

Name _____

Do not forget to write your name and fill in the bubbles with your student number, **leaving the last bubble blank**, and fill in test form A on the answer sheet. Write your name above as well. You have 50 minutes. For each question, mark the best answer. The formulas you may want are:

$$\sin\left(\frac{\theta}{2}\right) = \frac{\ell}{2d} \quad F = \frac{GMm}{d^2} \quad P^2 = a^3 \quad (M + m) P^2 = a^3$$

$$c = \lambda f \quad c = 3 \times 10^8 \text{ m/sec} \quad \frac{v_r}{c} = \frac{\lambda_1 - \lambda_0}{\lambda_0} \quad E = hf$$

$$P = knT \quad \lambda_{\text{Peak}} T = 2900 \text{ K} \cdot \mu\text{m}$$

- The Moon takes about one _____ to go from new moon to full moon
 - Day
 - Week
 - Fortnight (two weeks)
 - Month
 - Year
- What is the purpose of a spectrometer? Why would someone attach it to a telescope?
 - It increases the amount of light that the telescope gathers
 - It helps to focus the image of some astronomical object
 - It divides the light from a source up into its component wavelengths
 - It compensates for the blurring of the atmosphere
 - It rotates the telescope to compensate for the turning of the Earth
- Which of the following was an innovation in describing planetary motion introduced by Kepler that was not used by earlier scientists?
 - He applied the law of universal gravity to their motion
 - He suggested that the planets go around the Sun, not the Earth
 - He realized that the Sun also goes around the planets, a little bit
 - He used ellipses, instead of circles or some other shape, to describe their orbits
 - He actually used the correct distances for all of the planets
- If you were an ancient astronomer, and were trying to figure out the shape of the Earth, it would make special sense to pay attention during
 - First Quarter (of the Moon)
 - Third Quarter (of the Moon)
 - Solar Eclipses
 - Lunar Eclipses
 - High tide
- What is an arc-second?

- A) A very small unit of angle
 - B) A very small unit of distance
 - C) A very small unit of time
 - D) A very small unit of mass
 - E) A device used by Noah to save microbes from mini-floods
6. Besides visible light, what other type of astronomy is normally done from the surface of the Earth, rather than space?
- A) Gamma Rays
 - B) X-rays
 - C) Infrared
 - D) Ultraviolet
 - E) Radio waves
7. The Sun is about 1,000 times as massive as Jupiter. How does the Sun's gravitational force on Jupiter compare with Jupiter's gravitational force on the Sun?
- A) The Sun's force is about 1,000 times bigger
 - B) The Sun's force is about 1,000,000 times bigger
 - C) The Sun's force is about 32 times bigger
 - D) The two forces are equal
 - E) There is insufficient information to answer this question
8. Rockets work by pushing gasses out the back very fast. They do this because
- A) The gasses are hot and dangerous, and they are trying to get them away from the ship
 - B) If you push gas out the back, the gas is also pushing you forward
 - C) The gas has mass, and therefore gravity, which can be used to propel the rocket forward
 - D) The electric charges in the gas repel the oppositely charged rocket, propelling it forward
 - E) It makes the launches look more dramatic, which increases public interest and funding for space exploration
9. Which of the following is not a type of energy?
- A) Kinetic energy, or energy of motion
 - B) Light, or electromagnetic energy
 - C) Gravitational energy
 - D) Nuclear energy
 - E) Color energy
10. According to Newton, if an object is moving around a circle, and suddenly all forces on the object disappear, the object will
- A) Immediately come to a stop
 - B) Gradually come to a stop after continuing to move in a circle
 - C) Gradually come to a stop after continuing to move in a straight line
 - D) Move in a straight line at constant speed forever
 - E) Move in a straight line and gradually speed up
11. If we plot the apparent position of the planet Neptune compared to the stars, how does it move?

