

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:

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

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

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

- On a modern high-quality telescope, what is the first part of the telescope that the light hits?
A) Lens B) Mirror C) Polarizer D) Diffraction Grating E) Prism
- Which of the following pure colors has the longest wavelength?
A) Blue B) Violet C) Orange D) Green E) Red
- How long, approximately, does it take for the Moon to go through its cycle of phases, from new moon to new moon?
A) 1 hour B) 1 day C) 1 week D) 1 month E) 1 year
- Which of the following is true about the wavelength(s) of light that can be absorbed by any given atom?
A) Atoms can generally absorb any wavelength of light
B) Atoms can absorb a continuous range of wavelengths, but not all wavelengths
C) Atoms can absorb only a set of very narrow ranges of wavelengths, and these wavelengths are different for different types of atoms
D) Atoms can absorb only a set of very narrow ranges of wavelengths, and these wavelengths are the same for all types of atoms
E) Atoms cannot absorb light, they can only scatter it
- According to Kepler's Law, two portions of an orbit will take equal time if and only if
A) They are both at the same distance from the Sun
B) They are both the same length
C) A line joining them to the Sun sweeps out the same area
D) A line joining them to the Sun sweeps out the same angle
E) None of the above

6. If I look at two stars, how can I tell, by naked eye, which one probably has the higher surface temperature?
- A) Brightness: the one with the brighter color is hotter
 - B) Direction: the one nearest the galactic equator is hotter
 - C) Twinkling: the star that appears to twinkle more is hotter
 - D) Color: the star that is redder is hotter
 - E) Color: the star that is bluer is hotter
7. When we say that the Earth precesses over a period of about 26,000 years, what are we talking about?
- A) The tilt of the axis changes over time, much like a spinning top
 - B) The Earth's rotation causes it to bulge out at the equator
 - C) The Moon's distance from the Earth is gradually increasing
 - D) The Earth's distance from the Sun is gradually increasing
 - E) This is how long it takes the Earth to orbit the Sun
8. Which of the following was not a discovery of Isaac Newton?
- A) The Earth is round
 - B) The law of gravity applies both here on Earth and between objects in space
 - C) The three laws of motion
 - D) The fact that white light is composed of many different colors
 - E) Actually, all of these were discoveries of Newton
9. Which piece of evidence convinced ancient astronomers that the Moon was a sphere, and not a flat disk?
- A) The fact that it was round as viewed at any time during the month
 - B) The fact that we always see the same side of the Moon
 - C) The fact that during lunar eclipses, the shaded part was always round
 - D) The fact that during solar eclipses, the dark part of the Sun was always curved
 - E) The way the Moon was illuminated by the Sun at different parts of the lunar cycle
10. Which of the following is not a type of electromagnetic radiation?
- A) X-rays
 - B) Infrared
 - C) Heat
 - D) Radio waves
 - E) Gamma rays
11. Which of the following pieces of information is necessary to figure out how long it takes a particular asteroid to go around the Sun?
- A) The distance (semi-major axis) from the Sun of the orbit
 - B) The mass of the asteroid
 - C) The speed of the asteroid
 - D) The density of the asteroid
 - E) The gravitational force between the asteroid and the Sun

12. Which of the following describes the relative strength of the tidal effects of the Moon and the Sun on the Earth?
- A) The Sun's effect is so much bigger you can ignore the Moon
 - B) The Sun's effect is bigger than the Moon's, but not a lot bigger
 - C) They have equal or nearly equal size effects
 - D) The Moon's effect is bigger than the Sun's, but not a lot bigger
 - E) The Moon's effect is so much bigger you can ignore the Sun
13. Red light from the star Sirius takes 9 years to reach the Earth. How long does it take blue light to reach us from the star Sirius?
- A) 9 years
 - B) More than 9 years
 - C) Less than 9 years
 - D) Sometimes more, sometimes less, depending on the relative frequencies
 - E) Sometimes more, sometimes less, depending on the relative wavelengths
14. Which of the following is not considered a fundamental force of nature?
- A) Strong Nuclear
 - B) Electromagnetism
 - C) Weak Nuclear
 - D) Chemistry
 - E) Gravity
15. Which piece of evidence was the most convincing to Galileo that at least some planets went around the Sun?
- A) The fact that Venus got brighter and dimmer at different times of the year
 - B) The fact that Jupiter had moons, which could only happen for an object that circled the Sun
 - C) The fact that some planets had retrograde motion
 - D) The fact that Venus had a full cycle of phases
 - E) The fact that there were mountains and craters on the Moon
16. Visible light can penetrate our atmosphere. What other type of electromagnetic radiation can also easily penetrate the atmosphere?
- A) Ultraviolet
 - B) Infrared
 - C) X-rays
 - D) Radio
 - E) Gamma rays
17. Which objects in the sky have retrograde motion; that is, they sometimes move from west to east compared to the stars, but occasionally move from east to west?
- A) The Moon (only)
 - B) The Planets (only)
 - C) The Sun (only)
 - D) The Moon and planets, but not the Sun
 - E) The Sun and planets, but not the Moon
18. Suppose a spaceship were in a circular orbit around the Earth, when suddenly its engines failed. What would the spaceship do as a consequence?

