**Worksheet 8.1**

1. A 25.0 cm solenoid has 1800 loops and a diameter of 3.00 cm. Calculate the magnetic field in the air core of the solenoid when a current of 1.25 A is flowing. (1.13x10-2T)

2. An air core solenoid is 25 cm long and carries a current of 0.72 A If the magnetic field in the core is 2.1x10-3T how many turns does this solenoid have? (580)

3.An air core solenoid is 30.0 cm and has 775 turns. If the magnetic field in the core is 0.100 T what is the current flowing through this solenoid? (31 A)

4. What is the magnetic field near the centre of a .30m long solenoid that has 800 turns of wire if it carries a electric current of 2.0 A? (6.7x10-3T)

**Worksheet 8.3**

1. A proton traveling vertically at a speed of 2.10x105 m/s through a horizontal magnetic field experiences a magnetic force of 9.50x10-14 N what is the magnitude of the magnetic field? (2.83 T)

 2. A copper wire (l = 0.222m) carries conventional current of 0.960A a north through a magnetic field (B=7.50x10-4T) that has directed vertically upward what is the magnitude and direction of the magnetic force acting on the wire?

(1.60x10-4 N East)

3.Calculate the magnitude and the direction of the magnetic force on an electron traveling north at a speed of 3.52x105 m/s through a vertically upward magnetic field of 2.80x10-1T. (1.58x10-14N West)

4. Calculate the magnitude and the direction of the magnetic force on an alpha particle traveling south at a speed of 7.40x104 m/s through vertically upward magnetic field of 5.50T. (1.30x10-13 N West)

5. Calculate the magnitude and the direction of the magnetic field that produces a magnetic force of 1.70x10-14N East on a proton that is traveling 1.90x104 m/s North through the magnetic field. (5.59 T up)

6. An electron experiences an upward force of 7.1x10-14N when it is traveling 2.7x105m/s south through a magnetic field what is the magnitude and direction of the magnetic field? (1.6 T West)

7. Calculate the magnitude and the direction of the magnetic force on an alpha particle traveling upward at a speed of 2.11x105 m/s through a magnetic field that is directed down. (0)

8. A wire in the armature of an electric motor is 2.50x10-1m long and is perpendicular to a magnetic field of 5.00x10-1T Calculate the magnetic force on the wire when it carries a current of 3.60 A. (4.50x10-1)

9. An electron is accelerated from rest by a potential difference of 1.70x103V and then enters a magnetic field of 2.50x10-1T moving perpendicular to it what is the magnitude of the magnetic force acting on the electron?

 (9.77x10-13 N)

10. An electron is accelerated by a potential difference and then travels perpendicular through a magnetic field of 7.20x10-1T where it experiences a magnetic force of 4.1x10-13N. Assuming this electron starts from rest through what potential differences is the electron accelerated? (3.6x101 V)

11. Calculate the downward acceleration of an electron that is traveling horizontally at a speed of 6.20x105 m/s perpendicular to a horizontal magnetic field of 2.30x10-1 T. (2.50x1016m/s2)

12. An alpha particle travel through a magnetic field of 4.22 X 10-1 T perpendicular to the field. If the radius of the arc of the deflected particles is 1.50x10-3 m what is the speed of the particles? (3.05x104 m/s)

13. A proton travels through a magnetic field at a speed of 5.40x105 m/s perpendicular to the field. If the radius of the arc of the deflected proton is 7.20x10-3 m what is the magnetic field strength? (7.83x10-1 T)

14. Calculate the charge to mass ratio of a particle that is traveling 3.60x105 m/s and is deflected in an arc with a radius of 7.40x10-2 m as it travels through a perpendicular magnetic field of 6.10x10-1 T. (7.98x106 C/kg)

15. Alpha particles travel undeflected through magnetic and electric fields that are perpendicular to each other. The speed of the alpha particles is 7.80x105 m/s and the strength of the magnetic field is 2.20x10-1 T Assuming that the alpha particles are traveling perpendicular to these fields what is the strength of the electric field? (1.72x105 N/C)

16. Positive charged particles travel undeflected through magnetic and electric fields that are perpendicular to each other. The magnetic field strength is 6.50x10-1 T and the strength of the electric field is 2.10x105 N/C assuming the charged particles are traveling perpendicular to these fields what is the speed of the charged particles?

