

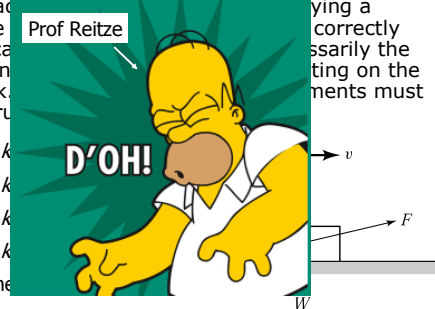
## Phy 2053 Announcements

1. Prof Chan has changed his Wednesday office hours from 11 am – 12 pm to 3-4 pm.
2. Access to homework solutions (and exam solutions)
  - Username: **chan** (all lower case)
  - Password: **send e-mail to Reitze**
3. Webassign useful information
  - the final answer usually requires 3 significant figures, and you should keep at least that many significant figures in intermediate steps to get the right answer.

## In class Quiz #7-2

A person pulls a block across a rough horizontal surface by applying a force  $F$ . The arrows in the diagram correctly indicate the directions but not necessarily the magnitudes of the various forces acting on the block. Which of the following statements must be true?

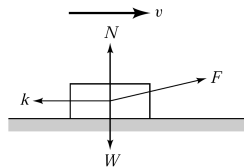
- Prof Reitze
- D'OH!
- A.  $F = k$   
 B.  $F = k$   
 C.  $F > k$   
 D.  $F > k$   
 E. None



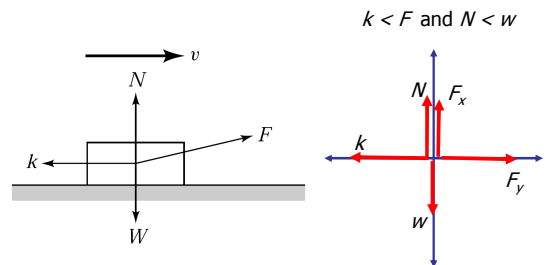
## In class Quiz #7-2

A person pulls a block across a rough horizontal surface at a constant speed by applying a force  $F$ . The arrows in the diagram correctly indicate the directions but not necessarily the magnitudes of the various forces acting on the block. Which of the following statements must be true?

- A.  $F = k$  and  $N = W$   
 B.  $F = k$  and  $N > W$   
 C.  $F > k$  and  $N = W$   
 D.  $F > k$  and  $N > W$   
 E. None of the above



## In class Quiz #7-2



Everybody who answered gets 2 points for this question

## Newton's Second Law

- The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.

$$\vec{a} \propto \frac{\sum \vec{F}}{m} \text{ or } \sum \vec{F} = m\vec{a}$$

## Newton's Third Law

- If object 1 and object 2 interact, the force exerted by object 1 on object 2 is equal in magnitude but opposite in direction to the force exerted by object 2 on object 1.

$$\vec{F}_{12} = -\vec{F}_{21}$$

– Equivalent to saying a single isolated force cannot exist

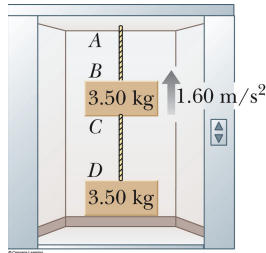
## Applications of Newton's Laws

- **Assumptions for now (will change in later chapters)**

- Objects behave as particles
  - Will ignore rotational motion
- Masses of strings, ropes, and pulleys are negligible and can be ignored when solving problems

**Example #4.21**

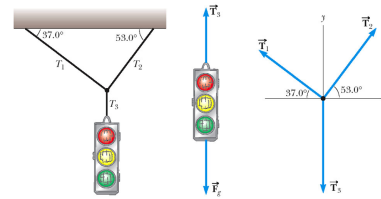
Two blocks each of mass 3.5 kg are fastened to the top of an elevator. (a) If the elevator accelerates upward at  $1.60 \text{ m/s}^2$ , find the tensions  $T_1$  and  $T_2$  in the upper and lower strings. (b) If the strings can withstand a maximum tension of 85 N, what maximum acceleration can the elevator have before the first string breaks?



**Free Body Diagram**

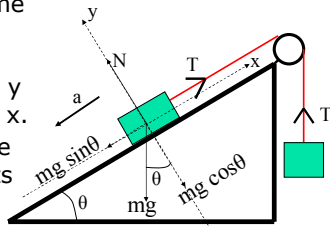
1. Identify all forces acting on object
2. Choose coordinate system
3. Resolve forces into components along the coordinate axes
4. Use Newton's laws to solve for unknown

$$\sum F_x = 0 \text{ and } \sum F_y = 0$$

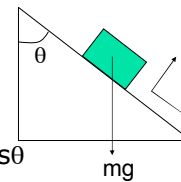


**Inclined Planes**

- Choose the coordinate system with  $x$  in the same or opposite direction of acceleration and  $y$  perpendicular to  $x$ .
- Replace the force of gravity with its components.



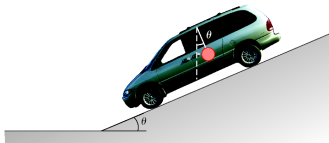
What force is acting on the mass along the inclined plane (in the +x-direction)?



- ✓ 1.  $mg \cos \theta$
- 2.  $-mg \cos \theta$
- 3.  $mg \sin \theta$
- 4.  $-mg \sin \theta$

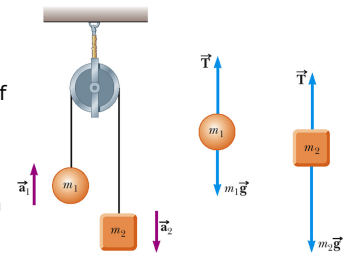
**Example #4-73**

A van accelerates down a hill (Fig. P4.71), going from rest to  $30.0 \text{ m/s}$  in  $6.00 \text{ s}$ . During the acceleration, a toy ( $m = 0.100 \text{ kg}$ ) hangs by a string from the van's ceiling. The acceleration is such that the string remains perpendicular to the ceiling. Determine (a) the angle  $\theta$  and (b) the tension in the string.



**Two objects connected by a massless string**

- Draw free body diagrams
- Apply Newton's Laws separately to each object
- The magnitude of the acceleration of both objects will be the same
- The tension is the same in each diagram
- Solve the simultaneous equations



**Example #4-38**

Two objects with masses of 3.00 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley, as in Figure P4.34. Determine (a) the tension in the string, (b) the acceleration of each object, and (c) the distance each object will move in the first second of motion if both objects start from rest.

