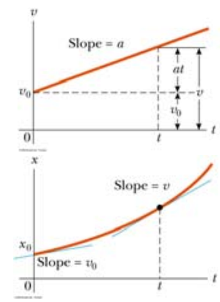
Phy 2053 Announcements

- Homework 1 due Jan 21 is posted in webassign. It will count towards course grade.
- 3 more days to register your code in webassign
- Yellow book (past exams and solutions) available at Target Copy for $16
- Should have received email listing your clicker response. Clicker questions will count towards course grade starting Jan 27.
- Optional solution manual: a limited number of copies will be available today at the UF bookstore, at ~ $54. It contains solutions to some but not all of the problems at the back of chapters.

Kinematic Equations

- Used in situations with uniform acceleration

- $v = v_o + at$
- $\Delta x = v_o t + \frac{1}{2}at^2$
- $v^2 = v_o^2 + 2a\Delta x$
- $\Delta x = v_{average}\ t = \left(\frac{v_o + v_f}{2}\right)t$



Important: use the correct sign for x, v and a.

Some examples of Use

Acceleration not in equation $\Delta x = v_{average}\ t = \left(\frac{v_o + v_f}{2}\right)t$

Displacement not in equation: $v = v_o + at$

Final velocity not in equation : $\Delta x = v_o t + \frac{1}{2}at^2$

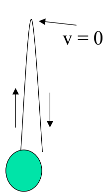
Time not in equation : $v^2 = v_o^2 + 2a\Delta x$

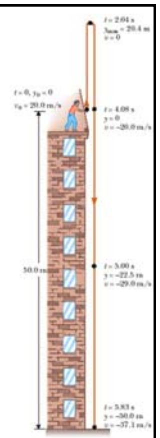
Free Fall

- If only force on object moving near surface of the earth is gravity it is in free fall
- Free fall is constant acceleration (same for **all** objects)
- The acceleration is called the acceleration due to gravity, symbolized by *g*
- g = 9.80 m/s²
  - When estimating, use $g \approx 10$ m/s²
- *g* is always directed downward
  - toward the center of the earth
- Ignore air resistance and assume *g* doesn't vary with altitude over short vertical distances
- Forces can apply to the object before or after the free fall

Free Fall options

- Initial velocity is zero
- Throw up -initial velocity non-zero and positive—instantaneous velocity at maximum height = 0
- Throw down –initial velocity is negative
- Starting and ending heights may be equal – symmetric or not equal-asymmetric - trajectory





A Typical Problem

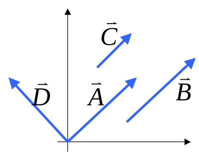
2-53. A model rocket is launched straight upward with an initial speed of 50.0 m/s. It accelerates with a constant upward acceleration of 2.00 m/s² until its engines stop at an altitude of 150 m. (a) what can you say about the motion of the rocket after its engines stop? (b) What is the maximum height reached by the rocket? (c) How long after lift-off does the rocket reach its maximum height? (d) How long is the rocket in the air?

Vectors

Vectors in one dimension: positive or negative, and magnitude
Vectors in two dimensions: direction and magnitude

- Equality of Two Vectors

  Two vectors are **equal** if they have the same magnitude and the same direction

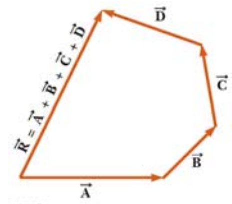


$\vec{A} = \vec{B}$

$\vec{A} \neq \vec{C}$

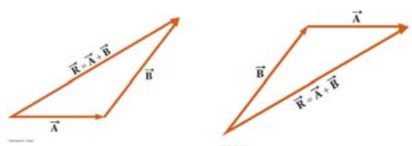
$\vec{A} \neq \vec{D}$

Graphically Adding Vectors



- When you add vectors, just put the tail of one on the head on the next…
- The resultant $\vec{\mathbf{R}}$ is drawn from the origin of the first vector to the end of the last vector.

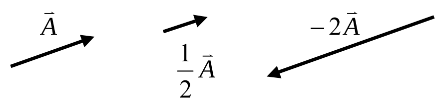
Commutative law of addition



The order in which the vectors are added doesn't affect the result $\vec{\mathbf{R}}$

$$\vec{\mathbf{A}} + \vec{\mathbf{B}} = \vec{\mathbf{B}} + \vec{\mathbf{A}}$$

Scalar Multiplication



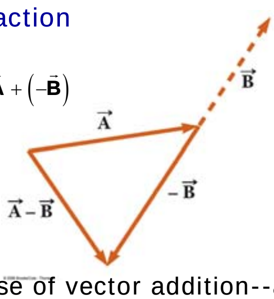
- The result of the multiplication or division of a vector by a scalar is a vector-the magnitude of the vector is multiplied or divided by the scalar

•If the scalar is positive, the direction of the result is the same as of the original vector

•If the scalar is negative, the direction of the result is opposite that of the original vector

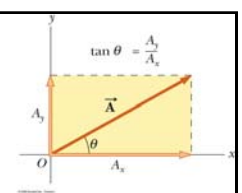
Vector Subtraction

$$\vec{\mathbf{A}} - \vec{\mathbf{B}} = \vec{\mathbf{A}} + \left(-\vec{\mathbf{B}}\right)$$



- Special case of vector addition--add the negative of the subtracted vector
- Continue with standard vector addition procedure

Vector Components



- The x-component of a vector is the projection along the x-axis

$$A_x = A\cos\theta \qquad \vec{\mathbf{A}}_x = A\cos\theta\,\vec{\mathbf{x}}$$

- The y-component of a vector is the projection along the y-axis

$$A_y = A\sin\theta \qquad \vec{\mathbf{A}}_y = A\sin\theta\,\vec{\mathbf{y}}$$

Then, $\vec{\mathbf{A}} = \vec{\mathbf{A}}_x + \vec{\mathbf{A}}_y$ These equations are valid ***only if θ is measured with respect to the x-axis***

Adding Vectors Algebraically

- Choose a coordinate system and sketch the vectors
- Find the x- and y-components of all the vectors

Add all the x-components $R_x = \sum A_x$

Add all the y-components $R_y = \sum A_y$

Use Pythagorean theorem find
The magnitude of the resultant: $R = \sqrt{R_x^2 + R_y^2}$

Use inverse tangent function
To find the direction of R: $\theta = \tan^{-1} \frac{R_y}{R_x}$

3.18 A small map shows Atlanta to be 730 miles in a direction 5° north of east from Dallas. The same map shows that Chicago is 560 miles in a direction 21° west of north from Atlanta. Assume a flat Earth and use the given information to find the displacement from Dallas to Chicago.

Displacement, Velocity, and Acceleration

- The position of an object is described by its position vector,
- The **displacement** of the object is defined as the
- ***change in its position*** $\vec{r}$ (meter)

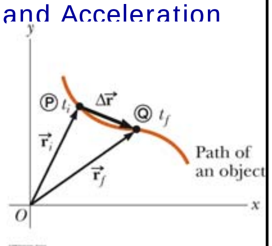
$$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$$

- ***Velocity*** (meter/sec)

$$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$$

- ***Acceleration*** (meter/sec²)

$$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$$



$\vec{a}_{av}$ **can change speed, direction, or both**