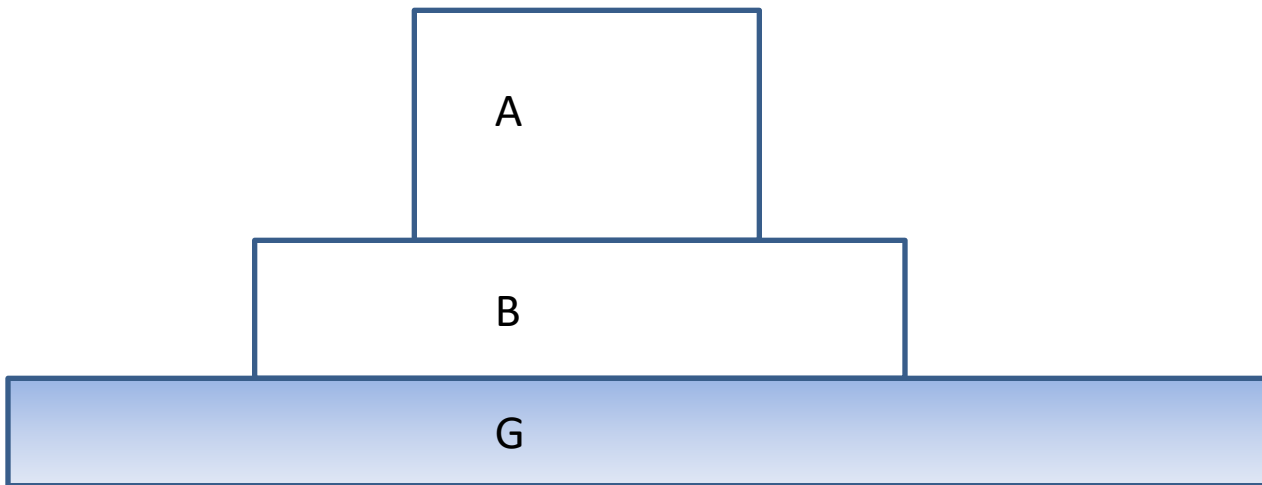


# Newton's Third Laws

- Newton's 3<sup>rd</sup> Law: For every action there is an equal and opposite reaction – a pair of action and reaction forces
  - Involves two objects (pair).
  - Action-reaction forces: from one to the other (and vice versa) the two forces are always on two objects (never on the same object).
  - Equal in magnitude and opposite in direction.
  - Always the same type of forces.

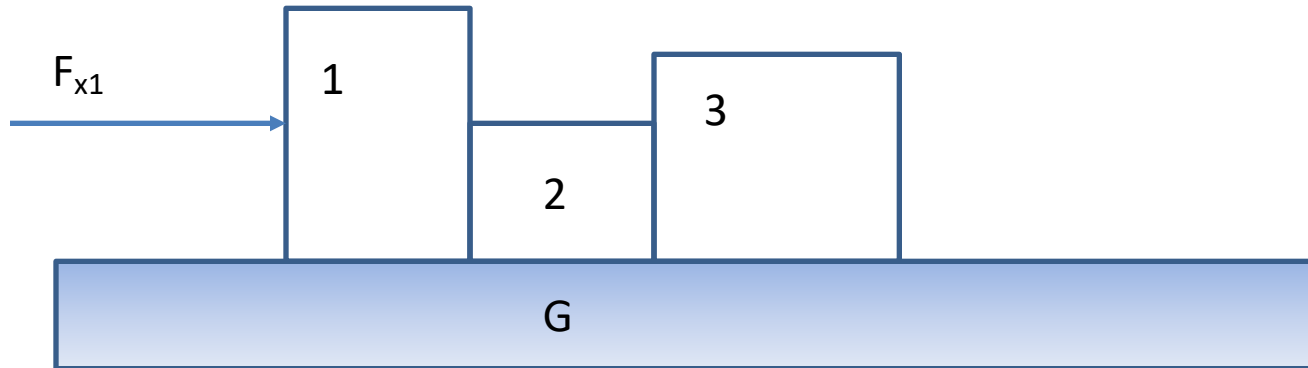
# Free Body Diagram

All objects are stationary and all surfaces have no friction.

