

# Units Transformation in Physics

## Introduction

In physics, proper unit conversion is crucial for solving problems and ensuring consistency in calculations. This document provides a clear guide to transforming units, starting with basic examples and progressing to more advanced ones.

## 1 Basic Unit Transformations

### 1.1 Length

Converting between common units of length:

$$\begin{aligned}1 \text{ m} &= 100 \text{ cm}, \\1 \text{ km} &= 1000 \text{ m}, \\1 \text{ inch} &= 2.54 \text{ cm}.\end{aligned}$$

Example: Convert 5 km to meters:

$$5 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} = 5000 \text{ m}.$$

### 1.2 Time

Common conversions for time:

$$\begin{aligned}1 \text{ minute} &= 60 \text{ seconds}, \\1 \text{ hour} &= 3600 \text{ seconds}.\end{aligned}$$

Example: Convert 2.5 hours to seconds:

$$2.5 \text{ hours} \times \frac{3600 \text{ s}}{1 \text{ hour}} = 9000 \text{ s}.$$

## 2 Intermediate Unit Transformations

### 2.1 Speed

Converting speed from kilometers per hour to meters per second:

$$1 \text{ km/h} = \frac{1000 \text{ m}}{3600 \text{ s}} = 0.2778 \text{ m/s}.$$

Example: Convert 90 km/h to m/s:

$$90 \text{ km/h} \times \frac{1000 \text{ m}}{3600 \text{ s}} = 25 \text{ m/s}.$$

## 2.2 Force

Given  $F = ma$ , where  $m$  is in kilograms and  $a$  is in meters per second squared, the unit of force is derived as:

$$[F] = \text{kg} \cdot \text{m/s}^2 = \text{N} \quad (\text{Newton}).$$

# 3 Advanced Unit Transformations

## 3.1 Energy

Energy in the form of kinetic energy is given by  $E = \frac{1}{2}mv^2$ . Suppose  $m$  is given in grams and  $v$  in kilometers per hour, and we want the result in joules:

Given:

$$\begin{aligned} m &= 500 \text{ g} = 0.5 \text{ kg}, \\ v &= 72 \text{ km/h} = 20 \text{ m/s}. \end{aligned}$$

Substitute into the equation:

$$E = \frac{1}{2} \cdot 0.5 \text{ kg} \cdot (20 \text{ m/s})^2 = 100 \text{ J}.$$

## 3.2 Pressure

Pressure is defined as  $P = \frac{F}{A}$ . Suppose we have force in newtons and area in square centimeters, and we need pressure in pascals:

Given:

$$\begin{aligned} F &= 50 \text{ N}, \\ A &= 20 \text{ cm}^2 = 0.002 \text{ m}^2. \end{aligned}$$

Substitute into the equation:

$$P = \frac{50 \text{ N}}{0.002 \text{ m}^2} = 25\,000 \text{ Pa}.$$

## Conclusion

Understanding and correctly applying unit transformations is essential for solving a wide range of problems in physics. By mastering both basic and advanced conversions, one can ensure accuracy and consistency in calculations.