

Chapter 20

1. $F = BIL\sin\Theta$. Force/meter = $BI\sin\Theta$
2. $F = BIL\sin\Theta$.
3. Since force is maximum you may assume $\sin\Theta = 90^\circ$.
5. For the maximum force, Θ must = 90° .
7. a) Use the RHR. Fingers point out of the north pole and toward the south.
b) The length of the wire exposed to the magnetic field is that length that passes between the pole faces of the magnet. That length will therefore equal the diameter of the pole faces.
c) $F = BIL\sin\Theta$.
9. $+2e$ means $2(1.6 \times 10^{-19} \text{ C})$ Since the magnetic field is providing centripetal force, set $F_m = F_c$ and solve for F_m .
10. $\Theta = 90^\circ$ and the length of wire exposed to the magnetic = the diameter of the pole faces.
11. For (-) charges use the LHR.
12. Use the RHR for (+) charges.
13. Using the RHR decide what will happen to the e^- if every time it moves forward it is pushed 90° over from its immediate path. Then see the class notes for day #63.
15. Use the LHR. Point your thumb south and your palm (F) up. Where (N, S, E, W) do your fingers point?
20. Set $F_m = F_c$ and solve for velocity. Substitute that equation for velocity in the momentum equation and simplify.
21. Set $F_m = F_c$ and solve for v in terms of the other variables. Substitute that equation for velocity in the KE equation and answer the question.
22. Set $F_m = F_c$ and solve for velocity. Convert to angular velocity and substitute the equation for angular velocity in the momentum equation. For a mass moving in a circular orbit, the moment of inertia is that of a ring. (See figure 8-20 on page 223).

23. This problem will take three steps:
- i) Find the force on the bullet due to the magnetic field. Solve for acceleration.
 - ii) Find the time the bullet it took the bullet to travel the horizontal distance given.
 - iii) Now you have initial velocity in the direction of the deflection, acceleration and time. Choose from VAT, VAX or VATX and solve for distance.
26. Use Ampere's Law (equation 20-5 on page 597).
29. See equation 20-6 on page 598.
54. See equation 20-9 on page 603.
60. $F_m = F_c$. Solve for v in terms of the other variables. To make the paths straight, the electric force must equal the magnetic force. Substitute your equation for velocity in $F_m = qE$. Substitute given numbers and solve for electric field.

Chapter 21

1. Use Faraday's Law on page 586.
2. Use the RHR for induced current. In this case the magnetic field is increasing.
3. Use the RHR for induced current.
4. Removing the loop in 0.15 seconds is the same as rotating it 90° . Either way, the magnetic flux changes from maximum to minimum in the time it takes to either rotate the loop or remove it.
5. $\text{Emf} = -N \Delta\Phi_B / \Delta t$ and when the face of the coil is perpendicular to the field, $\Theta = 0^\circ$. Substitute $BA\cos\Theta$ for $\Delta\Phi_B$ in the first equation, list your variables and solve for Emf.
8. a) If the resistance increases, the current will decrease assuming the voltage remains constant. Use the RHR for magnetic field around a current carrying wire to get the direction of the magnetic field. Then use the RHR for induced current that is increasing to figure out the direction of the current induced in the smaller wire.

b) Do the same as in (a), but place the smaller circle outside the larger one. The direction of the magnetic field should reverse.
9. Use the RHR for magnetic field around a current carrying wire to determine the direction of the magnetic field. Then use the RHR for induced current to figure out the direction of the current in the small circular wire.
10. Use the RHR to find which pole of the electromagnet is the north pole, and then the RHR for induced currents to find the current in the loop.
11. a) Use Faraday's Law on page 624.
b) Use the RHR for induced current.
13. a) To get the direction, use the RHR for decreasing field, because if the diameter of the loop is decreasing, so is the area.
b) Use the derivation of the equation for Emf that includes magnetic field and area. Instead of ΔB , use ΔA to create the change in flux.
15. The induced emf will be due to the movement of the vertical length of wire through the magnetic field, because it is the only part of the wire that crosses magnetic field lines. Calculate the induced current using Ohm's Law and the resistance given. Now use the equation for magnetic force on a wire moving through a magnetic field and solve for force.

18. a) Use the resistivity equation on page 534 to find the resistance of the wire and then Faraday's Law to find the induced emf. Now you have resistance and voltage and can use Ohm's Law to find the induced current.

b) The rate at which thermal energy is produced is another way of saying power.

20. Use equation 21-5 page 593. Since we are solving for the peak output voltage, we can use $\mathcal{E}_{\text{peak}} = NBA\omega$ and solve for N.

23. Use equation 21-5 page 593. Since we are solving for the peak output voltage, we can use $\mathcal{E}_{\text{peak}} = NBA\omega$ and solve for ω (it will be in radians per second) and convert to revolutions per second.

30. You are given the primary and secondary voltage (V_p and V_s) as well as the number of primary windings (N_p). Find N_s .

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

31. You are given the primary and secondary number windings. Using $\frac{V_s}{V_p} = \frac{N_s}{N_p}$, you can

see that the increase or decrease in number of turns is directly proportional to the increase or decrease in voltage. Use the ratio of the number of windings given to determine the ratio of the primary and secondary voltage. Voltage and current are inversely proportional.

$$\frac{V_s}{V_p} = \frac{I_p}{I_s}$$

32. You are given the primary and secondary voltage. Using $\frac{V_s}{V_p} = \frac{I_p}{I_s}$, you can

see that the increase or decrease in voltage is inversely proportional to the increase or decrease in current. Voltage and current are inversely proportional.

36. You are given the number of primary and secondary turns as well as the primary (input) voltage. Use this information to find the secondary voltage. Then use the given input voltage, the secondary voltage you just calculated and the output current given to find the primary or input current.

72. Use the RHR on the left loop to determine the direction of the magnetic field flowing through the right loop. The current changes the instant the switch is thrown and then remains constant until it is turned off.

a) Use the RHR for induced current due to the magnetic field from the left loop.

b) How does the magnetic field change when the current is constant?

c) Use the RHR for induced current.

73. Use Faraday's Law to calculate the induced emf and Ohm's Law to find the current. To find the energy dissipated, use energy = power times time.

Chapter 22

5. For these problems, just remember that these are electromagnetic waves that travel at the speed of light. ($c = 3 \times 10^8$). Now list your variables and solve for λ or f as the problem asks.
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9. Distance = velocity times time. You know the speed of light, change kilometers to meters and solve for time.
11. This is a conversion problem. Either look up the conversion factor for light years and meters, or use 3×10^8 for velocity, 4.2 years (converted to seconds) for time, and solve for distance.
14. Figure 22-10 is on page 622. Use the speed of light and the total distance it must travel to calculate the time for the rotating mirror to make $1/8$ rotation. Angular speed will be in radians per second.
16. Solve for the time it takes sound to travel in air (at 343 m/s) to the person in the balcony. Then solve for the time it will take the radio wave (which is an electromagnetic wave and travels at 3×10^8 m/s) to travel the 3000 km (convert to meters) to the person listening to the radio. Compare the two and answer the questions.
27. You are given frequency and you know speed. Find wavelength.
39. Messages are sent using radio waves, which travel at the speed of light.
 - a) Use Earth – Moon distance to calculate time.
 - b) Use Earth – Mars distance (78×10^9 m) to calculate time.