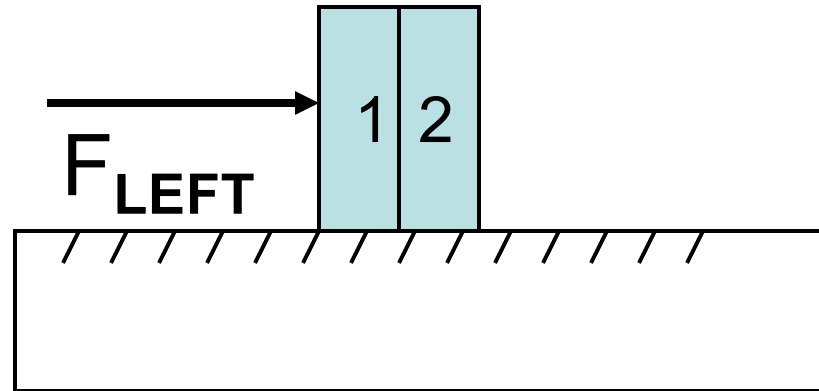


# Free Body Diagram

No Friction

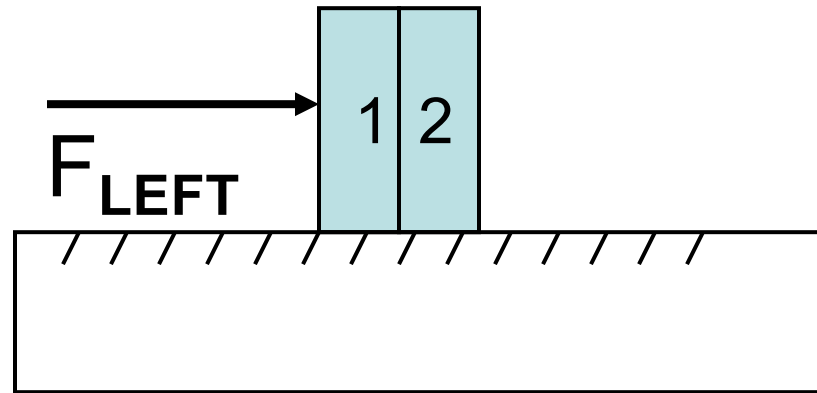


Tom pushes two identical blocks on a horizontal frictionless table **from the left**. The force that block 1 exerts on block 2 is  $F_{12}$ . The force that block 2 exerts on block 1 is  $F_{21}$ . Compare **the magnitude** of  $F_{12}$  and  $F_{21}$ .



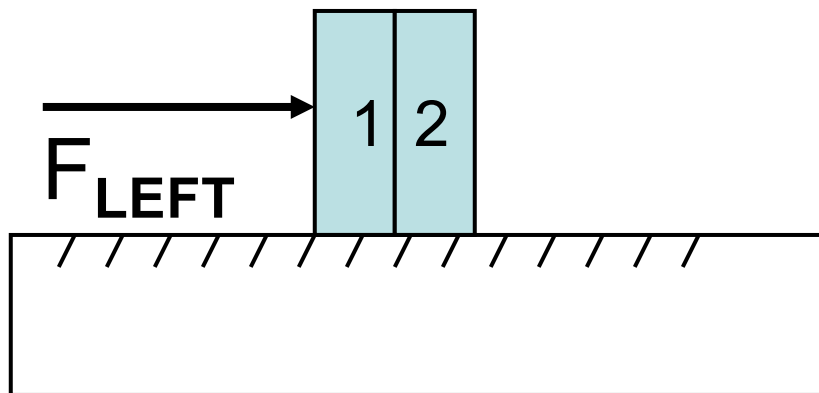
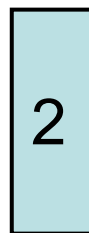
1.  $F_{12} < F_{21}$
2.  $F_{12} = F_{21}$
3.  $F_{12} > F_{21}$
4. Cannot be determined

Tom pushes two identical blocks on a horizontal frictionless table **from the left**. The force that block 1 exerts on block 2 is  $F_{12}$ . The force that block 2 exerts on block 1 is  $F_{21}$ . Compare **the magnitude** of  $F_{12}$  and  $F_{\text{LEFT}}$ .

