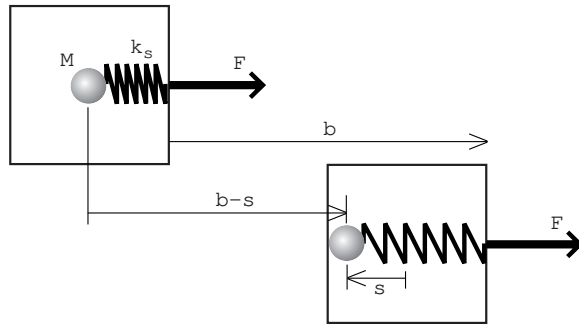


Physics 2211 GPS Week 12

Problem #1

A thin box in outer space contains a large ball of clay of mass M , connected to an initially relaxed spring of stiffness k_s . The mass of the box is negligible compared to M . The apparatus is initially at rest. Then a force of constant magnitude F is applied to the box. When the box has moved a distance b , the clay makes contact with the left side of the box and sticks there, with the spring stretched an amount s . See the diagram for distances.

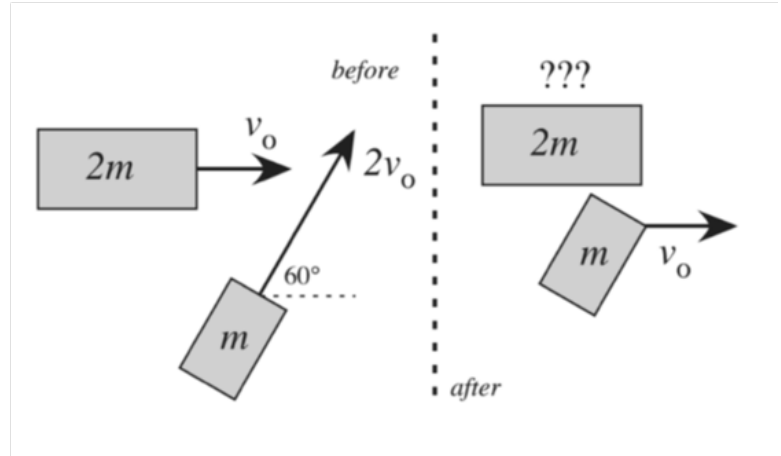


(a) Immediately after the clay sticks to the box, how fast is the box moving?

(b) What is the increase in thermal energy of the clay?

Problem #2

A cruise ship is moving due east with some speed v_0 when it collides with a boat moving 60° north of east with a speed $2v_0$. The boat's mass is m and the cruise ship's mass is $2m$. Immediately after the collision, the boat is observed to be floating due east with a speed v_0 .

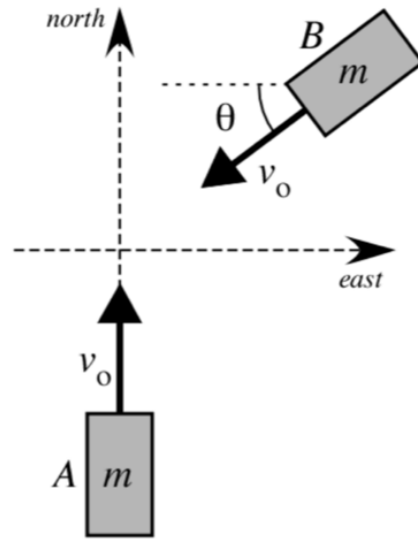


(a) Determine the velocity of the cruise ship just after the collision. You need to express your answer in terms of the parameter v_0 .

(b) What percentage of the original kinetic energy was lost in the collision?

Problem #3

Two cars of identical mass m are involved in a collision. Both cars are moving at the same speed v_0 . One of the cars is initially moving due north, and the other is initially moving south of west at an angle θ (where $45^\circ < \theta < 90^\circ$). The collision between the two vehicles is maximally inelastic; in other words, the vehicles stick together after the collision.



- (a) Determine the magnitude of the final velocity of each car after the collision, in terms of the quantities m , v_0 , and θ .

Problem #4

A person of mass m_1 is walking at constant velocity $\vec{v}_1 = \langle v_1, 0, 0 \rangle$ along the sidewalk towards an intersection, looking down at their phone. At the same time, another person riding a scooter (total mass m_2) approaches the intersection with unknown velocity $\vec{v}_2 = \langle 0, v_2, 0 \rangle$. Neither the person walking nor the person on the scooter notice each other, and so they crash.

The two people and the scooter stick together after the crash, moving together with an **unknown final speed** at an angle θ above the x-axis.

(a) How fast was the scooter moving before the crash? I.e., what was the initial speed v_2 ? Your answer must use **ONLY** variables that represent known quantities (m_1, m_2, v_1, θ). Hint: drawing a diagram may help.

(b) What was the change in internal energy of the system during the crash? Again, your answer must only use variables that represent known quantities in the problem.