1. In terms of its angular frequency $\omega$, the period $T$ of a simple harmonic oscillator is
   a. $T = \frac{2\pi}{\omega}$
2. When the position of an oscillating particle is $x = A \cos \omega t$, its velocity $v$ is
   c. $v = \frac{dx}{dt} = A \omega \sin \omega t$
3. If $F = -kx$, then $T/2\pi$ is
   a. $\frac{T}{2\pi} = \frac{1}{\omega} = \frac{m}{k}$
4. The total energy of a mass on a spring moving with simple harmonic motion is
   a. $E = \frac{1}{2} k A^2$
5. A mass $m = 2$ kg is attached to a spring having a force constant $k = 300$ N/m. The mass is displaced from its equilibrium position and released. Its frequency of oscillation in Hz is approximately
   d. $f = \frac{\omega}{2\pi} = \frac{1}{\sqrt{m/k}} = 2$ Hz
6. A uniform cord has a mass of 0.6 kg and a length of 12 m. The tension in the cord is 19.6 N. What is the speed of a wave on the cord in m/s?
   d. $v = \sqrt{\frac{F_t}{\mu}} = \sqrt{\frac{F_t}{(M/L)}} = 19.8$ m/s
7. The angular wave number of a sinusoidal wave is
   d. $k = \frac{2\pi}{l}$
8. The Doppler effect causes the sound from a source moving toward an observer to appear to have a higher frequency.
9. The wavelength of light visible to the human eye is of the order of $5 \times 10^{-7}$ m. If the speed of light in air is $3 \times 10^8$ m/s, find the frequency of the light wave in Hz.
   d. $6 \times 10^{14}$
10. If $y = 0.02 \sin ((30m^{-1})x - (400s^{-1})t)$, the frequency of the wave in Hz is
    c. $200/\pi$
11. A 500 Hz tone is given off at a train station as a train moves toward the station at 20 m/s. What frequency in Hz does the engineer hear if the speed of sound is 335 m/s?
    a. $f' = f \frac{v + v_e}{v} = 530$ Hz
12. Constructive interference occurs at a point in space when the path difference for waves from coherent sources to that point is an integer multiple of:
    e. $\lambda$
13. The longest wavelength that a standing wave can have on a stretched string of length $L$ is
    a. $2L$
14. Two harmonic waves traveling in opposite directions interfere to produce a standing wave described by $y = 2 \sin ((4.0m^{-1})x) \cos ((3s^{-1})t)$ where $x$ is in m and $t$ is in s. What is the speed in m/s of the interfering waves?
    a. $v = \omega/k = 0.75$
15. A steel wire in a piano has a length of 0.70 m and a mass of 4.3 grams. To what tension in N must this wire be stretched in order that the fundamental vibration in Hz correspond to middle C, ($f_C = 261.6$ Hz)?
    e. $F_T = v^2 \mu = (2L)^2 M/L = 824$ N
16. A fire engine approaches a wall at 5 m/s while the siren emits a tone of 500 Hz frequency. At the time, the speed of sound in air is 340 m/s. How many beats per second do the people on the fire engine hear?
    a. $f_b = f' - f = f(v + v_e)/(v - v_e) - f = 15$ Hz
17. On another planet a pendulum with a length of 2.00 m has a period of oscillation of 3.00 s. What is the acceleration due to gravity on that planet?

\[ g = \omega^2 L = (2\pi/T)^2 L = 8.77 \text{ m/s}^2 \]

18. Two trumpeters each play a note with a frequency of 300 Hz. The trumpeters move toward each other each moving at a speed of 2.0 m/s. What is the frequency of the beats that each trumpeter will hear as a result? (Assume the speed of sound is 343 m/s).

\[ f_b = f' - f = f(v + v_o)/(v_v) - f = 3.52 \text{ Hz} \]

19. The diagram above represents a resonant mode of vibration of sound waves in a tube. If the speed of waves in the tube is 380 m/s and the frequency of this mode is 440 Hz. What is the length of the tube?

\[ L = 5\lambda/4 = 5v/4f = 1.08 \text{ m} \]

20. Two sources \( S_1 \) and \( S_2 \) located on the x axis as shown, emit waves in phase at a wavelength of \( \lambda = 0.45 \text{ m} \). \( S_1 \) is located at \( x = 0 \), \( S_2 \) is located at \( x = 0.40 \text{ m} \). In the resulting standing wave, what are the x coordinates of the two nodes that are between \( S_1 \) and \( S_2 \)?

\[ x = (0.40m + (m+1/2)\lambda)/2 = 0.3125 \text{ m and } 0.0875 \text{ m} \]