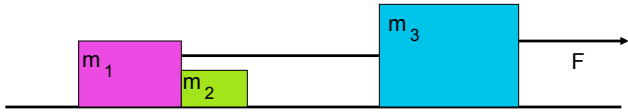


**Problem 4.29**

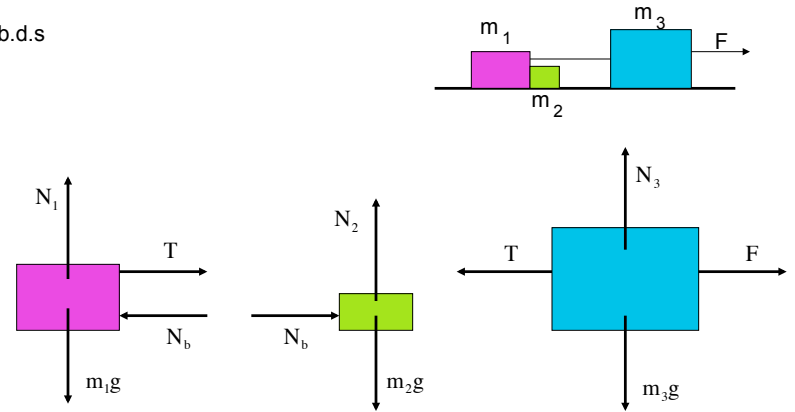
$m_1 = 1 \text{ kg}$   
 $m_2 = 2 \text{ kg}$   
 $m_3 = 3 \text{ kg}$   
 $F = 42 \text{ N}$



- Determine the acceleration of the system.
- Determine the tension in the line between the blocks.
- Determine the force exerted by the left mass on the central mass.

1.)

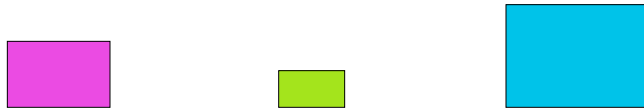
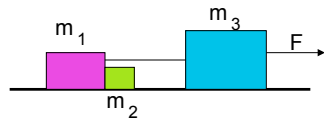
f.b.d.s



Notice that I've used common labels. That is, the normal force between the left two blocks are both labeled  $N_b$  with only the direction of the arrow being different. THIS IS THE WAY TO DO THIS. Use THE SAME SYMBOLS FOR ALL Newton's Third Law ACTION/REACTION COUPLES!

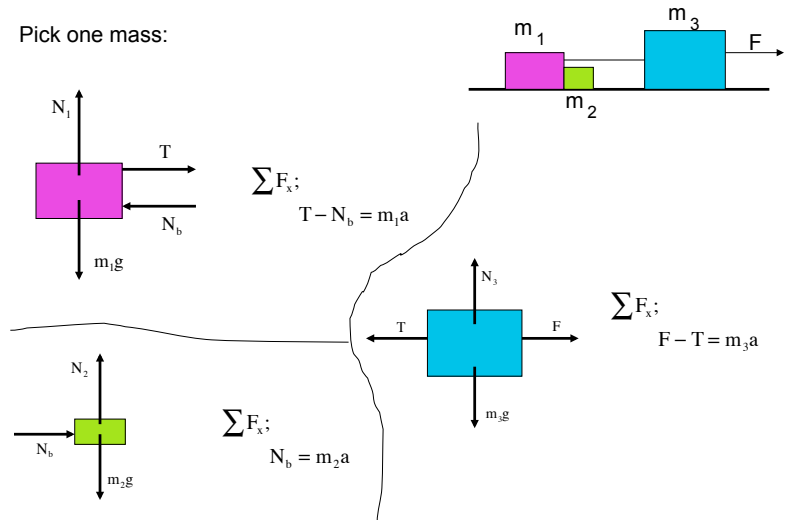
3.)

f.b.d.s



2.)

Pick one mass:

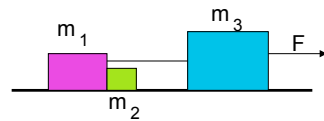


**NOTE:** Summing the vertical forces on any of the masses is useless as there is no friction in the system. If there had been, we'd have to include those force sums.

4.)

We know that  $F=40$  newtons and that our derived equations are as shown below.

$$T = (F - m_3 a) \quad T - N_b = m_1 a \quad N_b = m_2 a$$



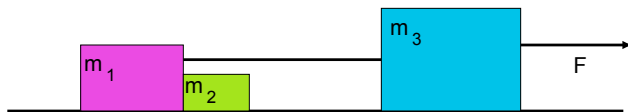
Substituting  $T$  from the first relationship and  $N$  from the last relationship into the middle equation, we get:

$$\begin{aligned} T - N_b &= m_1 a \\ (F - m_3 a) - (m_2 a) &= m_1 a \\ \Rightarrow a &= \frac{F}{m_1 + m_2 + m_3} \\ \Rightarrow a &= \frac{42 \text{ nt}}{1 \text{ kg} + 2 \text{ kg} + 3 \text{ kg}} \\ \Rightarrow a &= 7 \text{ m/s}^2 \end{aligned}$$

5.)

Quick and dirty on the acceleration calculation:

$$\begin{aligned} m_1 &= 1 \text{ kg} \\ m_2 &= 2 \text{ kg} \\ m_3 &= 3 \text{ kg} \\ F &= 42 \text{ N} \end{aligned}$$



The quick and dirty approach asks the question, "What are the forces that motivate the system?" In this case, it's just "F." That will equal the total mass times the total mass's acceleration. As such, we can write:

$$\begin{aligned} F &= (m_1 + m_2 + m_3) a \\ \Rightarrow a &= \frac{F}{(m_1 + m_2 + m_3)} \\ \Rightarrow a &= \frac{42 \text{ nt}}{(1 \text{ kg} + 2 \text{ kg} + 3 \text{ kg})} \\ \Rightarrow a &= 7 \text{ m/s}^2 \end{aligned}$$

6.)