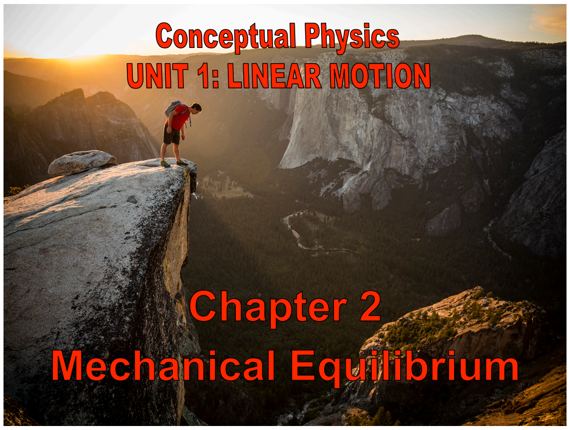
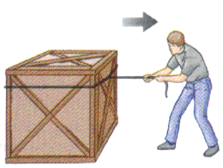


I. Force (2.1)

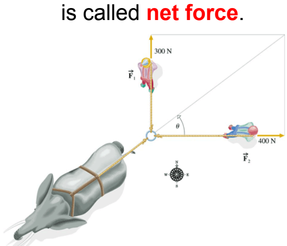
A. **force**– is a push or pull

1. A **force** is needed to change an object's state of motion
2. State of motion may be one of two things
   a. **At rest**
   b. **Moving uniformly** along a **straight-line path.**



B. **Net force**

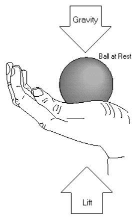
1. Usually more than one force is acting on an object
2. **combination of all forces** acting on object is called **net force**.
3. The net force on an object changes its **motion**

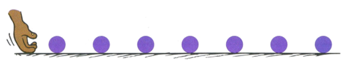


4. Can **add** or **subtract** to get resultant net force

5. If forces acting on object equal **zero** then we say the **net force** acting on the **object = 0**

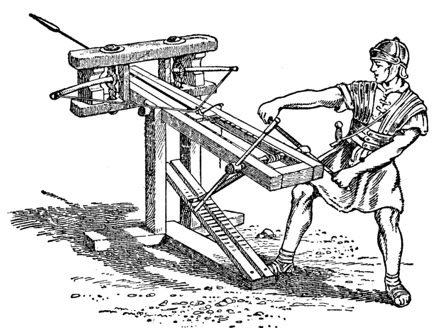
6. Scientific units for force are **Newtons (N)**





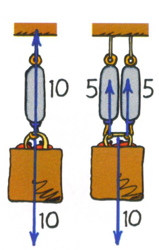
C. Tension and Weight

1. **Tension** is a "**stretching force**"



2. When you hang an object from a spring scale the there are <u>two</u> forces acting on object.

a. **Force of gravity** pulling <u>down</u> (also called **weight**)



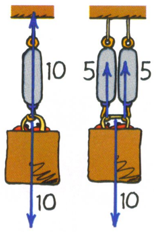
b. **Tension** force pulling <u>upward</u>

c. Two forces are **equal** and **opposite in direction** and add to zero (**net force = 0**)

D. Force Vectors

1. Forces can be represented by **arrows**

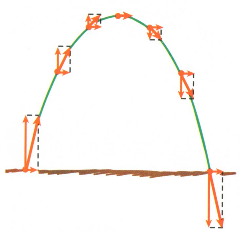
   a. **length** of arrow represents **amount** (**magnitude**) of force

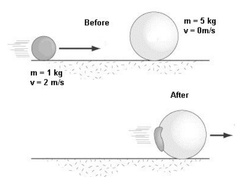


   b. **Direction** of arrow represents **direction of force**

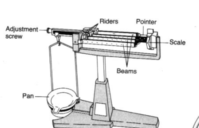
   c. Refer to arrow as a **vector** (represents both **magnitude** and **direction** of force

2. **Vector quantity**- needs both **magnitude** and **direction** to complete description (i.e. force, velocity, momentum)





3. **Scalar quantity**- can be described by **magnitude only** and has no direction (i.e. temperature, speed, distance)

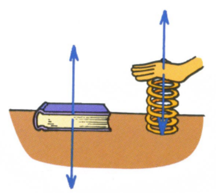


II. Mechanical Equilibrium (2.2)

A. Mechanical equilibrium- a state wherein **no physical changes occur (**state of steadiness)

1. When **net force equals zero**, object is said to be in **mechanical equilibrium**

a. Known as **equilibrium rule**

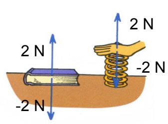


b. Can express rule **mathematically** as

$$\Sigma F = 0$$

1). ∑ symbol stands for "**the sum of**"

2). **F** stands for "**forces**"



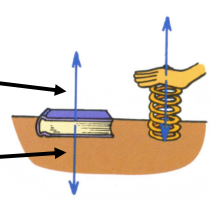
$$\Sigma F = (2 - 2) = 0$$

III. Support Force (2.3)

A. **support force**- the **upward** force that balances the weight of an object on a **surface**

1. The upward force balances the **weight** of an object

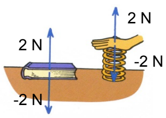
2. Support force often called **normal force**



