GRAVITY

AN EVERYDAY EXAMPLE OF CONSTANT ACCELERATION

[EXPERIMENTAL FACT - NEWTON'S LAW OF GRAVITY - LATER IN COURSE]

ALL OBJECTS ACCELERATE DOWNWARDS WITH:

\[ g = 9.8 \text{ m/s}^2 \]

(FREE FALL)
Let's define a coordinate system:

\[ \begin{align*}
+ & \\
0 & \\
- & \\
\end{align*} \]

So acceleration due to gravity is

\[ a = -g \]

\[ = -9.8 \text{ m/s}^2 \]

\[ v = v_0 + at \]

\[ x = v_0 t + \frac{1}{2} at^2 \]

\[ x = \frac{v_0 + v}{2} t \]

\[ v^2 = v_0^2 + 2ax \]

\[ u = v_0 - gt \]

\[ y = v_0 t - \frac{1}{2} gt^2 \]

\[ y = \frac{v_0 + v}{2} t \]

\[ v^2 = v_0^2 - 2gy \]
THROW AN OBJECT VERTICALLY UPWARDS

\[ \begin{align*} v &= 0 \quad \text{AND} \quad a = -g \end{align*} \]

\[ a = -g \quad \text{and} \quad a = -g \]

\[ \uparrow v_i \quad v_f \downarrow \]

WHILE THE OBJECT IS IN THE AIR:

\[ a = -g \quad \text{EVERYWHERE} \]

(IT DOESN'T MATTER WHAT \( v \) IS!)
SOLVING PROBLEMS (HW!)

Some problems are single step. i.e. use 1 equation.

Solve equation for what is wanted.

E.g. you are given \( u_0, u, a \). What is \( t \)?

Use:

\[
U = U_0 + at
\]

\[
\Rightarrow \quad u - U_0 = at
\]

\[
\Rightarrow \quad at = u - U_0
\]

\[
\Rightarrow \quad t = \frac{u - U_0}{a}
\]
Some problems are two-step problems. Need at least two equations.

Eg: An object accelerates from rest with a for a time t.

It then decelerates with -a'. How long does it take to stop?

Use final velocity of part one as initial velocity of part two.

IE \( U_0' = U \)

Initial \( U \) of part two

Final \( U \) of part one
FIRST PART:
\[ v = v_0 + at = at \]  \( \text{(1)} \)

SECOND PART
\[ v' = v_0' - a't' \]
\[ = v - a't' = at - a't' \]

But \( v' = 0 \)

So:
\[ 0 = at - a't' \]

or:
\[ a't' = at \]

\[ t' = \frac{at}{a'} \]