Formula Reference Card – For Teacher Use Only

This card summarizes key mathematical and physical relationships explored in the unit. It includes classic physics formulas for projectile motion, as well as the structure and logic behind dimensional modeling using Rayleigh's method.

I. Physics-Based Formulas for Horizontal Launch

1. Fall time based on vertical drop height (assuming no air resistance):

$$t = \sqrt{\frac{2h}{g}}$$

2. Horizontal range based on time and initial horizontal velocity:

$$R = v_0 . t$$

3. Combined dimensional model for horizontal range:

$$R = v_0 . \sqrt{\frac{2h}{g}}$$

These formulas assume no air resistance and highlight the independence of horizontal and vertical motion.

II. Rayleigh Dimensional Method

In Rayleigh's method, a physical quantity is modeled using a product of powers of relevant variables:

$$R = C . v_0^a . h^b . g^c$$

Using dimensional consistency (LHS = RHS), and the dimensional units:

$$[R] = L, \quad [v_0] = \frac{L}{T}, \quad [h] = L, \quad [g] = \frac{L}{T^2}$$

we solve for the exponents a, b, and c using dimensional balance:

$$L = \left(\frac{L}{T}\right)^a . L^b . \left(\frac{L}{T^2}\right)^c$$

This yields:

a = 1, b = 0.5, c = –0.5

So the dimensional form becomes:

$$R = C . v_0 . \sqrt{\frac{2h}{g}}$$

Rayleigh's method allows students to reason out the structure of the model without memorizing equations and connects mathematical modeling with the physical quantities at play.