Tensions, Systems and Newton's Laws

Concept: When connecting objects with a string, recall that there is a *single* value of the tension whenever:

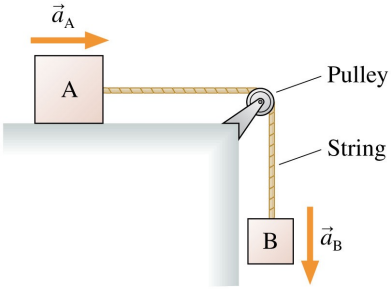
- The string is horizontal and in equilibrium; or
- The string is ideal (non-deformable and with negligible mass).

Before applying Newton's 1st or 2nd Law to a problem, make sure to:

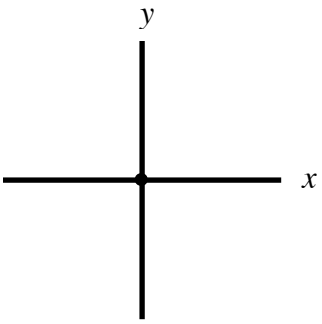
- Clearly identify the system or object(s) of interest.
- Consider the forces external to that system.
- Recall the acceleration constraint.

Blocks Connected by a String

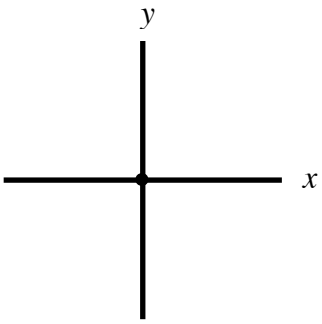
Block A (mass m_A) slides on a frictionless surface. It is connected to block B (mass m_B) by a string passing over a pulley. What is the acceleration of the system? (Both the string and pulley are ideal.)



block A:



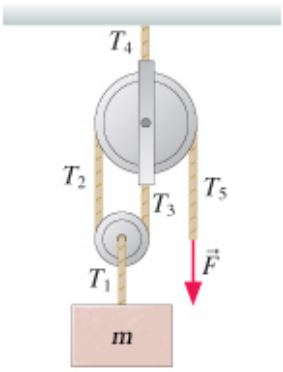
block B:



Block and Tackle

Consider the configuration of ropes and pulleys (block and tackle) illustrated in the figure.

What are the tensions in each rope segment and the pulling force ***F*** that maintain the system in equilibrium? Consider the ropes and pulleys to be ideal.



Guiding questions:

- How many ropes are there?
- How does the tension T_5 compare to T_2 and T_3?
- How does the tension T_5 compare to pulling force F?
- What is your system? Consider separately:
  i. the box
  ii. the small pulley
  iii. the large pulley