(3.23x105 m/s)

17. Alpha particles travel through a magnetic field of 3.60x10-1 T and are deflected in an arc with a radius of 8.20x10-2m. Assuming the alpha particles are traveling perpendicular to the field what is the energy of each alpha particle.

(6.71x10-15 J)

18. In a CRT electrons are accelerated from rest by a potential difference of 2.50x103 V. What is the maximum speed of the electrons? (2.96x107 m/s)

19. In a CRT electron reaches a maximum speed of 4.75x107 m/s if this electron is accelerated from rest what is the potential difference across the tube? (6.42x103V)

20. In a CRT electrons are accelerated from rest by a potential difference of 1.40x103V These electrons enter a magnetic field with a strength of 2.20x10-2 T Assuming the electrons are traveling perpendicular to the field what id the radius of the arc of the deflected electrons? (5.74x10-3m)

21. Electrons are accelerated form rest in a CRT. These electrons now pass through a magnetic field of 1.40 x 10-2 T and through an electric field of 4.20x105 N/C. The fields are perpendicular to each other the electron are no deflected assuming the electrons are traveling perpendicular to these fields what is the potential difference across the CRT?

(2.56x103 V)

22. A negatively charged particle with a mass of 8.4x10-27 kg is traveling at a velocity of 5.6x105 m/s perpendicularly through a magnetic field of 2.8x10-1 T If the radius of the path of the particle is 3.5 cm how many excess electrons does this particle carry? (3)

23. Alpha particles travel at a speed of 3.00x106 m/s through a magnetic field. If the magnetic field strength is 4.2x10-2 T what is the radius of the path followed by the alpha particles when the magnetic field is parallel to the direction the alpha particles travel? (no deflection)

24. A proton moves through a 0.75 T magnetic field in a circle with a radius of 0.30m what is the momentum of this proton? (3.6x10-20 kg\*m/s)

25. Electrons are accelerated from rest through a potential difference these electrons are than deflected along an arc of radius 0.77m when they travel through a 2.2x10-4 T magnetic field. What is the accelerated voltage? (2.5x103V)

26. An ion with a charge to mass ratio of 1.10x104 C/kg travels perpendicular to magnetic field (B=9.10x10-1 T) in a circular path (r=0.240 m) How long does it take the ion to complete one revolution? (6.28x10-4 s)

**Worksheet 8.4**

1. A magnetic field (B=3.2x10-3 T) passes perpendicular through a circular loop of wire (radius = 5.0 cm). What is the magnetic flux through the loop? (2.5x10-5 Wb)

2. A circular coil (200 turn radius of 6.0 cm) is rotated in a uniform magnetic field (B = 3.6x10-4 T) At t = 0 the coil is perpendicular to the field and at t = 0.015s the coil is parallel to the field what is the average emf induced in the coil?

(5.4x10-2 V)

3. A square loop of wire with an area of 2.5x10-3 m2 is perpendicular to a uniform magnetic field (B = 2.2x10-2 T).If the square collapsed to an area of essentially 0 m2 in a time of 0.100 s as shown in the diagram what is the average induced emf as it is collapsed and what is the direction of the induced current? (Remember to use conventional current) (5.5x10-4 V clockwise)

X X X X

X X X X

X X X X

X X X X

X X X X

X X X X

X X X X

X X X X

4. Find the average emf induced in a circular coil (50 turns radius of 0.050 m) if the magnetic flux through the loops is changing at a rate of 15.0 Wb/s? (750 V)

5. A square coil (100 turns area of each square loop = 4.0x10-3m2) is perpendicular to a uniform magnetic field. When the coil is rotated through 90o in 0.12 s, the average induced emf is 0.92 V. What is the magnetic field strength?

