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Milestone One: Pulse Width Modulation Lab

**1. At what frequency can you see the LED start to blink?**

The LED starts to visibly blink at approximately 10 Hz. At this frequency, your eye can distinguish the individual on and off transitions, resulting in a blinking effect. Frequencies higher than 10 Hz usually look like a constant light due to the vision persistence.

**2. At what duty cycle is the intensity of the LED perceptibly diminished from the initial 50% duty cycle?**

The LED's intensity visibly diminishes when the cycle drops below 30%. At this point, the on time is reduced significantly compared to the off time, making the LED appear dimmer. Below 10%, the LED may even look off, since the short on time isn't enough to provide visible brightness.

**3. When changing the duty cycle of the PWM, the loop used an increment of 5 every tenth of a second. Was this perceptibly smooth? If not, what could you change to improve the visual response? Why?**

Using an increment of 5 every 1/10 seconds results in a relatively smooth transition, but the changes could still appear somewhat abrupt, depending on the observer. I noticed on camera it appeared more sudden, but in person it was more gradual. To make it smoother, smaller increments like 1 or 2 could be used, combined with a shorter delay between updates like 0.01 seconds instead of 0.1 seconds. This would create steadier changes in brightness, improving our perception of smoothness.

**4. What function sets the PWM frequency for a GPIO line?**

The function that sets the PWM frequency is:

*pwm = GPIO.PWM(channel, frequency)*

Within this, *channel* sets the GPIO pin, and *frequency* sets your desired PWM frequency in Hertz.

**5. What function sets the duty cycle for a GPIO line?**

The function that sets the duty cycle for a GPIO line is:  
*pwm.ChangeDutyCycle(duty\_cycle)*  
It’s here where *duty\_cycle* is the percentage of the cycle in which the signal is high (from 0-100%)