Physics 513 Topic List/Study Checksheet

This should function more as an organizational guide rather than a be-all-and-end-all study guide. I have listed the information by topic. Note that the material that is labeled with an asterisk* will only be tested on one of the optional sections.

You should go through each of the major units and think about "what would be a long answer calculation that could be asked from this unit?" Note that this will be similar to the middling level long answer questions from the unit exams. In general, for a final, the physics teachers believe it would not be appropriate to ask the most difficult thing from a given unit. We are focusing on core issues and major ideas and themes.

The Basics

- Know your units! This means knowing the units for each quantity and what they break down into

- Relationship identification. From an equation, you need to be able to say what type of relationship exists between those variables (direct, squared, square root, inverse, inverse square or no relationship). You also need to be able to identify the graphs of each of these relationships

- Proportional reasoning. These are the "if I double the X, what happens to Y" type questions

- Unit conversions.

- Proper graphing skills
- Knowing which quantities are vectors vs scalars
- Making appropriate declarations when dealing with vector quantities
- Scaled vector drawings
- How to find the resultant of two vectors that are collinear and at right angles
- Finding components of vectors
- Appropriate experimental methodologies such as using multiple trials, increasing sample size and taking a full spread of data to see an entire trend

- Accuracy vs precision

- Appropriate discussion of error – Quantifying the approximate error in a measurement, comparing this measurement error to the sample size of individual measurements, looking at trends to find aberrant points, analyzing forms of systemic error

Kinematics

- Distance vs displacement

- Speed vs velocity

- Average velocity vs instantaneous velocity

- Acceleration – speeding up (a parallel with v), slowing down (a antiparallel with v) and changing directions (a at an angle to v)

- THE KINEMATIC EQUATIONS!!!

- Falling down and throwing up problems – Be able to mathematically and descriptively explain a falling down and an up and down motion. Remember that during these motions the acceleration due to gravity is a constant 9.8 m/s^2 DOWNWARD

- Galileo's Law of Falling Bodies
- Displacement/Distance/Position vs time graphs Slope is VELOCITY
- Velocity/Speed vs time graphs Slope is ACCELERATION, area is DISPLACEMENT

Newton's Laws/Forces

- Know Newton's three laws of motion VERBATEM. Have physical examples of each to help you explain when each can be observed

- Know the exact definition of inertia and what it means
- Difference between mass and weight (Fg)
- The fundamental forces and the general properties of a fundamental force
- Drawing appropriate free body diagrams
- finding net forces (think about our method!)
- breaking forces into x,y components
- the inclined plane
- static vs kinetic friction
- coefficient of friction
- normal force (support force, apparent weight, reading on the scale, etc)
- the definition of and possible descriptions of something in EQUILIBRIUM
- Elevator problems
- Torque/see saw problems*

Motion in a Plane

- Projectile Motion knowing how the vertical motion differs from the horizontal motion
 Horizontal projectile motion and projectiles fired at an angle on level ground
- Uniform Circular Motion centripetal force, direction of velocity, net force and acceleration
- Definition of period
- Vertical Circular motion* At the top and bottom of a circle, vmin and vmax
- Newton's Law of Universal Gravitation
- Kepler's Three Laws of Planetary Motion*
- Satellite Motion finding the orbital speed and period of a satellite in circular motion*
- Equation for and factors that affect the period of a simple pendulum.

Momentum

- Equation for and definition of momentum
- Impulse The amount and direction of change in an object's momentum
- Force vs time graph area is the impulse
- Impulse/Momentum theorem Calculations and applications (think the egg drop lab!)

- Conservation of momentum problems – Recoil/kickback, inelastic and elastic collisions. Know both how to describe what is happening in these problems in terms of force, momentum, impulse and system momentum as well as how to do calculations. BE CAREFUL FOR SIGNS.

Work/Energy/Power

- Work as both a change in the energy of an object/system as well as $F\Delta scos\theta$ (which is on the table as Fd...except we know better!), the meaning of positive vs negative work, situations in which NO WORK is done

- Power the RATE at which work is done (Work/time)
- Energy definition of energy (a quantization of the ability of an object to affect its environment/do work), different forms
- Gravitational Potential Energy
- Kinetic energy

- Work/energy theorem ($W_{net} = \Delta KE$)

- Force vs displacement graph - the area is the work done

- Law of Conservation of Mechanical Energy – when does it apply, how to do conservation of energy problems

- Conservative vs non-conservative forces
- Hooke's Law/the spring force
- Spring Potential Energy
- Factors that affect the period of a mass vibrating on a spring

Mechanical Waves

- Waves are a mechanism of energy transport without the net displacement of matter

- Mechanical vs Electromagnetic Waves

- Transverse vs Longitudinal vs Circular waves – know the difference between these as well as an example of each

- The electromagnetic spectrum – need to know the spectrum in order and be able to compare different aspects of light (i.e. which of the following has the longest wavelength)

- Medium
- Boundary
- Crest vs trough
- Amplitude what it is and what it signifies
- period SOURCE dependent
- frequency SOURCE dependent
- Speed of a wave MEDIUM dependent equation
- wavelength know relationship with speed, frequency and period
- phase/phase difference are two points in or out of phase?
- attenuation (damping)
- wavefront vs rays
- reflection invert or upright with waves in a linear medium, law of reflection for 2-D

- refraction – speeding up vs slowing down – what happens to direction, speed, wavelength and frequency during refraction

- diffraction – how diffraction is affected by slit width and frequency

- interference – constructive vs destructive – PRIMARY property of a wave...why? - Law of superposition/being able to draw or describe resulting waveforms.

