Webreview - Ch 26 Relativity Practice Test

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Which characterizes the main result of the Michelson-Morley experiment?
a. verified the existence of ether
b. involved measuring the speed of sound from a moving source
c. detected no difference in the speed of light regardless of speed of the source relative to observer
d. was designed purposely to verify Einstein's theory of relativity
e. verified the corpuscular behavior of light.

____ 2. Einstein's theory of relativity is based in part on which one of the following postulates?
a. mass and energy are equivalent
b. space and time are absolutes
c. energy is conserved only in elastic collisions
d. speed of light in a vacuum is same for all observers regardless of source velocity
e. speed of light in a vacuum is same at any wavelength.

____ 3. A mass is bouncing on the end of a spring with a period T when measured by a ground observer. What would the period of oscillation be (as measured by the same observer) if the mass and spring were moving past the ground observer at a speed of 0.80 c?
a. 0.44 T
b. 0.60 T
c. 1.0 T
d. 1.7 T
e. 1.9 T

____ 4. The observed relativistic length of a super rocket moving by the observer at 0.70 c will be what factor times that of the measured rocket length if it were at rest?
a. 0.45
b. 0.71
c. 0.82
d. 1.4
e. 1.9

____ 5. According to the special theory of relativity, which of the following happens to the length of an object, measured in the dimension parallel to the motion of its inertial frame of reference, as the velocity of this frame increases with respect to a stationary observer?
a. length increases
b. length decreases
c. length remains constant
d. length vanishes to zero when velocity equals half speed of light
e. More information is needed.

____ 6. According to the special theory of relativity, if a 30-year old astronaut is sent on a space mission is accelerated to speeds close to that of light, and then returns to earth after 20 years as measured on earth, what would be his biological age upon returning?
a. less than 50 years
b. 50 years
c. more than 50 years
d. exactly 100 years
e. more than 100 years

____ 7. The period of a pendulum is 2.0 s in a stationary inertial frame of reference. What is its period when measured by an observer moving at a speed of 0.60 c with respect to the inertial frame of reference?
a. 1.2 s
b. 1.6 s
c. 2.5 s
d. 3.3 s
e. 4.4 s

____ 8. The period of an oscillating weight on a spring in an inertial frame of reference is 0.80 s. What would be its speed if it were to move by an observer who measures its period as 1.2 s? ($c = 3.00 \times 10^8$ m/s)
a. 1.1×10^8 m/s
b. 2.2×10^8 m/s
c. 2.5×10^8 m/s
d. 2.7×10^8 m/s
e. 2.9×10^8 m/s

____ 9. A space probe has an 18.0-m length when measured at rest. What length does an observer at rest measure when the probe is going by at a speed of 0.700 c?
a. 25.2 m
b. 12.9 m
c. 12.6 m
d. 9.18 m
e. 7.57 m

____ 10. A rocket ship is 80.0 m in length when measured before leaving the launching pad. What would its velocity be if a ground observer measured its length as 60.0 m while it is in flight? ($c = 3.00 \times 10^8$ m/s)
a. 0.980×10^8 m/s
b. 1.15×10^8 m/s
c. 1.33×10^8 m/s
d. 1.98×10^8 m/s
e. 2.55×10^8 m/s

____ 11. The astronaut whose heart rate on Earth is 60 beats/min increases his velocity to $v = 0.80\ c$. What is now his heart rate as measured by an Earth observer?
a. 36 beats/min
b. 48 beats/min
c. 75 beats/min
d. 100 beats/min
e. 120 beats/min

____ 12. A meter stick moving in a direction parallel to its length appears to be only 40.0 cm long to an observer. What is the meter stick's speed relative to the observer? ($c = 3.00 \times 10^8$ m/s)
a. 1.19×10^8 m/s
b. 2.52×10^8 m/s
c. 2.75×10^8 m/s
d. 2.93×10^8 m/s
e. 2.98×10^8 m/s

____ 13. At what speed would a clock have to be moving in order to run at a rate that is one-third the rate of a clock at rest?
a. 0.79 *c*
b. 0.89 *c*
c. 0.94 *c*
d. 0.97 *c*
e. 0.99 *c*

____ 14. A muon formed high in the Earth's atmosphere travels at a speed 0.990 *c* for a distance of 4.60 km before it decays. What is the muon's lifetime as measured in its reference frame?
a. 1.55×10^{-5} s
b. 2.18×10^{-6} s
c. 3.04×10^{-6} s
d. 4.65×10^{-6} s
e. 5.77×10^{-6} s

____ 15. If astronauts could travel at $v = 0.95\ c$, we on Earth would say it takes (4.2/0.95) = 4.4 years to reach Alpha Centauri, 4.2 lightyears away. The astronauts disagree. How much time passes on the astronaut's clocks?
a. 1.4 years
b. 1.9 years
c. 2.4 years
d. 3.0 years
e. 4.8 years

____ 16. A proton with mass 1.67×10^{-27} kg moves with a speed of 0.600 *c* in an accelerator. What is its relativistic momentum? ($c = 3.00 \times 10^8$ m/s)
a. 0.530×10^{-19} kg·m/s
b. 2.40×10^{-19} kg·m/s
c. 3.76×10^{-19} kg·m/s
d. 6.67×10^{-19} kg·m/s
e. 8.85×10^{-19} kg·m/s

