25 Electromagnetic Induction

Solutions to Chapter 25 Exercises

4. The magnetic field of the iron core adds to the magnetic field of the coil, as stated in the answer to the previous exercise. Greater magnetic field means greater torque on the armature.

9. As in the previous answer, eddy currents induced in the metal change the magnetic field, which in turn changes the ac current in the coils and sets off an alarm.

20. The electromagnet is ac, which means a continually changing magnetic field in the copper ring. This induces a current in the ring, which then becomes its own electromagnet, which is continually repelled by the large electromagnet. The force of repulsion equals the weight of the ring, producing mechanical equilibrium.

23. Induction occurs only for a *change* in the intercepted magnetic field. The galvanometer will display a pulse when the switch in the first circuit is closed and current in the coil increases from zero. When the current in the first coil is steady, no current is induced in the secondary and the galvanometer reads zero. The galvanometer needle will swing in the opposite direction when the switch is opened and current falls to zero.

25. A transformer requires alternating voltage because the magnetic field in the primary winding must change if it is to induce voltage in the secondary. No change, no induction.

30. The name of the game with E & M is *change*. No change, no induction. Alternating current changes direction, normally at 60 Hz.

39. As the magnet falls, it induces current that circles in the conducting pipe and is accompanied by its own magnetic field. The moving magnet is slowed by interaction with this induced field.

Chapter 25 Problem Solutions

1. If power losses can be ignored, in accord with energy conservation, the power provided by the secondary is also **100 W**.

2. (a) From the transformer relationship,

$$\frac{\text{Primary voltage}}{\text{primary turns}} = \frac{\text{secondary voltage}}{\text{secondary turns}},$$

$$\text{secondary voltage} = \frac{\text{Primary voltage}}{\text{primary turns}} \times \text{secondary turns} = \frac{12\text{V}}{50} \times 250 = \mathbf{60\ V.}$$

(b) From Ohm's law, current $= \frac{V}{R} = \frac{60\text{V}}{10\Omega} = \mathbf{6\ A.}$

(c) Power supplied to the primary is the same as the power delivered by the secondary; Power = current × voltage = 6A × 60V = **360 W.**