- A) It would fall directly towards the center of the Earth
 - B) It would begin to follow a spiral path towards the Earth, getting lower and lower
 - C) It would move in a straight line forwards, whatever direction it was traveling at the moment the engines failed
 - D) It would move in a straight line directly away from the Earth
 - E) It would continue in its circular orbit.
19. Which of the following combinations of particles will repel each other?
- A) Two positively charged protons (only)
 - B) Two negatively charged electrons (only)
 - C) A positively charged proton and a negatively charged electron (only)
 - D) Both A and B are correct
 - E) Both B and C are correct
20. When the Moon goes around the Earth, how come the Earth doesn't go around the Moon as well?
- A) The Earth is more massive than the Moon, so it isn't affected
 - B) The Earth's magnetic field holds it in place, unlike the Moon
 - C) The Earth is orbiting the Sun, so it can't orbit the Moon
 - D) Actually, the Earth moves in a circle, just like the Moon, but the circle is much smaller
 - E) Actually, there is no way to tell which is orbiting which; we could just as easily say that the Earth is orbiting the Moon and the Moon stands still
21. If I put some gas in a bottle and compress it, what causes there to be an outward force (pressure) against the walls of the container?
- A) Electromagnetic repulsion between the atoms and the walls of the container
 - B) Light from the gas collides with the walls, pushing it
 - C) Molecules of the gas are bouncing against the walls, pushing them out
 - D) The atoms are connected by lines of force, which push against each other
 - E) The increased temperature causes the walls themselves to expand
22. How do planets move compared to the ecliptic, the imaginary circle that the Sun follows around compared to the stars?
- A) They are always exactly on the ecliptic
 - B) They are always near the ecliptic, but generally not on it
 - C) They can be either very far from the ecliptic or very near it
 - D) They are always very far from the ecliptic
 - E) None of the above
23. The core of the Earth has an enormous number of positively charged iron nuclei. Why do these nuclei not all repel each other, causing the core of the Earth to explode?

- A) There is ample gravity to hold it together
 - B) There are enough electrons to cancel out the charge of the iron nuclei
 - C) The size of the core is so large that the force is weak
 - D) The pressure is so great that it holds it in
 - E) Positively charged objects attract each other, not repel each other
24. What is the significance of escape velocity?
- A) It is the minimum speed needed to go into orbit around an object, escaping the surface
 - B) It is the minimum speed needed so that you can leave an object forever, so you aren't caught in an elliptical orbit
 - C) It is the minimum speed to move upwards against gravity, rather than falling
 - D) It is the minimum speed required to go in a straight line leaving an object, instead of curving
 - E) I have no idea; please mark this one wrong
25. An arc-minute is a measure of
- A) Time
 - B) Distance
 - C) Angle
 - D) Temperature
 - E) Energy
26. The main reason it is warmer in the summer is because
- A) The Sun is higher in the sky in the summer
 - B) The Sun is lower in the sky in the summer
 - C) The Earth moves closer to the Sun in the summer
 - D) The Earth moves farther from the Sun in the summer
 - E) The Sun moves closer to the Earth in the summer
27. If I have a gas and want to double the pressure, which of the following methods would work?
- A) Double the mass of each molecule in the gas (only)
 - B) Double the number density of the gas (only)
 - C) Double the temperature in Kelvin (only)
 - D) Doubling the mass and the number density both work
 - E) Doubling the number density and the temperature both work
28. If you have a relatively cool gas in front of a hot thick gas, what sort of spectrum do you get?
- A) A dark line, or absorption spectrum
 - B) A bright line, or emission spectrum
 - C) A continuous spectrum
 - D) A monochromatic, or just one wavelength spectrum
 - E) A top hat, or range spectrum
29. There is a line in the spectrum of the Sun with a wavelength of 656.28 nm. The Sun has a surface temperature of 5800 K and is not moving toward or away from us. Suppose the same spectral line were seen from a distant star at a wavelength of 650.36 nm. What would that tell us about the star?

- A) It is hotter than the Sun
 - B) It is cooler than the Sun
 - C) It is moving towards us
 - D) It is moving away from us
 - E) None of the above
30. Over billions of years, the Moon has moved steadily farther away from the Earth. What is causing this gradual change in distance?
- A) The gravitational force of the Moon on Earth's tidal bulges are gradually pulling it to a higher orbit
 - B) The Earth is slowly losing mass due to outgassing, causing the Moon to move away
 - C) The gravitational constant is gradually weakening over time
 - D) The slight pull of other planets on the Moon causes it to slowly move away
 - E) The solar wind from the Sun is gradually pulling it away
31. Approximately immediately after this test, I will be lecturing on protoplanetary DISKS. The fact that the gas forms into a disk implies that which two effects are affecting this gas?
- A) Gravity and pressure
 - B) Gravity and friction
 - C) Rotation and pressure
 - D) Rotation and friction
 - E) Gravity and rotation
32. Which of the following is true about the minimum amount of energy that can exist for any type of electromagnetic radiation?
- A) The minimum is constant, independent of the frequency or wavelength
 - B) The minimum is directly proportional to the frequency
 - C) The minimum is directly proportional to the wavelength
 - D) There is a minimum, but its relationship is complicated
 - E) There is no minimum amount of energy

33. Suppose the Earth and Moon were arranged as sketched at right. At how many of the points on Earth as marked by black dots would there be high tide?
- A) 0 B) 1 C) 2 D) 3 E) 4