____ 17. An electron of mass 9.11×10^{-31} kg moves with a speed of 0.600 *c*. What is its momentum? ($c = 3.00 \times 10^8$ m/s)
a. 1.34×10^{-22} kg·m/s
b. 2.05×10^{-22} kg·m/s
c. 4.12×10^{-22} kg·m/s
d. 6.03×10^{-22} kg·m/s
e. 7.26×10^{-22} kg·m/s

____ 18. Two identical boats can travel through still water at 3.00 m/s. They start from the same point on the bank of a river and travel the same distance from the starting point and then return to the starting point. One boat takes a path parallel (and anti-parallel) to the current while the other has a path that is perpendicular to the current. It takes one boat twice as long as the other boat. How fast is the current in the river flowing?
a. 1.50 m/s
b. 2.12 m/s
c. 2.25 m/s
d. 2.60 m/s
e. 3.70 m/s

____ 19. An electron moves to the right at a speed of 0.70 *c* while another electron moves to the left at a speed of 0.90 *c*, the electrons approaching a head-on collision. What is the speed of each electron as viewed form the other electron?
a. 0.20 *c*
b. 0.80 *c*
c. 0.89 *c*
d. 0.98 *c*
e. 1.60 *c*

____ 20. A star is receding from the Earth at 0.70 *c* when it emits a burst of material at 0.80 c from its surface in the direction away from the Earth. What is the speed of the burst relative to the Earth?
a. 0.96 *c*
b. 1.50 *c*
c. 0.22 *c*
d. 0.88 *c*
e. 0.99 *c*

____ 21. An object moves by an observer at 0.500 *c* (1/2 the speed of light). The total energy of the object will be what factor times that of the rest energy?
a. 0.600
b. 0.970
c. 1.15
d. 1.67
e. 2.83

____ 22. The total energy of a particle:
a. is not related to its relativistic momentum.
b. increases with increasing relativistic momentum.
c. decreases with increasing relativistic momentum.
d. is a constant.
e. behaves differently for different particles.

____ 23. What is the relativistic kinetic energy of an electron moving at a speed of 1.50×10^{8} m/s? (electron mass is 9.11×10^{-31} kg and $c = 3.00 \times 10^{8}$ m/s)
a. 1.27×10^{-14} J
b. 7.10×10^{-14} J
c. 9.47×10^{-14} J
d. 11.6×10^{-14} J
e. 13.8×10^{-14} J

____ 24. A nuclear reaction, which gives off a total of 1.0 x 10^{17} J of energy, expends how much mass in the process? ($c = 3.00 \times 10^8$ m/s)
a. 11 kg
b. 1.1 kg
c. 0.11 kg
d. 90 kg
e. 900 kg

____ 25. A proton with mass 1.67×10^{-27} kg moves with a speed of 0.600 c in an accelerator. What is its kinetic energy? ($c = 3.00 \times 10^8$ m/s)
a. 7.52×10^{-11} J
b. 9.02×10^{-11} J
c. 3.76×10^{-11} J
d. 1.88×10^{-10} J
e. 2.23×10^{-10} J

____ 26. If a proton with mass 1.67×10^{-27} kg moves in an accelerator such that its total energy is three times its rest energy, what is its speed? ($c = 3.00 \times 10^8$ m/s)
a. 2.83×10^8 m/s
b. 1.41×10^8 m/s
c. 2.12×10^8 m/s
d. 1.00×10^8 m/s
e. 8.94×10^7 m/s

____ 27. A proton with mass 1.67×10^{-27} kg moves in an accelerator with a speed of 0.800 c. What is its total energy? ($c = 3.00 \times 10^8$ m/s)
a. 0.540×10^{-10} J
b. 1.08×10^{-10} J
c. 2.51×10^{-10} J
d. 3.26×10^{-10} J
e. 4.47 10^{-10} J

____ 28. When a one-megaton nuclear bomb is exploded, approximately 4.5×10^{15} J of energy is released. How much mass would this represent in a mass-to-energy conversion? ($c = 3.00 \times 10^8$ m/s)
a. 1.5×10^6 kg
b. 0.050 kg
c. 5.3×10^{10} kg
d. 1.7×10^3 kg
e. 4.5×10^6 kg

____ 29. Suppose an object whose mass is m is moving with a speed of 0.8 c. Which is the correct expression for its kinetic energy?
a. $K = mv^2/2$
b. $K = \gamma\, mc^2$
c. $K = (\gamma - 1)mc^2$
d. $K = mc^2/(\gamma - 1)$
e. Answers a and c are both correct.

____ 30. A satellite is powered by a small nuclear generator that puts out 15 W. How much matter is converted into energy over the 10 year life span of the generator?
a. 53 μg
b. 53 g
c. 16 g
d. 16 kg
e. 60 kg

____ 31. A lump of uranium has a mass of 2.0 kg, and begins at rest. Half of the lump's mass is going to be totally converted into kinetic energy of the other half. After this is done, how fast is the remaining half going?
a. 0.60 *c*
b. 0.80 *c*
c. 0.87 *c*
d. 0.98 *c*
e. 1.0 *c*

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Answer Section

MULTIPLE CHOICE

1. C
2. D
3. D
4. B
5. B
6. A
7. C
8. B
9. B
10. D
11. A
12. C
13. C
14. B
15. A
16. C
17. B
18. D
19. D
20. A
21. C
22. B
23. A
24. B
25. C
26. A
27. C
28. B
29. C
30. A
31. C