

Name _____

Do not forget to write your name and fill in the bubbles with your student number, 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:

$$F = \frac{GMm}{d^2} \quad F = ma \quad P^2 = a^3 \quad (M + m) P^2 = a^3$$

$$c = \lambda f \quad c = 3 \times 10^8 \text{ m/sec} \quad E = hf \quad P = knT$$

$$\frac{v_{\text{rad}}}{c} = \frac{\lambda_{\text{shift}} - \lambda_{\text{rest}}}{\lambda_{\text{rest}}} \quad \lambda_{\text{max}} T = 2900 \text{ K} \cdot \mu\text{m}$$

- Which of the following methods would decrease the gravitational force of the Earth on the Moon by a factor of four?
 - Increase their separation by a factor of two (only)
 - Increase their separation by a factor of four (only)
 - Decrease their masses by a factor of two each (only)
 - A and C would both work, but not B
 - B and C would both work, but not A
- Which of the following is not true of the Bohr model of the atom?
 - Electrons can only orbit the nucleus only in specific orbits
 - When electrons jump from one level to another, the energy is emitted or absorbed as light
 - Any type of atom can emit or absorb any amount of energy
 - The spectrum of light emitted or absorbed by an atom can tell you what kind of atom it is
 - Actually, all of these are true about the Bohr model of the atom
- As viewed from a city like Winston-Salem, what do the stars do over the course of the night?
 - They all rise in the east and set in the west
 - They all rise in the west and set in the east
 - Some rise in the east and set in the west, and some do it the other way
 - Some rise and set each night, but some are always up and circle the North Star
 - The stars appear not to move as viewed from the Earth

4. Copernicus' model of the universe differed from most others of his time in that
 - A) The Moon went around the Earth
 - B) The planets, including Earth, went around the Sun
 - C) The Moon was assumed to be spherical
 - D) The orbits of the planets were based on ellipses, not circles
 - E) The Earth was assumed to be spherical

5. If a rocket were moving somewhat faster than escape velocity from the Sun, what shape would its orbit take?
 - A) Circle
 - B) Ellipse
 - C) Parabola
 - D) Straight Line
 - E) Hyperbola

6. When you put a gas in a bottle and heat it up, there is pressure pushing outwards on the bottle, which can make it explode. What is causing this outwards pressure?
 - A) Hot molecules of the gas expand, pushing outwards against the bottle
 - B) The electrons become more repulsive at high temperature, pushing outwards
 - C) There are force lines connecting all the molecules, and these become stronger at high temperatures
 - D) The molecules in the bottle move faster at high temperature, colliding with the walls
 - E) The walls of the bottle expand; it isn't caused by the gas at all

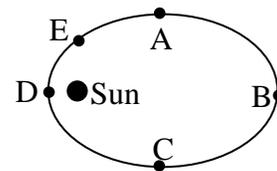
7. Suppose a new asteroid is discovered that orbits the Sun more quickly than the Earth does. Which of the following could be its average distance a from the Sun?
 - A) 0.87 AU
 - B) 1.03 AU
 - C) 3.26 AU
 - D) 5.84 AU
 - E) 9.62 AU

8. Which of the following is *not* explained with the help of Newton's law of universal gravitation?
 - A) Why the Earth is round
 - B) Why atoms are generally neutral
 - C) Why tides occur
 - D) Why the Moon always keeps one side facing the Earth
 - E) How the planets orbit the Sun

9. When you make a black body cold (but not absolute zero), what happens to the black body radiation coming off of it?
 - A) It decreases the amount of radiation, but the wavelength peak stays the same
 - B) It decreases the amount of radiation, and the wavelength shifts to a shorter wavelength
 - C) It decreases the amount of radiation, and the wavelength shifts to a longer wavelength
 - D) The amount of radiation stays the same, but the wavelength shifts to invisibility
 - E) Cold objects do not emit any radiation at all, even perfect black bodies

