Objectives for Physics II

Chapter 18: Electric Current and Electric Resistance

1. Be able to describe what is meant by each term in $V_{a,b} = iR$ and to solve for an unknown in this relationship.
2. Be able to describe the role of the power supply or battery in an electric circuit.
3. Be able to describe what is meant by "emf", including its basic units, and to distinguish it from "terminal voltage," "potential difference" and from "potential."
4. Be able to calculate the energy *received* by any circuit element per second using $P = iV_{a,b}$.
5. Be able to explain why energy is transported via electrical power lines at high potential rather than low potential.
6. Be able to determine how much energy, expressed in both Joules and in kilowatt-hours, a household appliance receives in a typical month. By the way, what happens to this energy, ultimately?

Chapter 19 Objectives

1. In analyzing circuits be able to use the fact that the potential difference between two points connected by copper in a functioning circuit is for all practical purposes equal to zero.
2. Be able to identify resistors in a circuit that are in parallel with each other and that are in series with each other, and to explain how one decides.
3. Be able to solve for all the currents and potentials in resistor circuits.
4. Be able to make a schematic diagram of an electric circuit that includes light bulbs or resistors in series and in parallel and to build it.
5. Be able to state what is meant by "short circuit".
6. Be able to state two practical reasons that household circuits are wired in parallel instead of in series.
7. Be able to describe how "overloading" occurs in household circuits.
8. Be able to describe common household electrical hazards and how to be safe.
9. Be able to describe the role of the small opening, the wider opening, the third, "ground" wire and the GFI on household outlets.

RC Circuits

10. Be able to describe what a capacitor is and what its role is in electric circuits.
11. Be able to list three different changes to features of a capacitor that would increase its capacitance.
12. Be able to calculate the amount of energy stored in a capacitor.
13. Be able to recognize 1) an RC circuit that will charge up its capacitor and 2) an RC circuit that will discharge its capacitor.
14. Be able to explain how to vary R and/or C in order to increase or decrease the amount of time it takes to charge or discharge a capacitor.

Chapter 20: The magnetic field: models of particles and magnetic fields

1. Be able to determine the direction of a magnetic field based upon the direction indicated by a compass.
2. Be able to sketch the magnetic field of bar magnets, of current in a long, straight wire, of current in a single loop, and of a solenoid with magnetic field lines.
3. Be able to use the right hand rule for currents to determine the orientation of magnetic fields created by currents in straight wires, in circular wire loops, and in solenoids.
4. Be able to describe the magnitude and direction of the force exerted by a magnetic field on a charged particle moving through the magnetic field using $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$.
5. Be able to describe the magnitude and direction of the force exerted by a magnetic field on an electric current passing through the magnetic field using $\mathbf{F} = i\mathbf{l} \times \mathbf{B}$.
6. Be able to calculate the radius of the path of a charged particle of known mass, charge, and velocity in a magnetic field of known strength and direction (perpendicular to the particle velocity) or calculate the mass, given the radius, charge and velocity.
7. Be able to describe how a loudspeaker works because of the force exerted by a magnetic field on an electric current.
8. Be able to describe how a motor works because of the force exerted by a magnetic field on an electric current.

Chapter 21: Induction and Alternating Currents

1. Be able to describe and calculate magnetic flux and to identify when it is increasing or decreasing.
2. Be able to describe at least two ways in which magnetic flux can be changed.
3. Be able to use plots of magnetic flux Φ *vs* t to determine induced emf.
4. Be able to calculate the size of the emf and/or the direction of the current induced in a coil of wire as a result of a change in magnetic flux in a specified amount of time.
5. Be able to explain how door bells, credit card readers, and magnetic disks in hard drives exploit emfs induced by changes in magnetic flux.
6. Be able to describe what "eddy currents" are, how they arise, and what effect they have on the motion between conductors and magnets.
7. Be able to describe what alternating current (AC) is and to distinguish it from direct current (DC).
8. Be able to describe how alternating current is produced by generators.
9. Be able to make calculations for ideal transformers using the numbers of windings on primary and secondary coils in raising or lowering alternating emfs. (Why aren't transformers used to change DC emfs?)

Chapter 22: Electromagnetic Waves

1. Be able to describe electromagnetic waves in general terms.
2. Be able to describe what polarized light is by contrasting it with unpolarized light.
3. Be able to describe the orientation of polarization of light after unpolarized light reflects off a horizontal or a vertical surface.
4. Be able to state the direction of polarization of light after it passes through sun glasses and why sun glasses are designed to polarize it that way.
5. Be able to describe how rod antennae and how loop antennae are able to detect EM waves.
6. Be able to list the seven categories of EM waves in order of increasing frequency (decreasing wavelength) and to state uses of each category of EM wave.
7. Be able to state the range of wavelengths of visible light from red to violet.
8. Be able to state the speed of electromagnetic waves to at least three significant figures.
9. Be able to use $c = f\lambda$ to solve for an unknown f or λ.

