Module 7: Translating Physics Word Problems (PHY 1100)

Introduction

Physics problems are often presented as written descriptions of physical situations. These descriptions must be translated into mathematical equations in order to solve the problem.

Many students find this step challenging. They may understand the formulas used in physics, but they are unsure how to identify which formula applies to a particular situation.

Learning to translate word problems into equations is therefore an important skill in physics.

The purpose of this module is to provide a systematic method that students can use to analyze and solve physics problems.

The Nature of Physics Problems

Physics attempts to describe how objects move and interact.

To do this, physicists identify measurable quantities such as:

- distance
- velocity
- time
- acceleration
- force

These quantities are related through mathematical equations.

When solving physics problems, the goal is to identify which equation describes the situation being analyzed.

A Systematic Problem-Solving Strategy

Students can solve many physics problems using the following five steps.

Step 1

Carefully read the problem.

Understanding the physical situation described in the problem is essential.

Step 2

Identify the known quantities.

These are the values provided in the problem statement.

Step 3

Identify the unknown quantity.

This is the quantity the problem asks you to calculate.

Step 4

Select the appropriate equation.

Choose an equation that relates the known quantities to the unknown quantity.

Step 5

Substitute values and solve.

Insert the numerical values into the equation and perform the calculation.

Example Problem

A car travels at a constant velocity of 20 meters per second for 5 seconds.

How far does the car travel?

Step 1: Understand the Problem

The problem describes motion at constant velocity.

Step 2: Identify Known Quantities

Velocity = 20 m/s
Time = 5 s

Step 3: Identify Unknown Quantity

Distance traveled.

Step 4: Choose Equation

The relationship between velocity, distance, and time is:

$v = d / t$

Rearrange to solve for distance:

$d = vt$

Step 5: Solve

$d = 20 \times 5$

$d = 100$ meters

Answer:

The car travels 100 meters.

Identifying Key Words in Physics Problems

Certain words in a physics problem may suggest specific equations or concepts.

Examples include:

Word or Phrase	Possible Concept
constant speed	uniform motion
accelerates	acceleration
free fall	gravitational acceleration
distance traveled	displacement
time required	time variable

Recognizing these clues helps identify which equations are appropriate.

Example Problem

A bicycle starts from rest and accelerates at 2 m/s^2 for 6 seconds.

What is the final velocity?

Step 1: Identify Known Quantities

Initial velocity = 0 m/s
Acceleration = 2 m/s^2
Time = 6 s

Step 2: Identify Unknown

Final velocity.

Step 3: Choose Equation

$v = v_o + at$

Step 4: Solve

$v = 0 + (2 \times 6)$

$v = 12$ m/s

Final velocity = 12 meters per second.

Drawing Diagrams

Drawing a diagram often helps clarify the physical situation described in a problem.

For example, a motion diagram may show:

- starting position
- direction of motion
- forces acting on an object

Even simple sketches can make physics problems easier to understand.

Using Units as Clues

Units can help determine which equation to use.

For example:

If the answer must have units of meters, the equation should involve distance.

If the answer must have units of meters per second, the equation should involve velocity.

Unit analysis helps verify whether the equation selected is appropriate.

Checking Answers

After solving a physics problem, students should check their results.

Questions to consider include:

- Does the answer have the correct units?
- Is the answer physically reasonable?
- Did the calculation follow the correct steps?

This final check helps detect calculation errors.

Worked Example

A runner travels 100 meters in 10 seconds.

Find the runner's velocity.

Step 1
Identify known values.

Distance = 100 m
Time = 10 s

Step 2
Choose equation.

$v = d / t$

Step 3
Solve.

$v = 100 / 10$

$v = 10$ m/s

The runner's velocity is 10 meters per second.

Practice Problems

1. A car travels at 15 m/s for 8 seconds.
   Find the distance traveled.
2. A runner covers 200 meters in 20 seconds.
   Find the velocity.
3. An object accelerates at 3 m/s^2 for 4 seconds starting from rest.
   Find the final velocity.
4. A bicycle travels 120 meters in 12 seconds.
   Find the velocity.

Challenge Problems

1. A car accelerates from rest at 4 m/s^2 for 5 seconds.
   Find the final velocity.
2. A runner travels 150 meters in 12 seconds.
   Find the average velocity.
3. A train moves at 30 m/s for 20 seconds.
   How far does it travel?