

1. If an electron is completely detached from an atom
  - a) **the atom is ionized.**
  - b) the atom is in its ground state.
  - c) the atom must be in a molecule.
  - d) the atom is an isotope.
  - e) none of the above.
2. We can determine the distance to a galaxy that contains Cepheid variable stars by using
  - a) the period-colour relation
  - b) the mass-luminosity relation
  - c) the mass-radius relation
  - d) the velocity-distance relation
  - e) **the period-luminosity relation**
3. An atom of nitrogen with 7 electrons, 7 protons and 7 neutrons has an atomic number and atomic weight of
  - a) 7 and 7, respectively
  - b) 14 and 7, respectively
  - c) 7 and 21, respectively
  - d) 14 and 21, respectively
  - e) **7 and 14, respectively**
4. The Doppler effect
  - a) explains the rainbow of visible light
  - b) causes a prism to form a spectrum
  - c) causes the speed of light to be finite
  - d) **is the change in wavelength from a source moving towards or away from us**
  - e) was used by de Broglie to study quantum mechanics
5. You are moving to west at  $0.75c$  and your friend is moving to the east at  $0.75c$ . 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  $1.5c$ , and your friend will see your light arrive at a speed of  $1.5c$
  - 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  $1.5c$
  - e) none of the above
6. What did Planck use to solve the blackbody problem?
  - a) that light is made up of waves
  - b) that electrons have a wavelength
  - c) that when you shine light on a metal it produces a current
  - d) that light interferes with itself
  - e) **that light comes in packets of energy**

7. The spectral lines of a star are observed to be shifted toward larger wavelengths. This shows
- a) that the star is relatively cool.
  - b) that the star is very hot.
  - c) that the star is moving away from us.**
  - d) that the star is approaching us.
  - e) that it is impossible to tell anything with information given.
8. Parallax to a star would be easier to measure if:
- a) The distance between the observer and the star were larger.
  - b) The Earth moved more slowly in its orbit (took longer than a year to orbit the Sun)
  - c) We lived on Mars**
  - d) all of above
  - e) none of the above
9. In order to be classified as a dwarf planet in our Solar System, a body must orbit the Sun and
- a) be round.
  - b) not be a moon.
  - c) clear its orbit of other objects.
  - d) all of the above.
  - e) only answers a and b.**
10. A statement was made in class that, "The vacuum is not empty." This referred to the fact:
- a) That the bag has not been emptied lately
  - b) That quarks and electrons are continually being created and destroyed
  - c) That the vacuum has many atoms in it
  - d) That electrons and positrons are continually created and destroyed**
  - e) None of the above
11. Assume you are observing a rotating spiral galaxy. If you could suddenly turn off gravity what would happen?
- a) The galaxy would collapse down to a point
  - b) The galaxy would fly apart**
  - c) The galaxy would rotate more quickly
  - d) Nothing would happen-- the galaxy would keep rotating at the same rate
  - e) The galaxy would start rotating in the opposite direction
12. Which of the following characteristics do NOT apply to giant elliptical galaxies?
- a) Rapidly rotating**
  - b) Not forming many stars
  - c) Lacking spiral arms
  - d) Found in the centres of galaxy clusters
  - e) All of the above

13. The Heisenberg Uncertainty Principle tells us that
- a) knowing the exact energy also tells us exactly the time.
  - b) determining the energy more accurately leads to a more accurate determination of time.
  - c) determining the energy more accurately leads to a less accurate determination of time.**
  - d) the accuracy of knowing the energy is independent of the accuracy of knowing the time.
  - e) none of the above
14. The distance between the Sun and the nearest star is smaller than the distance between the Milky Way and the our nearest neighbour (Andromeda) by a factor of
- a) A few tens
  - b) A hundred
  - c) A thousand
  - d) A million**
  - e) A billion
15. Atoms make spectral lines because
- a) electrons have only certain allowed orbits.**
  - b) photons have only certain allowed orbits.
  - c) speed of light in a vacuum is a constant.
  - d) light consists of waves.
  - e) none of the above
16. An astronomer finds an object at a distance of 1 000 lightyears from Earth. Based on the distance, which of the following is this object most likely to be?
- a) An object in the Kuiper Belt
  - b) an artificial satellite orbiting the Earth
  - c) the blackhole at the centre of the Milky Way
  - d) a galaxy
  - e) a star in our galaxy**
17. We can study how galaxies evolve because
- a) galaxies are transparent to visible light
  - b) the further away we look, the further back in time we see**
  - c) we can watch how they interact in real time
  - d) early astronomers kept good records that we can use today
  - e) all of the above
18. As you move to higher altitude above the Earth, what happens to you?
- a) your weight decreases and your mass stays the same.**
  - b) your weight and mass decrease
  - c) your weight increases and your mass stays the same
  - d) your weight and mass stay the same
  - e) impossible to know

