Physics 247 HW09

1)

A rocket of initial mass 10 kg burns until its mass is 1 kg. The rocket starts at rest, and its ejected gas leaves at a velocity of 2000 m/s.

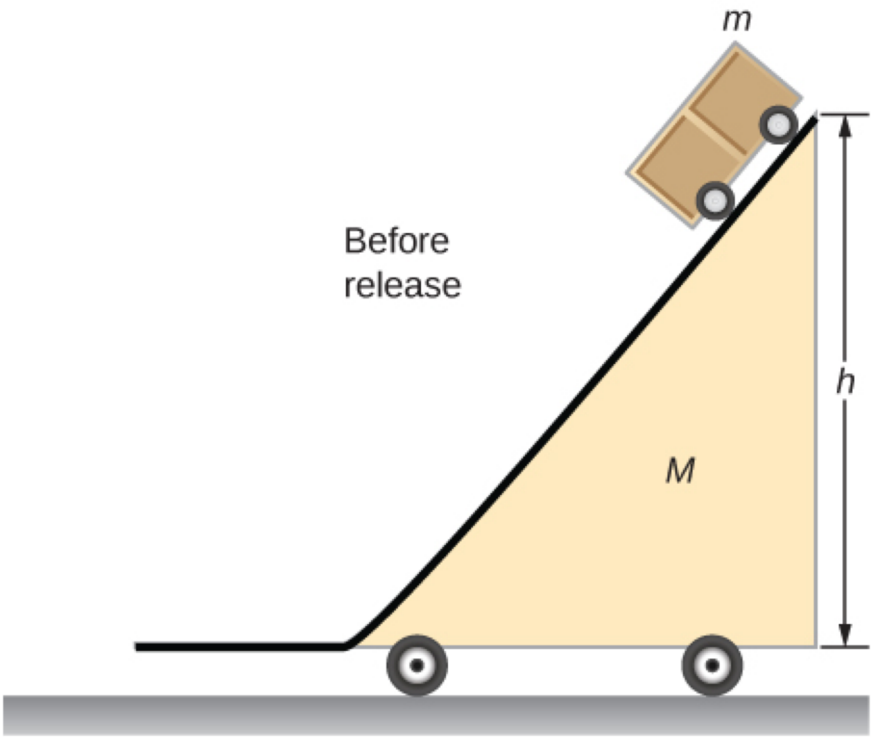
(a) If the rocket moves in a region of space with no gravitational field, what is its velocity at the end of the burn?

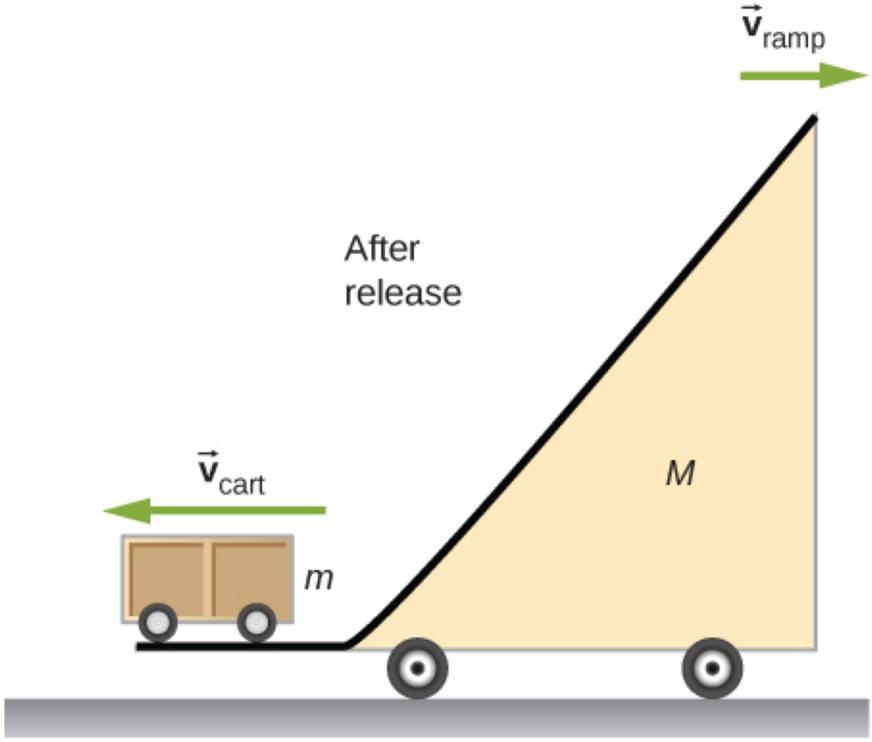
(b) After the burn, the rocket collides inelasitically with a piece of debris which is at rest. The mass of the debris is 1kg, the collision is head on, and the rocket and debris stick together after the collision. What is their velocity after the collision?

(c) If instead the rocket collides elastically with the debris, what is the rocket's velocity after the collision? Assume the debris moves in the direction of the rocket's initial velocity.

2) A particle of mass $m_1 = m$ and velocity $v_1 = 1000$ m/s collides head on with a particle of mass $m_2 = 2m$ which is at rest before the collision. The collision is elastic, and the two particles move in the $\hat{x}$ direction after the collision.
(a) Write down the equations which express conservation of momentum and con- servation of energy using classical physics.
(b) Find the final velocity of both particles by solving the equations you wrote down for part (b).

3) (from OpenStax) A ramp of mass M is at rest on a horizontal surface. A small cart of mass m is placed at the top of the ramp and released. What are the velocities of the ramp and the cart relative to the ground at the instant the cart leaves the ramp?


m
Before
release
h
M


$\vec{v}_{ramp}$
After
release
M
$\vec{v}_{cart}$
m