

PHYSICS 1050: Assignment #13

DUE: Monday April 18, 2016

Readings:

- Chapter 7 of Franklin et al.
- Chapter 8 of Franklin et al.
- Chapter 9 of Franklin et al.
- Chapter 37 of Franklin et al.
- Chapter 38 of Franklin et al.
- Chapter 39 of Franklin et al.

Problems:

- include name or PIN;
- staple your assignment;
- show all your work;
- all answers are to have three significant figures unless stated otherwise.

1. **Problem 8.2 on page 82**

2. **Problem 8.5 on page 82**

3. **Problem 9.5 on page 98**

4. **Problem 9.7 on page 98**

5. **Problem 9.8 on page 98**

6. **Opera is music too**

A person discovers their partner is an opera singer and cannot stand the singing. One day the person snaps and attaches their partner to the hood of the car. The person then drives towards a brick wall at 30.0 m/s. Fortunately, the opera singer was a former physics student and knew this wall would resonant at 600 Hz. If a continuous sound wave at that frequency hits the wall, it will fall down allowing the singer to go on singing another day. The speed of sound is 340 m/s.

- (a) At what frequency must the singer sing at so that the wall will crumble?
- (b) What frequency will the singer hear reflected from the wall?

7. Going batty over food

In its search for flying insects, a bat uses an echolocating system based on pulses of high frequency sound. These pulses are 2.0 ms in duration, have a frequency of 50 kHz, and an intensity level of 100 dB at 1.0 m from the bat's mouth. Assume the bat produces acoustic waves in a cone with a total angle of 30° .

- (a) What is the acoustic power of each pulse?
- (b) How much acoustic energy is there in each pulse?
- (c) What is the intensity and intensity level at a conical surface centered on the bat with radius equal to 5.0 m?
- (d) A June bug is located 5.0 m from the bat. The effective cross-sectional area of the insect is 10 mm^2 . How much of the acoustic power emitted by the bat is intercepted by the insect?
- (e) Assume all the acoustic power intercepted by the June bug goes into the reflected wave which is hemispherical. What is the intensity and intensity level of the reflected wave at the bat's ears?

8. PP - pet problems

Your pet bats, Joe, Bob and Curly love coffee. Unfortunately, after their Saturday morning cups of coffee, you are horrified to learn that the coffee is laced with radioactive isotope Y. Opening the window to let in some air 1 day later, two of your bats (Bob and Curly) escape, only to become a snack for your neighbour's pet falcon (who loves coffee drinking bats). By the time you shoot the falcon 3.00 days later, you measure a total body count of 1,050,000 Bq, which is almost the same count rate at the same time for Joe (1,000,000 Bq). $1 \text{ Bq} = 1 \text{ becquerel} = 1 \text{ disintegration per second}$. Joe drank 4 cups of coffee, Bob drank 2 cups of coffee, Curly drank 3 cups of coffee, the physical half-life of radionuclide Y is 5.00 days, and the effective half-life in the falcon is 3.00 days.

- (a) What is the biological half-life of this isotope in the falcon?
- (b) What is the biological half-life of this isotope in the bat?
- (c) What was the initial activity of a 14-cup pot of coffee?