

This is the last and optional problem set of the semester.

**Reading:**

In this past week we have worked with HRW Chapters 15 (oscillations), 16 (waves) and 17 (more waves) I *will not* include sections 16-3, 16-4, 16-6, 17-8 on the final.

In last week in the semester we'll move on to discuss Thermodynamics, discussed in sections 18-1,18-2,18-4,18-5,19-1 through 19-4, 19-7 through 19-9, and Chapter 20.

**Problems:***Optional*

- (1) HRW Chapter 19 Problem 9
- (2) HRW Chapter 19 Problem 27
- (3) HRW Chapter 20 Problem 3
- (4) HRW Chapter 20 Problem 9
- (5) What is the intensity of a sound at the pain level of 120 dB? Compare it to that of a whisper at 20 dB.
- (6) You are standing still. What frequency do you detect if a fire engine whose siren emits at 1550 Hz moves at a speed of 29 m/s (a) toward you, or (b) away from you?
- (7) Workers around jet aircraft typically wear protective devices over their ears. Assume that the sound level of a jet airplane engine, at a distance of 31 m, is 140 dB, and that the average human ear has an effective radius of 2.0 cm. What would be the power intercepted by an unprotected ear at a distance of 31 m from a jet airplane engine?
- (8) A hot-air balloon achieves its buoyant lift by heating the air inside the balloon, which makes it less dense than the air outside. Suppose the volume of a balloon is  $1800\text{ m}^3$  and the required lift is 2700 N (rough estimate of the weight of the equipment and passenger). Calculate the temperature of the air inside the balloon which will produce the required lift. Assume that the outside air temperature is  $0^\circ\text{C}$  and that air is an ideal gas under these conditions. What factors limit the maximum altitude attainable by this method for a given load? (Neglect variables like wind.)