Equilibrium and Center of Mass

1. What two concepts are associated with equilibrium? $\Sigma F = 0\ N \quad \Sigma \tau = 0\ Nm$

2. Three particles of mass 12, 20 and 45 kg are at locations on the XY plane of (1,5), (2,10) and (8,7), respectively. Determine the center of mass of the 3 particle system.

$X_{com} = 5.35m \quad Y_{com} = 7.5\ m$

3. Three forces act on a 20 kg object, causing it to accelerate. The forces are as follows: F1 = 7i +6j N, F2 = -12i +4j N and F3 = 15i – 29 J N.

   a. Determine the magnitude and direction of the object's acceleration.

$1.08\ m/s^2 \ @ -62.2°$

   b. Create a fourth force that can act on the object so the object will no longer accelerate.

$F_4 = 10\hat{i} - 19\hat{j}$

4. Two forces act on an object, F1 = 784N @10°SW and F2 = 245 N @ 40° SE. Determine the magnitude and direction of the 3rd force that will put the object in equilibrium.

$654\ N @ 26.7°$

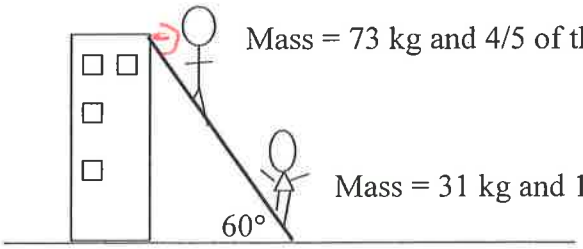
5. A 15 meter long teeter totter, with uniformly distributed mass of 39.9 kg, was poorly designed and the fulcrum controlling the teetering dandiness was placed 5 meters from the end. When Bobby (90 kg) was placed on the far end of the board, how much mass did he need to put on the short side (at the end) so he could hang out perfectly balanced in equilibrium.

$m = 199.95\ kg$

6. A 17 kg ladder is propped up against a house making a 75° angle with the ground. Starbo (95 kg) begins to climb the ladder to run off with his love, Milak. As he gets 2/3 of the way up the ladder, Milak's Dad (140 kg) peers his head out of the window, freezing Starbo in his tracks. What is the force of the wall on the ladder keeping it in equilibrium, just before Milak's dad removes the force completely?

$F = 188.63\ N$

7. Find the force of the wall, if the ladder is 25 meters in length, has a mass of 30 kg and is uniformly distributed while the system is in equilibrium (picture not drawn to scale).



$F_{n_{wall}} = 450.4\ N$