Answer on Question 73439, Physics, Mechanics, Relativity

Question:

A $150\ g$ baseball pitched at a speed of $40\ m/s$ is hit straight back to the pitcher at a speed of $60\ m/s$. What is the magnitude of the average force on the ball if the bat is in contact with the ball for $5.0\ ms$?

Solution:

Let's choose the direction of motion of the baseball to the pitcher as positive. Then, we can find the magnitude of the average force on the ball from the definition of the impulse:

$$J = \Delta p = m\Delta v = F\Delta t,$$

$$F\Delta t = m\Delta v = mv_f - mv_i = m(v_f - v_i),$$

here, J is the impulse imparted on the baseball, Δp is the change of momentum, $m = 0.15\ kg$ is the mass of the ball, Δv is the change of speed, $\Delta t = 5.0\ ms$ is the time during which the bat is in contact with the ball, $v_f = 60\ m/s$ is the final speed of the baseball, $v_i = -40\ m/s$ is the initial speed of the baseball and F is average force on the ball.

Then, we get:

$$F = \frac{m(v_f - v_i)}{\Delta t} = \frac{0.15\ kg \cdot \left(60\ \frac{m}{s} - \left(-40\ \frac{m}{s}\right)\right)}{0.005\ s} = 3000\ N.$$

Answer:

$F = 3000\ N.$