Advanced Placement Physics

LA9904A : Sample Topics

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Bear in mind that these are only sample topics. While you are free to adapt one of them as your own, it is strongly encouraged that you decide on a topic of interest to you.

Marine Environment Monitoring

It might be interesting to construct an apparatus to monitor and report the environment of one of the salt water tanks, for use by the Hun School Marine Science classes. The apparatus would need to monitor salinity, temperature, etc. Research would include standard values for safe conditions, calibration of the apparatus, and design of the interface. If the early part of the project went smoothly, it could be expanded to include construction of environment maintenance apparatus; for example, a device to add salt if salinity drops too low.

(This project was attempted in AY 2003 but did not meet with success.)

Solar System Dynamics

Students with an interest in computer science could simulate the behavior of hypothetical solar systems, especially binaries and triplets. The regions of stability, especially in three dimensions, would lend themselves to numerical investigation. This would tie in nicely with the growing field of extrasolar planet mapping.

Phosphorescence

Some imaginative things could be done with phosphorescent paints and a light sensor. For example, the decay curve (intensity of light plotted versus time) could be interesting: Is it constant? An exponential? What controls the time constant? Can phosphorescent materials be recharged indefinitely, or does the reaction have an irreversible component? Literature research would include some reading in quantum emission, plus of course the chemistry of phosphorescent materials. Apparatus would need to include a light-tight box.

Radiometry

It should be possible to use a radiometer (a four-vaned device in a glass bulb) to measure the insolation (the average power per square meter provided by the Sun to the Earth's surface). One could use a laser to measure the frequency of the spinning vane, calibrating via standard bulbs. Literature research would include current measures of the insolation rate. Construction would include a light-tight box.

Astrophysics

With the advent of CCD (digital cameras) and the Internet, there has been a veritable explosion of data available from astronomical and space observatories. One can imagine conducting a statistical survey using such data. Admittedly, I haven't looked any time recently, so I'm not sure what would be available. But NASA makes data public two years after it is taken, and almost all NASA archives can be reached by Internet. Literature research would obviously play a major role here.

An observational program is conceivable. However, be realistic about the number of nights you are willing to dedicate to this project. Also bear in mind the generally poor weather conditions in New Jersey. Even Mauna Kea, the world's premiere telescope site, loses about 50% of its nights to clouds or rains.

Recently a service called "slooh.com" has begun operating. Members in slooh.com participate in directed viewings of the sky through real, astronomer-grade telescopes over the Internet. Members also get some time to direct the telescope and choose its target. This could conceivably be turned into a real observation program.

Electropendulum

A standard problem in electrostatics involves finding the equilibrium angle for two equal point charges suspended like pendulum bobs. Finding that angle is a relatively simple exercise, but the behavior of such a system displaced from equilibrium strikes me as interesting and challenging. A numerical simulation would be a worthwhile project, mapping out the phase space for a range of initial conditions.

Choas Pendulum II

One of the toys in the lab is a system of nested spheres driven by a periodic kick from a electromagnet. The behavior seems chaotic (in the technical sense). Hooking up a voltmeter or probe to the battery should provide an easy way to measure some of the chaotic paramters.

Magnetoconvection

When a fluid is heated strongly, it undergoes convection, as cells of hot material rise and shed heat, then resubmerge. The Sun, being a hot plasma, experiences convection. However, as a plasma in a strong magnetic field, that fluid behaves differently than a normal liquid. It would be intriguing to model this using an electromagnet and, perhaps, rheoscopic fluid.