

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:

$$F = \frac{GMm}{d^2}$$

$$F = ma$$

$$P^2 = a^3$$

$$(M + m) P^2 = a^3$$

$$c = \lambda f$$

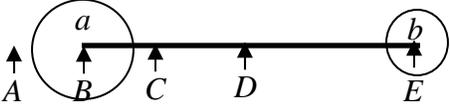
$$c = 3 \times 10^8 \text{ m/sec}$$

$$E = hf$$

$$P = knT$$

$$\frac{v_{\text{rad}}}{c} = \frac{\lambda_{\text{shift}} - \lambda_{\text{rest}}}{\lambda_{\text{rest}}}$$

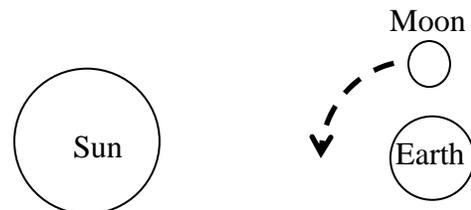
$$\lambda_{\text{max}} T = 2900 \text{ K} \cdot \mu\text{m}$$

- We can measure the angular size of Jupiter through a telescope. What additional information would allow us to deduce Jupiter's actual size?
A) Its distance B) Its temperature C) Its mass D) Its brightness E) None of these
- Suppose two stars are gravitationally bound, with star *a* substantially heavier than star *b*. Around which point might the two stars actually orbit?

- The first person who speculated that planets orbit in ellipses, not circles, was
A) Galileo B) Tycho Brahe C) Kepler D) Copernicus E) Newton
- Light is really a combination of what two types of energy?
A) Motion and electric
B) Motion and magnetic
C) Heat and motion
D) Heat and electric
E) Electric and magnetic
- According to Newton's laws, when a heavy object pushes or pulls on a light object, what force does the light object exert on the heavy object?
A) No force – only heavy objects can push on light objects
B) Some force, but a smaller force than the heavy object exerts
C) A larger force than the heavy object exerts
D) The same force that the heavy object exerts
E) It is impossible to tell without further information
- In the early solar system, dust and gas is pulled by the protostar towards the center, but due to rotation, it doesn't all fall in. What shape will this gas form?
A) Sphere B) Triangle C) Line D) Spiral E) Disk
- The arc-second and arc-minute are units of

A) Time B) Mass C) Velocity D) Angle E) Force

8. Which event would have been especially useful for ancient astronomers in trying to figure out the shape of the Earth?
- A) New moon
 - B) First quarter
 - C) Full moon
 - D) Solar eclipse
 - E) Lunar eclipse
9. The Moon causes high tide on the side of the Earth facing the Moon. Why is there also a high tide on the side of the Earth facing away from the Moon?
- A) The Earth is “falling” towards the Moon, but since the far side of the Earth is farthest from the Moon, it is falling the slowest and gets left behind
 - B) If the Moon is on one side (the night), the Sun will be on the other side (the day), so it causes the other high tide
 - C) The Moon was at that location around twelve hours earlier, so it is just left over from then
 - D) The Moon’s gravity is still strong on the back of the Earth, causing high tide
 - E) The water is simply shifting up and down as an echo of the high tide twelve hours earlier
10. Galileo’s observations of the phases of Venus were important to astronomy because they demonstrated that Venus
- A) Was a sphere, not a flat disk
 - B) Went around the Sun, not the Earth
 - C) Underwent retrograde motion
 - D) Was closer to the Earth than the Sun was
 - E) Was moving in an ellipse, not a circle

11. The sketch at right is an approximate sketch of the Moon orbiting the Earth, such that it is about to get between the Sun and the Earth and cause a solar eclipse. In what way is this drawing unrealistic, so that in fact a solar eclipse might not occur?



- A) The Moon goes around the Earth the other way, so it won't actually cause an eclipse
- B) The Earth is moving as well, so it will not be where it is drawn
- C) The orbit of the Moon is tilted, so it might pass above or below the line of sight to the Sun
- D) The Moon is actually much smaller than drawn, so it would not actually block out the Sun
- E) The Moon changes the direction it orbits the Earth periodically

