Critical Thinking Items

1.1 Physics: Definitions and Applications 19.

In what sense does Einstein's theory of relativity illustrate that physics describes fundamental aspects of our universe?

a. It describes how speed affects different observers' measurements of time and space.
b. It describes how different parts of the universe are far apart and do not affect each other.
c. It describes how people think of other people's views from their own frame of reference.
d. It describes how a frame of reference is necessary to describe position or motion.

20.

Can classical physics be used to accurately describe a satellite moving at a speed of 7500 m/s? Explain why or why not.

a. No, because the satellite is moving at a speed much smaller than the speed of the light and is not in a strong gravitational field.
b. No, because the satellite is moving at a speed much smaller than the speed of the light and is in a strong gravitational field.
c. Yes, because the satellite is moving at a speed much smaller than the speed of the light and it is not in a strong gravitational field.
d. Yes, because the satellite is moving at a speed much smaller than the speed of the light and is in a strong gravitational field.

21.

What would be some ways in which physics was involved in building the features of the room you are in right now?

a. Physics is involved in structural strength, dimensions, etc., of the room.
b. Physics is involved in the air composition inside the room.
c. Physics is involved in the desk arrangement inside the room.
d. Physics is involved in the behavior of living beings inside the room.

22.

What theory of modern physics describes the interrelationships between space, time, speed, and gravity?

a. atomic theory
b. nuclear physics
c. quantum mechanics
d. general relativity

23.

According to Einstein's theory of relativity, how could you effectively travel many years into Earth's future, but not age very much yourself?

a. by traveling at a speed equal to the speed of light
b. by traveling at a speed faster than the speed of light
c. by traveling at a speed much slower than the speed of light
d. by traveling at a speed slightly slower than the speed of light

1.2 The Scientific Methods 24.

You notice that the water level flowing in a stream near your house increases when it rains and the water turns brown. Which of these are the best hypothesis to explain why the water turns brown. Assume you have all of the means to test the contents of the stream water.

a. The water in the stream turns brown because molecular forces between water molecules are stronger than mud molecules
b. The water in the stream turns brown because of the breakage of a weak chemical bond with the hydrogen atom in the water molecule.
c. The water in the stream turns brown because it picks up dirt from the bank as the water level increases when it rains.
d. The water in the stream turns brown because the density of the water increases with increase in water level.

25.

Light travels as waves at an approximate speed of 300,000,000 m/s (186,000 mi/s). Designers of devices that use mirrors and lenses model the traveling light by straight lines, or light rays. Describe why it would be useful to model the light as rays of light instead of describing them accurately as electromagnetic waves.

a. A model can be constructed in such a way that the speed of light decreases.
b. Studying a model makes it easier to analyze the path that the light follows.
c. Studying a model will help us to visualize why light travels at such great speed.
d. Modeling cannot be used to study traveling light as our eyes cannot track the motion of light.

26.

A friend says that he doesn't trust scientific explanations because they are just theories, which are basically educated guesses. What could you say to convince him that scientific theories are different from the everyday use of the word theory?

a. A theory is a scientific explanation that has been repeatedly tested and supported by many experiments.
b. A theory is a hypothesis that has been tested and supported by some experiments.

c. A theory is a set of educated guesses, but at least one of the guesses remain true in each experiment.
d. A theory is a set of scientific explanations that has at least one experiment in support of it.

27.

Give an example of a hypothesis that cannot be tested experimentally.

a. The structure of any part of the broccoli is similar to the whole structure of the broccoli.
b. Ghosts are the souls of people who have died.
c. The average speed of air molecules increases with temperature.
d. A vegetarian is less likely to be affected by night blindness.

28.

Would it be possible to scientifically prove that a supreme being exists or not? Briefly explain your answer.

a. It can be proved scientifically because it is a testable hypothesis.
b. It cannot be proved scientifically because it is not a testable hypothesis.
c. It can be proved scientifically because it is not a testable hypothesis.
d. It cannot be proved scientifically because it is a testable hypothesis.

1.3 The Language of Physics: Physical Quantities and Units

29.

A marathon runner completes a 42.188\,\text{km} course in 2\,\text{h}, 30\,\text{min}, and 12\,\text{s}. There is an uncertainty of 25\,\text{m} in the distance traveled and an uncertainty of 1\,\text{s} in the elapsed time.

1. Calculate the percent uncertainty in the distance.
2. Calculate the uncertainty in the elapsed time.
3. What is the average speed in meters per second?
4. What is the uncertainty in the average speed?

a. 0.059\,\%, 0.01\,\%, 0.468\text{m/s}, 0.0003\text{m/s}
b. 0.059\,\%, 0.01\,\%, 0.468\,\text{m/s}, 0.07\,\text{m/s}
c. 0.59\,\%, 8.33\,\%, 4.681\,\text{m/s}, 0.003\,\text{m/s}
d. 0.059\,\%, 0.01\,\%, 4.681\,\text{m/s}, 0.003\,\text{m/s}

30.

A car engine moves a piston with a circular cross section of 7.500 \pm 0.002\,\text{cm} diameter a distance of 3.250 \pm 0.001\,\text{cm} to compress the gas in the cylinder. By what amount did the gas decrease in volume in cubic centimeters? Find the uncertainty in this volume.

a. 143.6 \pm 0.002\,\text{cm}^3
b. 143.6 \pm 0.003\,\text{cm}^3
c. 143.6 \pm 0.005\,\text{cm}^3

d. 143.6 \pm 0.1\,\text{cm}^3

31.

What would be the slope for a line passing through the two points below?

Point 1: (1, 0.1) Point 2: (7, 26.8)

a. 2.4
b. 4.5
c. 6.2
d. 6.8

32.

The sides of a small rectangular box are measured 1.80\,\text{cm} and 2.05\,\text{cm} long and 3.1\,\text{cm} high. Calculate its volume and uncertainty in cubic centimeters. Assume the measuring device is accurate to \pm 0.05\,\text{cm}.

a. 11.4 \pm 0.1\,\text{cm}^3
b. 11.4 \pm 0.6\,\text{cm}^3
c. 11.4 \pm 0.8\,\text{cm}^3
d. 11.4 \pm 0.10\,\text{cm}^3

33.

Calculate the approximate number of atoms in a bacterium. Assume that the average mass of an atom in the bacterium is ten times the mass of a hydrogen atom. (Hint—The mass of a hydrogen atom is on the order of 10^{-27} kg and the mass of a bacterium is on the order of 10^{-15} kg .)

a. 10^{10} atoms
b. 10^{11} atoms
c. 10^{12} atoms
d. 10^{13} atoms