

RELATIVE MOTION NOTES:

Followed by Relative Velocity Directions (Users:Physics) Interactive Physics

Relative Web

Speedy

NEW:

Relative Motion:

NOTES:

REFERENCE FRAME: place that is 0 velocity

How fast are you?

YOU are the Center of Your Universe!

Does the Earth revolve around the Sun, or does the Sun revolve around the Earth? Does it matter?

NO

Think of a fly in a train. The train goes 60 mph (26.8 m/s) forwards and is 10m long. The fly can go 6 mph. (2.68 m/s).

If the fly goes from the back to the front.... How fast does he appear to be going from the ground?

66 mph

If the fly goes from the front to the back, how long does it take him?

***54 mph fly to ground..... but still -6 mi ph to train, so 10 m at -2.68 m/s
= 10/2.68 = 3.73 sec***

PERSON MOVING ON OBJECT MOVING ON EARTH

$$V_{pe} = V_{po} + V_{oe}$$

Velocity of person with respect to earth is velocity of person with respect to object plus velocity of object with respect to earth.

RELATIVE VELOCITY I HW:

1. Pretend that you are walking from the back to the front of a bus. The bus is moving forward at 10 m/s, and you are walking in the bus at 1 m/s. How fast are you walking relative to the ground?

$$10 \text{ m/s } bg + 1 \text{ m/s } pb = 11 \text{ m/s person to ground}$$

2. Now pretend that you are walking from the front to the back. The bus is still moving forward at 10 m/s, but you are walking 1 m/s toward the back. How fast are you now walking relative to the ground?

$$10 \text{ m/s } bg + -1 \text{ m/s } pb = 9 \text{ m/s } pg$$

3. Pretend that the bus driver and an observer on the sidewalk have accurate stopwatches. They both have agreed to time you as you walk from the back to the front of the bus, recording how much time it took. Will both of their measurements agree? Will they agree on how far you traveled?

Agree on time, not on distance

5. You are walking up an escalator at a rate of 1 step per second. The escalator is running at a speed of 0.5 steps per second.

$$\text{What is your effective climb rate? } 1 \text{ s/s } pe + .5 \text{ s/s } eg = 1.5 \text{ s/s } pg$$

Approximately how long will it take you to ascend the equivalent of 15 steps?

$$15 \text{ steps} / 1.5 \text{ s/s} = 10 \text{ seconds}$$

6. The water of the Gualt River travels at a rate of 0.3 m/s. You paddle upstream at a rate of 0.7 m/s relative to the water. What is your velocity upstream relative to the earth?

$$.3 \text{ m/s } wg + -.7 \text{ m/s } pw = -.4 \text{ m/s } pg$$

7. An airplane is moving 600 mi/h northward with respect to the earth. The winds are blowing to the south at a rate of 20 mi/h with respect to the earth. What is the velocity of the plane with respect to the air?

$$-20 \text{ mph } we + Vpw = 600 \text{ mph } pe \quad Vpw = 620 \text{ mph (north)}$$

**7. Bob the astronaut takes off due west from the equator at escape velocity (11.2 km/sec=40320 km/hr). The Earth rotates west to east (counterclockwise) at a velocity of .465 km/sec=1674 km/hr and travels around the Sun (revolves) counterclockwise at 29.77 km/sec=107,000 km/hr). Sound goes 334 m/s=.093 km/hr)

How fast is Bob going relative to the Earth?

Relative to the Moon (orbits with the Earth)?

Relative to the Sun?

Will he break the sound barrier?