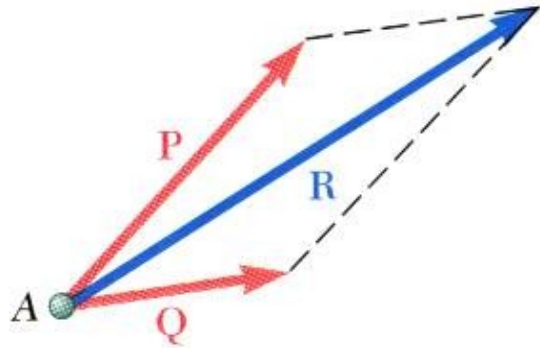
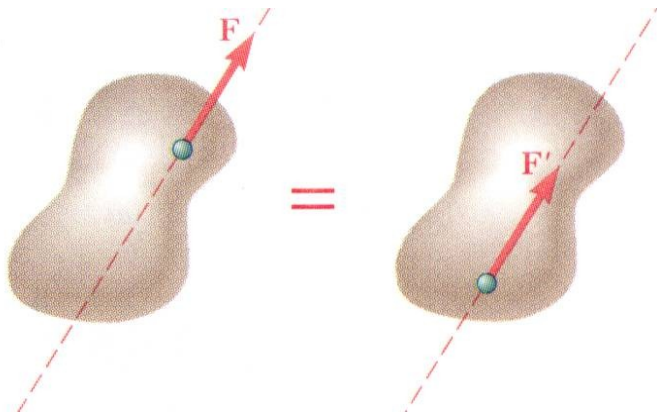


Fundamental Principles



- *Parallelogram Law*



- *Principle of Transmissibility*

- *Newton's First Law:* If the resultant force on a particle is zero, the particle will remain at rest or continue to move in a straight line.
- *Newton's Second Law:* A particle will have an acceleration proportional to a nonzero resultant applied force.

$$\vec{F} = m\vec{a}$$

- *Newton's Third Law:* The forces of action and reaction between two particles have the same magnitude and line of action with opposite sense.

- *Newton's Law of Gravitation:* Two particles are attracted with equal and opposite forces,

$$F = G \frac{Mm}{r^2} \quad W = mg, \quad g = \frac{GM}{R^2}$$

Systems of Units

- *Kinetic Units*: length, time, mass, and force.
- Three of the kinetic units, referred to as *basic units*, may be defined arbitrarily. The fourth unit, referred to as a *derived unit*, must have a definition compatible with Newton's 2nd Law,

$$\vec{F} = m\vec{a}$$

• *International System of Units (SI)*:

The basic units are length, time, and mass which are arbitrarily defined as the meter (m), second (s), and kilogram (kg). Force is the derived unit,

$$F = ma$$

$$1 \text{ N} = (1 \text{ kg}) \left(1 \frac{\text{m}}{\text{s}^2} \right)$$

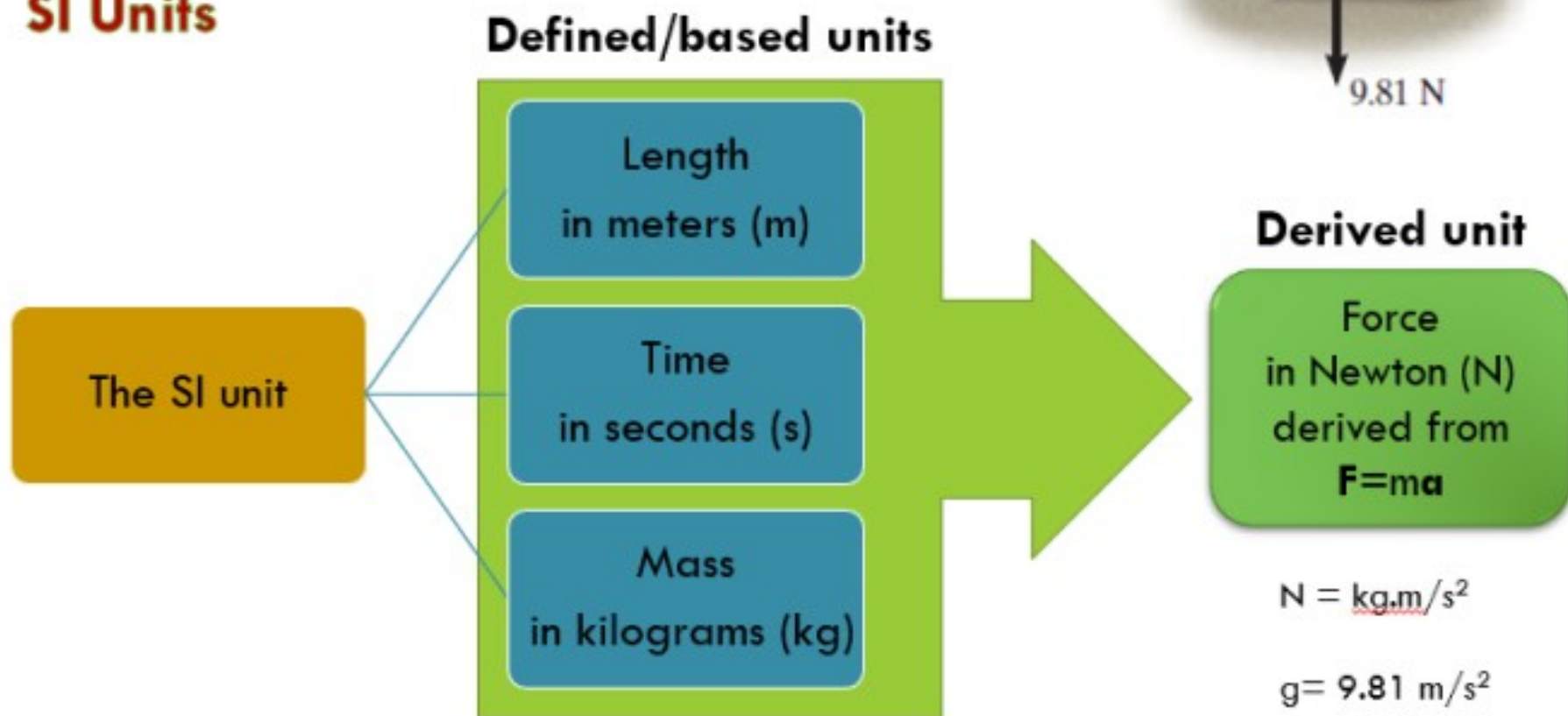
• *U.S. Customary Units*:

