

TRAJECTORY AND DISPLACEMENT

OBJECTIVES

1. To introduce the concept of a Reference system as a basic element for studying any movement.
2. To relativize the concept of trajectory.
3. To work with the concept of displacement.

1. INTRODUCTION TO THE STUDY OF MOVEMENT.

We could ask why movement is the first physical phenomenon we study in an introductory course on Physics. The answer is simple: it is one of the most common phenomena which occur around us, even in nature we find movements which are easily observed and truly beautiful .

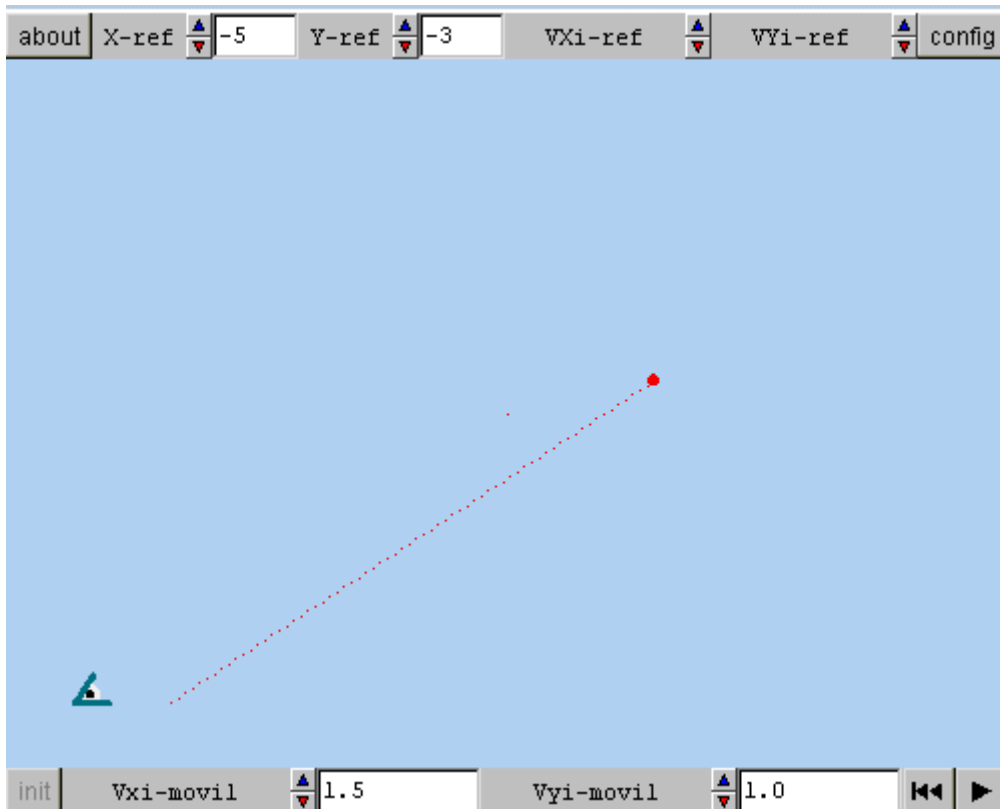
A rigorous study of any event needs to be described with exactitude. What do we need to observe a movement?

An indispensable instrument for observing and analyzing a movement is one that measures time. You can probably think of several instruments we use for this. We will think of a simple chronometer which will show the passing of time while we make the observations. We also need an exact definition of other concepts: Reference System, trajectory and displacement.

We will introduce them one by one...


2. REFERENCE SYSTEM

In the following simulation we are going to present two moving objects



Click on  and you will observe the movement of the red dot.

Modify the position of the "eye" by changing X-Ref and Y-Ref, (It represents any of us observing the movement of the red dot).

Give the "eye" velocity by changing Vx-ref (velocity along the horizontal axis) and Vy-ref (velocity along the vertical axis), animate the visual by clicking on .

The "eye" has observed the movement of the red spot from different places.

