

IGCSE Physics Worksheet

Friction, Air Resistance, and Terminal Velocity

Reading Passage:

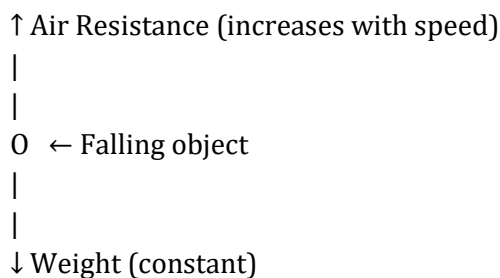
Friction is a force that opposes motion when two surfaces are in contact. It can be helpful, such as allowing shoes to grip the ground, or unhelpful, such as causing machines to wear out. The size of the frictional force depends on the nature of the surfaces and how hard they are pressed together.

Air resistance is a type of friction that acts on objects moving through air. It always acts in the opposite direction to motion. The faster an object moves, the larger the air resistance becomes. This is why cyclists lower their bodies to reduce the area facing the air, decreasing air resistance.

When an object falls through air, two forces act on it: weight (downward) and air resistance (upward). At the start of the fall, air resistance is small, so the object accelerates. As its speed increases, air resistance increases. Eventually, the upward air resistance becomes equal to the downward weight. At this point, the forces are balanced, and the object stops accelerating. It continues falling at a constant speed called terminal velocity.

Diagram :

Object Falling Through Air



Stages:

1. Start of fall: $\text{Weight} > \text{Air resistance} \rightarrow \text{Accelerates}$
2. Mid-fall: Air resistance increasing \rightarrow Acceleration decreases
3. Terminal velocity: $\text{Weight} = \text{Air resistance} \rightarrow \text{Constant speed}$

Questions:

A. Understanding the Concepts

1. What is friction, and what does it oppose?

2. 2. Give one helpful and one unhelpful example of friction.
3. 3. Why does air resistance increase as an object moves faster?
4. 4. What two forces act on a falling object?
5. 5. Why does a falling object stop accelerating after some time?
6. 6. What is terminal velocity?

B. Application Questions

7. 7. A skydiver jumps from a plane. Describe how the forces change from the moment they jump until they reach terminal velocity.
8. 8. Why do parachutes increase air resistance?
9. 9. Explain why a feather reaches terminal velocity much sooner than a stone.
10. 10. Cyclists often wear tight clothing. How does this help them reduce air resistance?

Answer Key:

- A1. Friction is a force that opposes motion between two surfaces in contact.
- A2. Helpful: Shoes gripping the ground. Unhelpful: Machine parts wearing out.
- A3. Faster motion pushes more air particles aside per second, increasing the opposing force.
- A4. Weight (downward) and air resistance (upward).
- A5. Air resistance increases until it balances the weight, making acceleration zero.
- A6. Terminal velocity is the constant speed reached when air resistance equals weight.
- B7. Start: Weight > air resistance → accelerates. Mid-fall: Air resistance increases → acceleration decreases. Terminal velocity: Air resistance = weight → constant speed.
- B8. Parachutes increase surface area, increasing air resistance.
- B9. A feather has large surface area and low weight, so air resistance quickly balances its weight. A stone has higher weight and smaller surface area.
- B10. Tight clothing reduces surface area facing the air, lowering air resistance.