CONCEPT: DIMENSIONAL ANALYSIS

● Equations work only if they are *dimensionally consistent*, meaning the units on both sides are ___________.

- Easy way to check if equations make sense ***without*** calculations.

EXAMPLE: You walk a constant speed v = 5m/s for a time **t** of 2s. Which equation from below would be appropriate for determining the distance **d** in meters?

Distance = speed × time		Distance = speed × time²
$d = v \times t$	OR	$d = v \times 2\,t^2$
[ ] = [ ] × [ ]		[ ] = [ ] × [ ]
[CONSISTENT | INCONSISTENT]		[CONSISTENT | INCONSISTENT]

DIMENSIONAL CONSISTENCY
1) Replace variables with units
2) Ignore – signs & numbers (2, ½, etc..)
3) Multiply & divide to cancel out units
4) Check if units on left **=** units on right

DETERMINING UNITS OF UNKOWN VARIABLES

● You'll also need Dimensional Analysis to figure out the units of unknown variables.

EXAMPLE: Hooke's Law states that a restoring Force **F**, measured in Newtons [N], in springs is related to the distance from equilibrium **x** by the equation **F = —kx.** What are the units of the force constant **k**?

SOLVING UNITS OF VARIABLES
1) Replace variables with units
2) Ignore – signs & numbers (2, ½, etc..)
3) Isolate unknown variable
4) Solve

PRACTICE: A box moving with an initial speed **v** is accelerated horizontally. If **x** is measured in [m], **v** in [m/s], **a** in [m/s^2], **t** in [s] which of the following equations is correct for solving the distance **x**?

A) x = $\frac{a}{t^2}$
B) x = v + ½ at
C) x = vt + ½ at^2

PRACTICE: Newton's Law of Gravitation describes the attraction force between two masses. The equation is $\boldsymbol{F} = \mathbf{G}\frac{\boldsymbol{m_1 m_2}}{\boldsymbol{r^2}}$, where F is in [$\frac{\mathbf{kg \cdot m}}{\mathbf{s^2}}$], $\boldsymbol{m_1}$ and $\boldsymbol{m_2}$ are masses in [**kg**], and ***r*** is the distance in [**m**] between them.

Determine the units of the Universal Constant ***G***.

A) $\frac{kg \cdot s^2}{m^3}$

B) $\frac{m^3}{kg \cdot s^2}$

C) $\frac{m}{s^2}$

D) $\frac{m^3}{s^2}$