**Name:** _____ **Date:** _____ **Class:** _____

# Dimensional Analysis Worksheet: SI Base Units

In physics, **dimensional analysis** helps verify equations, convert units, and understand relationships between physical quantities. All physical quantities can be expressed using **seven SI base units**.

## The 7 SI Base Quantities

| Quantity | SI Unit | Symbol | Dimensional Symbol |
|---|---|---|---|
| Length | meter | m | [L] |
| Mass | kilogram | kg | [M] |
| Time | second | s | [T] |
| Electric Current | ampere | A | [I] |
| Temperature | kelvin | K | [Θ] |
| Amount of Substance | mole | mol | [N] |
| Luminous Intensity | candela | cd | [I] |

## Part A: Basic Dimensions

Write the dimensional formula for each quantity below:

1. Velocity (m/s): _____
2. Acceleration ($m/s^2$): _____
3. Force (F = ma): _____
4. Energy (E = F·d): _____
5. Power (P = E/t): _____
6. Pressure (P = F/A): _____
7. Charge (Q = I·t): _____
8. Potential Difference (V = E/Q): _____

# Part B: Unit Conversions Using Dimensional Analysis

Convert the following quantities. Show your work using conversion factors.

1. Convert 120 km/hr to m/s.

2. Convert 5.0 grams per cubic centimeter ($g/cm^3$) to $kg/m^3$.

3. Convert 72,000 seconds into days.

4. A car travels 60 miles/hour. What is this in meters per second?

# Part C: Apply Dimensional Analysis

1. The formula for the period of a pendulum is:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

where $T$ is time, $L$ is length, and $g$ is acceleration due to gravity.
**Verify** the dimensional consistency of this equation.

2. Suppose you are given an equation for force:

$$F = mv$$

Is this dimensionally correct? Explain why or why not.

3. A student proposes that the equation for kinetic energy is:

$$KE = \frac{1}{2}mv^3$$

Use dimensional analysis to determine whether this formula is valid.

4. The Stefan-Boltzmann Law relates the power $P$ radiated by a blackbody to its temperature $T$:

$$P = \sigma A T^4$$

where $\sigma$ is the Stefan-Boltzmann constant, $A$ is surface area, and $T$ is temperature. Use dimensional analysis to determine the dimensions of the constant $\sigma$.
*Hint: Power has dimensions* $[ML^2T^{-3}]$*, Area has* $[L^2]$*, and Temperature has* $[\Theta]$.