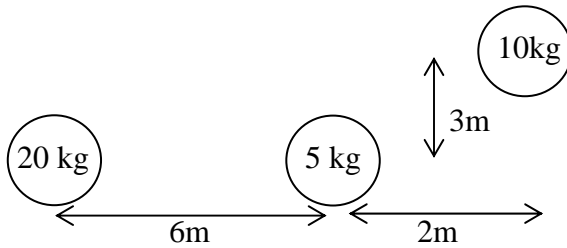


## Center of Mass

1. Find the center of mass (relative to (0,0)) for the spheres with the following masses and locations :  $m_1 = 5\text{kg}, (1,1)$        $m_2 = 10\text{ kg}, (3,1)$        $m_3 = 15\text{kg}, (1,6)$ .

2. Find the center of mass of the following particles (drawn large so they can be seen):



3. An old go-kart with a mass of 300 kg is traveling in a straight line at 80 m/s. It is followed by a 4-wheeler with mass of 200 kg moving at 60 m/s. How fast is the center of mass moving?

4. A 1500 kg VW is heading 40 m/s in a straight line. A 4000 kg Cadillac is heading directly for it at 60 m/s. Find the velocity (magnitude and direction) of the center of mass.
5. A 1500 kg car is at rest. At the instant it starts to move (with an acceleration of  $3.5\text{m/s}^2$ ), a truck ( $m= 3000\text{kg}$ ) traveling at a constant speed of 12 m/s passes it. At  $t = 3$  seconds:
- How far is the center of mass of the vehicles, relative to the starting point of the car?
  - What is the speed of the center of mass of the vehicles?
6. A rock, of mass  $M$ , is dropped at  $t= 0$  seconds. Two seconds later a stone, of mass  $2M$ , is dropped. At  $t = 3$  seconds (assume neither hits the ground):
- What is the center of mass of the rock and stone relative to the drop point?
  - How fast is the center of mass going at this time?

7. Calculate the  $V_{cm}$  before the collision and then calculate the  $V_{cm}$  after the collision.  
(Show all work for this problem)

