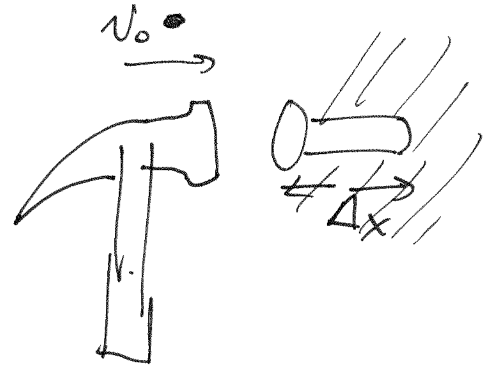
Chapter 9

Problem 30

$m = 0.450 kg$

$v_0 = 7.00 m/s$

$\Delta x = 1.00 cm = 0.010 m$



Acceleration is constant

Final velocity of the hammer is zero.

$\therefore v^2 - v_0^2 = 2a\Delta x \rightarrow a = \frac{v^2 - v_0^2}{2\Delta x}$

$= \frac{0^2 - (7.00 m/s)^2}{2(0.010 m)}$

$a = -2450 m/s^2$

a) The time it takes for the hammer to stop is

$v = v_0 + at \rightarrow t = \frac{v - v_0}{a} = \frac{0 - 7.00 \frac{m}{s}}{-2450 m/s^2}$

$\boxed{t = 2.86 \times 10^{-3} s}$

b) Average force on the hammer is

$F_{net} = ma = (0.450 kg)(-2450 m/s^2)$

$\boxed{F_{net} = -1100 N}$

Alternate solution

with constant acceleration, average velocity is $\bar{v} = \frac{v_0 + v}{2}$

$\bar{v} = \frac{7.00 + 0}{2} = 3.5 m/s$

a) Then $x = \bar{v} \cdot t \rightarrow t = \frac{x}{\bar{v}} = \frac{0.010 m}{3.5 m/s} = \boxed{2.86 \times 10^{-3} s}$

b) Impulse $\Delta p = J = F_{avg} \cdot \Delta t$

$F_{avg} = \frac{\Delta p}{\Delta t} = \frac{m \Delta v}{\Delta t} = \frac{(0.450 kg)(0 - 7.0 m/s)}{2.86 \times 10^{-3} s} = \boxed{-1100 N}$