- standing waves what causes these patterns, what do the patterns look like, nodes vs antinodes
- Doppler Effect what is it, what occurs during it, what is the picture of Doppler
- Beat frequency what is it, picture of it, calculate it
- sound waves what type of wave, factors that affect speed of, pitch, volume
- resonance

Light

- Speed of light in a vacuum
- Energy is directly proportional to frequency
- REMEMBER ALL ANGLES ARE TO THE NORMAL LINE
- Law of reflection (from straight and curved boundaries)
- Index of refraction
- Snell's Law calculations and scaled diagram drawing with protractors

- Critical Angle/Total Internal Reflection
- Dispersion

- Young's Double Slit Experiment – how it was done, what the results were, what it proves, why does it prove it, be able to describe the resulting pattern, calculations using the equations

- Polarization - what is it, what does it prove

Geometric Optics*

- object distance vs image distance*
- real vs virtual images*
- upright vs inverted images*
- Images formed by plane mirrors*
- concave mirror (converging) vs convex mirrors (diverging)*
- focal length of a mirror, signs of focal length*
- radius of curvature*

- be able to find and describe the image formed by a mirror using both ray diagrams and the mirror/lens equation and the magnification equation*

- spherical aberration*
- convex lenses (converging) vs concave lenses (diverging)*
- factors that affect the focal length of a lens*
- be able to find and describe the image formed by a lens using both ray diagrams and the mirror/lens equation and the magnification equation*
- Chromatic aberration*

Electrostatics

- type of charge, particles with charge, Coulombs
- what it means to be positive, negative and neutral
- rubber rod/fur, glass rod/silk
- conductor vs insulator
- conservation of charge
- quantization of charge
- charging by friction
- the electroscope what it is used for, how it does what it does, pictures of it
- charging by conduction
- polarization
- grounding
- charging by induction
- Coulomb's Law/the electric force be able to calculate it and describe it

- the electric field/electric field lines – know how to draw an electric field, know how to interpret how a particle would move in an electric field, how to calculate the size of an electric field

- parallel plate capacitor electric field/potential gradient inside a parallel plate capacitor
- potential difference/voltage
- work done to move a charge in an electric field
- electronvolts as a tiny unit of energy
- Milliken's Oil Drop Experiment what was it, what did it prove

Circuits

- current what causes it to flow, how to measure it
- resistor/resistance what it does it do in a circuit, physical factors that affect resistance
- voltage
- Ohm's Law
- simple circuit
- power with electrical quantities/calculating energy
- drawing schematic diagrams
- Kirchhoff's Laws (junction rule and loop rule)
- series circuits what is the same, what is split, how to find R_T
- parallel circuits what is the same, what is split, how to find R_T
- short circuit
- fuses/circuit breakers

Magnetism

- the compass
- geomagnetism
- shape of a magnetic field around a bar magnet, horseshoe magnet
- ferromagnetism what materials, concept of domains/magnetizing/demagnetizing
- Magnetic forces between permanent magnets/electromagnets
- Oersted's Law
- Left Hand Rule 1 finding direction of magnetic field around a wire
- Left Hand Rule 2 finding the north pole of an electromagnet
- Factors that affect the strength of an electromagnet
- Left Hand Rule 3 finding the direction of the force on a wire in a magnetic field
- calculating the force on a current carrying wire in a magnetic field
- calculating the force on a single moving particle in a magnetic field and its resulting motion,
- how the 3LHR applies to this AND how to deal with positive particles*
- motors*
- the galvanometer, internal structure of ammeter & voltmeter*
- Faraday's Law of Electromagnetic Induction*
- Lenz's Law*
- Slicing wire problems and equation*
- Left Hand Rule 4 finding the direction of the induced current in a slicing wire
- The generator*
- Step up and Step Down Transformers and equations*

Modern Physics

- Photoelectric effect experiment – what it is, what it proves, the results, how the results shows what it proves

- KE_{max} vs frequency graph
- threshold frequency
- work function
- Planck's constant
- stopping potential*
- Photoelectric effect calculations*

- Calculating the energy of a photon
- Calculating the momentum of a photon*
- Rutherford's Gold Foil Experiment*
- Bohr Model of the atom*
- Ground state*
- Minimum Ionization energy*
- Emission/Absorption Spectra*
- Compton's scattering experiment what was it, what did it prove*
- de Broglie/matter waves*
- Davisson & Germer's electron diffraction experiment*