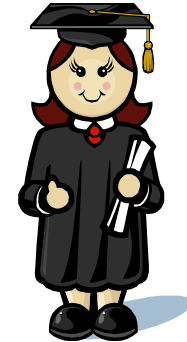
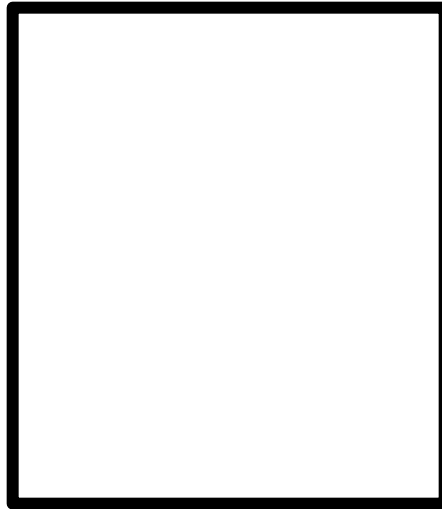
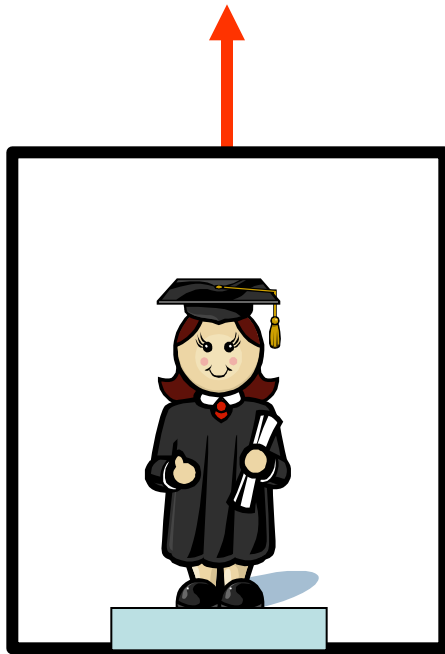


1.  $F_{12} < F_{\text{LEFT}}$
2.  $F_{12} = F_{\text{LEFT}}$
3.  $F_{12} > F_{\text{LEFT}}$
4. Cannot be determined

## Free Body Diagrams for 1 and 2

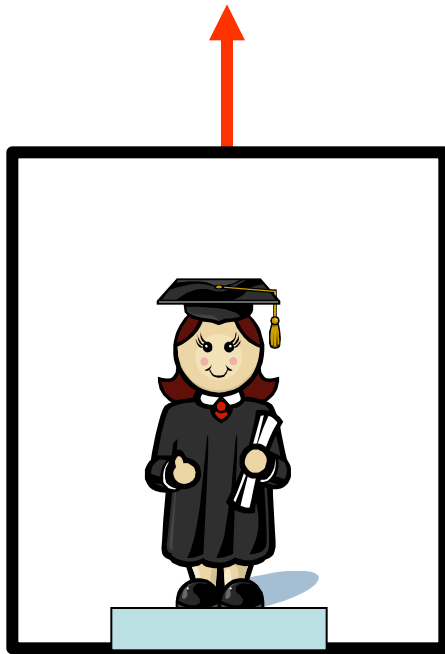


# Set up the problem

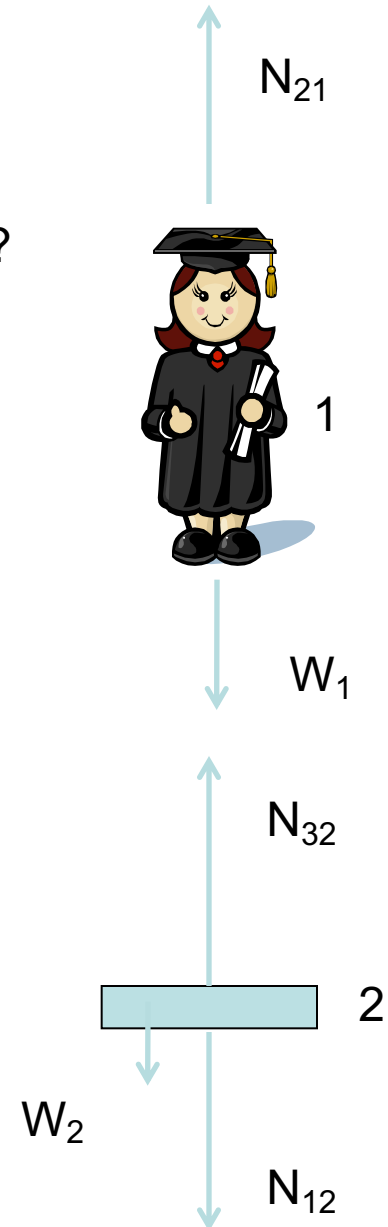


# Free Body Diagrams

How do  $W_1$  and  $N_{21}$  compare?

