.6 x 10^3 x 5.1 x 10^{-5} x 2.0 x 10^4
emf = 7752 volts

4.   A spark can jump between two non-touching conductors if the potential difference
        between them is sufficiently large. A potential difference of approximately 940 V
        is required to produce a spark in an air gap of 1.0 x 10^{-4} m. How fast would a 1.3-
        m rod have to be moving in a magnetic field of 4.8 T to cause a spark to jump
        across the gap?

emf = vBL
940 = v(4.8)(1.3)
v = 940 / 4.8 / 1.3 = 151 m/s