IB Physics - Electromagnetic Induction. Name _____
(Show all work to get underscored answers.)

Equations: Magnetic Flux, $\Phi = BA\cdot\cos(\theta)$ Induced Emf in a wire: $\mathcal{E} = BLv\cdot\sin(\theta)$ Ohm's Law: $\mathcal{E} = IR$

Induced Emf in a coil: $\mathcal{E} = -N\cdot\Delta\Phi/\Delta t = -N\cdot\Delta(BA\cdot\cos(\theta))/\Delta t$ Transformers: $P_P = P_S$ $V_P\cdot I_P = V_S\cdot I_S$ $V_P/V_S = N_P/N_S$

1. A coil is wrapped with 300 turns of wire on the perimeter of a circular frame (radius = 8.0 cm). Each turn has the same area, equal to that of the frame. A uniform magnetic field is turned on perpendicular to the plane of the coil. This field changes at a constant rate from 20 to 80 mT in a time of 20 ms. What is the magnitude of the induced emf in the coil?
   a. 24 V **b.** 18 V **c.** 15 V **d.** 10 V **e.** 30 V

2. A square coil (length of side = 24 cm) of wire consisting of two turns is placed in a uniform magnetic field that makes an angle of 60° with the plane of the coil. If the magnitude of this field increases by 6.0 mT every 10 ms, what is the magnitude of the emf induced in the coil?
   a. 55 mV **b.** 46 mV **c.** 50 mV **d.** 60 mV **e.** 35 mV

3. A 20-cm length of wire is held along an east-west direction and moved horizontally to the north with a speed of 3.0 m/s in a region where the magnetic field of the earth is 60 μT directed 30° below the horizontal. What is the magnitude of the potential difference between the ends of the wire?
   a. 36 μV **b.** 18 μV **c.** 31 μV **d.** 24 μV **e.** 21 μV

4. A metal blade spins at a constant rate of ω = 5.0 revolutions per second about a pivot through one end of the blade. This rotation occurs in a region where the component of the earth's magnetic field perpendicular to the blade is 30 μT. If the blade is 60 cm in length, what is the magnitude of the potential difference between its ends? (Recall that 1 rev. = 2π rad. and $v = \omega\cdot r$)
   a. 0.24 mV **b.** 0.20 mV **c.** 0.17 mV **d.** 0.27 mV **e.** 0.34 mV

5. A transformer steps down a primary voltage of 120 V to 5.0 V to charge a cellphone battery. The battery then supplies power of 1.0 W to the phone. There are 2300 turns of fine wire in the primary coil of the transformer. Calculate the following:

(i) the number of turns in the secondary coil. **a.** 85 **b.** 96 **c.** 124 **d.** 148

(ii) the current in the secondary coil. **a.** 0.24 A **b.** 0.20 A **c.** 0.17 A **d.** 0.27 A