Quiz.

1. According to the special theory of relativity, events that are simultaneous in one frame of reference
   a) are simultaneous in all frames of reference.
   b) are not simultaneous in other frames of reference.
   c) may or may not be simultaneous in other frames of reference.

2. When a blinking light source moves relative to you, the speed of the light
   a) changes, but its frequency remains constant.
   b) remains constant, but its frequency can change.
   c) stays the same, as does its frequency.

3. When an object is pushed to relativistic speeds, its momentum is
   a) greater than *mv*.
   b) smaller than *mv*.
   c) equal to *mv*.

4. Suppose you look at the huge clock on the Big Ben Tower in London, and it reads 12 noon. If you could travel away from the clock at the speed of light and view it with a telescope, it would
   a) run slower than usual.
   b) run faster than usual.
   c) be frozen at 12 noon.

5. A spaceship that is traveling very fast with respect to your frame of reference fires a photon beam that travels at speed *c* with respect to the spaceship. You measure the phton beam's speed to be
   a) less than *c*.
   b) equal to *c*.
   c) more than *c*.

6. According to the special theory of relativity, if you measure your own pulse while traveling at very high speeds, you would notice your pulse rate to
   a) increase.
   b) decrease.
   c) be the same as usual.

7. We are actually looking into the past when we look at
   a) a distant star.
   b) our physics books.
   c) actually, both of these
   d) none of these

8. To outside observers, the overall sizes of objects traveling at relativistic speeds are
   a) smaller.
   b) larger.
   c) it depends on who is moving.
   d) None of the above choices are correct.

9. Suppose you and your sister travel in space in such a way that you notice a slowing of time for your sister. Your sister will notice that your time runs
   a) faster than hers.
   b) slower than hers.
   c) the same as hers.
   d) not enough information given

Answer Key.
1. c)

Simultaneity is affected by relativistic speeds when there is more than one frame of reference moving very fast with respect to the other.

2. b)

Remember, when a source moves towards you its waves become blueshifted, meaning the frequency increases. However, according to the special theory of relativity the speed of light in free space (a vacuum, essentially), is constant.

3. a)
Particles in an accelerator have been found to increase in their mass when traveling at relativistic speeds, increasing their momenta by the same Lorentz factor.

4. c)

In spacetime, the four dimensions are length, height, width, and time. If you are at rest with respect to your reference frame, then you are still progressing in time. However, if you travel at the speed of light, then time itself stands still for you.

5. b)

According to the first postulate, you must not be able to conduct any experiment that would allow you to determine whether or not you were accelerating at a uniform rate or merely stationary with respect to your reference frame. This is how Einstein was able to determine that the speed of light in free space was invariant.

6. c)

This question clearly does not take into account the biological effects of travel at relativistic speeds. However, if you were to think of your pulse as the ticking of a clock, then you would not notice a change in your pulse as you traveled.

7. c)

The only thing we can see is light, and it takes a finite amount of time (in our frame of reference) to reach our eyes. So, wait. Does that mean that light is always in the present in its own reference frame? How zen…

8. a)

This is evident from the equation for length contraction. Remember, objects moving at relativistic speeds do not notice anything unusual about themselves, so it is as though both objects are moving. It is impossible to tell which one is “moving” with respect to the other.

9. b)

This is evident from the equation for time dilation.