12. Why does the Moon always show (approximately) the same side to the Earth?

- A) It doesn't rotate, so it's always the same side
 - B) Tidal forces of the Earth on the Moon hold it in that position
 - C) Earth's magnetic field causes it to line up, like a needle on a compass
 - D) The Earth's atmosphere has caused friction on the Moon, causing it to stop spinning compared to us
 - E) It's a vanity thing; the Moon considers its backside less attractive than its front
13. The high temperature outside today (Friday) is probably closest to
A) 3 K B) 19 K C) 31 K D) 284 K E) 5800 K
14. If you wait the length of time for the Earth to rotate exactly once on its axis (one sidereal day), which astronomical object would be in the same apparent place in the sky?
A) Stars B) Sun C) Moon D) Planets E) None of these
15. When do two objects with electric charges attract each other?
A) Always
B) Never
C) If they both have positive charges
D) If they both have negative charges
E) If one has positive charge and the other has negative charge
16. The Earth is approximately a sphere, but the equator is actually larger in radius than the distance from the center to the poles (it is an oblate spheroid). What factor causes this bulging of the equator?
A) Magnetic fields
B) Rotation
C) Tidal forces from the Moon
D) Tidal forces from the Sun
E) Thermal expansion of the Earth caused by tropical heating
17. How much detail you can make out in a telescope is limited, in principle, by
A) How much the first mirror or lens bends the light
B) How wide the first mirror or lens is
C) How thick the first mirror or lens is
D) How long the telescope is
E) How large the eyepiece is
18. Compared to the stars, the planets move
A) East to west
B) West to east
C) North to south
D) South to north
E) Sometimes west to east, and sometimes east to west
19. If you looked at the position of the Sun when it is highest in the sky during each day, how would its apparent position vary over the course of a year?

- A) It would be pretty much the same position every day
- B) It would be high in the sky in the winter and low in the summer
- C) It would be low in the sky in the winter and high in the summer
- D) It would be to the east in the summer and to the west in the winter
- E) It would be to the west in the summer and to the east in the winter

20. Which color of light has the shortest wavelength?

- A) Red
- B) Blue
- C) Green
- D) All colors of light have the same wavelength
- E) Insufficient information

21. If you have a relatively cool gas in front of a hot, thick, gas, the spectrum you would see (looking at the hot gas through the cool gas) would be a

- A) Absorption or dark line spectrum (only)
- B) Emission or bright line spectrum (only)
- C) Continuous spectrum (only)
- D) It could be any of the above
- E) I can be none of the above

22. Which of the following would tell you what element a given atom is?

- A) The mass
- B) The charge of the nucleus
- C) The number of electrons
- D) The number of nuclei
- E) The physical size of the atom

23. Which of the following would give you some indication of which of several stars has the hottest temperature?

- A) Brightness: the star that looks the brightest is hottest
- B) Brightness: the star that looks the dimmest is hottest
- C) Color: the star that looks bluish is hottest
- D) Color: the star that looks reddish is hottest
- E) Color: the star that looks whitish is hottest

24. When you increase the temperature in a gas, why does the pressure go up?

- A) The molecules are moving faster, so when they bounce off the walls, they give more force

- B) The molecules expand, creating pressure
 - C) The molecules shed their electrons, and then electric forces get greater from the repulsion of the bare nuclei
 - D) The molecules form chemical compounds that push on the walls
 - E) The heat creates more molecules, and more molecules means more force
25. A couple weeks ago, astronomers announced indirect evidence of a new planet circling our Sun. If the distance from the Sun to the new planet is an average of 400 AU, how long would it take to orbit the Sun?
- A) 20 years
 - B) 54.3 years
 - C) 400 years
 - D) 8,000 years
 - E) 64,000,000 years
26. Which of the following would have the most energy if you had a single photon?
- A) Gamma ray
 - B) X-ray
 - C) Ultraviolet
 - D) Radio
 - E) Microwave
27. The period of time it takes for the Moon to go through its full cycles of phases is about a
- A) Year
 - B) Month
 - C) Fortnight (two weeks)
 - D) Week
 - E) Day
28. Hydrogen normally has a spectral line with a wavelength of approximately 656.3 nm. Under what circumstances would we anticipate that this wavelength might be shifted to a shorter wavelength?
- A) If the source is moving towards us
 - B) If the source is moving away from us
 - C) If the source is rotating
 - D) If the source is exceptionally hot
 - E) If the source is exceptionally cool
29. Which of the following planets is always in the same general direction as the Sun?
- A) Mercury (only)
 - B) Venus (only)
 - C) Mars (only)
 - D) Mercury and Venus, but not Mars
 - E) Mercury, Venus, and Mars
30. Besides visible light, the other type of electromagnetic radiation that can be studied from the surface of the Earth is
- A) Gamma ray
 - B) X-ray
 - C) Ultraviolet
 - D) Radio
 - E) Microwave
31. According to Kepler, objects in orbit around each other always follow ellipses. According to Newton, what additional shape can an orbit take?
- A) Parabola (only)
 - B) Hyperbola (only)

- C) Spiral (only)
- D) Parabola or hyperbola, but not spiral
- E) Parabola, hyperbola, or spiral

32. Can an atom absorb light?

- A) Yes, it can absorb any wavelength
- B) No, it cannot absorb any wavelength
- C) Yes, but only specific wavelengths that depend on the type of atom
- D) Yes, but only specific wavelengths that are the same for all atoms
- E) Yes, but not on Sundays and holidays

33. The fundamental advantage that space telescopes like the Hubble has over ground-based telescopes like the Keck observatory is that the Hubble

- A) Is closer to the objects it is observing
- B) Is larger than ground-based telescopes
- C) Doesn't have to deal with vibrations, since it's in vacuum
- D) Can be maneuvered to new positions to see objects anywhere
- E) Doesn't have to try to peer through the atmosphere