

Problem 5: A cup containing 0.25 kg of water at 22 °C is placed in a microwave oven. After 60 s the temperature of the water is found to be 50 °C.

- a) How much heat flowed to the water?
- b) What was the average power delivered to the water?

~~**Problem 6:** (Momentum, kinetic energy, and collision) Suppose a mass $m = 2.0$ kg moves in the $+x$ direction with a speed $v = 2.0$ m/s on a frictionless surface. The mass then explodes into two pieces with the first piece $m_1 = 0.5$ kg moving backwards with a speed of $v_1 = 1.0 \times 10^1$ m/s. The second piece with a mass of $m_2 = 1.5$ kg moves forward.~~

- ~~c) What is the speed of m_2 ?~~
- ~~d) How much kinetic energy is lost or gained in the explosion?~~

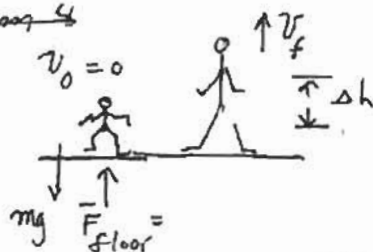
~~**Problem 7:** A mass m_1 is initially moving in the positive x direction with a speed $v_{1,0}$ and collides elastically with a mass m_2 , which is initially moving in the opposite direction with an unknown speed $v_{2,0}$. After the collision m_1 moves with an speed $v_{1,f} = v_{1,0} / 2$, at an angle $\theta_{1,f} = 90^\circ$ with respect to the positive x direction. After the collision, m_2 moves with an unknown speed $v_{2,f}$, at an angle $\theta_{2,f} = -45^\circ$ with respect to the positive x direction.~~

- ~~a) Find the speed $v_{2,f}$ in terms of $v_{1,0}$, m_1 , and m_2 .~~
- ~~b) Find the speed $v_{2,0}$ in terms of $v_{1,0}$, m_1 , and m_2 .~~
- ~~c) Find the mass ratio m_1 / m_2 .~~

~~**Problem 8:** The rubber bands in Expt VS have a spring constant k and are attached to a mass m_1 . The rubber bands are initially stretched spring a distance y from the equilibrium position.~~

- ~~a) What is the period of oscillation for this system?~~
- ~~b) What is the velocity of the mass when it reaches the equilibrium position?~~
- ~~c) When the rubber bands are completely compressed, a second mass $m_2 = 2 m_1$ is attached to the first mass, completely inelastically. What is the new period of the system?~~
- ~~d) Will the rubber band mass now extend to the same distance y ? Assume mechanical energy is conserved.~~

Problem 4



solve for v_f :

$$v_f = \left(2 \left(\frac{\bar{F}_{\text{floor}} - mg}{m} \right) \Delta h \right)^{1/2} = \left(\frac{(2)(2mg) \Delta h}{m} \right)^{1/2}$$

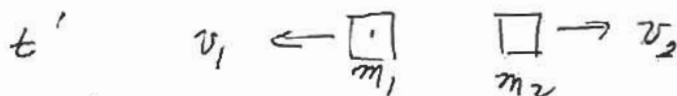
$$v_f = (2)(g \Delta h)^{1/2} = (2) \left(\frac{9.8 \text{ m}}{\text{s}^2} \right) (0.2 \text{ m})^{1/2} = 2.8 \frac{\text{m}}{\text{s}}$$

Problem 5 a) $\Delta Q = m c_w \Delta T$

$$= (25 \text{ kg}) \left(\frac{4190 \text{ J}}{\text{kg} \cdot \text{K}} \right) (28 \text{ K}) = 2.9 \times 10^4 \text{ J}$$

$$\text{b) } P_{\text{ave}} = \frac{\Delta Q}{\Delta t} = \frac{2.9 \times 10^4 \text{ J}}{60 \text{ s}} = 4.9 \times 10^2 \text{ W}$$

Problem 6:



Momentum is conserved because there are no external forces. Energy is not conserved due to the explosion.

$$\Delta p_x = 0$$

$$m_2 v_2 - m_1 v_1 = m v = 0$$

$$v_2 = \frac{m v + m_1 v_1}{m_2} = \frac{(2.0 \text{ kg})(2.0 \frac{\text{m}}{\text{s}}) + (0.5 \text{ kg})(1.0 \times 10^1 \frac{\text{m}}{\text{s}})}{(1.5 \text{ kg})} = 6 \text{ m/s}$$