B. For an object at **rest** on a horizontal surface, the **support force** must equal the objects **weight**.

1. Upward force is positive (+) and the downward force is negative (-).
2. Two forces add mathematically to zero

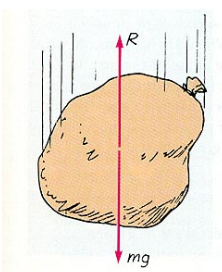
$$\Sigma F = 0$$



$$\Sigma F = (2 - 2) = 0$$

IV. Equilibrium of Moving Objects (2.4)

A. Equilibrium can exist in both objects at rest and objects moving at constant speed in a straight-line path.



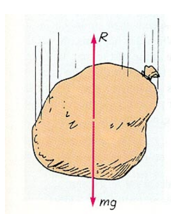
1. **Equilibrium** means **state of no change**
2. **Sum of forces equal zero**

$$\Sigma F = 0$$

B. Objects at rest are said to be in **static equilibrium**

C. Objects moving at constant speed in a straight-line path are said to be in **dynamic equilibrium**

Static equilibrium

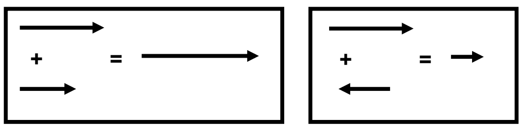


dynamic equilibrium

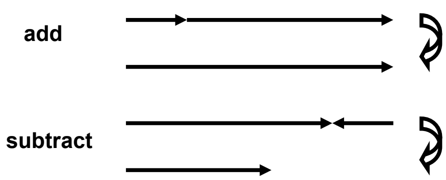
V. Vectors (2.5)

A. **Parallel vectors**

1. **Add** vectors if in **same direction**
2. **Subtract** vectors if in **opposite direction**
3. The sum of two or more vectors is called the **resultant vector.**



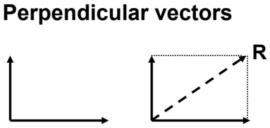
B. ***Parallel vectors***– simple to add or subtract



C. **Non-parallel vectors**

1. Construct a **parallelogram** to determine **resultant vector**
2. The **diagonal** of the parallelogram shows the **resultant**

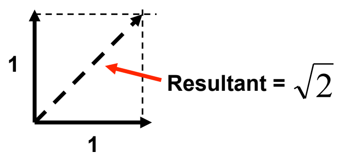
a. **Perpendicular vectors**



b. Perpendicular vectors with **equal** sides (special case)

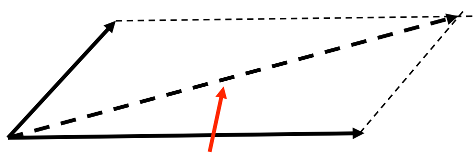
1). For a square the length of diagonal is $\sqrt{2}$ or 1.414

2). **Resultant = 1.414 x one of sides**

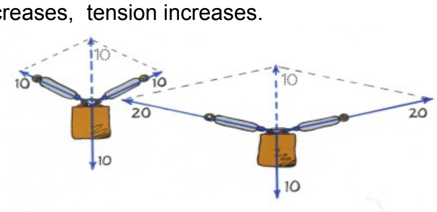


c. Parallelogram (**not perpendicular**)

- *Construct parallelogram*
- *Construct with two vectors as sides*
- *Resultant is the diagonal*

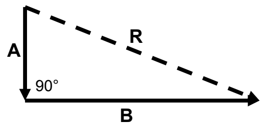


C. Applying the Parallelogram Rule- as angle increases, tension increases.



Pythagorean Theorem- can be used if vectors added are at ***right angles***

$$R^2 = A^2 + B^2 \text{ or } R = \sqrt{A^2 + B^2}$$



SOHCAHTOA

- **sin, cos,** and **tan** are functions of the angle of a triangle compared to the lengths of the sides of a triangle
- If you know the distances of the triangle sides, you can determine the inside angles.
- If you know the angle and one side, you can calculate the length of the other side of the triangle.
- Remember the following acronym: **SOHCAHTOA**
- These will give you the formula depending on which side or angle you need to calculate

$$\sin\theta = \left(\frac{O}{H}\right)$$

$$\cos\theta = \left(\frac{A}{H}\right)$$

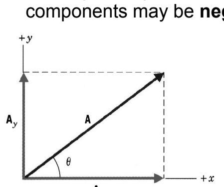
$$\tan\theta = \left(\frac{O}{A}\right)$$

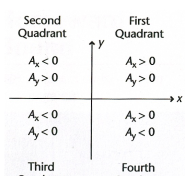
Components calculated using following **formulas**

$$A_x = A\cos\theta; therefore, \cos\theta = \left(\frac{adjacent}{hypotenuse}\right) = \left(\frac{A_x}{A}\right)$$

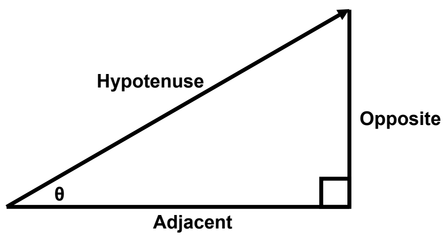
$$A_y = A\sin\theta; therefore, \sin\theta = \left(\frac{opposite}{hypotenuse}\right) = \left(\frac{A_y}{A}\right)$$

When angles larger than 90°, sign of one or more components may be **negative**





- Remember what the sides of a triangle are called

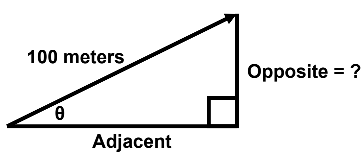


Example:

sin 25° = $\frac{\textbf{Length of Opposite side}}{\textbf{Length of Hypotenuse}}$

sin 25° = $\frac{\textbf{Length of Opposite side}}{\textbf{100 meters}}$

length of Opposite side = 38.3 meters



Graphical Addition of Vectors

•Simple method for combining vectors to get resultant vector

•Use ***ruler*** to measure ***length*** of **vector**

•Use ***protractor*** to measure ***angle***