Physics 360/Geology 360  Test #1  2/13/09

Multiple Choice. (Questions are rated at 1 point apiece) Please ignore the numbers with dashes to the right. Please return this question/problem sheet to the front of the room when you are done.

1. The daily motion of the stars, planets, Moon, Sun and other objects from east to west is called
   a. Diurnal motion
   b. Orbital motion
   c. Rotational motion
   d. Centripetal motion

   1-1

2. All the celestial objects rise in the East and set in the West because
   a. The Earth is rotating from east to west.
   b. The Earth is rotating from west to east
   c. The Earth is orbiting around the Sun from east to west
   d. The celestial sphere is rotating from east to west

   1-4

3. In which season is the Earth closest to the Sun?
   a. When it is winter in America
   b. When it is summer in America
   c. When it is autumn in America
   d. When it is spring in America

   1-5

4. Which of the following objects passes through the zodiac?
   a. Sun
   b. Planets
   c. Earth and Moon
   d. All of the above
   e. None of the above

   1-7

5. On what dates does the Sun rise exactly due east and set exactly due west?
   a. June 21 and December 21
   b. March 21 and September 23
   c. Only on March 21
   d. Only on June 21

   1-10

6. What is the ecliptic?
   a. The line of the solar and lunar eclipses on the celestial sphere
   b. The extension of the Earth's path on the celestial sphere
   c. The elliptical shape of the Earth's orbit around the Sun
   d. All of the above

   1-14

7. Which of the following is true during the equinoxes?
   a. The Sun is on the ecliptic
   b. The Sun is on the celestial equator
   c. The Sun rises due east and sets due west.
   d. All of the above
   e. Only A and C are correct

   1-19
8. What causes the seasons?
a. The changing distance between the Earth and the Sun
b. The tilt of the Earth's spin axis relative to the Earth's orbit
c. The Earth's spin axis is tilted from the poles of the celestial sphere
d. The elliptical shape of the Earth's equator

9. What is retrograde motion?
a. East to west motion of the Sun
b. East to west motion of the Moon relative to the stars
C. Occasional east to west motion of the planets relative to the stars
d. Occasional west to east motion of the planets relative to the stars

10. Suppose that the Earth's spin would suddenly reverse direction, but the direction of the Earth's motion around the Sun was preserved. Which of the following changes would you expect to observe?
a. The Sun would rise in the West and set in the East
b. The stars would rise in the West and set in the East
c. The planets would rise in the West and set in the East
d. All of the above would be observed
e. Only A and B are correct

11. During retrograde motion, a planet rises in the _______ and sets in the _______.
a. East, west
b. West, east

c. Kepler's major contribution to astronomy is his extensive series of measurements of planetary positions.
a. Tycho Brahe's
b. Galileo's
c. Kepler's

13. According to Newton's first law of motion if a body is not moving in a straight line at a constant speed,
a. Some net force is acting on it
b. The body is accelerating
c. The body will have a tendency to stay in motion
d. All of the above

14. An astronaut feels weightlessness in space. Therefore, the astronaut's mass in space is
a. Zero
b. The same as on the Earth
c. Double than on the Earth
d. Becoming lesser and lesser as s/he is going higher

15. If you double the distance between two bodies, the force of gravity between them would become
a. Double too
b. One half
c. One fourth
d. Four times
16. If you are lucky enough to get a chance to visit different planets of our Solar System, which of the following statements will be true?
   a. Your weight will change, but mass will remain same
   b. Your mass will change, but weight will remain same
   c. Both your weight and mass will remain same
   d. Both your weight and mass will change

17. The speed an object needs to move away from the gravitational pull of the Earth is called
   a. Orbital velocity
   b. Escape velocity
   c. Rotational velocity
   d. Random velocity

18. If a rope on which you are swinging a rock breaks, what will happen to the rock?
   a. Rock will fall down immediately
   b. Rock will complete the circle before falling down
   c. Rock will go in a straight line before falling down
   d. Rock will fly upward

