

# Chapter 4: Dynamics: Newton's Laws of Motion

## Lecture 1

The University of Jordan/Physics Department

Prof. Mahmoud Jaghoub

أ.د. محمود الجاغوب

**Force:** - vector quantity  
- causes motion of objects.

**Kinematics:** Studying motion of objects without taking the cause of motion (**Forces**) into account.

**Remember:** Equations of motion were all expressed in terms of  $v, a, x, t$  **BUT NO Force.**

**Dynamics:** Studying motion of objects taking the cause of motion (**Forces**) into account.

When we pull or push an object we act on it by a force.

## Newton's first law

Every object remains in its state of rest or of constant velocity (constant in magnitude and direction) as long as no net (resultant) force acts on it.

This means an object cannot change its state of motion <sup>at rest OR constant  $v$</sup>  on its own. It needs a net force to change from: rest to motion  
motion to rest  
accelerate or decelerate

The first law is sometimes called the law of inertia. (قانون القصور الذاتي)

### Example

The truck is moving to the right. Suddenly, the driver applies the breaks and the truck stops.



Question: what happens to the box?

Answer: the box slides forward. Why?

The truck stopped because a net force acted on it and changed its state of motion.

This force did not act on the box. The box needs a net force to act on it to stop it or reduce its velocity.

The box cannot change its state of motion (rest or constant velocity) unless a net force acts on it. This is what is called inertia.

Inertial frame of reference:  $\left\{ \begin{array}{l} \rightarrow \text{either at rest} \\ \rightarrow \text{or moving at constant velocity.} \end{array} \right.$

A frame that does NOT accelerate. Newton's laws hold in such a frame (can be applied in such a frame).

If you are   
 - standing at rest, or   
 - moving at constant velocity   
 then you are in an inertial frame of reference.

