Traditional Physics, Semester Two final exam preparation

The exam: It consists of 140 multiple choice questions split between two days. It covers all of second semester: Electrostatics, Current Electricity, Magnetism, Waves and Sound, Light and Color, and Optics (lenses, mirrors, reflection, and refraction).

Seniors: You will be taking a 50 question multiple choice test on senior finals day. You are exempt from the rest of the exam.

Juniors: You will be taking the 50 question multiple choice test on senior finals day which counts as about 1/3 of your exam grade **AND** a 90 question multiple choice exam on junior finals day which counts as the remaining portion of your exam grade.

We will **not** be providing in-class reviews before senior finals day. However, you have access to this outline of topics and the websites of materials from all of our Traditional Physics teachers.☺ Look around; there's lots of great stuff.

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DrVetrone: http://www.hinsdale86.org/staff/jvetrone/

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Physics Traditional Semester Two Outline of Topics: Electricity and Magnetism and Waves

I. Electrostatics

A. Parts of the Atom

1. location of proton, electron, neutron in atom
2. charge of each particle
3. interaction between particles

B. Methods of charging

1. Friction charging
2. Conduction
3. Induction using grounding

C. Electrostatic Forces

1. Coulomb's Law: $F = k Q q / r^2$ (absolute value)
2. Vector addition via x and y components
3. Requires force diagramfor solving
4. units are Newtons (N)

D. Electric Fields

1. Definition: $E = F / q$, defined in the direction a positive charge would be pushed
2. Electric Field for point source: combine with Coulomb's law to get: $E = k Q / r^2$
3. Vector addition via x and y components
4. Requires force diagram for solving
5. units are Newtons per coulomb (N/C)
6. Field lines
    a. defined in direction a positive would be pushed
    b. show strength of electric field
    c. typical arrangements include single sources, two similar sources, two opposite sources, and parallel plates oppositely charged

E. Electric Potential and Electric Potential Energy

1. Definition of Electric Potential: $V = PE / q$ or $V = W / q$ (either, since Work →→ Potential Energy)
2. Electric Potential Energy for point sources: $PE = k Q q / r$
3. Combine for Potential of point sources: $V = k Q / r$
3. Electric Potential for parallel plates: $V = E d$
4. All energy calculations use scalar addition (just add, keeping signs)
5. units of potential: Volts (V) or Joules per coulomb (J/C)
6. units of potential energy: Joules (J)

II. Current Electricity

A. Schematics (circuit diagrams)

1. typical symbols to know: battery, resistor, ammeter, voltmeter, bulb, switch

A. Voltage (see " electricpotential" above; voltage is potential difference, or $V_f - V_i$)

1. measured by voltmeter set up how?
2. loop rule for voltages
3. voltagesin parallel

B. Current

1. Definition: $I = \Delta Q / \Delta t$
2. know current types: Alternating current (AC) vs Direct Current (DC)
3. units: amp (A) = coulombs per second (C/S)
4. measured by ammeter set up how?

5. junction (node) rule for currents
6. currents in series

C. Resistance
1. units: ohms (Ω)
2. R determined by which physical properties of item
3. resistor codes
a. know how to use given chart of values and colors (don't memorize)
b. know how to translate first three bands
c. Know what fourth band means
3. series circuits
a. $R_{tot} = R_1 + R_2 + ...$
b. know how total resistance compares to individual resistor values
c. know how brightness of each item changes as more items are added in series
d. pros and cons for series circuits
4. parallel resistors:
a. $1/R_{tot} = 1/R_1 + 1/R_2 + \ldots$
b. know how total resistance compares to individual resistor values
c. know how brightness of each item changes as more items are added in parallel
d. pros and cons for parallel circuits

D. Ohm's Law
1. $V = I R$
2. Know which two variables <u>determine</u> the third (the physics, not the math!)
3. Charts used for solving V, I, R problems

E. Power
1. $P = I V$ (two other forms gained by combining with Ohm's Law)
2. what other mechanics equation for power is still true?
3. units: watts
4. connection to brightness
5. changes in power for items added in series
6. changes in power for items added in parallel
7. (theoretical) power rating versus actual power in circuit

III. Magnetism
A. Requirement that MUST be true before there is magnetism
B. Special magnets we know about
1. world's largest magnet
a. know location of north and south magnetic poles
2. world's smallest magnet
a. know connection to why some atoms are magnetic and others are not

B. Magnetic fields
1. symbol is B (we do not use defining equation)
2. units: Tesla (T)
3. know from which pole field lines originate and where they go
4. rules about lines crossing
5. typical magnetic fields to know: single bar, parallel or antiparallel bars, horseshoe, long wire
6. connection between field strength and location of magnet poles or line density
7. relationship between compass direction and magnetic field direction
8. Right Hand Rule #2 – know what thumb and curling fingers mean

