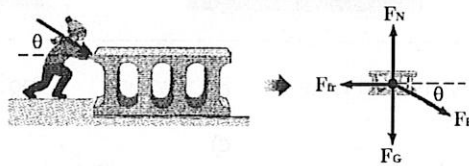


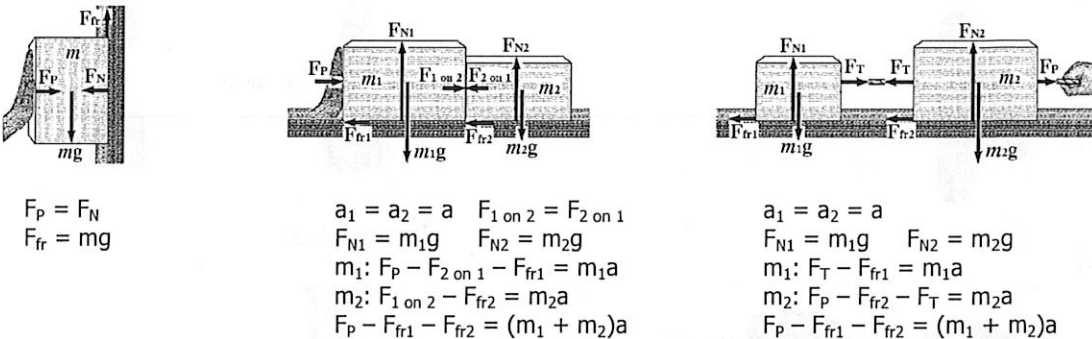
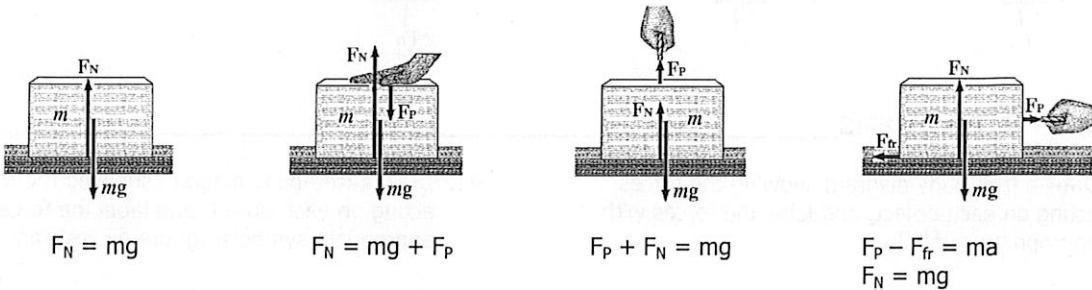
**POINT 8 Free-Body Diagram and Labeling**

A. Free-body diagram

- a. A free-body diagram is a diagram that represents an object and the forces acting on it.
- b. Only the forces acting on the object appear in a free-body diagram. A free-body diagram is very helpful to solve problems involving the forces on one or more objects.



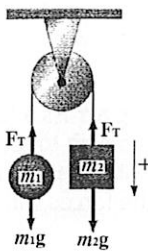
B. Forces acting on one or more objects



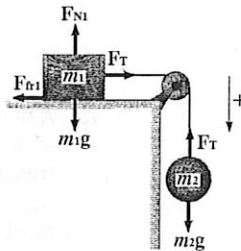
$F_p = F_N$   
 $F_{fr} = mg$

$a_1 = a_2 = a$     $F_{1 \text{ on } 2} = F_{2 \text{ on } 1}$   
 $F_{N1} = m_1g$     $F_{N2} = m_2g$   
 $m_1: F_p - F_{2 \text{ on } 1} - F_{fr1} = m_1a$   
 $m_2: F_{1 \text{ on } 2} - F_{fr2} = m_2a$   
 $F_p - F_{fr1} - F_{fr2} = (m_1 + m_2)a$

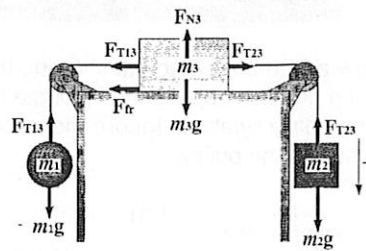
$a_1 = a_2 = a$   
 $F_{N1} = m_1g$     $F_{N2} = m_2g$   
 $m_1: F_T - F_{fr1} = m_1a$   
 $m_2: F_p - F_{fr2} - F_T = m_2a$   
 $F_p - F_{fr1} - F_{fr2} = (m_1 + m_2)a$



