For solution consider $|F| = 20 N$ for $\Delta t = 0.5 s$

each mass $m = 3 kg$. $b = 0.5 m$

Magnitude of momentum gained from impulse:

$$\Delta p = F \cdot \Delta t = (20 N)(0.5 s) = 10 kg\, m/s = 10 Ns$$

We also know that $p = mv$

in this case, $\Delta p = 2m \Delta V$ since $V_i = 0$:

$$\Delta p = 2mV = F \cdot \Delta t$$

$$\Rightarrow V = \frac{\Delta p}{2m} = \frac{10\, N \cdot s}{2 \cdot 3 kg} = 5/3 = \underline{\underline{1.667}}\ m/s$$ <u>linear velocity</u>

Now for angular velocity, use:

$$I_G \omega_1 + \sum \int_{t_1}^{t_2} p_G\, dt = I_G \omega_2$$

Where I_G is the moment of inertia, p_G is the momentum, (about the centre of the dumbbell), and ω_1 and ω_2 are the initial and final angular velocities.

$t_1 = 0.$, $t_2 = \Delta t = 0.5 s$: $\omega_1 = 0.$

$$I_G = \sum_i m_i r_i^2 = m \cdot b^2 + mb^2 = 2mb^2$$

$$\Rightarrow \cancel{I_G (0)}^{0} + \Delta p \cdot \Delta t = I_G \omega_2$$

$$\omega_2 = \frac{\Delta p \cdot \Delta t}{I_G} = \frac{(10) \cdot (0.5)}{2(3)(0.5)^2} = 10/3 = \underline{\underline{3.333}}\ rad/s$$

<u>Angular velocity</u>.