Chapter 23: Ray model of light, reflection, and refraction

1. Be able to explain how we can determine the location of a source of light with our visual system.

Reflection

2. Be able to describe specular and diffuse reflection.
3. Be able to use the rule for reflection with light rays and mirrors, including identifying the angle in incidence and the angle of reflection.
4. Be able to describe what an image is and why we see it at a specific location.
5. Be able to explain how a plane mirror forms an image of a point source of light using several rays.
6. On a diagram be able to mark the location of an image formed by a plane mirror with respect to the object and the mirror.
7. Be able to describe what the principle axis and the focus of a curved mirror are.
8. Be able to describe how to find the focus of a converging or a diverging mirror using parallel rays.
9. Be able to explain how parabolic reflectors work in transmitters and collectors such as searchlights, satellite dishes, etc.
10. Be able to use the principal, focal, and central rays of light from a specific point on an object to determine the position of its image when formed by a mirror.
11. Be able to describe what a real focus is, what a virtual focus is, what a real image is, and what a virtual image is.
12. Be able to calculate the unknown among f, d_i, and d_o in $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$, noting when the focal length and the image distance is positive or negative.

Refraction

13. Be able to describe what is meant by the angle of refraction.
14. Be able to sketch a diagram that shows a ray of light travel from one material into another material and to label the angle of incidence, the angle of refraction, and to determine which of the two angles will be bigger, given the indices of refraction of the two materials.
15. Knowing the indexes of refraction for two materials, be able to decide whether a ray of light will refract toward or away from the normal as it travels from one material to the other.

16. Be able to determine the index of refraction for a material from the angles of incidence and refraction of a light ray.

17. Be able to explain why refraction occurs according to the wave model.

18. Be able to determine the speed of light in a material given its index of refraction.

19. Be able to state how the frequency of incident light compares to the frequency of light after it is refracted.

20. Be able to determine the wavelength and frequency of refracted light given the indices of refraction of both media and the wavelength of the incident light.

21. Be able to state the conditions under which there will be total internal reflection.

22. Be able to find the critical angle for an appropriate pair of optical materials.

23. Be able to use Snell's Law to describe the relationship between incident and reflected rays.

24. Be able to describe how to find the foci of a converging and diverging lenses using parallel rays.

25. Be able to use the principal, focal, and central rays of light from a specific point on an object to determine the position of its image formed by a lens.

26. Be able to use the Gaussian lens formula, $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$, to determine the position and size of an image and to determine whether the image is real or virtual.

27. Be able to describe how to use a magnifying glass, including the kind of lens needed and the positioning of object, image, and observer.

28. Be able to describe how sunlight disperses in a raindrop and how that can lead to a rainbow.

29. Be able to explain how a prism produces a spectrum.

30. Be able to describe how a rainbow is produced, why we see red on the outside of the bow and violet on the inside, and why no two people see exactly the same bow.

Chapter 24: Wave model of light

1. Be able to describe what we mean by the "phase" of a wave and what it means when two waves are "in phase" and when two waves are "out of phase."
2. Be able to explain how nodes and antinodes come to be in two-source interference.
3. Be able to calculate the wavelength of light from a two-source interference pattern.
4. Be able to explain why light reflected from soap films and oil slicks is colored although the soap films and oil slicks are not colored.

Chapter 30: Nuclear Physics

1. Be able to name who discovered radioactivity, who discovered radium, and who figured out what alpha particles and beta particles are.
2. Be able to describe the forces experienced by a proton in an atomic nucleus, and the same for a neutron.
3. Describe qualitatively the nuclear force experienced by protons and neutrons.
4. Be able to describe alpha particles, beta particles, and gamma rays.
5. Why do alpha particles have such high speeds?
6. Be able to write the nuclear reaction expressions for α, β, and γ decays for nuclides given in this form: ${}^{A}_{Z}\mathrm{X}$.
7. You should be able to describe the penetrating power of α and β particles and γ rays.

Chapter 31: Nuclear Energy

1. Be able to describe nuclear fission in terms of particles and in terms of how we get energy from it.
2. Be able to describe nuclear fusion in terms of particles and in terms of how we get energy from it.