

6. The uncertainty principle applies not only to momentum and position, but also to energy and time. This statement is
(1) true. (2) false. (3) — (4) — (5) —
7. Two beams of light, a red beam and a blue beam, have the same energy. The beam with the greater number of photons is the
(1) red beam. (2) blue beam. (3) both the same. (4) — (5) —
8. Which of the following are conserved when a photon collides with an electron?
(1) momentum and energy
(2) momentum, energy, and velocity
(3) energy and velocity
(4) momentum and velocity
(5) None of the other choices is correct.
9. X-rays are similar to
(A) beta rays. (B) gamma rays. (C) alpha rays.
(1) B (2) A (3) C (4) all of these (5) none of these
10. Which radiation has no electric charge associated with it?
(A) beta rays. (B) gamma rays. (C) alpha rays.
(1) B (2) A (3) C (4) all of these (5) none of these
11. The atomic number of an element is the same as the number of its
(1) protons. (2) nucleons. (3) neutrons. (4) none of these (5) —
12. An atom with an imbalance of electrons to protons is
(1) an ion. (2) a baryon. (3) an isotope. (4) a hadron. (5) none of these
13. The half-life on an isotope is one day. At the end of three days, how much of the isotope remains?
(1) one-eighth (2) one-third (3) one-quarter (4) one-half (5) none of these
14. Carbon 14 is produced in the atmosphere principally by
(1) cosmic-ray bombardment. (2) plants and animals. (3) nitrogen bombardment. (4) photosynthesis. (5) none of these
15. The helium in a child's balloon is composed of
(A) former beta particles.
(B) alpha-particle remnants of previous radioactive processes.
(1) both of these (2) A (3) B (4) none of these (5) —

16. When radium ($A = 88$) emits an alpha particle, the resulting nucleus has atomic number
- (1) 86. (2) 92. (3) 88. (4) 90. (5) none of these
17. When the hydrogen isotope tritium-3 emits a beta particle, it becomes an isotope of
- (1) helium. (2) hydrogen. (3) carbon. (4) lithium. (5) none of these
18. In nuclear fission and nuclear fusion reactions, the amount of mass converted to energy of other forms is
- (1) less than 1%. (2) about 30%. (3) about 10%. (4) about 20%. (5) more than 30%.
19. In the fissioning of uranium, a chain reaction is caused by
- (1) ejected neutrons.
(2) the conversion of mass to energy.
(3) the enormous energy release.
(4) the kinetic energy of the decay products.
(5) none of these
20. In which of these processes is an element of matter changed into a completely different element?
- (A) nuclear fusion (B) nuclear fission
- (1) both of these (2) A (3) B (4) neither of these (5) —
21. According to the special theory of relativity, events that are simultaneous in one frame of reference
- (1) may or may not be simultaneous in other frames of reference.
(2) are not simultaneous in other frames of reference.
(3) are simultaneous in all frames of reference.
(4) —
(5) —
22. Suppose the time taken for light to bounce to and fro between the parallel mirrors of a light clock is 1 second, in the frame of reference of the light clock. As seen by another observer moving at high speed at right angles to the to-and-fro motion of the bouncing light, the time taken would be
- (1) more than 1 second. (2) also 1 second. (3) less than 1 second. (4) — (5) —
23. A woman standing on the ground sees a rocket ship move past her at 95% of the speed of light. Compared to when the rocket is at rest, the woman measures the rocket's length as
- (1) shorter. (2) longer. (3) the same length. (4) — (5) —
24. 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 photon beam's speed to be
- (1) equal to c . (2) less than c . (3) more than c . (4) — (5) —

25. If you were to travel at speeds close to the speed of light, you would notice that your own
- (A) shape changes. (B) pulse decreases.
- (1) neither of these (2) both of these (3) B (4) A (5) —
26. A 10-meter-long spear is thrown at relativistic speeds through a 10-meter-long pipe. (Both these dimensions are measured when each is at rest.) When the spear passes through the pipe, which of the following statements is true?
- (1) any of these, depending on the motion of the observer (moving with the spear, at rest with the pipe, etc.)
 (2) The spear appears to shrink so the pipe completely covers it.
 (3) Both appear to shrink equally so the pipe barely covers the spear.
 (4) The pipe appears to shrink so the spear extends from both ends.
 (5) none of these
27. Consider a spaceship that moves toward you at half the speed of light. It fires a probe toward you, relative to itself, at 0.7 the speed of light. Relative to you, the probe approaches at about
- (1) 90% c. (2) 70% c. (3) 87% c. (4) 92% c. (5) 96% c.
28. From a general relativistic point of view, a person on the ground floor of a skyscraper ages
- (1) slower than a person on the top floor.
 (2) faster than a person on the top floor.
 (3) at the same speed as a person on the top floor.
 (4) —
 (5) —
29. According to the principle of equivalence,
- (1) observations made in an accelerating reference frame are indistinguishable from those made in a gravitational field.
 (2) mass and energy are two forms of the same thing.
 (3) electricity and magnetism are two forms of the same thing.
 (4) space and time are two forms of the same thing.
 (5) all of these
30. The muzzle velocity of a bullet fired from a new rifle is 100 m/s. Neglecting air resistance, at the end of one second a bullet fired straight up into the air will have traveled a distance of
- (1) $(100 - 4.9)$ m. (2) $(100 + 4.9)$ m. (3) 4.9 m. (4) 100 m. (5) none of these
31. A 1-kg chunk of putty moving at 1 m/s collides with and sticks to a 5-kg bowling ball initially at rest. The bowling ball and putty then move with a momentum of
- (1) 1 kg m/s. (2) 0 kg m/s. (3) 5 kg m/s. (4) 2 kg m/s. (5) more than 5 kg m/s.
32. A coin and a ring roll down an incline starting at the same time. The one to reach the bottom first will be the
- (1) coin. (2) ring. (3) Both reach the bottom at the same time. (4) — (5) —

33. A bullet is fired horizontally with an initial velocity of 300 m/s from a tower 20 m high. If air resistance is negligible, the horizontal distance the bullet travels before hitting the ground is about
- (1) 600 m. (2) 200 m. (3) 500 m. (4) 300 m. (5) 400 m.
34. Voltage can be induced in a wire by
- (A) moving a magnet near the wire.
(B) changing the current in a nearby wire.
(C) moving the wire near a magnet.
- (1) Choices A, B, and C are all true. (2) A only (3) B only (4) C only (5) None of the above
35. A mixture of cyan and yellow pigments appears
- (1) green. (2) blue. (3) blackish brown. (4) magenta. (5) orange.