

## MODULE 2

# THINKING ABOUT MOTION

### INTRODUCTION

A daladala moves, stops, jerks forward, and moves again. A boda-boda swerves, a football flies through the air, rain falls from the sky, and you walk from the school gate to your classroom. None of these events look like equations. Yet Physics insists that they all speak the same language; **motion**.

Most students meet motion as a collection of formulas. But your body already understands motion. You feel it when a bus starts suddenly. You predict it when you throw a ball. You fear it when a bicycle rushes downhill. Long before you meet formulas, you already live inside motion.

In this part, we rebuild the foundations you once met at O-level. Not to repeat them, but to understand them properly. We will move from everyday meaning to precise description, and only then to mathematics. By the time we reach formulas, they will feel like summaries of ideas you already own.

### MOTION AND REFERENCE FRAMES

*Is a person sitting in a bus at rest or in motion?* The answer depends on who is watching. To another passenger, the person is at rest. To a person standing by the road, the same person is moving at the speed of the bus. Motion is therefore relative.

Physics resolves this confusion by introducing a **reference frame** which *is a chosen point of view from which motion is described*. Without stating the reference frame, statements about motion are incomplete. Whenever you describe motion, always ask: *From whose point of view is it being observed?*

For now, let us pause the theory and bring the ideas down to earth with a few carefully chosen worked examples.

### **BINDER Example 1**

A student sits quietly inside a moving train, deeply absorbed in a book. One may argue that the student is both *at rest* and *in motion* at the same time. Justify this statement.

#### **Solution**

Since motion is not absolute but depends on the reference frame chosen, the student is **at rest relative to the train** because there is no change in position with respect to the seat, the floor, or other passengers. However, the student is **in motion relative to the ground** because the train itself is moving along the track.

**Making Sense of the Answer:** *The student looks still to someone inside the train, but to someone outside, the student is moving with the train. The difference comes from who is observing.*

**Think Like a Physicist:** *Before deciding whether something is at rest or in motion, always ask: “Relative to what?”*

### **REAL Example 2**

**Mr. Akilikubwa** is teaching Motion and Reference Frames. While standing by the roadside with **Kipute** and **Kipanga**, they watch a daladala moving past them. At that moment, a passenger inside the daladala accidentally drops a coin.

Kipute says, *“From here, the coin seems to follow a curved path.”*

But Kipanga insists, *“To the passenger inside, the coin must fall straight down.”*

**Explain why Kipute and Kipanga can both be correct.**

## Solution

Kipute and Kipanga are both correct because they are describing the motion of the coin from **different reference frames**.

- Kipute is standing on the ground, so she observes the coin as it falls while the daladala continues moving forward. To her, the coin has **two motions at the same time**:
  - ✓ a forward motion (same as the daladala), and
  - ✓ a downward motion (due to gravity).

The combination of these motions makes the coin appear to follow a curved path.

- The passenger inside the daladala is moving with the vehicle, so in that reference frame the coin has **no forward motion relative to the passenger**. It only moves downward due to gravity, so it appears to fall straight down.

**Making Sense of the Answer:** *The coin does the same motion, but it looks different depending on where you are observing from outside or inside the moving daladala.*

**Think Like a Physicist:** *Whenever an object is released from a moving vehicle, it still keeps the **horizontal velocity** of the vehicle at the moment of release.*

With these worked examples complete, we are ready to welcome the next subtopic and see how the story continues.