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| **Physics 12 - Chapter 11 Quiz** |

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| **True/False**  *Indicate whether the sentence or statement is true or false.* | | |
|  | 1. | The speed of light in water is p12ch11_files/i0020000.jpg, where *n =*1.33 is the index of refraction of water. The speed of light in water is thus less than the speed of light in a vacuum. This fact violates the speed-of-light postulate of the special theory of relativity. |
|  | 2. | We customarily say that Earth revolves around the Sun. We can also say that the Sun revolves around Earth. |
|  | 3. | If events E1 and E2 are simultaneous in an inertial frame, then no observers stationary in the same frame will regard E1as occurring before E2. |
|  | 4. | Any two observers moving with a clock will agree on the rate at which it ticks. |
|  | 5. | Any two observers moving relative to each other, and simultaneously moving relative to a clock, will agree on the rate at which the clock ticks. |
|  | 6. | An observer moving with a clock, measuring the time between ticks, measures the proper time between ticks. |
|  | 7. | Earth rotates on its axis once each day. To a person observing Earth from an inertial frame of reference in space, that is, stationary relative to Earth, a clock runs slower at the North Pole than at the equator. (Ignore the orbital motion of Earth about the Sun.) |
|  | 8. | A young astronaut has just returned to Earth from a long mission. She rushes up to an old man and in the ensuing conversation refers to him as her son. She cannot possibly be addressing her son. |
|  | 9. | An object will be greater in length if the observer is moving with the object than if the object is moving relative to the observer. |
|  | 10. | An observer at rest relative to a moving object measures the object’s proper length. |
|  | 11. | Relativistic effects such as time dilation and length contraction are for practical purposes undetectable in automobiles. |
|  | 12. | The total relativistic energy of an object is always equal to or greater than its rest mass energy. |
|  | 13. | Since rest mass is a form of energy, a spring has more mass when the coils are compressed than when relaxed. |
|  | 14. | The classical laws of conservation of energy and conservation of mass do not need to be modified for relativity. |
| **Multiple Choice**  *Identify the letter of the choice that best completes the statement or answers the question.* | | |
|  | 15. | You are in a windowless spacecraft. You need to determine whether your spaceship is moving at constant nonzero velocity, or is at rest, in an inertial frame of Earth.   |  |  | | --- | --- | | a. | You can succeed by making very precise time measurements. | | b. | You can succeed by making very precise mass measurements. | | c. | You can succeed by making very precise length and time measurements. | | d. | You cannot succeed no matter what you do. | | e. | You are in a position not correctly described by any of these propositions. | |  |  | |
|  | 16. | You and your friend recede from each other in spacecraft in deep space without acceleration. In an inertial frame on your spaceship, your friend is receding at a speed of 0.9999*c*. If you direct a light beam at your friend, and your friend directs a light beam at you, then   |  |  | | --- | --- | | a. | neither beam will reach the ship to which it is directed | | b. | you will see your friend’s light arrive at a speed of 2*c*, and your friend will see your light arrive at a speed of 2*c* | | c. | you will see your friend’s light arrive at a speed of *c*, and your friend will see your light arrive at a speed of *c* | | d. | one of you will see light arrive at a speed of *c*, and the other will see light arrive at 2*c* | | e. | none of these propositions is true | |  |  | |
|  | 17. | Simultaneity is   |  |  | | --- | --- | | a. | dilated | | b. | absolute | | c. | invariant | | d. | relative | | e. | none of these | |  |  | |
|  | 18. | The Michelson–Morley experiment established that   |  |  | | --- | --- | | a. | there is no observable ether wind at the surface of Earth | | b. | the ether moves at *c* as Earth travels in its orbit | | c. | the ether is an elastic solid that streams over Earth | | d. | Earth does not move with respect to the Sun | | e. | none of these | |  |  | |
|  | 19. | A Klingon spaceship is approaching Earth at approximately 0.8*c* measured relative to Earth. The spaceship directs a laser beam forward directly through your physics classroom window. You measure the speed of this light to be   |  |  | | --- | --- | | a. | 1.8*c* | | b. | 1.0*c* | | c. | 0.9*c* | | d. | 0.8*c* | | e. | 0.2*c* | |  |  | |
|  | 20. | You are an astronaut heading out toward a star. In the inertial frame of the star, you are steering directly for the star and are moving at constant speed. You can determine that you are in motion by   |  |  | | --- | --- | | a. | the slowing down of on-board clocks | | b. | the contraction of on-board metre sticks | | c. | your increase in mass | | d. | the increase in your heart rate | | e. | none of these | |  |  | |
|  | 21. | A clock, designed to tick each second, is moving past you at a uniform speed. You find the moving clock  to be   |  |  | | --- | --- | | a. | ticking slowly | | b. | ticking quickly | | c. | accurate | | d. | running backward | | e. | none of these | |  |  | |
|  | 22. | The proper time between events E1 and E2 is   |  |  | | --- | --- | | a. | the time measured on clocks at rest with respect to E1 and E2 | | b. | the time measured on clocks at rest in an inertial system moving properly with respect to E1 and E2 | | c. | the time measured on clocks moving uniformly with respect to E1 and E2 | | d. | the time between E1 and E2 as measured by a clock in a national-standards laboratory, such as the National Research Council in Ottawa | | e. | none of these | |  |  | |
|  | 23. | There are about 2.81 p12ch11_files/i0250000.jpg 109 heartbeats in an average lifetime of 72 years. Space travellers who are born and die on a spaceship moving at a constant speed of 0.600*c* can expect their hearts to beat a total of   |  |  | | --- | --- | | a. | (0.600)(2.81 p12ch11_files/i0250001.jpg 109) times | | b. | 2.81 p12ch11_files/i0250002.jpg 109 times | | c. | (0.800)(2.81 p12ch11_files/i0250003.jpg 109) times | | d. | (1.25)(2.81 p12ch11_files/i0250004.jpg 109) times | | e. | none of these | |  |  | |
|  | 24. | A mass–spring system oscillates up and down with a period *T* when stationary in the inertial frame of an Earthbound observer. The same system is then moved past the Earthbound observer, with a velocity which in the observer’s frame is constant and of magnitude 0.50*c*. The observer now determines the period to be   |  |  | | --- | --- | | a. | 0.50*T* | | b. | 0.87*T* | | c. | 1.0*T* | | d. | 1.2*T* | | e. | 2.0*T* | |  |  | |
|  | 25. | According to the effects of length contraction, from the viewpoint of an observer stationary with respect to a body moving at a uniform speed relative to the observer,   |  |  | | --- | --- | | a. | the body is not now contracted but would contract if it were to accelerate | | b. | the body contracts along the direction of motion | | c. | the time it takes for a clock incorporated in the body to tick contracts | | d. | the body contracts in some direction transverse to the direction of its motion | | e. | none of these | |  |  | |
|  | 26. | The energy output of the Sun is 3.7 p12ch11_files/i0280000.jpg 1026J/s. Matter is converted to energy in the Sun at the rate of   |  |  | | --- | --- | | a. | 4.1 p12ch11_files/i0280001.jpg 109 kg/s | | b. | 6.3 p12ch11_files/i0280002.jpg 109 kg/s | | c. | 7.4 p12ch11_files/i0280003.jpg 101 kg/s | | d. | 3.7 p12ch11_files/i0280004.jpg 109 kg/s | | e. | none of these | |