19. If you draw a spacetime diagram, the worldline of something moving at the speed of light in your reference frame is
- a) horizontal.
  - b) slanted.**
  - c) vertical.
  - d) curved.
  - e) a circle.
20. Which of the following is *false*?
- a) The order of events can be different for observers in different reference frames.
  - b) From your point of view, time runs slower in the reference frame of anyone moving relative to you.
  - c) If one observer measures two events to be simultaneous, all observers must agree on their simultaneity.**
  - d) Time dilation is an observationally verified fact.
  - e) Time runs slower in a high-speed rocket ship.
21. You are observing a star about 500 trillion km (50 lightyears) away. How old is the most recent information you can get about this star?
- a) 50 years**
  - b) 300,000 seconds
  - c) This can't be determined without having more information.
  - d) 500 trillion seconds
  - e) 500 years
22. Which was the final prediction of General Relativity experimentally observed?
- a) Gravitational Lensing
  - b) Gravitational Redshift
  - c) Gravitational Length Contraction
  - d) Gravitational Waves**
  - e) Gravitational Time Dilation
23. In the raisin bread analogy for the Universe, what do the raisins represent?
- a) stars
  - b) intergalactic space
  - c) black holes
  - d) galaxies**
  - e) something else
24. In what way is general relativity more general (deals with more situations) than special relativity?
- a) It includes accelerated motion but not gravitation.
  - b) It includes accelerated motion and gravitation.**
  - c) It includes only constant, unaccelerated motion.
  - d) It includes only motion at the speed of light.
  - e) None of the above

25. Suppose we look at two distant galaxies: Galaxy 1 is twice as far away as Galaxy 2. In that case,

- a) Galaxy 1 must be twice as big as Galaxy 2
- b) we are seeing Galaxy 1 as it looked at an earlier time in the history of the universe than Galaxy 2**
- c) we are seeing Galaxy 1 as it looked at a later time in the history of the universe than Galaxy 2
- d) Galaxy 2 must be twice as old as Galaxy 1.
- e) none of the above

26. Which is the weakest of the fundamental forces in the Universe?

- a) weak force
- b) electromagnetic force
- c) strong force
- d) gravitational force**
- e) none of the above

27. The Milky Way star, Sirius, is 9 light-years from the Sun while the Milky Way star, Canopus, is 100 light-years from the Sun. Hubble's Law implies that:

- a) Sirius is moving at the same speed as Canopus
- b) Sirius is moving more slowly than Canopus
- c) Sirius and Canopus are BOTH moving away from the Sun
- d) both b & c
- e) none of the above**

28. During one lecture, a thought experiment was discussed that involved a skateboarder. The main point of the discussion was to show

- a) that light follows a curved path.
- b) that the speed of light is constant.
- c) that different observers could obtain different measures of time.**
- d) that different observers see light redshifted by different amounts.
- e) none of the above.

29. Famous observations were made in 1919 to test the prediction of Einstein's general theory of relativity. The main reason that it was done during a total eclipse of the sun was

- ~~a) so that the star light would follow a curved path~~
- ~~b) so that star light that passed close to the sun would be visible~~
- ~~c) so that the light could pass close to the moon~~
- ~~d) so that the gravitational force from the sun and moon would be combined~~
- ~~e) none of the above~~ **DID NOT COUNT. Ambiguous.**

30. Which of the following are the correct standard units of mass, distance and time?

- a) kg, light yrs, yrs
- b) g, m, s
- c) kg, m, s**
- d) g, light yrs, yrs
- e) none of the above