Topic 2B: Acceleration Due To Gravity (Projectiles in One Dimension) Con't

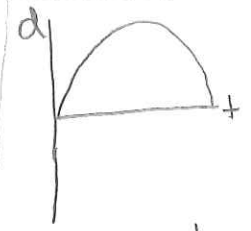
Skill 15: Objects Launched Upwards

Objects launched upward have an initial velocity (launch velocity) that is in the opposite direction of gravity (downward)
Since directions do not agree we must define directions:
by default up = + & down = − assume t=0 & d=0 occur at the ground

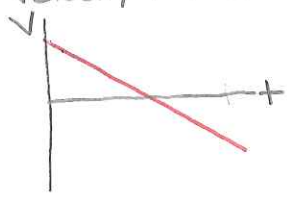
dot diagram

velocity vector diagram

position vs time graph



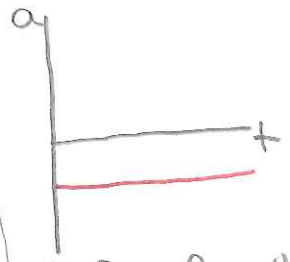
velocity vs time



description of motion

- object starts with a positive velocity that decreases while on the way up (gravity pulling down)
- object reaches v of zero at highpt
- object falls downward with an increasing (negative) speed (gravity pulling down)
- Reaches ground with velocity equal in magnitude but opposite in direction to launch velocity

acceleration vs time



The force of gravity is constant, so the acceleration is constant

Rules for Projectiles launched upward

The upward motion and the downward fall mirror oneanother when launch and landing are at same height.

- time up equals, time down: time to high pt is ½ of total flight time
- launch velocity is equal in magnitude but opposite in direction from landing velocity
- Velocity at the high point is zero
- acceleration is $9.81 \frac{m}{s^2}$ downward, the entire time of flight
- You may simplify the problem by considering only the falling half and working backward using rules.

- If the projectile lands at the same height as from where it was launched the displacement is zero.
- Since $\Delta V = V_f - V_i$ and $V_f = -V_i$ (equal but opposite) then $\Delta V = -2V_i$

therefore $a = \frac{\Delta V}{t}$ becomes $a = \frac{-2V_{iy}}{t}$

So $t = \frac{-2V_{iy}}{a}$ for approximation $t = \frac{-2V_{iy}}{-10 \frac{m}{s^2}}$

~~shortcut for total time of flight~~