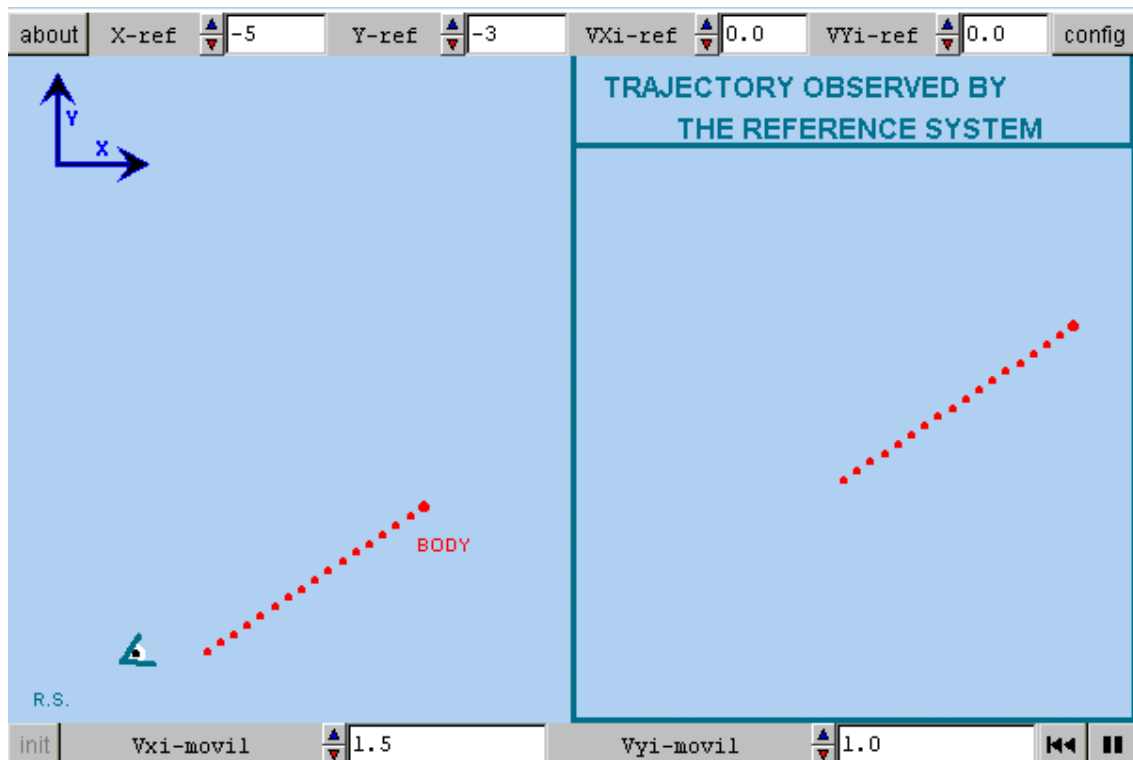
What if, from now on, instead of the word "eye" we refer to it as a **Reference system (RS)**?


Reference System (RS) The place from which the position of a moving body is observed through time.

The most distant stars in the firmament are often used as reference systems at rest (absolute) as their movement is imperceptible from the earth.

3. TRAJECTORY

In our next visual we are going to show what the RS sees when we change its position of observation and/or move it:



Place the observer in the position $X\text{-ref} = -2$, $Y\text{-ref} = 0$, and click on  in the visual.

Observe the result.

Change to another position. $X\text{-ref} = -1$, $Y\text{-ref} = 2$, for example.

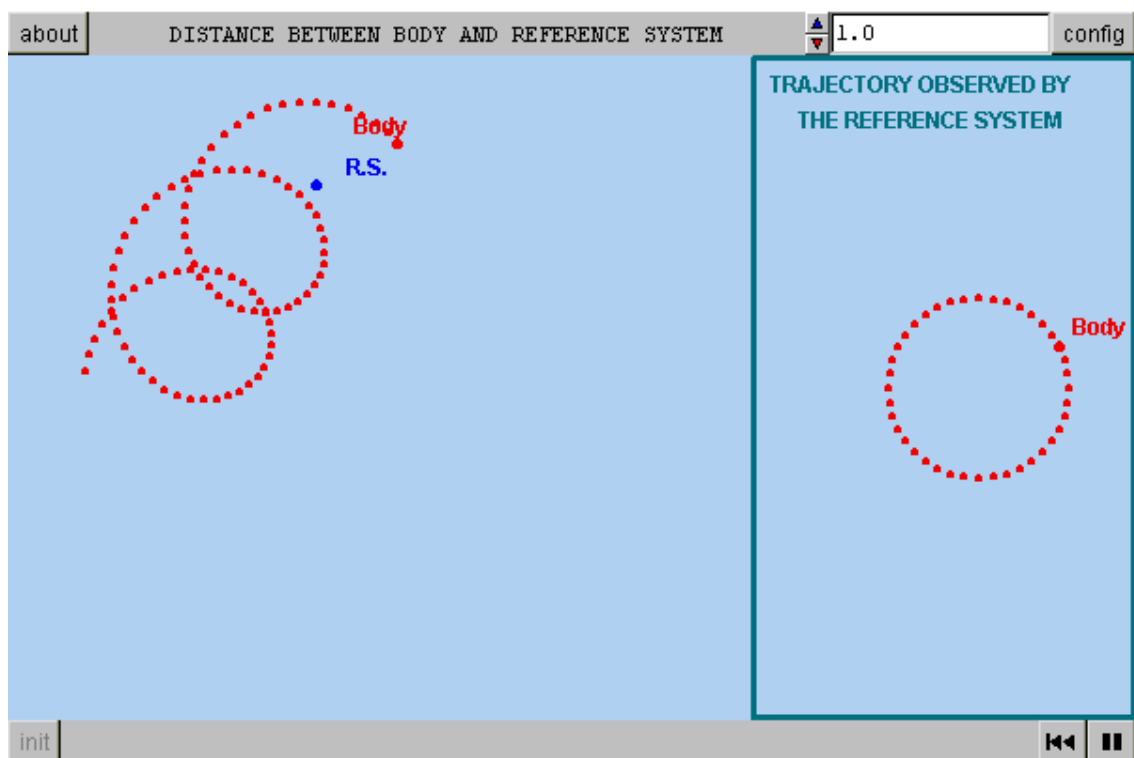
What happens then?

