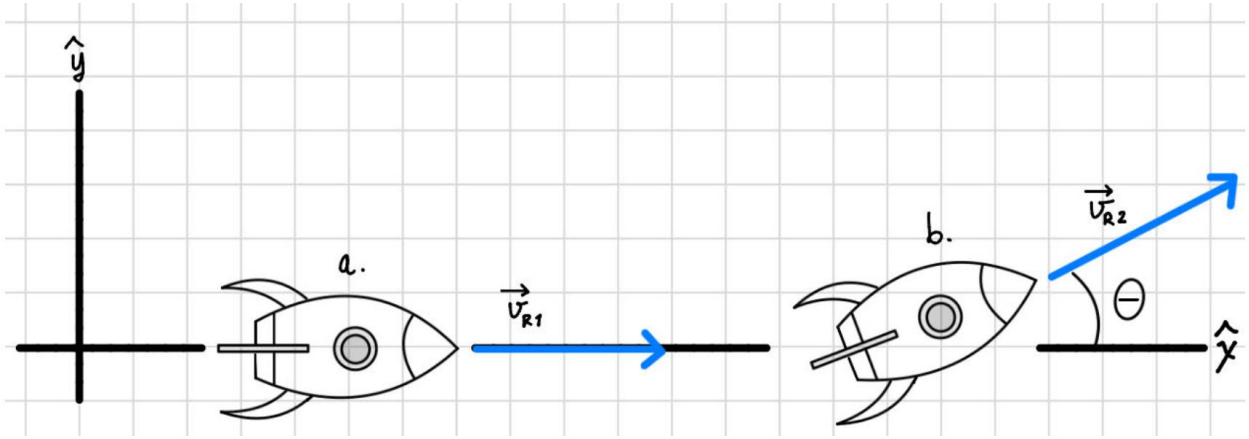
Name: _____

HW 7: Chapter 7

1. Discrete rocket Bursts

A rocket drifts at rest in deep space. Its total mass (structure + fuel) is $M_0 = 2000\ kg$. The pilot can fire identical "bursts" that eject $m_f = 5.0\ kg$ of propellant at exhaust speed $u = 2500\ m/s$ relative to the rocket. Each burst is short enough to treat as impulsive.

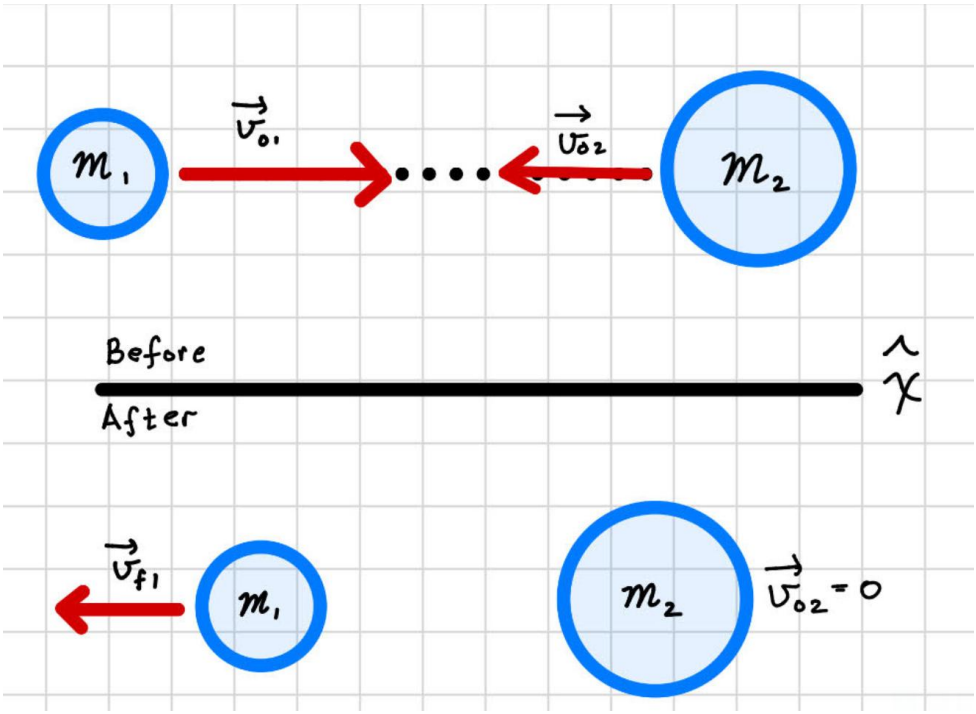
a. The pilot fires one burst straight backwards (so thrust points $+\hat{x}$). What speed does the rocket gain?
b. Immediately after, the pilot yaws and fires a second identical burst with thrust 30^0 above $+\hat{x}$. What is the rocket's new speed and heading?
c. If the bursts lasts $\Delta t = 0.50\ s$, estimate the average thrust during the second burst and the rocket's average acceleration during that burst.



2. Head-on Elastic Collision Between Two Masses

The figure shows a head-on elastic collision between two balls. No external forces act on the balls. What must $\vec{v}_{01}$ be such that m_2 is at rest after the collision?

a. Write a general equation for v_{01} in terms of $v_{02},\ m_1, m_2$.
b. If $m_1 = 5\ kg$, and $m_2 = 50\ kg$, and $v_{02} = 5\ m/s,$ what is v_{01} and v_{f1}?



3. When Objects Collide!

Two objects undergo an elastic collision. Object 1 ($m_1 = 5\ kg$) is initially moving along with an unknown initial velocity $\vec{v}_{10} = (v_{10x}, v_{20x})$ and object 2 ($m_1 = 3\ kg$) moves along the x-axis with an unknown velocity $\vec{v}_{20} = (v_{20x}, 0)$. After the collision, object 1's velocity is $\vec{v}_{1f} = (1, 2)\ m/s$ and object 2, $v_{2f} = (1, -2)\ m/s$. Calculate the unknown initial velocities $v_{10x}, v_{10y}, v_{20x}$.

(Hint: You can use conservation of linear momentum or conservation of center-of-mass velocity along with the conservation of kinetic energy)