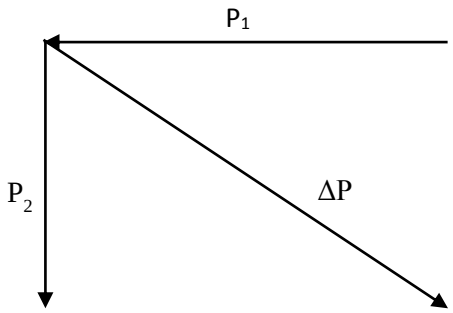
Answer on Question #57987, Physics / Mechanics | Relativity

Problem: A cricket ball of mass m=150 grams is delivered from a hand of a fast bowler at a speed of v_1=90000 m/s. The batsman strikes the ball with a bat of mass M=900 grams causing the ball to go straight down the ground with a momentum of p_2=162 kgm/s. What is the velocity of the bat before collision, given that the bat comes to rest after striking the ball.

Solution: Before collision: momentum of ball:

$$p_1 = m \cdot v_1 = 0.150\text{kg} \cdot 90000\text{ms}^{-1} = 13500\text{kg} \cdot \text{ms}^{-1}$$



Momentum of bat:

$$p_b = M \cdot v_b$$

After collision: momentum of ball: $p_2 = m \cdot v_2 = 162\ \text{kg} \cdot \text{ms}^{-1}$

$$\overrightarrow{p_2} = \overrightarrow{p_1} + \overrightarrow{\Delta p} \Rightarrow \overrightarrow{\Delta p} = \overrightarrow{p_2} - \overrightarrow{p_1}$$

Following II Newton's law: $\overrightarrow{\Delta p} = \overrightarrow{p_b}$

$$p_b = |\overrightarrow{\Delta p}| = \sqrt{p_1^2 + p_2^2}$$

$$v_b = \frac{\sqrt{p_1^2 + p_2^2}}{M} = \frac{\sqrt{13500^2 + 162^2}}{0.9} ms^{-1} = 15001 ms^{-1}$$

Answer: $v_b = 15001 ms^{-1}$