21-P-MOM-AG-038

Cats are known for batting things off tables or out of the air. You are a cosmonaut currently on a voyage where you are not subject to any gravitational fields, and you brought your cat along with you. You throw a m_1 gram cat toy towards your cat at V_1 $\frac{m}{s}$ and they bat it directly back at you so that it reaches you P% as fast as you threw it. Assuming your cat's m_2 kg paw hit the toy at V_2 $\frac{m}{s}$, how fast is their paw moving now? Give a positive answer.

Neglect air friction

ANSWER:

Conservation of linear momentum tells us that:

$$m_1V_1 + m_2V_2 = m_1V_{P\%} + m_2V_{cat}$$

$$V_{cat} = \frac{m_1V_1 + m_2V_2 - m_1V_{P\%}}{m_2} = \frac{m_1V_1 \cdot \left(1 + \frac{P}{100}\right) - m_2V_2}{m_2}$$