Preview

Objectives

- **Describe** situations in terms of frame of reference.
- **Solve** problems involving relative velocity.

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Frames of Reference

- If you are moving at **80 km/h** north and a car passes you going **90 km/h**, to you the faster car seems to be moving north at **10 km/h**.
- Someone standing on the side of the road would measure the velocity of the faster car as **90 km/h** toward the north.
- This simple example demonstrates that velocity measurements depend on the **frame of reference** of the observer.

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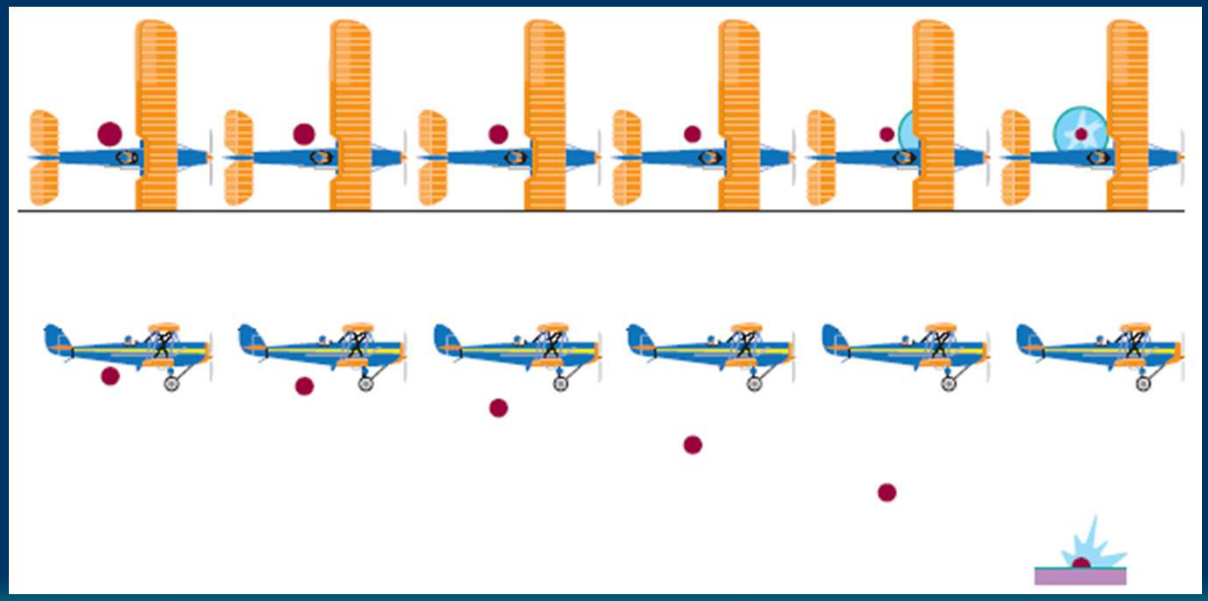
Frames of Reference, *continued*

Consider a stunt dummy dropped from a plane.

(a) When viewed from the plane, the stunt dummy falls straight down.

(b) When viewed from a stationary position on the ground, the stunt dummy follows a parabolic projectile path.



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Relative Motion

Click below to watch the Visual Concept.

Visual Concept

Relative Velocity

- When solving relative velocity problems, write down the information in the form of velocities with subscripts.
- Using our earlier example, we have:
  - v_{se} = +80 km/h north (se = slower car with respect to Earth)
  - v_{fe} = +90 km/h north (fe = fast car with respect to Earth)
  - unknown = v_{fs} (fs = fast car with respect to slower car)
- Write an equation for v_{fs} in terms of the other velocities. The subscripts start with **f** and end with **s**. The other subscripts start with the letter that ended the preceding velocity:
  - $v_{fs} = v_{fe} + v_{es}$

Relative Velocity, *continued*

- An observer in the slow car perceives Earth as moving south at a velocity of 80 km/h while a stationary observer on the ground (Earth) views the car as moving north at a velocity of 80 km/h. In equation form:
  - $v_{es} = -v_{se}$
- Thus, this problem can be solved as follows:
  - $v_{fs} = v_{fe} + v_{es} = v_{fe} - v_{se}$
  - $v_{fs} = (+90 \text{ km/h n}) - (+80 \text{ km/h n}) = +10 \text{ km/h n}$
- A general form of the relative velocity equation is:
  - $v_{ac} = v_{ab} + v_{bc}$

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Relative Velocity

Click below to watch the Visual Concept.

Visual Concept