

## Chapter Assessment

### Now Questions

- Space and time are two parts of one whole.
- Yes, in time
  - Yes; no; no
  - Stretching of time due to motion in space
  - It depends on a frame of reference.
  - No, the speed of light is always the same.
  - It has the same value in all frames of reference.
  - The laws of nature are the same in all uniformly moving frames.
  - $c$  is always the same whether the source, the receiver, or both move.
  - $c$ , the speed of light
  - It takes correspondingly more time.
  - Slow also; each sees the same effect in the other.
  - Only frequency
  - a. One b. two
  - Yes, a person moving at speeds close to  $c$  lives longer.

### Plug and Chug

16.  $V = (0.8c + 0.5c) / (1 + (0.5c^2/c^2)) = c/1.25 = 0.8c$
17.  $V = (c + c)/(1 + (c^2/c^2)) = 2c/(1 + 1) = c$
18. For small speeds,  $v_1 v_2 / c^2 = 0$ , so  $V = (v_1 + v_2)/(1 + 0) = v_1 + v_2$

### Think and Explain

19. No; yes; by observing that the surface of water in a bowl is not horizontal

# 15 Chapter Assessment



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### Concept Summary

According to Einstein's special theory of relativity, time is affected by motion in space at constant velocity.

- Time appears to pass more slowly in a frame of reference that is moving relative to the observer.

All the laws of nature are the same in all uniformly moving frames of reference.

- No experiment can be devised to detect whether the observer is moving at constant velocity.

The speed of light in empty space is the same in all frames of reference.

- The speed of light has the same value regardless of the motion of the source or the motion of the observer.

### Key Terms

- first postulate of special relativity (15-4)
- postulate (15-3)
- second postulate of special relativity (15-5)
- space-time (15.1)
- special theory of relativity (15.0)
- time dilation (15.1)

### Review Questions Check Concepts

- What is space-time? (15.1)
- Can you travel while remaining in one place in space? Explain. (15.1)

- Does light travel through space-time? Through both space and time? (15.1)
- What is time dilation? (15.1)
- What does it mean to say that  $t$  is relative? (15.2)
- The speed of a ball you catch it from a moving truck depends on speed and direction of the truck. Does light caught from a moving source depend on the speed and direction of the source? Explain. (15.3)
- What does it mean to say that light is a constant? (15.3)
- What is the first postulate of relativity? (15.4)
- What is the second postulate of relativity? (15.5)
- The ratio of velocity gain to  $t$  falling body is  $g$ . Similarly,  $w$  distance to time for light is  $c$ .
- The path of light in a vertical high-speed spaceship is seen when viewed from a station on Earth. Why, then, does the light appear to be moving faster? (15.6)
- If we view a passing spaceship, do the inhabitants' time run slower or faster? (15.7)
- When a flashing light source moves, does the speed of light, or the arrival of light flashes, or both change? (15.7)
- a. How many frames of reference does the stay-at-home twin experience?  
b. How many frames of reference does the traveling twin experience?
- Is it possible for a person to travel farther than the years? Explain. (15.8)

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