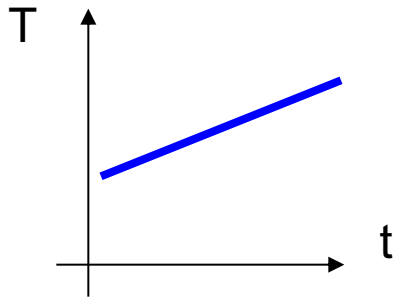


3

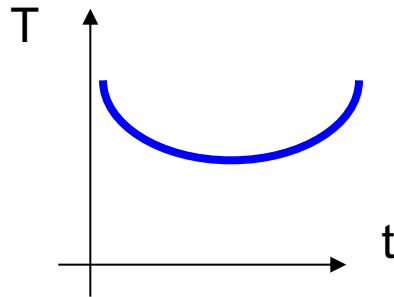




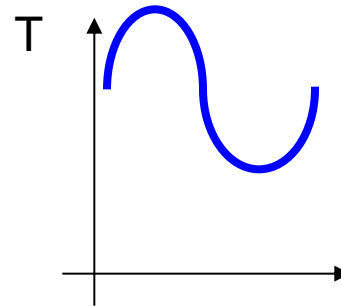
A student is riding an elevator in the Acme Building, and the elevator is moving a constant upward speed. Which plot shows the **tension  $T$  in the elevator cable** as a function of time?



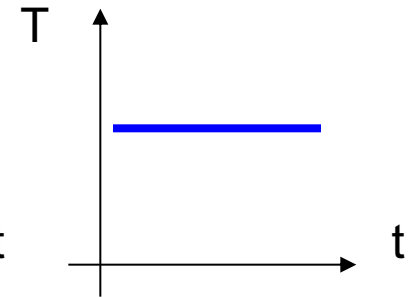
(a)



(b)

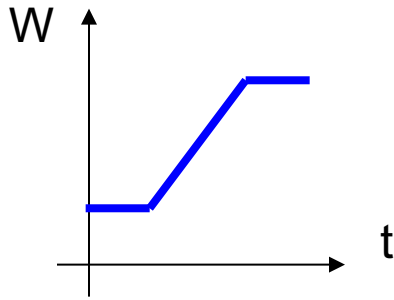


(c)

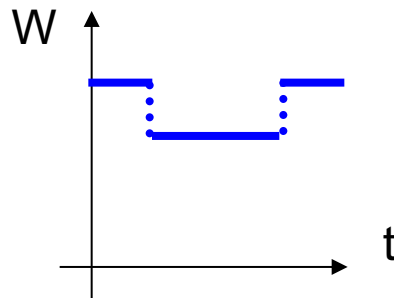


(d)

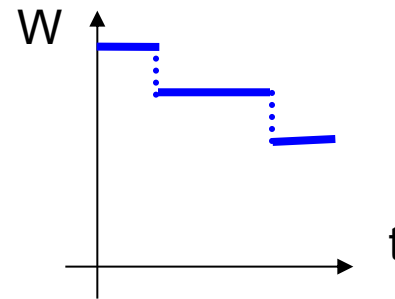
A student steps onto a bathroom scale in a stationary elevator on the first floor of the Acme Building. The elevator uniformly accelerates until it reaches the second floor and then continues at constant speed until the 5<sup>th</sup> floor, where it uniformly slows and stops on the 6<sup>th</sup> floor. Which sketch of **weight shown on the scale vs. time during the entire process** is most likely to be correct?



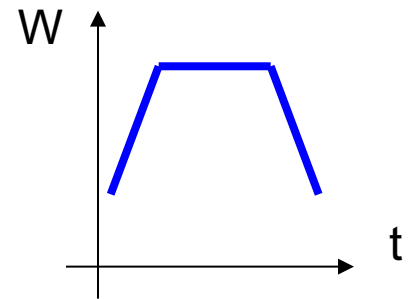
(a)



(b)



(c)



(d)