¡ Do not press init!. Change $Vx\text{-ref}$ to 0 and/or $Vy\text{-ref}$ to 0.5, What happens now?

Describe what happens when we change the position and/or velocity of the Reference system.

Cambia a tu voluntad algunos o todos los parámetros que te permite la escena y trata de encontrar alguna relación entre las condiciones de observación del SR y lo que observa.

Does any observer see the same path described by the moving object?...



Click on  and watch the visual. Change the distance between the objects and watch the animation again.

The path described by the red spot is simply a circumference for the observer. However this path for us, other observers, is a much more complicated curve than a circumference. From now on we will refer to this path as a trajectory.

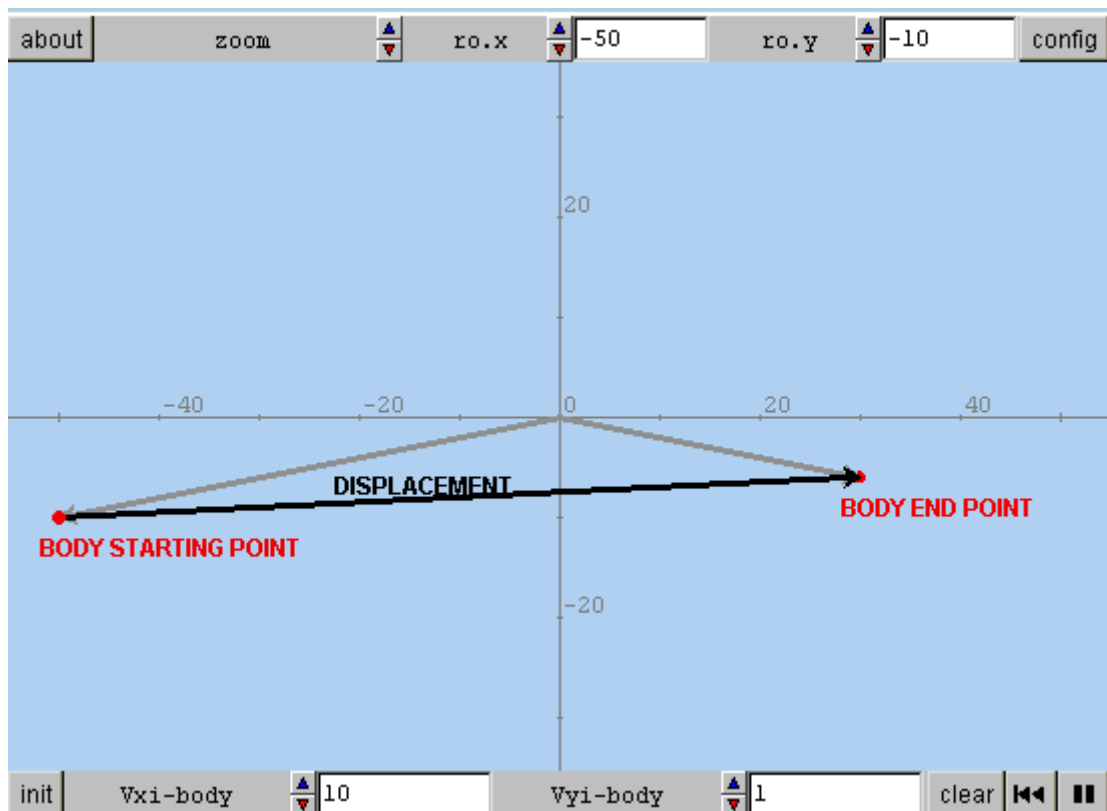
Trajectory is the line which marks the position of an object at each instant for a determined reference system.


