Answer onQuestion #49996, Physics, Mechanics | Kinematics | Dynamics

An object of mass 10 kg falling from a height of 20 m on to a hard floor rebounds to a height of 5m. If the time during which the object was in intact with the ground is 0.004s what was the force exported by the object on the ground?

Solution:

The impulse of force can be extracted and found to be equal to the change in momentum of an object provided the mass is constant:

$$Impulse = F\Delta t = m\Delta v$$

For collisions, the mass and change in velocity are often readily measured, but the force during the collision is not. If the time of collision can be measured, then the force of impact can be calculated.

$$\Delta v = v_2 - v_1$$

The velocity v_1 we found from energy

$$mgh_1 = \frac{1}{2}mv_1^2$$

$$v_1 = \sqrt{2gh_1} = \sqrt{2 * 9.8 * 20} = 19.8 \text{ m/s}$$

Also,

$$v_2 = \sqrt{2gh_2} = \sqrt{2 * 9.8 * 5} = 9.9 \text{ m/s}$$

The direction of velocities is opposite, thus we take v_1 with minus sign.

Hence,

$$m\Delta v = m\big(v_2 - (-v_1)\big) = 10 * (9.9 + 19.8) = 297 \text{ kg}\frac{\text{m}}{\text{s}}$$

The force is

$$F = \frac{m\Delta v}{\Delta t} = \frac{297}{0.004} = 74250 \text{ N} = 74.25 \text{ kN}$$

Answer: $F = 74250 \text{ N} = 74.25 \text{ kN}$