10. The reason that there are not solar and lunar eclipses approximately every month is because
- The Moon orbits the Earth much more slowly than once a month
 - The Moon's orbit around the Earth is tilted slightly compared to the Earth's orbit around the Sun
 - The Moon's orbital rate is almost exactly the same as the Earth's orbital rate, so they very rarely are at the correct corresponding point in their orbit
 - The Moon sometimes has too small an angular size to block out the Sun
 - There actually are such eclipses somewhere every month, but not necessarily where you see them
11. Besides looking at the light through an eyepiece or a CCD camera, what else is an astronomer likely to do with the light that his telescope gathers from a distant source?
- Put it through a mixer, which combines it with light from other sources
 - Put it through a diffuser, which spreads the light uniformly over a large area
 - Put it through a spectrometer, which divides it into its component wavelengths
 - Put it through a pinhole filter, which makes sure all the light is at one point
 - Use it to heat his coffee pot
12. Which of the following is *not* a form of electromagnetic wave, like visible light?
- Infrared
 - Radio
 - Sound
 - X-rays
 - Gamma-rays
13. Arc-seconds and arc-minutes are used to measure
- Time
 - Distance
 - Velocity
 - Angle
 - Mass

14. According to Kepler's second law, at which of the points labeled in the diagram will a planet move most quickly? Assume the planet is traveling clockwise around the Sun.



15. Neutral hydrogen atoms emit radio signals with a wavelength of about 21.1 cm. Suppose a distant cloud of hydrogen was found to emit radio signals which we detect at a wavelength of about 21.8 cm. What could we conclude about this cloud of hydrogen?
- It is moving at about 10^7 m/s towards us
 - It is moving at about 10^7 m/s away from us
 - It is moving at about 10^7 m/s, but there is no way to know if it is towards or away from us
 - It is moving at about 10^{-10} m/s towards us
 - It is moving at about 10^{-10} m/s away from us

16. All the light from the supernova SN1987A got to Earth at essentially the same time, even though it was very far away. Why is this so?
- A) Light moves so fast that all of it got here nearly instantaneously, no matter what combination of wavelengths it produced
 - B) The low speed light was emitted first, and the high speed light was emitted last, so it got here at the same time
 - C) The light from a supernova is almost all one wavelength, so it all goes at almost the same speed
 - D) Light always moves at the same speed c , no matter what wavelength it has
 - E) I have no idea; please mark this one wrong
17. We talked a great deal about visible light telescopes. Why are there no X-ray telescopes?
- A) There are no known sources of X-rays in the universe
 - B) No detectors for X-rays have ever been built
 - C) X-rays cannot reach the solar system, because the solar wind pushes them away
 - D) Though there are X-ray sources, they are all understood and uninteresting
 - E) Actually, there ARE X-ray telescopes, but they are all in space
18. Kepler related the period and size of a planet's orbit by the formula $P^2 = a^3$. Newton modified this formula to show that $(M + m) P^2 = a^3$. How can these formulas be consistent?
- A) Kepler's version is almost exactly correct for planets around the Sun, in which case $M + m = 1$, so they are then the same formula, but this doesn't work in other situations
 - B) Kepler's version applies to planets in the Solar System, Newton's version does not
 - C) Kepler's version is simply wrong, they are not consistent, even approximately
 - D) Newton's version is simply wrong, they are not consistent, even approximately
 - E) In all circumstances, $M + m = 1$, so they are always consistent
19. How come sometimes solar eclipses are total, with the whole Sun blocked out, and sometimes annular, where all but a narrow ring is blocked out?
- A) Because the radius of the Sun changes slightly over the course of a year
 - B) Because the size of the Moon changes slightly due to tidal forces from the Earth
 - C) Because the distance between the Earth and Moon changes slightly as it orbits the Earth
 - D) Because the atmosphere of the Earth sometimes bends the light and magnifies the Sun
 - E) Because the gravity of the Moon sometimes bends the light of the Sun

