Physics 2D Quiz 0 Solutions Fall 2020

Problem 1

$u = 6\,m/s$, $m = 1\,kg$

(a) We find u_f^* by using momentum conservation:

initial momentum: $p_i = mu + m \cdot 0 = mu$

final momentum: $p_f = 2m u_f^*$

momentum conservation $\Rightarrow$ $p_i = p_f \Rightarrow$ $2m u_f^* = mu \Rightarrow$

$\Rightarrow$ $\boxed{u_f^* = \frac{u}{2}}$ $\Rightarrow$ $\boxed{u_f^* = 3\,m/s}$

(b) Initial kinetic energy: $K_i = \frac{1}{2} m u^2$

Final kinetic energy: $K_f = \frac{1}{2}(2m) u_f^{*2} = \frac{1}{4} m u^2$

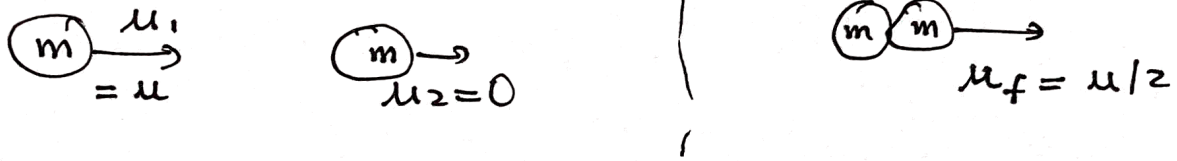
$\Rightarrow$ kinetic energy is <u>not</u> conserved.

The missing energy was dissipated as heat, or is stored as potential energy, or both. $\boxed{\Delta K = K_i - K_f = \frac{1}{4} m u^2}$

(c) We used momentum conservation to find u', so it obviously holds.

Missing energy: $\Delta K = \frac{1}{4} m u^2 = \frac{1}{4} \cdot 1\,kg \cdot 36 \frac{m^2}{s^2} = \boxed{9\,J}$

Problem 2



In S' reference frame moving at speed $v = 3m/s = u/2$:

$$u'_1 = u_1 - v = \frac{u}{2}$$

$$u'_2 = 0 - v = -\frac{u}{2}$$

$$\boxed{u'_f = u_f - v = 0} \quad (a)$$

(b) Initial momentum: $p'_i = m \cdot u'_1 + m \cdot u'_2 = 0$

Final momentum: $p'_f = 2m \cdot u'_f = 0$

$\Rightarrow$ momentum conservation holds in S'.

(c) Initial kinetic energy: $K'_i = 2 \cdot \frac{1}{2} m \cdot \left(\frac{u}{2}\right)^2 = \frac{1}{4} m u^2$

Final kinetic energy: $K'_f = \frac{1}{2} \cdot 2m \cdot u'^2_f = 0$

Kinetic energy lost: $\Delta K' = K'_f - K'_i = \frac{1}{4} m u^2$

same as in S reference frame.