19. Consider a large truck and a small car driving up a straight steep hill. The truck is moving at 60 miles per hour and the car at 30 miles per hour. Assuming that the speeds are constant, which of the two vehicles experiences a larger net force?
   a. The truck
   b. The car
   c. The same: zero net force

20. Suppose that the Sun started shrinking in size, without losing any mass. What would be the effect of the Sun's change on the orbits of the planets?
   a. The orbits would become smaller in size
   b. The orbits would become larger
   c. The orbits would not be affected
   d. The planets would escape

21. Which of the following objects move according to Kepler's laws?
   a. A satellite orbiting the Earth
   b. A planet orbiting the Sun
   c. Runners racing around a track
   d. All of the above
   e. Only A and B

22. A force that pulls an upward going ball back to the Earth and keeps the Moon in its orbit is called
   a. Inertia
   b. Gravity
   c. Pressure
   d. Escape speed

2-10
2-11
2-14
2-18
2-21
2-24
2-5
23. The recoil experienced when firing a shotgun is a consequence of ____ law.
   a. Newton's 1st
   b. Kepler's 3rd
   c. Newton's 3rd

24. The speed of light in materials like glass or water is ________
   a. Reduced
   b. Increased
   c. The same as in vacuum
   d. Sometimes reduced and sometimes increased

25. Which of the following statements is true?
   a. X-rays have higher energy, hence they move faster than visible light
   b. X-rays have higher energy, but still they move slower than visible light
   c. Even though X-rays have higher energy, they move with the same speed as that of visible light
   d. None of the above

26. Which radiations have more energy?
   a. Higher frequency radiations
   b. Lower frequency radiations
   c. Longer wavelength radiations
   d. Shorter wavelength radiations
   e. Both A and D

27. In an atom when an electron jumps from a lower energy orbit to a higher energy orbit, it is called
   a. Ionization
   b. Acceleration
   c. Excitation
   d. A ground stage

28. ________ spectrum has dark lines on a continuous background.
   a. Absorption
   b. Emission
   c. Continuous
   d. None of these

29. Which of the following can be determined from Wien's law?
   a. The temperature of the surface of the Sun
   b. The chemical composition of the surface of the Sun
   c. The temperature of a hot tenuous gas
   d. All of the above
   e. Only A and C are correct
30. What determines the identity of a chemical element?

a. The number of protons in the nucleus
b. The number of electrons orbiting the nucleus
c. The number of neutrons in the nucleus
d. All of the above
e. Only A and B above

31. You are heating a jar full of hydrogen and observing its spectrum. If you add more hydrogen in it, the position of spectral lines will change.
a. True
b. False

32. The Alpha star in the constellation of Orion shifts its position on the celestial sphere by 0.03 arc seconds per year and the Beta star shifts by 0.001 arc seconds per year. Based on this observation, which of the following conclusions is justifiable?
a. The spectral lines from the Beta star are more red-shifted
b. The spectral lines from the Alpha star are more red-shifted
c. The shifts in direction do not provide information on the speed along the line of sight, therefore we cannot draw any conclusion on the shift of the spectral lines

33. What is the disadvantage of using a lens in a large telescope?
a. Large lenses are expensive to fabricate
b. A lens has to be supported only at its edges, so the lens can sag in the middle
c. Different colors of white light on passing through a lens focus at different points and result in a blurred image
d. Some lens materials completely absorb short-wavelength

34. Why does the Sun look flattened near the horizon?
a. The Sun is made up of gases, so it keeps changing its shape and takes a flattened shape near the horizon
b. The Earth's dense atmosphere compresses the gaseous Sun
c. The larger refraction near the horizon lifts the lower edge of the Sun more than the upper edge and makes the Sun look flattened
d. The Sun is cooler in the horizon, so it looks flattened

