Question #72008, Physics / Mechanics | Relativity

A metal ball of mass 0.5 kg is dropped from top of a vertical Clift of height 90 m. When it hits the beach below it penetrates to a depth of 6.0 cm calculate the average retarding force of the sand (neglect air resistance).

Solution

The ball's kinetic energy right before it enters sand is equal to the reduction in its gravitational potential energy:

$$E_k = \Delta E_p = mgh$$

The retarding force is determined as the work done to bring the ball to complete stop per unit distance.

$$F = \frac{W}{d}$$

Since the work is equal to the change in the ball's kinetic energy, $W = E_k$, deriving equation for F.

$$F = \frac{mgh}{d};$$

$$F = \frac{0.5 \times 9.81 \times 90}{0.06} = 7357.5\,\text{N} = 7.36\ \text{kN}.$$

Answer: 7.36 kN

(if assumed $g = 10$, then $F = 7.5$ kN)