B. Permanent magnets
1. two types of poles and their interactions with each other
2. three common elements and one alloy which are magnetic on an atomic level
3. know when permanent magnets are used and why
4. domains and methods of making strong permanent magnets
5. methods of weakening permanent magnets

C. Electromagnets
1. materials needed to make a strong one (and how to put them together)
2. know when electromagnets are used and why
3. magnetic force (Lorenz force)
a. $F = I L B$ versus $F = q v B$
b. know angle needed between moving charge and magnetic field to get a force
c. Right Hand Rule #1 – know what each finger means
d. units: Newtons (N)

4. Induced voltage/emf
a. Faraday's Law: $\varepsilon = - N (\Delta AB) / \Delta t$ note: add $\cos\theta$ term inside parentheses if needed
b. connection to Ohm's Law
c. units: Volts (V)
d. Lenz' law
1. his part of the equation
2. connection to changes in original magnetic field
3. demos with Thompson coil: floating ring, non-floating ring, lighting bulb without a battery, dancing coil
e. non-symmetric relationship between currents and magnetism

IV. Waves and Sound
A. Types of waves (know examples, particle motion vs wave direction, and basic shape)
1. Transverse
a. when a medium is required
b. direction of particle motion vs wave motion
c. classic example: light
1. speed of light: $c = 3 \times 10^8$ m/s
2. forms of light (low frequency to high): radio, microwaves, infrared, ROYGBIV ultraviolet, x-rays, gamma rays
2. Longitudinal
a. when a medium is required
b. direction of particle motion vs wave motion
c. classic example: sound
1. speed of sound in air: $Vsnd = 331.5 + .6(T)$
2. average speed of sound in air: 343 m/s
3. mach speed calculations

B. Parts of a wave (know definitions, be able to locate on a picture, and know units)
1. trough
2. crest
3. node

4. antinode
5. wavelength
    a. symbol is λ
    b. units are meters
6. amplitude (won't be asked to show on longitudinal waves).

C. Wave equation
1. $v = f \lambda$
2. velocity- know what determines the velocity of a wave
3. frequency (not shown on static picture)
    a. $f = 1 / T$
    b. units are hertz
    c. know what determines the frequency of a wave
4. period (not shown on static picture)

D. Δx TNEOM
1. $\Delta x = Vi\Delta t$ (a=0 for waves)
2. Echoes
3. Distance from a storm

E. Sound terms
1. natural frequency
2. frequency of tuning forks and short or long tines
3. forced vibration
4. sympathetic vibration
5. beats
    a. # beats = $f_2 - f_1$
6. resonance

F. Intensity
1. Absolute Intensity
    a. $I = P / (4\pi r^2)$ (Using surface area of a sphere)
    b. units are W/m^2
2. Relative Intensity
    a. use chart to go between I and b
    b. units are decibels (dB)
    c. increase of 10dB = 2 x louder
    d. increase of 10dB = 10 x more intensity (energy)

G. Harmonics
1. Three types of instruments
    a. open-open
        1. examples
        2. picture and relationship between length and wavelength (l and λ)
        3. fundamental frequency calculation
    b. open-closed
        1. examples
        2. picture and relationship between length and wavelength (l and λ)
        3. fundamental frequency calculation

    c. closed-closed
        1. examples

2. picture and relationship between length and wavelength (l and λ)
3. fundamental frequency calculation

H. Doppler Effect- know cause of effect
1. Redshift and Blueshift
2. examples

V. Light and Color
A. Color Mixing Circle for mixing lights
1. know 3 primary colors, 3 secondary colors, and when all are combined they form white
B. Filters and stained glass windows
C. Colored costumes under colored spotlights
D. Mixing paints
E. Polarization of light
1. direction of filter and direction of blocked light
2. crossed filters

VI. Optics
A. Reflection
1. Equations
a. law of reflection
b. mirror/lens equation: 1/do + 1/di = 1/f
c. magnification equations: M = hi/ho M = - di/do
4. Types of images – know orientation and
a. real
b. virtual
5. Concave mirrors – know the shape and the "tag" (where you find them)
a. sign of focal point and center
b. images formed when object is closer than f
c. images formed when object is at f
d. images formed when object is much farther than f
5. Convex mirrors- know the shape and the "tag" (where you find them)
a. sign of focal point and center
b. images formed by this mirror no matter what distance object is at
6. Flat mirrors
a. images formed by this mirror no matter what distance object is at

B. Refraction
1. Snell's law: $n_1 \sin \theta_1 = n_2 \sin \theta_2$
2. index of refraction equation: n = c / v
3. mirror/lens equation: 1/do + 1/di = 1/f
4. magnification equations: M = hi/ho M = - di/do

5. Converging lens- know shape and "tag" (where you find them)
1. they do the same job as which mirror?
6. Diverging lens – know shape and "tag" (where you find them)
1. they do the same job as which mirror?

C. Ray Diagrams
a. 3 special rays- how they differ between lenses and mirrors
b. orientation of images