PHYS-2020: General Physics II
Problem Set 3, Spring 2012

There are 9 problems you are to complete via the web at

http://capa.etsu.edu/

You will gain access to this set by typing in your CAPA Student Number and CAPA ID which will be supplied to you. These problems will be graded and must be completed by 6:00 p.m. on Friday, March 30, 2012. **Start working on these problems immediately! Don't wait until the last day to start them. One never knows when the network will go down, and you will not be able to use this as an excuse for not doing your CAPA problems.** As a matter of fact, there will be no allowed excuses for not doing your CAPA homework.

The following problems will not be graded, but should be done for review. These problems are from your textbook (College Physics, 9th Edition, Serway & Vuille). The solutions are posted on the course web page. **Try to work these problems out by yourself before looking at the solutions I have supplied for you.**

1. A rope is attached between two vertical walls and a spring is attached to this rope at the halfway point and to the floor. As a result, the spring pulls the rope downward such that both sides of the rope make an angle of $32.5°$ to the horizontal at the point where the spring is attached. (a) If the tension on either side of the rope is 210 N and the spring constant is 5.60×10^4 N/m, how far must the spring be stretched with respect to its equilibrium position? (b) Now replace the rope with two identical springs such that the system makes the same V shape as described above. If the stretch of each of these new springs is twice that of the original spring, what must be the spring constant of these new springs?

2. Problem 13.19, Page 467.

3. A "seconds" pendulum is one that moves through its equilibrium position once each second. (The period of the pendulum is 2.000 s.) The length of a seconds pendulum is 0.9927 m at Tokyo and 0.9942 m at Cambridge, England. What is the ratio of the free-fall accelerations at these two locations?

4. Problem 13.57, Page 470.

5. A sound wave has a frequency of 700 Hz in air and a wavelength of 0.50 m. What is the temperature of the air?

6. The intensity level of an orchestra is 85 dB. A single violin achieves a level of 70 dB. How does the intensity of the sound of the full orchestra compare with that of the violin's sound?

7. Problem 14.22, Page 508.

8. Problem 14.26, Page 508.

9. Two loudspeakers are placed above and below each other 3.00 m apart and are driven by the same source at a frequency of 500 Hz. (a) What minimum distance should the top speaker be moved back in order to create destructive interference between the speakers? (b) If the top speaker is moved back twice the distance calculated in part (a), will there be constructive or destructive interference? Why?

10. A 0.300 g wire is stretched between two points 70.0 cm apart. If the tension in the wire is 600 N, find the frequencies of the wire's first, second, and third harmonics.

11. Problem 14.51, Page 510. Take the speed of sound to be $34\underline{0}$ m/s.

12. A particular electromagnetic wave traveling in vacuum has a magnetic field amplitude of 1.5×10^{-7} T. Find (a) the electric field amplitude and (b) the average power per unit area associated with the wave.

13. Problem 21.61, Page 759.

14. The "size" of the *nucleus* in Rutherford's model of the atom is about 1.0 fm $= 1.0 \times 10^{-15}$ m. (a) Determine the repulsive electrostatic force between the two protons separated by this distance. (b) Determine (in MeV) the electrostatic potential energy of these two protons.

15. Problem 28.7, Page 954.

16. Analyze the Earth-Sun system by following the Bohr model, where the gravitational force between the Earth (mass m) and the Sun (mass M) replaces the Coulomb force between the electron and proton (so that $F = GMm/r^2$ and $\text{PE} = -GMm/r$). Show that (a) the total energy of the Earth in an orbit of radius r is given by $E = -GMm/2r$, (b) the radius of the nth orbit is given by $r_n = r_\circ n^2$, where $r_\circ = 10^{-138}$ m, and (c) the energy of the nth orbit is given by $E_n = -E_\circ/n^2$, where $E_\circ = G^2M^2m^3/2\hbar^2 = 1.71 \times 10^{182}$ J. (d) Using the Earth-Sun orbit radius of $r = 1.49 \times 10^{11}$ m, determine the value of the quantum number n for the Earth. (e) Should you expect to observe quantum effects in the Earth-Sun system? Why?

17. Problem 28.23, Page 955.