- A) It always moves from west to east near the ecliptic
 - B) It always moves from east to west near the ecliptic
 - C) It always moves from west to east, but it stays far from the ecliptic
 - D) It always moves from east to west, but it stays far from the ecliptic
 - E) It sometimes moves from west to east and sometimes east to west, and always near the ecliptic
12. Why is it difficult to simply use the formula $\sin(\theta/2) = \ell/2d$ to get the size ℓ of an object, such as the planet Pluto?
- A) The letter ℓ stands for the luminosity, not the size of the object
 - B) Although it is easy to get the distance d , it is hard to get the angular size θ of the object
 - C) Although it is easy to get the angular size θ of the object, it is difficult to get the distance d to the object
 - D) Although it is easy to get both the angular size and the distance, it is hard to solve this equation for the size ℓ .
 - E) Neither the angular size θ nor the distance d of an object are easy to determine
13. In late June, the angle of the Sun at local noon will be relatively
- A) Low in the sky in the Northern hemisphere and high in the sky in the Southern hemisphere
 - B) High in the sky in the Northern hemisphere and low in the sky in the Southern hemisphere
 - C) High in the sky in either hemisphere
 - D) Low in the sky in either hemisphere
 - E) Alternately low and high on successive days, in either hemisphere
14. How come the Earth's gravity doesn't have any effect on the Space Shuttle's orbit?
- A) The space shuttle is too far from the Earth to be affected by it
 - B) The Earth's atmosphere shields the shuttle from the Earth's gravity
 - C) It does have an effect, but the rockets compensate for it
 - D) It does have an effect; that's why the shuttle has to land eventually
 - E) It does have an effect, that's why the shuttle is going around the Earth instead of in a straight line
15. What is the most important difference between the solar system model of the atom and the Bohr model?
- A) In the solar system model, the electrons are allowed to spin around their axis like a planet
 - B) The solar system model allows smaller "moon" electrons to orbit the main "planet" electrons
 - C) In the solar system model, energy flows out from the nucleus
 - D) The Bohr model demands that the electrons only orbit at very specific distances, and hence can only have certain amounts of energy
 - E) The solar system model is exciting, the Bohr model is Bohr-ing
16. How does the Moon's rotation on its axis compare to its orbit around the Earth?
- A) The Moon rotates once for each orbit, and in the same direction
 - B) The Moon rotates more than once for each orbit, and in the same direction

- C) The Moon rotates less than once for each orbit, and in the same direction
 - D) The Moon rotates once for each orbit, but in the opposite direction
 - E) The Moon does not rotate on its axis
17. What method or measurement would tell me how hot a star is?
- A) How bright it looks to the naked eye
 - B) How bright it looks in a telescope
 - C) How big across it is in a telescope
 - D) How black a black-body it is
 - E) What color it is
18. Two stars orbit each other at a separation of 100 AU. What is the period of their orbit around each other?
- A) 10 years
 - B) 100 years
 - C) 1,000 years
 - D) 1,000,000 years
 - E) There is insufficient information to solve the problem
19. How come tides are so much bigger sometimes and smaller at others?
- A) The Moon's distance to the Earth varies
 - B) Sometimes the Sun combines with the Moon to make big tides; other times it interferes
 - C) The Sun's distance to the Earth varies
 - D) The other planets also contribute substantially to Earth's tides
 - E) Vibrations in the Earth sometimes help and other times hinder the tides
20. What happens to a large moon (or any large object) that falls within the Roche limit of a planet?
- A) It gets captured and remains in orbit around the planet
 - B) It gets absorbed and becomes part of the planet
 - C) It gets expelled from the planet, never to return
 - D) It gets broken apart into small pieces
 - E) It gets distorted into a spindle shape
21. What force prevents an electron from leaving an atom?
- A) Gravity
 - B) Electromagnetic forces
 - C) Heat
 - D) Pressure
 - E) (Strong) nuclear forces
22. What huge disadvantage did Tycho Brahe have compared to later astronomers?
- A) He was a very sloppy experimenter
 - B) He relied almost exclusively on mathematics, rather than doing observations