The basic units are length, time, and force which are arbitrarily defined as the foot (ft), second (s), and pound (lb). Mass is the derived unit,

$$m = \frac{F}{a}$$

$$1 \text{ slug} = \frac{1 \text{ lb}}{1 \text{ ft/s}}$$

SI Units



U.S. Customary (FPS)

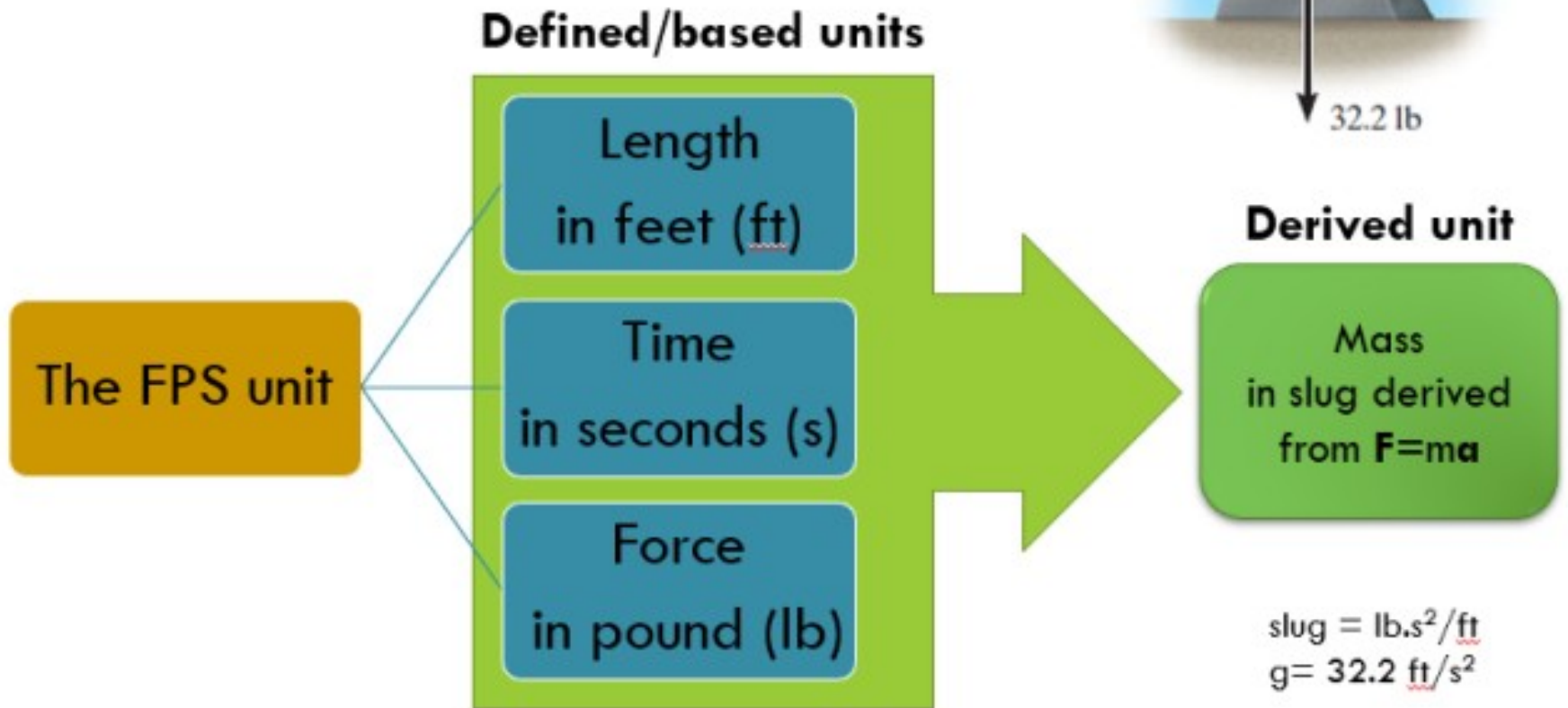


TABLE 1.1 SI Prefixes

Multiplication Factor	Prefix†	Symbol
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^9	giga	G
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto‡	h
10 = 10^1	deka‡	da
0.1 = 10^{-1}	deci‡	d
0.01 = 10^{-2}	centi‡	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

TABLE 1–1 Systems of Units

Name	Length	Time	Mass	Force
International System of Units SI	meter m	second s	kilogram kg	newton* N $\left(\frac{\text{kg} \cdot \text{m}}{\text{s}^2}\right)$
U.S. Customary FPS	foot ft	second s	slug* $\left(\frac{\text{lb} \cdot \text{s}^2}{\text{ft}}\right)$	pound lb

*Derived unit.

Conversion of Units

TABLE 1–2 Conversion Factors

Quantity	Unit of Measurement (FPS)	Equals	Unit of Measurement (SI)
Force	lb		4.448 N
Mass	slug		14.59 kg
Length	ft		0.304 8 m