$a_1 = a_2 = a$   
 $m_1: F_T - m_1g = m_1a$   
 $m_2: m_2g - F_T = m_2a$   
 $m_2g - m_1g = (m_1 + m_2)a$



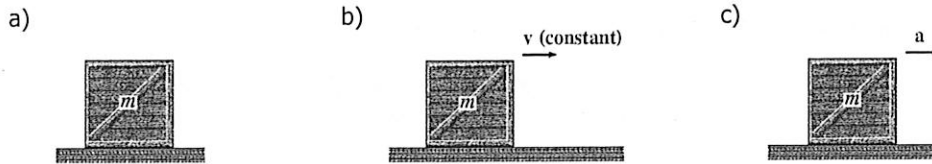
$a_1 = a_2 = a$   
 $F_{N1} = m_1g$   
 $m_1: F_T - F_{fr1} = m_1a$   
 $m_2: m_2g - F_T = m_2a$   
 $m_2g - F_{fr1} = (m_1 + m_2)a$



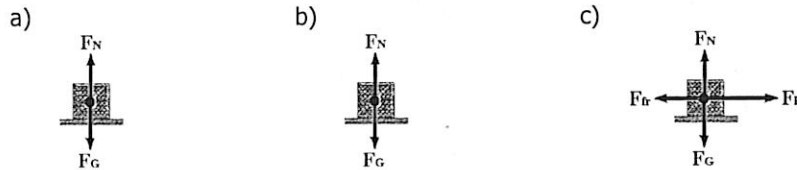
$a_1 = a_2 = a_3 = a$   
 $F_{N3} = m_3g$   
 $m_1: F_{T13} - m_1g = m_1a$   
 $m_2: m_2g - F_{T23} = m_2a$   
 $m_3: F_{T23} - F_{T13} - F_{fr} = m_3a$   
 $m_2g - m_1g - F_{fr} = (m_1 + m_2 + m_3)a$

**PROBLEM 8 Free-Body Diagram and Labeling**

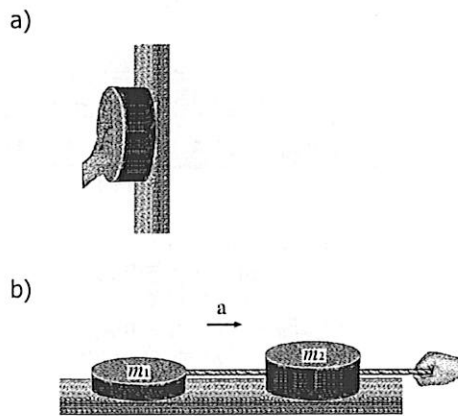
Draw a diagram showing the forces acting on each object and label the forces with appropriate symbols.



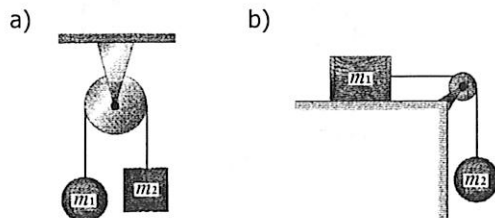
**Solution**  $F_P$ : applied force     $F_N$ : normal force     $F_{fr}$ : friction     $mg$ : gravitational force

**RELATED PROBLEMS**

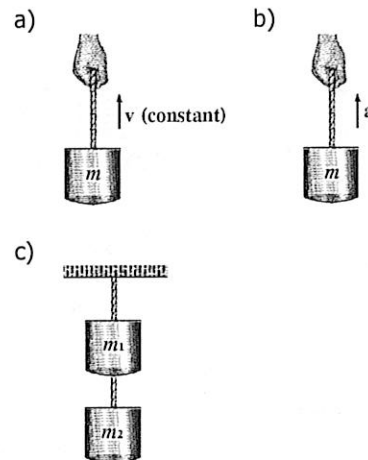
39. Draw a free-body diagram showing the forces acting on each object, and label the forces with appropriate symbols.



40. Draw a free-body diagram showing the forces acting on each object, and label the forces with appropriate symbols. Ignore the mass and friction of the pulley.



41. Draw a free-body diagram showing the forces acting on each object, and label the forces with appropriate symbols. Ignore air resistance.



42. A boy on a sled is moving across a horizontal stretch of snow before coming to rest. Draw a free-body diagram showing the forces acting on the system, and label the forces with appropriate symbols.