35. An interstellar gas is emitting radiations of 10-centimeter wavelength and a nearby star is emitting radiations of 100-micrometer wavelength. Which of these can you observe through an Earth-based telescope?
a. The interstellar gas
b. The star
c. Both of them
d. None of them

36. Which of the following telescopes is most suitable for observing cool gas clouds?
a. X-ray telescope
b. Radio telescope
c. Visible light telescope
d. All of the above
e. Cool gas clouds cannot be observed by telescopes
37. ______ is the most important quality of an astronomical telescope.
   a. Magnification
   b. Resolving power
   c. Ability to see at night
   d. Rigidity 4-21

38. The design of radio telescopes is very similar to the design of refracting telescopes.
   a. True
   b. False 4-23

39. Why does the Moon appear bigger near the horizon?
   a. Due to an optical illusion
   b. Due to refraction
   c. Due to reflection
   d. Due to the compression produced by the Earth's atmosphere 4-5

40. Jon has a 5-inch refracting telescope and Jim has a 3-inch reflecting telescope. Whose telescope has a higher light-gathering power?
   a. Jon's, because lenses gather more light
   b. Jim's, because mirrors gather more light.
   c. Jon's, because the larger the diameter, the more light to be collected
   d. Jim's, because the smaller the diameter, the more light to be collected
   e. Both the telescopes have the ability to gather the same amount of light 4-8

Problems (Problems are weighted at 2 points apiece) (41-45)

41. The acceleration of gravity on the Earth's surface is 9.8 m/s². What is the acceleration of gravity at a height of 6,400 km above the Earth's surface? (Hint: recall the 1/r² dependence and note that the Earth's radius is 6,400 km)
   a. 4.9 m/s²
   b. 2.45 m/s²
   c. 19.6 m/s²
   d. 9.8 m/s²
   2-22

42. Mars completes one orbit around the Sun in approximately two Earth years. Mars orbits at an average distance to the Sun of about 1.5 AU, and Mars' mass is about 1/10 of the Earth's mass. Therefore Mars' orbital speed is ______ the orbital speed of the Earth.
   a. About 0.8 times
   b. 1.5 times larger than
   c. About 1/10 of
   d. About 3 times
   2-27

43. Jon has a 14-inch refracting telescope. Jon is trying to resolve two stars separated by 0.1 seconds. Using the wavelength of the middle of the spectrum can Jon do this with his telescope.
   a. Yes he can
   b. Sorry, Jon. You can't do it.
44. A planet is discovered orbiting a nearby star once every 125 years. If the star is identical to the Sun, use Kepler's third law to find the planet's distance to the star in AU units.

\[ \frac{p^2}{a^3} = \frac{3}{125^2} = a \]

- a. 25
- b. 5
- c. 11
- d. 125

45. Compare the light-gathering power of a telescope with a 10 centimeter (about 4 inch) diameter mirror to that of a human eye as a ratio. (Take the diameter of the pupil of the eye to be about 5 millimeters)

- a. 100
- b. 20
- c. 100
- d. 200

Useful equations (not all may be needed)

\[ g = G \frac{M}{R^2} \] Where \( M \) is the mass of the planet, \( R \) is the distance to the center of the planet (meters), \( G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2 \) the Gravitational Constant and \( g \) is the acceleration of gravity on the planet.

\[ P^2 = a^3 \] Kepler's Law where \( P \) is in earth years and \( a \) is in AU units.

\[ D \geq \frac{0.02 \lambda}{\alpha} \] Resolving Power of a telescope where \( D \) is expressed in centimeters, \( \lambda \) in nanometers and \( \alpha \) in arc-seconds.

\[ g \text{ (sea level)} = 9.8 \text{ m/s}^2 \] where \( g \) is the gravitational acceleration.

\[ F = G \frac{m_1 m}{r^2} \] Universal law of Gravitation

\[ E = \frac{hc}{\lambda} \]

\[ T = \frac{3 \times 10^6}{\lambda_m} \]

\[ S = \theta R \] where \( \theta \) is in radians (formula for arc length)