Two-Body Analysis

Two-body problems (and three-body problems) are typically approached by completing two distinct analyses. There is a **system analysis** in which the two objects are considered to be a single object moving (or accelerating) together as a whole. The mass of the system is the sum of the mass of the individual objects. If an acceleration is involved, the acceleration of the system is the same as that of the individual objects. There is also an **individual object analysis** in which an object is isolated and considered as a separate entity. Free-body diagrams are constructed in the usual manner and individual forces acting upon the object are identified and calculated. In general, a system analysis is usually performed to determine the acceleration of the system (and therefore of the individual objects). And an individual object analysis is performed to determine the value of any force which acts between the two objects - for example, contact forces or tension forces.

1. A 5.0-kg and a 10.0-kg box are touching each other. A 45.0-N horizontal force is applied to the 5.0-kg box in order to accelerate both boxes across the floor. Ignore friction forces and determine the acceleration of the boxes and the force acting between the boxes. Start by constructing free-body diagrams and solving for the appropriate unknowns.

System Analysis (find acceleration)	**Individual Object Analysis** (find contact force on big box)
	

2. Repeat the above analysis, but assume that there is friction between the boxes and the floor. The coefficient of kinetic friction is 0.200. Determine the acceleration and the contact force.

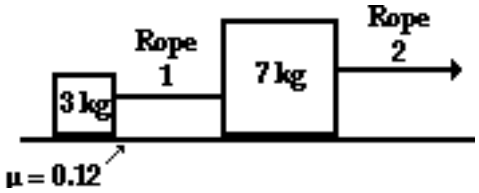
System Analysis (find acceleration)	**Individual Object Analysis** (find contact force on big box)
	

3. A truck hauls a car cross-country. The truck's mass is 4000. kg and the car's mass is 1600. kg. If the force of propulsion resulting from the truck's turning wheels is 25000. N, then determine the acceleration of the car (or the truck) and the force at which the truck pulls upon the car. Assume negligible air resistance forces.

System Analysis (find acceleration)	**Individual Object Analysis** (find applied force on car)
	

4. Conduct a free-body analysis for the truck in the above problem and determine the force applied by the car upon the truck. What do you notice?

5. A 7.00-kg box is attached to a 3.00-kg box by rope 1. The 7.00-kg box is pulled by rope 2 with a force of 25.0 N. Determine the acceleration of the boxes and the tension in rope 1. The coefficient of friction between the ground and the boxes is 0.120.



System Analysis (find acceleration)	**Individual Object Analysis** (find tension in rope 1)