
Projectile Motion

Vectors and Scalars

- A Vector is a measurement that has both a magnitude and a direction.
- Ex. Velocity, Force, Pressure, Weight
- A Scalar is a measurement that just has a magnitude.
- Ex. Speed, Mass, Time (does time have a direction? Hmmm….)

Vector Addition

- If two vectors are going in the same direction, then the magnitudes are added.
- If two vectors are going in opposite directions, then their components can be subtracted.
- If there is a angle between them, then trigonometry needs to be used.
- If the angle is 90^o then use the Pythagorean Theorem ($a^2 + b^2 = c^2$)

Drawing Vector Diagrams

- Draw the component of the first vector by drawing an arrow (should be to scale).
- From the end of the first arrow, draw the second component as an arrow.
- Repeat for each additional component.
- Once all components are drawn, draw a third arrow from the base of the first component to the tip of the last component. This is the resultant.
- The resultant is the direction that the object is moving or being changed in.
- The parallelogram method works too!

Trigonometry

- Remember SOHCAHTOA? If not remember it now!
- SOH = sinθ = opposite / hypotenuse
- CAH = cos θ = adjacent / hypotenuse
- TOA = tan θ = opposite / adjacent
- This only works for right triangles
- The opposite and adjacent refers to the length of the sides next to or across from the angle being measured.

Projectile Motion

- What if an object is not fired straight up, or straight down?
- What is the acceleration?
- When?
- Does that change the motion in every direction?

Math of projectiles

- The first step in attacking a projectile motion problem is to determine the x and y components of its velocity.
- Use SOHCAHTOA to determine those components.
- Next separate the problem into the x direction and the y direction.
- What is your acceleration in the x? Always?
- What is your acceleration in the y? Always?

Math of projectiles continued

- Determine the total flight time by determining the time in the y-direction.
- Apply that term to the x-direction to determine the distance.
- If there is no initial y-component to the velocity, then the problems are simplified!
- If there is no initial x-component to the velocity, then it’s a freefall.

Satellites

- Satellites are in a constant state of freefall.
- That is why they feel no effects of gravity even though the Earth still has a rather large gravitational force at those small distances.
- Satellites have a large x-component of velocity, so they fall “around” the Earth and never hit the ground.
- Molecular friction does slowly slow the satellite’s x-component down so the orbits degrade. That’s why they come back!