Answer on Question #44272 - Physics - Mechanics | Kinematics | Dynamics

A ball of mass 50g is dropped from a height of 20m. A boy on ground hits the ball vertically upwards with a bat with an average force of 200N,so that it attains a vertical height of 45m.the time for which the ball remains in contact with the bat is?(take g=10m/s)

Solution

According to the conservation of energy law potential energy of the ball on height $h_1 = 20\ m$ is equal to kinetic energy of the ball on the ground:

$$mgh_1 = \frac{mv_1^2}{2} \to v_1 = \sqrt{2gh_1}.$$

When a boy on the ground hits the ball vertically upwards it have kinetic energy which equal potential energy of the ball on height $h_2 = 45\ m$:

$$\frac{mv_2^2}{2} = mgh_2 \to v_2 = \sqrt{2gh_2}.$$

Impulse transmitted to the ball by bat:

$$I = F\Delta t = P_2 - P_1 = mv_2 - (-mv_1) = m(v_1 + v_2) = m\left(\sqrt{2gh_1} + \sqrt{2gh_2}\right).$$

P_1 is negative because it is opposite to direction of force F.

A time for which the ball remains in contact with the bat:

$$\Delta t = \frac{m\left(\sqrt{2gh_1} + \sqrt{2gh_2}\right)}{F} = \frac{50 \cdot 10^{-3} kg\left(\sqrt{2 \cdot 10\frac{\text{m}}{\text{s}^2} \cdot 20m} + \sqrt{2 \cdot 10\frac{\text{m}}{\text{s}^2} \cdot 45m}\right)}{200N} = 0.0125\ s.$$

Answer: $\mathbf{0.0125}s$.