- C) The telescope was not yet invented, or at least he didn't have one
 - D) He assumed the heavens were forever unchanging
 - E) He came after Copernicus, and hence was not aware of the possibility that the Sun was the center of everything
23. If we have two different wavelengths of light, which one will move faster in vacuum?
- A) The one with the longer wavelength
 - B) The one with the higher frequency
 - C) The one with the lower frequency
 - D) They will move at the exact same speed
 - E) There is insufficient information to tell
24. Comet Halley is in orbit around the Sun. Sometimes it is very far from the Sun. Sometimes it is very close to the Sun. When is it moving the fastest?
- A) When it is closest to the Sun
 - B) When it is farthest from the Sun
 - C) When it is moving in towards the Sun
 - D) When it is moving away from the Sun
 - E) Since it is in orbit, it's speed is always exactly the same
25. How does the orbit of the Moon around the Earth compare to the orbit of the Earth around the Sun?
- A) The Moon's orbit is nearly perpendicular to the Earth's orbit
 - B) The Moon's orbit is tilted slightly compared to the Earth's orbit
 - C) The Moon's orbit is in almost exactly the same plane as the Earth's, but it goes around in the opposite direction
 - D) The Moon's orbit is in almost exactly the same plane as the Earth's, and it goes around in the same direction at about the same speed
 - E) The Moon's orbit is in almost exactly the same plane as the Earth's, and it goes around the same direction, but at a very different speed
26. Currently, the North pole of Earth points towards the star Polaris. Will it always point there, as long as the Earth exists?
- A) No, it will change in a few hours due to the rotation of the Earth
 - B) No, it will change in a few weeks due to the orbit of the Moon
 - C) No, it will change in a few months due to the orbit of the Earth
 - D) No, it will change over thousands of years, due to precession of the Earth
 - E) Yes
27. The formula $E = hf$ can be used to calculate the energy of light under what circumstances?
- A) When you know you have exactly one photon, or particle of light
 - B) When you turn on your light source for a known amount of time h
 - C) When your light is coming from a distant source, like a star or galaxy
 - D) When you know all your light is exactly at the same frequency f , no matter how bright it is
 - E) When you are in vacuum
28. How is it possible that there are sometimes total solar eclipses and sometimes annular solar eclipses?
- A) The size of the Sun varies slightly throughout the year

- B) The size of the Moon varies slightly throughout the year
 - C) The light is bent by the gravity of the Moon different amounts throughout the year
 - D) The Earth isn't exactly a sphere, so the geometry is different at different angles
 - E) The distance from the Earth to the Moon varies a little, causing different types of eclipses
29. Which planets are observed sometimes to be in the opposite direction from the Sun?
- A) Mars, but not Mercury nor Venus
 - B) Mars and Venus, but not Mercury
 - C) Mars and Mercury, but not Venus
 - D) Mercury and Venus, but not Mars
 - E) Mercury, but not Venus nor Mars
30. What effect, if any, is there on the shape of the Earth caused by its rapid rotation?
- A) Friction has removed all the bumps and wiggles, making the Earth more spherical
 - B) The Earth bulges out at the North and South poles, because that's where it's spinning around
 - C) The Earth bulges out at the equator, making it look like a squashed ball
 - D) The rotation is the cause of tides, which move around the Earth at different times
 - E) The rotation has no measurable effect on the shape of the Earth
31. Which of the following has the longest wavelength?
- A) Red visible light
 - B) Violet visible light
 - C) Microwaves
 - D) Ultraviolet light
 - E) X-rays
32. After you take this test, your professor will explain that during the early stages of the solar system, there was a huge cloud of gas and dust that was pulled to the center of the solar system by gravity, but rotation resisted that pull. The resulting shape of that gas and dust is a
- A) Disk
 - B) Flattened sphere
 - C) Line
 - D) Sphere
 - E) Ellipse
33. A certain atom normally emits infrared light with a wavelength of $1.000\ \mu\text{m}$. However, it is discovered that a certain astronomical source produces light from this atom that appears to have a wavelength of $1.100\ \mu\text{m}$. How can one account for this discrepancy?
- A) It must be moving towards us at about $3 \times 10^7\ \text{m/s}$
 - B) It must be moving away from us at about $3 \times 10^7\ \text{m/s}$
 - C) It must be rotating at about $3 \times 10^7\ \text{m/s}$
 - D) It must be hotter than a normal atom by about 10%
 - E) It must be cooler than a normal atom by about 10%