**Answer on Question #47980-Physics-Other**

We know that any matter falls in the earth duo to the gravitational force and it depends on the mass of that matter. But in the Falling matter principle of Galileo there said two matter of various mass falls at the same time when there is no air friction. My question is why the two matter fall in same time as there remains a matter of gravitational force? Doesn't the heavier one will fall down at first?

**Answer**

Let's say two separate mass $m_1$ and $m_2$ where $m_1 \ll m_2$, both fall, from the same instant in a gravitational field

Force on $m_1$ is $F_1 = G\frac{M_{earth}m_1}{R^2}$.

Force on $m_2$ is $F_2 = G\frac{M_{earth}m_2}{R^2}$.

Therefore the forces are $F_1 \gg F_2$.

So, most people think $m_1$ should accelerate much faster than $m_2$.

But as you wrote above $a = \frac{F}{m}$ and substituting $F_1$, $F_2$, $m_1$ and $m_2$ into that formula we find:

$$\frac{F_1}{m_1} = \frac{F_2}{m_2} = G\frac{M_{earth}}{R^2}.$$

Therefore the acceleration is independent of the masses we drop, and is a constant.

Since they are accelerated the same and start with the same initial conditions (at rest and dropped from the same height) they will hit the surface at the same time.