20. The test you are currently holding contains approximately 10^{24} electrons. The reason the test does not expand or blow up as a consequence is because
- A) There is also gravity holding it together, and gravity is stronger than electric forces
 - B) The paper is held together by the pressure of the atmosphere pushing in on it
 - C) Electrons have negative charge, and hence attract each other
 - D) The electric force is so small that it cannot tear apart even paper
 - E) There is an equal amount of positive charge contained in nuclei, cancelling out the negative charge
21. Which of the following made it clear, even to ancient astronomers, that the Moon was a sphere, not a flat disk?
- A) The way the Moon was illuminated as it went through its phases
 - B) The way the Moon blocked out the Sun during a solar eclipse
 - C) The way the Moon's illumination is blocked during a lunar eclipse
 - D) The presence of craters on the Moon
 - E) The presence of large dark and light areas on the Moon
22. Sometimes the Earth, Moon, and the Sun are all in a line. When they are in a line, which one can be between the other two?
- A) The Sun (only)
 - B) The Moon (only)
 - C) The Earth (only)
 - D) The Sun and the Earth, but not the Moon
 - E) The Moon and the Earth, but not the Sun
23. According to Kirchoff's Laws, what sort of object can produce a bright line, or emission spectrum?
- A) A hot, thin gas
 - B) A hot, thick gas
 - C) A hot, thick, solid or liquid
 - D) A hot, thick solid or liquid with a cool thin gas in front of it
 - E) None of the above
24. Besides visible light, what other type of electromagnetic radiation can readily make it to the surface of the Earth?
- A) Radio
 - B) Microwaves
 - C) X-rays
 - D) Infrared
 - E) Ultraviolet
25. According to Newton's Laws, what happens to a moving object if it has no forces acting on it?
- A) It will immediately stop moving
 - B) It will gradually slow until it is stopped
 - C) It will gradually slow down, but never stop
 - D) It will continue moving in a straight line at a constant speed
 - E) It will continue moving at a constant speed, but not in a straight line

26. Arrange the colors red, blue, green in order from lowest frequency to highest frequency
- A) Red, blue, green
 - B) Red, green, blue
 - C) Green, blue, red
 - D) Blue, green, red
 - E) Green, red, blue
27. Which of the following is true about energy
- A) There are only three types – kinetic, nuclear, and chemical
 - B) Energy can be converted from one form to another
 - C) When there is friction, energy disappears
 - D) Energy is the same thing as force
 - E) Light waves are a form of nuclear energy
28. What is one reason that it is useful to have really large primary (or objective) mirror or lens as the first optical component?
- A) It allows you to gather very long wavelength visible light
 - B) It allows you to examine large astronomical objects like galaxies
 - C) It allows you to build a very sturdy telescope that won't warp when it is moved
 - D) It gives you a better chance of missing any clouds that might be blocking your view
 - E) It allows you to gather a lot of light and see very dim objects
29. As the Moon orbits the Earth, the Moon moves a lot, while the Earth moves little. Why?
- A) The force of the Earth on the Moon is much greater than the Moon on the Earth, because the Earth is more massive
 - B) The force of the Earth on the Moon is much greater than the Moon on the Earth, because the Earth-Moon distance is much smaller than the Moon-Earth distance
 - C) The forces are equal, but because of $F = ma$, the less massive object (the Moon) accelerates more
 - D) The more massive object doesn't actually move at all because of the less massive object; the only movement of the Earth is caused by the Sun
 - E) The Earth's rapid rotation averages out any pull from the Moon
30. It is hotter in the summer than in the winter primarily because
- A) The atmosphere is most transparent to sunlight in the summer
 - B) The Earth is closer to the Sun in the summer
 - C) The Sun shines most directly down on the ground during the summer
 - D) The Sun is more luminous (brighter) during the summer
 - E) Warm air current flow to our hemisphere from the equator during the summer

31. Which of the following was not done by Isaac Newton?
- A) Invented a new type of telescope
 - B) Showed that white light is made up of all the colors of the rainbow
 - C) Deduced three laws of motion
 - D) Deduced the universal law of gravitation
 - E) Actually, Newton *did* do all of these things
32. Which of the following would be the best definition of the wavelength of a wave?
- A) The distance from one wave to the next
 - B) The time over which a wave repeats itself
 - C) The speed with which a wave moves
 - D) The number of waves that pass any given point in a second
 - E) The number of waves that fit into one meter
33. Suppose a detector is hit by a single photon of light. Which kind of light would have the highest energy for a single photon?
- A) The light with the highest frequency
 - B) The light with the lowest frequency
 - C) The light with the highest velocity
 - D) The light with the lowest velocity
 - E) All photons of light have the same energy