

## Physics 303K Worksheet 7

1. Name (Write legibly! If I can't read your name, you don't get credit for attending.):
  
2. The Ghost Pirate LeChuck needs to flee Melee Island quickly. His normal crew of ghost pirates are on strike because of his managerial style. In a hurry, he commissions a crew of circus performers to sail his ship. Unfortunately, the performers don't know the ropes. LeChuck makes a characteristic decision as captain. To propel the ship, LeChuck wants to fire the circus performers out of a cannon in the opposite direction of intended travel. But LeChuck wants to save gunpowder, so he charges you, the cabin mate, to calculate how fast they can go by some other means that doesn't use gunpowder. You figure the crew can pole-vault astern. There are enough crew members to approximate the process as continuous. In time  $t$ ,  $n$  crew members of mass  $m$  each jump off the back of the ship, so the average rate of mass change is  $\frac{d(nm)}{dt}$ . There are  $N$  crew members in total. The crew jumps with a speed  $v_{rel}$  relative to the ship. The ship itself has mass  $M$  and starts at rest in the dock. What is the maximum velocity that the pirate ship can attain?

