

7. [14 points] In music, the *pitch* of a tone, P , measured in *cents*, is a function of the tone's frequency, f , measured in Hertz. The pitch is defined to be

$$P = 6000 + k \ln \left(\frac{f}{f_0} \right)$$

where f_0 is the frequency of a tone called “middle C”, and k is a constant.

- a. [2 points] What is the pitch of “middle C”? (*Remember to include units.*)

Answer: _____

- b. [3 points] If the frequency of one tone is two times the frequency of middle C, then the pitch of that tone is 7200 cents. Use this information to find the *exact* value of k . Then give an approximation of k rounded to the nearest 0.1.

Exact value of k : _____ **Approximation:** _____

Use the *approximation* of k you found in part (b) to answer the questions below.
(If you were unable to answer part (b), leave your answers below in terms of k .)

- c. [4 points] Let P_1 and P_2 represent the pitches of tones of frequency f_1 and f_2 , respectively. Find a formula for the difference in pitches, $P_2 - P_1$, in terms of the two frequencies f_1 and f_2 . *Simplify your answer; your formula should **not** involve f_0 .*

Answer: $P_2 - P_1 =$ _____

- d. [5 points] The tone called “A above middle C” has a frequency of 440 Hertz. Find the frequency of the tone whose pitch is 400 cents higher than the pitch of “A above middle C.” (*Remember to include units.*)

Answer: _____