21-P-KM-AG-005

You live in a parallel universe where everything is the same except gears don't exist. You are on a bike, stopped at a red light. When the light turns green, you begin to peddle, making one peddle revolution every second and getting faster at a rate of $A\ revolutions/s^2$. Your peddles are connected directly to your back wheel, which is D meters in diameter. How fast are you going? What is your acceleration?

ANSWER:

First, determine the angular velocity and angular acceleration of the peddles.

$$1\ \frac{rev}{s} \cdot 2\pi \frac{rad}{rev} = 2\pi \frac{rad}{s}$$

$$A\ \frac{rev}{s^2} \cdot 2\pi \frac{rad}{rev} = 2\pi A \frac{rad}{s^2}$$

Your back wheel is D meters in diameter, or $D/2$ meters in radius. Therefore, the velocity of your bike as you start is $2\pi \frac{rad}{s} \cdot \frac{D}{2} m = D\pi\ \frac{m}{s}$. You are accelerating at $2\pi A \frac{rad}{s^2} \cdot \frac{D}{2} m = AD\pi\ \frac{m}{s^2}$.