Answer on Question #65175, Physics / Mechanics | Relativity

Block A of mass4.0 kg is on a horizontal frictionless tabletop and is placed against a spring of negligible mass and spring constant 650 Nm. The other end of the spring is attached to a wall. The block is pushed toward the wall until the spring has been compressed a distance x, as shown above. Block A is released, then strikes and sticks to Block B at the edge of the table. The blocks then fall to the ground following the trajectory shown, falling 0.80 m vertically to the floor. Air resistance is negligible.

5. The spring has 3.25 J of elastic potential energy when it is compressed distance x. Determine the distance x.
6. Determine the velocity of Block A on the table when it leaves contact with the spring.
7. Determine the velocity of the stuck together blocks immediately following the collision.
8. What is the total kinetic energy of the blocks just before they hit the floor?

Solution:

5. We use the equation of potential energy of the spring

$$PE = \frac{1}{2}\, kx^2$$

$$x = \sqrt{\frac{2PE}{k}}$$

$$x = \sqrt{\frac{2 \times 3.25\, J}{650\, N/m}} = \sqrt{0.01} = 0.1\, m$$

6. Potential energy of spring equate to kinetic energy block

$$KE = \frac{1}{2}\, mv^2$$

$$KE = PE = \frac{1}{2}\, mv^2$$

$$v = \sqrt{\frac{2PE}{m}}$$

$$v = \sqrt{\frac{2 \times 3.25\, J}{4.0\, kg}} = \sqrt{1.625} = 1.27\, ms^{-1}$$

7. We use the law of conservation of momentum

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v'$$

$$v_2 = 0\, ms^{-1}$$

$$m_1 v_1 = (m_1 + m_2) v'$$

$$v' = \frac{m_1 v_1}{(m_1 + m_2)}$$

$$v' = \frac{4\ kg \times 1.27\ ms^{-1}}{(4\ kg + 4\ kg)} = 0.635\ ms^{-1}$$

8. The formula of the total energy system bodies

$$W = \frac{1}{2} Mv^2 + Mgh$$

Where, M = m_1 + m_2 = 8 kg

$$W = \frac{1}{2} \times 8\ kg \times (0.635\ ms^{-1})^2 + 8\ kg \times 9.8\ ms^{-2} \times 0.8\ m = 65.26\ J$$

Answer: $0.1\ m$; $1.27\ ms^{-1}$; $0.635\ ms^{-1}$; $65.26\ J$