The Flying Mammoth Problem

A Physics Tale of Terminal Velocity

Scenario

In a magical realm, a satyr and a human wizard are ambushed by a dragon. Their ingenious plan to defeat the attacking dragon involves polymorphic transformation and precise timing:

- The wizard will polymorph into a 6,000-kg woolly mammoth
- The satyr will polymorph into a 200-kg giant ape
- The ape will throw the mammoth at the dragon flying 300 feet overhead

However, being prudent adventurers, they wish to calculate the worst-case scenario: What happens if the dragon breaks the wizard's concentration mid-flight?

Given Parameters

For the falling mammoth-wizard:

$m = 6,000$ kg	(mass)
$A = 4.2$ m^2	(cross-sectional area)
$C = 0.7$	(drag coefficient)
$\rho = 1.21$ kg/m^3	(air density)
$g = 9.80$ m/s^2	(gravitational acceleration)

Physical Analysis

Terminal velocity occurs when:

$$\text{Force of gravity} \;=\; \text{Drag force}$$

Leading to the formula:

$$v_t = \sqrt{\frac{2mg}{\rho C A}}$$

Where:

- v_t is the terminal velocity
- The numerator represents gravitational force factors
- The denominator represents air resistance factors

Mathematical Solution

Substituting the values into our equation:

$$v_t = \sqrt{\frac{2 \times 6000 \text{ kg} \times 9.80 \text{ m/s}^2}{1.21 \text{ kg/m}^3 \times 0.7 \times 4.2 \text{ m}^2}}$$

$$v_t = \sqrt{\frac{117,600}{3.5574}}$$

$$v_t = \underline{98.8 \text{ m/s}}$$

Conversion to Kilometers per Hour

$$98.8 \text{ m/s} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{3600 \text{ s}}{1 \text{ hr}} = \underline{355.7 \text{ km/h}}$$

Conclusion

The mammoth-wizard would reach a terminal velocity of 98.8 m/s (355.7 km/h).

"Well," says the wizard, examining these calculations with concern, "let's hope the dragon doesn't burn us alive."

The satyr nods grimly, noting that while this terminal velocity is impressive, it's also precisely why their timing must be perfect - there won't be a second chance if something goes wrong.