**21-P-MOM-AG-040**

Suppose a car of mass $m_{car}$ kilograms is speeding in a straight line on a horizontal highway at $V$ metres per second. The road is very slippery due to ice, so the brakes and the gas pedal have no effect on the car. It moves in a straight line at a constant speed due to inertia.

Then the driver sees a moose on the road. It collides with a moose of mass $m_{moose}$ kilograms that was stationary before the collision. The moose is thrown upwards through the windshield of the car with the result that the car and moose are travelling at the same speed after the collision. Assume that as soon as the car hits the moose the driver of the car does not hit the brakes or gas pedal of the car. It continues to slide.

*Ignore all effects of friction and air resistance in this whole question.*

What is the speed of the car and moose after the collision?

What is the initial kinetic energy of the car and the moose?

What is the final kinetic energy of the car and the moose?

If there was a change in the kinetic energy, where did it go as energy is always conserved? Explain using a few brief but complete sentences.

Please note that in the province of Newfoundland and Labrador on the very East coast of Canada, there were 5,422 moose-vehicle collisions (MVCs) between 1988 and 1994, resulting in 14 human and approximately 4,800 moose deaths. Source: http://www.jstor.org/pss/3784010

ANSWER:

We know that momentum is conserved, but not kinetic energy because this is an INELASTIC collision.

$$m_{car}v_{car} + m_{moose}v_{moose} = m_{car+moos} \ v_{final}$$

$$v_{final} = \frac{m_{car}v_{car} + m_{moose}v_{moose}}{m_{car+moose}} = \frac{m_{car}V}{m_{car} + m_{moose}}$$

The kinetic energy before the collision was:

$$KE_{initial} = \frac{1}{2}m_{car}v_{car}^{2} + \frac{1}{2}m_{moose}v_{moose}^{2} = \frac{1}{2}m_{car}V^{2}$$

The kinetic energy after the collision was:

$$KE_{final} = \frac{1}{2}m_{car+moose}v_{final}^{2} = \frac{1}{2}(m_{car} + m_{moose})v_{final}^{2}$$

$KE_{final} - KE_{initial}$ Joules of kinetic energy was lost. The energy was converted into heat, noise, and the work to break the windshield. There was also some lost to potential energy to "lift" the moose onto the hood of the car.