

Two students are on a balcony 18.4m above the street. One student throws a ball vertically downward at 15.3 m/s. what is the velocity of the ball as it strikes the ground?

The law of conservation of energy:

$T + U = \text{const}$ - the sum of potential energy (PE) and kinetic energy (KE) is the total mechanical energy is constant:

$$T = \frac{mv^2}{2} - \text{kinetic energy}$$

m - mass of the body

v - speed

$$U = mgh - \text{potential energy}$$

g - gravitational acceleration

h - high

$$T_1 + U_1 = T_2 + U_2$$

$$1 - \text{initial state: } T_1 = \frac{mv_0^2}{2}, U_1 = mgh$$

$$2 - \text{final state: } T_2 = \frac{mv^2}{2}, U_2 = 0$$

Therefore:

$$\frac{mv^2}{2} = \frac{mv_0^2}{2} + mgh$$

$$v = \sqrt{v_0^2 + 2gh} = \sqrt{15.3^2 + 2 * 9.8 * 18.4} = 24.4 \frac{m}{s}$$

Answer: $24.4 \frac{m}{s}$