A. The wavelength of green light is 500 nm. What is the frequency of an oscillator that produces green light?

The frequency will be given by the relationship among frequency, propagation speed, and wavelength. Given a wavelength $\lambda = 500$ nm, and the speed of light $c$, the frequency is

$$f = \frac{c}{\lambda} = \frac{3 \times 10^8 \text{ m/s}}{500 \times 10^{-9} \text{ m}} = 6 \times 10^{14} \text{ Hz}$$

And that’s a lot of Hertz.

B. The musical note A is defined to have a frequency of 440 Hz. What is the wavelength of this sound?

Similarly, the wavelength is

$$\lambda = \frac{v_{\text{SOUND}}}{f} = \frac{340 \text{ m/s}}{440 \text{ Hz}} = 0.77 \text{ m}$$

The speed of sound in air varies with temperature, so when you look up the speed of sound you might find different values in different references. I used the speed of sound at 20 degC, which is a bit cool for most concert halls.

C. Consider a taut string. What happens to the speed of a wave propagating on the string if you double the tension in the string? What happens when you double the “weight” or mass density of the string? Write a short, non-mathematical explanation of why speed increases with tension and decreases with “weight”. Assume an audience at the level of our class.

The speed of wave propagation on a string depends upon the rapidity with which a segment of string responds to a disturbance in the position of an adjacent segment. If a segment reacts to nearby motion quickly, the disturbance propagates quickly; if the segment reacts slowly, the disturbance propagates slowly. This “reaction time” will be related to the acceleration of the segment of string, and the acceleration is proportional to the force applied and inversely proportional to the inertia of the segment. The force applied to a segment of string is due to the tension in the string, so the motion of one segment of string is communicated to the next segment by way of the tension. Higher tension means faster propagation speed. Conversely, the inertia of a segment of string--its mass--tends to make the segment resist being accelerated, thus slowing the reaction time. Increased mass density (also known as “string weight”) therefore slows propagation speed.
A detailed analysis of these effects will show that for a string of linear mass density $\mu$, held at a tension $T$, the propagation velocity is

$$v_{WAVE} = \sqrt{\frac{T}{\mu}}$$

Consequently, doubling the tension multiplies the speed by $\sqrt{2}$; doubling the ‘weight’ divides the speed by $\sqrt{2}$ (which is the same as multiplying by $\sqrt{2}/2$).