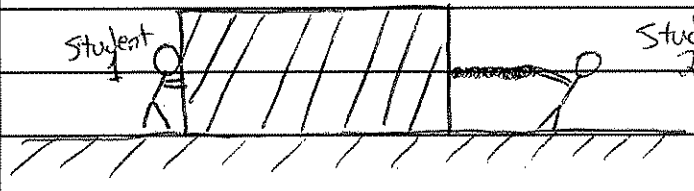


# Forces and Free Body Diagrams (FBD's)

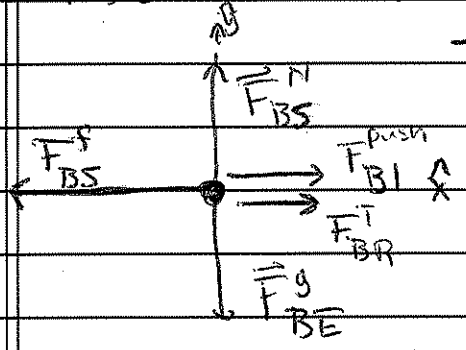
- Questions about exam
- Questions about HW
- What is a force?
  - Examples: gravity, friction, tension, push, pull
    - Categorize into contact and non-contact forces
  - Always between two objects
    - specify by identifying the object on which the force acts
  - Notation and the object that exerts the force.
    - $F_{AB}^A$
    - $F_{BA}^B$
    - Read "force of A on B by B"
- Free Body Diagram
  - A simplified diagram depicting the forces acting on your system.
  - Should never include forces exerted by the system on other objects
  - Should never include sketches of other objects that exert forces on the system.
  - The "system" is your choice.
    - Try to choose a system which simplifies the problem as much as possible.
    - Once system is identified draw dotted lines around it.

Student 1 pushes on the block while student 2 pulls on a rope which is attached to the block.



- Identify all forces acting on the block and draw them in a free body diagram.
- 1<sup>st</sup> draw a dot to represent the system of interest
  - in this case the block.
- 2<sup>nd</sup> draw vectors indicating both the magnitude and direction of the forces exerted on the system (block)
- 3<sup>rd</sup> label each vector using the notation given
  - $F_{AB}^C$

FBD for block

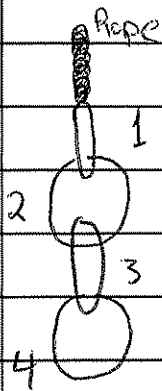


- Scaling
- Vectors should be scaled such that the total force vector can be easily obtained.
- Do not include total force vector on FBD.

- Question: As I have drawn this FBD, can you tell if the block is moving?

- Do include on FBD
  - Any important angles
  - Axes

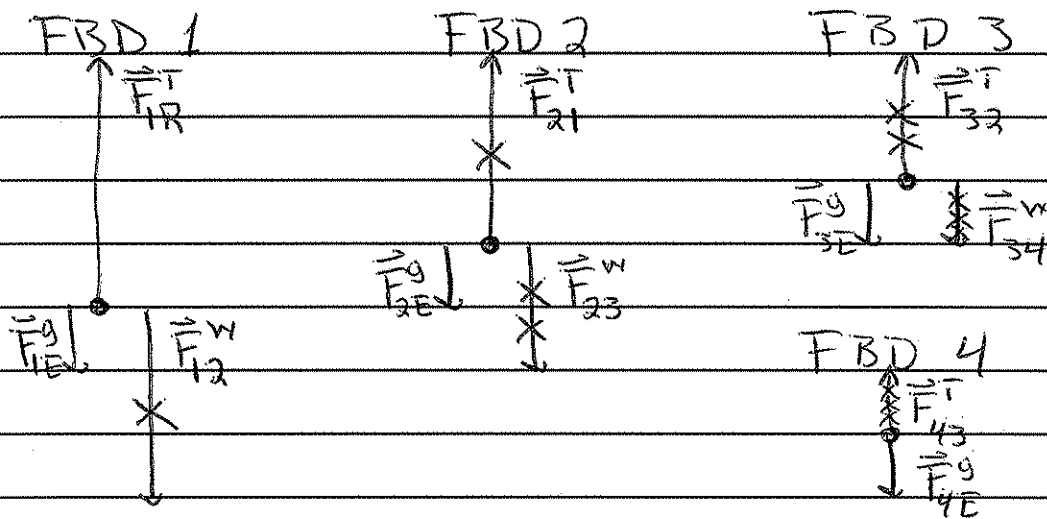
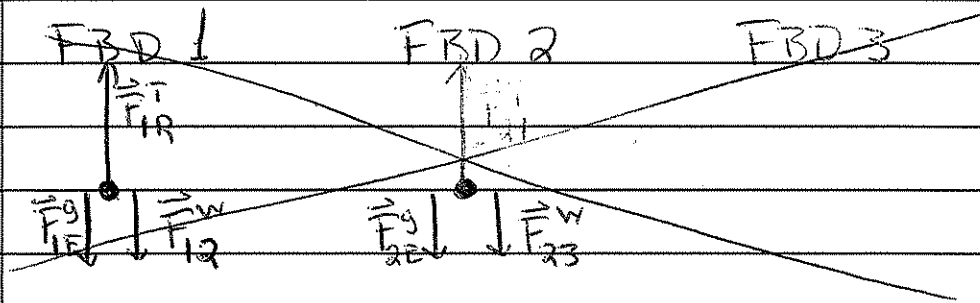
- Should we include a force by student 2 on the block?



- Consider a chain suspended by a rope

- Draw FBD for each of the four links individually

- Be mindful of the scaling of the vectors



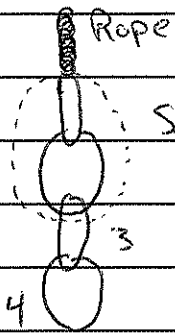
- Newton's 3rd law; (Karma law)

- When one body exerts a force on a second body, the second body exerts a force of equal magnitude and opposite in direction to that of the first body.

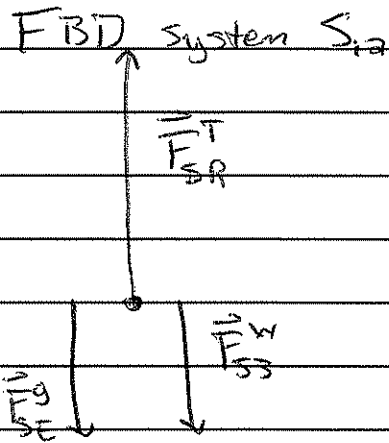
- For every action there is an equal and opposite reaction

- Identify force pairs in the 4 FBD's above

- Should not have force pairs on same FBD.



- Create FBD for system  $S_{12}$  comprised of 1st two links in the chain



- For each force in FBD list the corresponding force or forces from FBD 1 and FBD 2

$$\vec{F}_{SE}^g = \vec{F}_{1E}^g + \vec{F}_{2E}^g$$

$$\vec{F}_{SR}^T = \vec{F}_{1R}^T$$

$$\vec{F}_{S3}^w = \vec{F}_{23}^w$$

- Which forces are not included on this FBD, but were included on FBD 1 and FBD 2.

$$F_{12}^{wv} \text{ and } F_{21}^T$$

- The forces which are internal to the system.  
- The 3rd law force pairs.

- Draw FBD for the system comprise of all 4 links of chain