An understanding of the trajectory described by a moving body through time from a known Reference system is our objective when we describe any movement.

4. DISPLACEMENT

What do you understand by displacement?

In Physics words which are in common use tend to have a similar meaning to that which they have colloquially but a more exact one. Observe the following simulation:

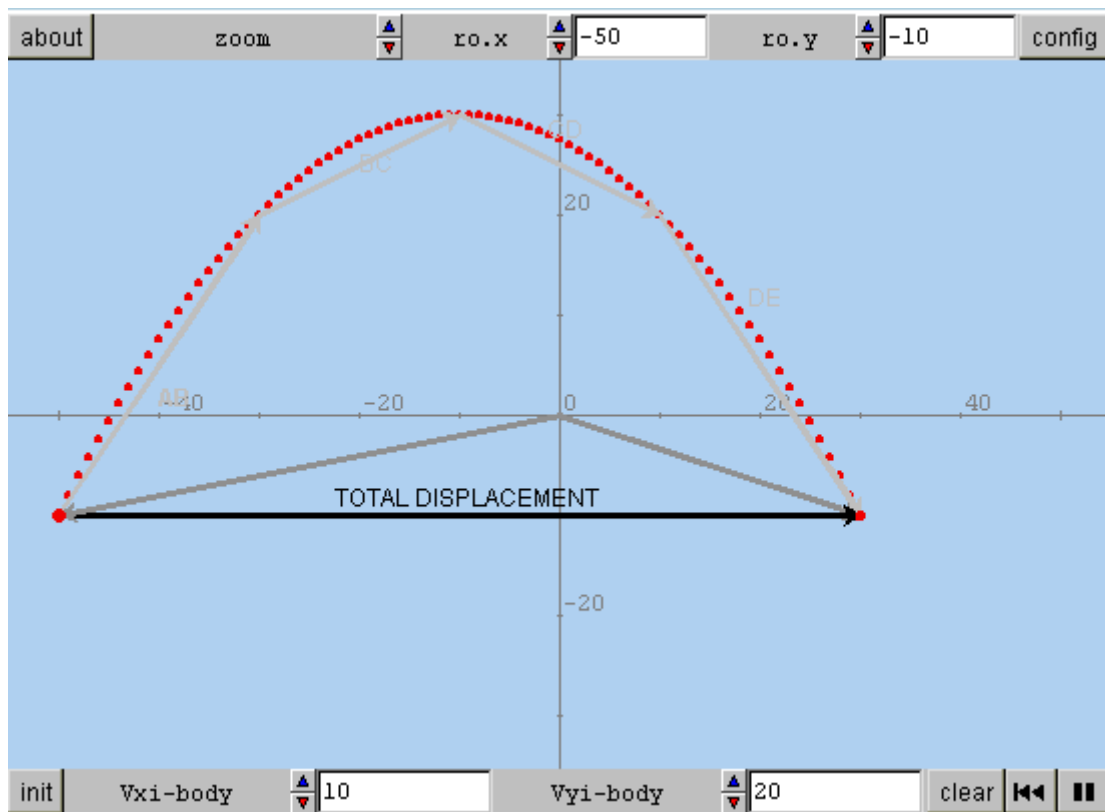


Click on . Observe what happens.
Press "init". Change the initial position of the body by clicking on it and dragging it to the new position.

Change the speed of the body with the controls VXi-body and VYi-body. Press 

Bearing in mind what the visual highlights as displacement, try to define it and write your definition down.

Now observe this other visual:



Click on  and watch the visual

If your definition of **displacement**, when applied to this new simulation is valid WELL DONE! However, if it isn't you should revise it and write another one. In Science concepts should have a very exact definition and be valid provided that all the conditioners indicated in the definition are complied with.

The displacement shown by a moving object between two instants is determined by the segment which joins the two positions through which the object moves between these two instants.

If the trajectory is rectilinear displacement coincides with the space covered between these two instants.

EVALUATION

What is absolutely necessary to describe a movement?

- Trajectory and displacement
- Reference system and moving body
- Reference system and trajectory
- Displacement

What is the name of the place from which a movement is observed?

- Observer
- Point of observation
- Reference system
- Displacement

Mark the correct sentences

- Trajectory and displacement have the same meaning
- The trajectory that characterizes a movement is unique
- Displacement coincides with the space covered when the trajectory is rectilinear
- Whether a reference system is moving or at rest influences the trajectory plotted

If a movement on the earth, as observed from the most distant stars, is a straight line, then it will also be moving in a straight line from the point of view of a reference system on the earth.

- True
- False

An observer on the earth is a reference system at rest

- True
- False