Answer on Question #42861 – Physics – Mechanics | Kinematics | Dynamics

You drive a nail horizontally into a wall, using a 0.52 kg hammerhead. If the hammerhead is moving horizontally at 4.5 m/s and in one blow drives the nail into the wall a distance of 2.9 cm, determine the average force acting on
(a) the hammerhead
(b) the nail

Solution:

$m = 0.52\ kg - mass\ of\ the\ hammerhead;$

$v = 4.5\frac{m}{s} - velocity\ of\ the\ hammerhead;$

$S = 0.029\ m - distance\ on\ which\ one\ blow\ drives\ the\ nail\ into\ the\ wall;$

Law of conservation of energy of the hammerhead:

$$KE = W_{nail} \quad (1)$$

$$KE = \frac{mv^2}{2} \quad (2)$$

$$W_{nail} = F \cdot S \cdot \cos\alpha = F \cdot S \cdot \cos 0 = F \cdot S \quad (3)$$

$(3) and\ (2)\ in\ (1)$:

$$F \cdot S = \frac{mv^2}{2}$$

$$F = \frac{mv^2}{2S} = \frac{0.52\ kg\ \cdot \left(4.5\frac{m}{s}\right)^2}{2 \cdot 0.029\ m} = 182\ N$$

Magnitude of the force acting on the hammerhead is equal to the magnitude of the force acting on the nail, but directions of the forces are opposite (according to the Newton's Third Law).

Answer:

(a): $182\ N$

(b): $-182\ N$