Ph201H/211H
F08 Homework – Due November 20, 2008

1. Consider a system composed of three particles initially at rest: a mass of 4.1 kg initially located at $(x,y) = (-2,3)$, 8.2 kg at (4,2), and 4.1 kg at (1,-2). All distances are given in meters. (a) Find the initial location of the center of mass of the system. (b) The particles are acted upon by three different external forces: a force of 6 N in the negative x direction acts on the first particle, 12 N at +45° acts on the second particle, and 14 N in the positive x direction acts on the third particle. The system is released from rest at $t = 0$. Find the location of the center of mass at $t = 2.5$ s in two different ways: (i) by applying Newton's 2nd law separately to each particle and finding its location at 2.5 s; (ii) by applying Newton's 2nd law to the entire system and finding the velocity of the center of mass.

Answers: (a) $x_{cm} = 1.8$ m, $y_{cm} = ??$ (b) $x_{cm} = ??$, $y_{cm} = 2.9$ m

2. A projectile of mass 9.6 kg is launched from the ground with an initial velocity of 12.4 m/s at an angle of 54° above the horizontal. At some time after its launch, an explosion splits the projectile into 2 pieces. One piece, of mass 6.5 kg, is observed at 1.42 s after the launch at a height of 5.9 m and a horizontal distance of 13.6 m from the launch point. (a) If the projectile had not exploded, where would it be located at $t = 1.42$ s? (b) The explosion is an internal force which cannot change the motion of the center of mass. Where is the center of mass of the 2 fragments at $t = 1.42$ s? (c) Find the location of the second fragment at that time.

Answers: (a) (10.35, 4.36) m (c) $x = 3.5$ m, $y = ??$