Name:

Math Questions - Partial credit will be given. If you can't find the number, give the method. If you don't know the method, give your thoughts. (Note: Be sure to answer everything asked.)

1. (15 pts) If the speed limit is posted at 70 mph, express this in $\frac{km}{hr}$ and in $\frac{m}{s}$.

2. (15 pts) An electric motor, rated at $\frac{1}{2}$ horsepower, requires 450 watts of electrical power. Calculate its efficiency (power out divided by power in). What happens to the rest of the power?

3. (15 pts) Most grandfather clocks have a pendulum that ticks (make half a vibration) each second. What length of pendulum is required? (The value of g is given in Chapter 1 as 9.8 $\frac{m}{s^2}$).

4. (15 pts) A bass-reflex loudspeaker enclosure (see Fig. 20.19) is essentially a Helmholtz resonator. Given the following parameters, what resonance frequency might be expected? $V = 0.5\,m^3$, $a = 0.02\,m^2$, $l = 0.05\,m$, speed of sound $v = 343\,\frac{m}{s}$ at $T = 20\,℃$.

5. Britney Spears is on tour and staying in hotels.

   (a) (15 pts) Just as Britney steps from the 10th floor penthouse level onto an elevator with her three bodyguards, the cable above them snaps. If her bodyguards each have a mass of 85 kg, Britney's mass is 45 kg, and the elevator car has a mass of 700 kg, what is the force necessary to break the cable?

   (b) (15 pts) If she has three seconds before the car is level with the ground floor having achieved a velocity of 24 $\frac{m}{s}$ downward, what is Britney's average acceleration for those three seconds?

   (c) (15 pts) As a safety precaution, the elevator shaft is built to form an air tight seal and create an air piston at the bottom of the shaft. If the elevator car has an outside floor area of 1.5 m² and the seal is formed at ground level, 13.25 m above the bottom of the elevator shaft, what is the vibrating frequency of this air piston? (The ratio of specific heats for air is 1.4 and assume the pressure in the piston is the atmospheric pressure of 101,000 Pa.) What do you think about the safety of the riders?