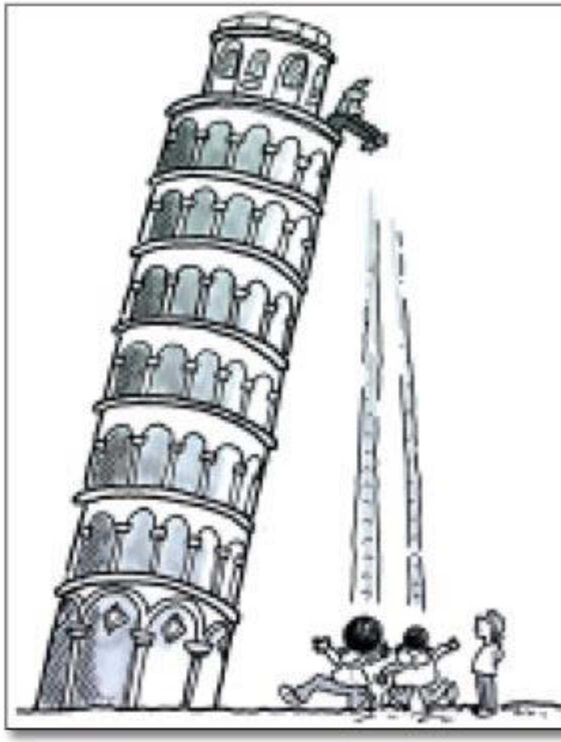
Acceleration

- Acceleration: $a = \frac{\text{change in velocity}}{\text{change in time}} = \frac{\Delta v}{\Delta t}$

Standard units of acceleration : m/s^2

- If there were no air resistance, all objects in Earth gravity would fall with the same acceleration,

$g = 9.81$ m/s^2 (directed downward)



Galileo Galilei's experiment in Pisa (possibly, a legend)

- For motion at constant acceleration a , with no initial speed, the displacement after time t is:

$$\Delta x = v_{average} t = \left(\frac{0 + at}{2} \right) \times t = \frac{at^2}{2}$$

Review of Kinematics

Velocity

$$v = \frac{\text{change in position}}{\text{change in time}} = \frac{dx}{dt}$$

displacement :

$$\Delta x = v\Delta t$$

Equation of Uniform Motion :

$$x(t) = x_0 + v_0 t$$

Acceleration

$$a = \frac{\text{change in velocity}}{\text{change in time}} = \frac{dv}{dt}$$

$$\Delta v = a\Delta t$$

displacement (if $v_0 = 0$) :

$$\Delta x = \frac{at^2}{2}$$

Equations of "$a = const$" Motion :

$$v(t) = v_0 + at$$

$$x(t) = x_0 + v_0 t + \frac{at^2}{2}$$

* Here x_0 and v_0 are position and velocity at t=0.

HOMEWORK

Problem 1.

According to a legend, Gallileo Gallilei was experimenting by dropping different objects from the top of the Leaning tower of Pisa (height is h=56 m). Neglecting air resistance, find how much time it took for those objects to fall, and what was their speed when they hit the ground. Assume $g=10m/s^2$.

Problem 2.

Imagine that Mr. Gallileo (from Problem 1) throws a rock from the top of the Tower of Pisa, with an initial velocity v=6 m/s directed <u>upward</u> .

a) Write equations of motion for this rock. To do this, first pick up your coordinate 'x': decide, where is 0, which way is positive. Than, determine initial position and velocity, as well as acceleration (pay attention to signs). Now you can write equations of motion in the form x(t)=…, and v(t)=….

b) From your equations, find the time 't' at which the rock hits the ground (you'll need to solve quadratic equation for that). How big is its speed at that time?