

## Reference Section

**Sound travels at approximately 343 meters/sec at room temperature**

**Gravity on Earth is = 9.8 meters/sec<sup>2</sup>**

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}} \quad \frac{1}{2\pi} \sqrt{\frac{g}{l}} \quad f_a = \frac{1}{2\pi} \sqrt{\frac{k}{m}} \quad f_b = \frac{1}{2\pi} \sqrt{\frac{3k}{m}} \quad f = \frac{v}{2\pi} \sqrt{\frac{a}{vl}}$$

$$v = 331 + 0.6t \text{ m/sec} \quad c = 0.61r \quad v = f\lambda \quad v = \sqrt{T/\mu}$$

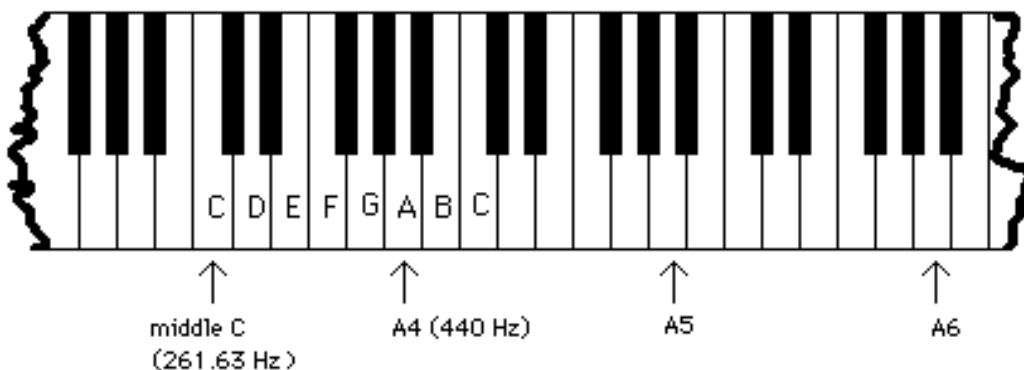
$$\lambda_n = \frac{2L}{n} \quad (n = 1, 2, 3 \dots) \quad \lambda_n = \frac{4L}{n} \quad (n = 1, 3, 5 \dots)$$

$$f_n = n \frac{v}{2L} = nf_1 \quad (n = 1, 2, 3 \dots) \quad f_n = n \frac{v}{4L} = nf_1 \quad (n = 1, 3, 5 \dots) \quad f_n = \frac{n}{2L} \sqrt{\frac{T}{\mu}} = nf_1$$

$$f' = f_s \left( \frac{v+v_0}{v} \right) \quad f' = f_s \left( \frac{v-v_0}{v} \right) \quad f' = f_s \left( \frac{v}{v-v_s} \right) \quad f' = f_s \left( \frac{v}{v+v_s} \right)$$

$$\log(ab) = \log(a) + \log(b) \quad \log(a/b) = \log(a) - \log(b) \quad \log(x^n) = n\log(x)$$

Pinna, ossicles, hammer, anvil, stirrup (*malleus, incus, stapes*), tympanic membrane, semicircular canals, oval window, round window, basilar membrane, organ of Corti, auditory nerve, endolymph, stereocilia, critical bands, cochlea, tonotopicity, Haas effect, Fechner's law of psychophysics



(The piano goes down to A0, which is four octaves below A4)