

CONCEPT: EQUILIBRIUM

- IF all the forces acting on an object _____, the object is at **EQUILIBRIUM**: _____ $\Leftrightarrow$ _____
 - Equilibrium **DOESN'T** mean an object isn't *moving* ($v = 0$)! It means the object isn't **accelerating** ($a = \underline{\hspace{1cm}}$)!

$$\Sigma F = ma$$

- In some problems, you'll know $\Sigma F = 0$, which means _____

$$\Sigma F = ma$$

- In other problems, you'll know $a = 0$, which means _____

EXAMPLE:

- a) Two equal forces pull on a box moving at a constant 5m/s. Assuming the box has no weight, calculate the box's acceleration.



- b) A 2kg book rests on a table and stays at rest. Assuming the book has weight, calculate the forces acting on the book.



FORCES

- 1) Draw FBD:
 W, F_A, T, N, f
- 2) Write $\Sigma F = ma$
- 3) Solve

PROBLEM: A 3-kg box of junk is being lowered on a string at a constant speed. What is the tension in the string?

- A) 0 N
- B) 3 N
- C) 29 N
- D) 32 N

FORCES
1) Draw FBD: $\mathbf{W, F_A, T, N, f}$
2) Write $\Sigma \mathbf{F} = m\mathbf{a}$
3) Solve

PROBLEM: A loudspeaker is held in place by four vertical cables. The tension in each cable is 30 N. What is the mass of the loudspeaker?

- A) 3.06 kg
- B) 12.2 kg
- C) 30 kg
- D) 120 kg

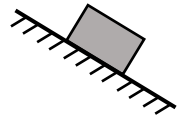
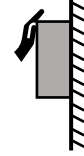
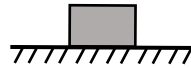
FORCES
1) Draw FBD: $\mathbf{W, F_A, T, N, f}$
2) Write $\Sigma \mathbf{F} = m\mathbf{a}$
3) Solve

CONCEPT: THE NORMAL FORCE

- IF anything is pushed against a surface in ANY direction, the surface pushes back with a force called _____ (___).

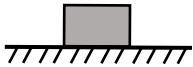
- **Normal** is always _____ (___) to surface.

- **NO EQUATION** for $\vec{N}$! Always calculate $\vec{N}$ using $\Sigma \vec{F} = m\vec{a}$.



EXAMPLE:

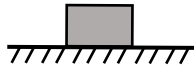
a) A 2.04kg book rests on a table. Calculate N .



- No other applied forces:

N mg

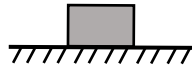
b) You push the book down with 10N. Calculate N .



- Push down (F_y along with mg):

N mg

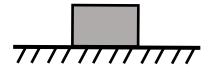
c) You pull the book up with 15N. Calculate N .



- Pull up, not enough to lift ($|F_y| < |mg|$):

N mg

d) You pull up with 30N. Calculate the acceleration.



- Pull up, enough to lift ($|F_y| \geq |mg|$):

N