 (2.8 x 10 –1 T)

6. A circular coil (10 turns, diameter = 25 cm) is placed perpendicular to a uniform magnetic field (B = 2.7 x 10-3 T). If the direction of the magnetic field is reversed in 0.30s, what is the average emf induced in the coil? (8.8 x 10-3 V)

7. A magnet is quickly removed from a circular coil (25 turns, area = 5.0 x 10-3 m2) changing the magnetic field within the coil at a rate of 0.40 T/s. What is the average emf induced in the coil? (5.0 x 10-2 V)

8. A square loop of wire (area= 7.2 x 10-3 m2) has a resistance of 12.0Ω. Assume that the magnetic field drops uniformly from 1.6 T to zero in 0.050 s as the loop is pulled from the magnetic field.

**. . .**

**. . .**

**. . .**

1. What is the average emf induced in the loop? (2.3 x 10-1 V)
2. What is the current induced in the loop? (1.9 x 10-2 A)
3. What is the direction of the **electron flow** in the loop? (clockwise)

9. A square loop of wire (4.0 cm per side) is placed in a magnetic field (B= 0.20 T).

**. . .**

**. . .**

**. . .**

The magnetic field is increased to 0.50 T in 0.30 s.

1. Find the current through the loop if the resistance of the loop is 2.0 Ω. (8.0 x 10-4 A)
2. Find the direction of the **electron flow** through the loop. (counter-clockwise)

## **Worksheet 8.5**

1. A conducting rod 0.35 m long moves perpendicular to a magnetic field (B=0.75 T) at a speed of 1.5m/s calculate the induced emf in the rod . (0.39 V)

2. A conducting rod 0.28 m long moves perpendicular to a magnetic field at speed of 0.80m/s if the induced emf is 0.075 V what is the magnitude of the magnetic field? (0.33 T)

3. The conducting rod in the diagram below is 22.0 cm long and is moving at a speed of 1.25m/s perpendicular to a 0.150 T magnetic field

x x x x

x x x x

x x x x

If the resistance in the circuit is 2.25 ohms what is the magnitude and direction of the current through the circuit?

 (1.83x10-2A counter clockwise)

4. The conducting rod in the diagram below is 15 cm long and is moving at a speed of 0.95 m/s perpendicular to the magnetic field.

**. . . .**

**. . . .**

**. . . .**

If the resistance in the circuit is 1.5 ohms and a current of 5.6x10-2 A is induced in the circuit

a) What is the magnitude of the magnetic field? (0.59 T)

b) What is the direction of the induced current? (counter clockwise)

5. The conducting rod in the diagram below is 30.0 cm long and is moved perpendicular to 0.950 T magnetic field.

x x x x

x x x x

x x x x

If the resistance in the circuit is 3.25 ohms what force is required to move the rod at a constant 1.50 m/s?

(3.75x10-2 N)

6. A plane with a wing span of 6.25 m is flying horizontally at a speed of 95.0 m/s if the vertical component of the Earth’s magnetic field is 4.70x10–6 T what is the induced emf between the tips of the wings? (2.79x10-3 V)

7. The conducting rod in the diagram below is 30.0 cm long and is moving at a speed of 3.00 m/s perpendicular to a 0.600 T magnetic field

**. . . .**

**. . . .**

**. . . .**

If the resistance in the circuit is 2.25 ohms what is the electric energy dissipated in the resistor in 15.0s? (1.94 J)

8. The conducting rod in the diagram below is 1.2 m long and is moving at a speed of 2.5m/s perpendicular to a 0.75 T magnetic field

x x x x

x x x x

x x x x

If the current in the circuit is 0.45 A what is the resistance in the circuit? (5.0 ohms)

9. A conducting rod is 1.0 m long and is moved at a speed of 3.0m/s perpendicular to a 0.95 T magnetic field directed into the page. If the resistance in the circuit is 45.0 ohms how much work is done against the magnetic field in 10s s? (1.8 J)

10. A conducting rod is 0.50m long and is moved at a constant speed perpendicular to a 0.65 T magnetic field. If the resistance in the circuit is 2.9 ohms and the induced current is 5.2x10-2 A what is the speed of the conducting rod?

