Test 4A
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4.1A. A basic postulate of Einstein's theory of relativity is:
A. moving clocks run more slowly than when they are at rest
B. moving rods are shorter than when they are at rest
C. light has both wave and particle properties
D. the laws of physics must be the same for observers moving with uniform velocity relative to each other
E. everything is relative

4.2A. A consequence of Einstein's theory of relativity is::
A. moving clocks run more slowly than when they are at rest
B. moving rods are longer than when they are at rest
C. light has both wave and particle properties
D. the laws of physics appear the same for all observers moving with uniform velocity relative to each other
E. everything is relative

4.3A. The spaceship U.S.S. Enterprise, traveling through the galaxy, sends out a smaller explorer craft that travels to a nearby planet and signals its findings back. The proper time for the trip to the planet is measured by clocks:
A. on board of the Enterprise
B. on board of the explorer craft
C. on Earth
D. at the center of the galaxy
E. none of the above

4.4A. As we watch, a spaceship passes us in time Δt. The crew of the spaceship measures the passage time and finds it to be $\Delta t'$. Which of the following statements is true?
A. Δt is the proper time for the passage and it is smaller than $\Delta t'$
B. Δt is the proper time for the passage and it is greater than $\Delta t'$
C. $\Delta t'$ is the proper time for the passage and it is smaller than Δt
D. $\Delta t'$ is the proper time for the passage and it is greater than Δt
E. None of the above statements are true

4.5A. Two events occur on the *x* axis separated in time by Δt and in the space by Δx. A reference frame, traveling at less than the speed of light, in which the two events occur at the same coordinate:
A. exist no matter what the values of Δx and Δt
B. exist only if $\Delta x/ \Delta t<c$
C. exist only if $\Delta x/ \Delta t>c$
D. exist only if $\Delta x/ \Delta t=c$
E. does not exist under any condition

4.6A. Two events occur 100 m apart with an intervening time interval of 0.37 μs. The speed of clock that measures the proper time between the events is:
A. 0
B. 0.45c
C. 0.56c

D. 0.90c
E. 1.8c

4.7A. A measurement of the length of an object that is moving relative to the laboratory consists of noting the coordinates of the front and back:
A. at different times according to clocks at rest in the laboratory
B. at the same time according to clocks that move with the object
C. at the same time according to clocks at rest in the laboratory
D. at the same time according to clocks at rest with respect to the fixed stars
E. none of the above

4.8A. A meter stick moves sideways at 0.95c. According to the measurements taken in the laboratory, its length is:
A. 0
B. 0.098m
C. 0.31m
D. 3.2m
E. 1.0m

4.9A A rocket ship of rest length 100 m is moving at speed 0.8c past a timing device which records the time interval between the passage of the front and back ends of the ship. This time interval is:
A) 0.20 μs B) 0.25 μs C) 0.33 μs D) 0.52 μs E) 0.69 μs

4.10A A certain automobile is 6 m long if at rest. If it is measured to be 4/5 as long, its speed is:
A) 0.1c B) 0.3c C) 0.6c D) 0.8c E) > 0.95c

4.11A As a rocket ship moves by at 0.95c a mark is made on a stationary axis at the front end of the rocket and 9×10^{-8} s later a mark is made on the axis at the back end. The marks are found to be 100 m apart. The rest length of the rocket is:
A) 31 m B) 78 m C) 100 m D) 240 m E) 320 m

4.12A A clock is moving along the x axis at 0.6c. It reads zero as it passes the origin ($x = 0$). When it passes the $x = 180$ m mark on the x axis the clock reads:
A) 0.60 μs B) 0.80 μs C) 1.00 μs D) 1.25 μs E) 1.67 μs

4.13A An event occurs at $x = 500$ m, $t = 0.90$ μs in one frame of reference. Another frame is moving at 0.90c in the negative x direction. The origins coincide at $t = 0$ and clocks in the second frame are zeroed when the origins coincide. The coordinate and time of the event in the second frame is:
A) 500 m, 0.90 μs
B) 1700 m, 5.5 μs
C) 740 m, 2.4 μs
D) 260 m, –0.60 μs
E) 590 m, –1.4 μs

4.14A Star S1 is moving away from us at a speed of 0.8c. Star S2 is moving away from us in the opposite direction at a speed of 0.5c. The speed of S1 as measured by an observer on S2 is:
A) 0.21c B) 0.5c C) 0.93c D) 1.3c E) 2.17c

4.15A If the mass of a particle is zero its speed must be:

A) c
B) infinite
C) 0
D) any speed less than c
E) any speed greater than c

4.19A An electron ($m = 9.11 \times 10^{-31}$ kg, $q = 1.60 \times 10^{-19}$ C) travels at $0.95c$ around a circular orbit perpendicular to a uniform 1.8-T magnetic field. The radius of its orbit is:

A) 0.28 mm B) 0.90 mm C) 1.1 mm D) 2.9 mm E) 4.7 mm

4.20A According to the theory of relativity:

A) all forms of energy have mass-like properties
B) moving particles lose mass
C) momentum is not conserved in high speed collisions
D) a rod moving rapidly sideways is shorter along its length
E) a rod moving rapidly sideways is longer along its length

4.21A Light from some stars shows an apparent change in frequency because of:

A) interference
B) refraction by layers of air
C) diffraction
D) reflection
E) relative motion

4.22 A. An electron is moving at 0.6c. If we calculate its kinetic energy using $(1/2)mv^2$, we get a result that is:

A. just right
B. just half enough
C. twice the correct value
D. about 1% too low
E. about 28% too low

4.23 A. An electron ($m = 9.11 \times 10^{-31}$ kg) has a speed of 0.95c. The magnitude of its momentum is:

A. 2.6×10^{-22} kg · m/s
B. 2.9×10^{-22} kg · m/s
C. 6.0×10^{-22} kg · m/s
D. 8.3×10^{-22} kg · m/s
E. 8.8×10^{-22} kg · m/s