2020A F=ma Exam: Problem 18

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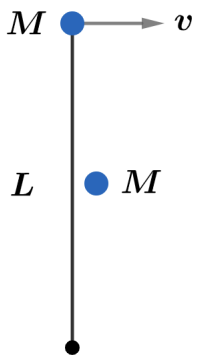

The initial angular momentum of the system about the pivot is

$$L_0 = MvL$$

After the collision, note that both masses have the same angular velocity ω. The total moment of inertia is

$$I = ML^2 + M\left(\frac{L}{2}\right)^2 = \frac{5}{4}ML^2$$

Using conservation of angular momentum, the kinetic energy of the system after the collision is

$$K = \frac{1}{2}I\omega^2 = \frac{L_0^2}{2I} = \frac{M^2v^2L^2}{2}\frac{4}{5ML^2} = \frac{2}{5}Mv^2$$

so the answer is $\boxed{\text{D}}$.