 (0.46m/s)

11. A rectangle loop of wire is moved at a speed of 1.80m/s perpendicular to a 1.30 T magnetic field as shown below

**. . . .**

**. . . .**

**. . . .**

If the length of the side moving perpendicular to the field is
0.625 m and the resistance in the circuit is 1.50 ohms

a) What is the induced current? (0.975A)

b) What is the direction of the current? (clockwise)

12. A rectangle coil of wire containing 5 loops is moved at a speed of 2.7m/s perpendicular to a 1.1 T magnetic field as shown below

x x x x

x x x x

x x x x

If the length of the side of the coil moving perpendicular to the field is 0.18m

and the resistance in the circuit is 3.5 ohms

a) What is the induced current? (0.76A)

b) What is the direction of the current? (counter-clockwise)

# **Worksheet 8.6**

1. A 120 V DC motor draws 12.0 A when it reaches its full operating speed. If the resistance of the armature of this motor is 6.0 Ω, what is the back emf when it reaches its full operating speed? (48 V)

2. A 120 V motor draws 15.0 A when it reaches its full operating speed and 40.0 A when it is initially turned on. Find.

a) The resistance of the armature. (3.00 Ω)

b) The back emf when it reaches its full operating speed. (75 V)

3. A 120 V motor draws 9.0 A when it reaches its full operating speed. If the resistance of the armature is 5.0 Ω, find.

a) The back emf when the motor is operating at full speed. (75 V)

b) The back emf when the motor is initially turned on. (0 V)

c) The current when the motor is initially turned on. (24 A)

4. The armature of a 120V motor slows down because of an increased load (for example an electric lawn mower enters thick, tall grass). The resistance of the armature is 6.0 Ω, and the current drawn by the motor when operating at full speed is 3.6 A. The current drawn by the motor when the increased load is applied is 8.4 A.

a) Explain why the motor (armature) gets hotter when the increased load slows it down.

b) Explain why the current through the armature increase when the load is increased.

c) What is the back emf when

* + 1. the motor is operating at full speed. (98 V)
		2. the motor slowed down because of the increased load. (70 V)

5. The back emf in a motor is 90.0 V when the armature of the motor is turning at 1000 rev/min. What is the back emf in the same motor when the motor is turning 500 rev/min? (45.0 V)

6. The current drawn by a 120 V motor when the motor is turned on is 10.0 A and 3.0 A when it is operating at its full speed.

a) What is the resistance of the armature? (12.0 ohms)

b) What is the back emf when the motor is operating at full speed? (84 V)

# **Worksheet 8.7**

1) Currents of 0.25 A and 0.95 A flow through the primary and secondary coils of a transformer respectively if there are 1.0x103 turns in the primary coil how many turns are in the secondary coil? (2.6x102)

2) A step-down transformer has coils of 1.20 x 103 and 1.5- x 102 turns. If the transformer is connected to a 1.20 x 102 V power line, and the current in the secondary coil is 5.00 A. what is the current in the primary coil?(0.625 A)

3) Near your home the voltage pf the power line is 3.6 x 103 V. The transformer between your home and the line reduces this voltage to 1.20 x 102 V. If the transformer is to deliver 2.4 x 103 J of energy each second to your house, what is the current in:

1. the primary coil (0.67 A)
2. the secondary coil (2.0x101A)

4) A step-down transformer (Np= 1.50 x 102, NS=25) is connected to a 1.20 x 102 V primary line. If there is a 75Ω electrical device placed in the secondary circuit, what is the current in the primary coil? (4.4x10-2A)

5) If the voltage and current of the primary coil is 1.20 x 102 V and 3.0 A, what is the power delivered to the secondary coil? (3.6x102W)

6) If the power delivered to the secondary coil of a step-up transformer is 5.0 x 101 W from a 1.20 x 102 V power line, what is the current in the primary coil? (0.42 A)

7) A transformer (Np= 5.5 x 102, NS=36) is connected to a 1.20 x 102 V power line. If the current in the primary coil is 1.0 A, what is the power in the secondary coil? (120 W)

8) A 100 W transformer (Ns = 1500) has an input voltage of 9.0 V and an output current of 0.65 A. How many turns are on the primary coil? (88)