

UNITS

We are going to be using our own notation for units, starting with

- M mass
- Q charge
- S space
- T time

NEWTON'S FAB FOUR

Isaac Newton started out with four abstract quantities, which we can remember by their

FAME

what	formula in units
F	force $M \cdot S / T^2$
A	action $M \cdot S^2 / T$
M	momentum $M \cdot S / T$
E	energy $M \cdot S^2 / T^2$

and four calculated quantities(two rates and two amounts):

MAAE

formula	description
$F \cdot T = M$	force production rate
$E \cdot T = A$	energy consumption rate
$M \cdot S = A$	momentum production amount
$F \cdot S = E$	energy consumption amount

Newton's Law of Gravity

$$F_g = G \cdot m \cdot M / r^2$$

where

Symbol	Description	Units
F_g	force between particles	$M * S / T^2$
G	gravitational constant	$S^3 / T^2 * M$
m, M	mass of each body	M
r	distance between them	S

The Paths Relating Energy and Momentum

These build complementary paths between **Momentum** and *Energy* modulated by **Force** and **Action**.

The transformation from **Energy** to *Momentum* is called **Gravitational Attraction**, losing the first to gain the second, and we describe it as “losing Potential Energy to gain Kinetic Energy”.

The transformation from *Momentum* to **Energy** is called **Accelerated Motion** and we describe it as “using Kinetic Energy to gain Potential Energy”.