29:52 Exploration of the Solar System
First Hour Exam
March 3, 2010

There are 30 questions. Read through each question and all the answers before choosing. Budget your time. No whining.

Walk with Ursus!

1. The Sun has just set. You look up in the sky and see that the Moon is on the meridian. What phase is it?
   (a) new
   (b) waxing crescent
   (c) first quarter*
   (d) full
   (e) waning gibbous

2. Where in the sky, and what time of day, is the planet Mars to be seen at present?
   (a) in the east, about halfway up the sky in the early evening*
   (b) low in the southwest, shortly after sundown
   (c) near the zenith at dawn
   (d) rising in the northeast about one hour before dawn
   (e) too close to the Sun to be seen at nighttime at the present time

3. According to one of Kepler's Laws of Planetary Motion, the orbits of planets around the Sun are a geometric figure (technically plane curves). Which one of these figures is it?
   (a) circle
   (b) hyperbola
   (c) polyhedron
   (d) ellipse*
   (e) square

4. The age of formation of rocks on the Moon and other astronomical objects (including the Earth) is determined by a technique called
   (a) laser-induced fluorescence
   (b) x-ray spectroscopy
   (c) radioisotope dating*
   (d) Young's Modulus age determination method
   (e) petrochronology
5. The surface of the Moon is covered with craters. These craters were produced by
   (a) volcanic eruptions
   (b) impacts of meteors and asteroids
   (c) subsidence of the land due to hydrology
   (d) the effect of wind and water from the atmosphere of the ancient Moon
   (e) an excavating effect of charged particle beams from the Sun.

6. In what part of the sky will we always see the planet Mars?
   (a) along the ecliptic
   (b) along the celestial equator
   (c) within about 5 degrees of the zenith
   (d) near the north celestial pole
   (e) along the meridian

7. At the beginning of the semester, I noted that the Sun set at about 5:11 PM in the southwest. Where and when does it set now?
   (a) it sets at the same time and the same direction
   (b) it sets later, and further to the south than at the beginning of the semester
   (c) the Sun sets earlier, and slightly north of west
   (d) it sets later, nearly due south
   (e) later in the day, and more west than southwest

8. Very roughly, what is the diameter of the planet Earth?
   (a) 1700 kilometers
   (b) 13,000 kilometers
   (c) 230 kilometers
   (d) 500,000 kilometers
   (e) 2 light years

9. The unit which is conventionally used to describe distances in the solar system is the
   (a) mile
   (b) astronomical unit
   (c) light year
   (d) parsec
   (e) Angstrom

10. Which of the following correctly describes the location of Venus in the solar system?
    (a) it is closer to the Sun than Jupiter, but further from the Sun than Mars
    (b) it is closer to the Sun than Mars, but further from the Sun than Earth
    (c) it is the closest planet to the Sun
(d) Venus is beyond the orbit of Neptune
(e) it is closer to the Sun than the Earth, but further from the Sun than Mercury*

11. What feature of the Earth’s moon is unusual, relative to the moons of other planets?
(a) it is small compared with the planet it orbits
(b) it is unusually far from its planet
(c) it is large compared with the planet it orbits*
(d) it has a thick atmosphere
(e) it is believed to have formed about 1.3 billion years after the other major objects in the solar system

12. This semester, the planet Mars was at opposition. This means that
(a) the Sun, Earth, and Mars were on a line, and in that order*
(b) a line from Mars to the Sun, and a line from the Sun to the Earth formed a right angle
(c) the Earth, Sun, and Mars were on a line, and in that order
(d) Mars was at its most distant in the past two years
(e) Mars was diametrically opposite to Earth, on the far side of the Sun

13. The semimajor axis of the orbit of Mars is 1.52 au. Given this, what additional information does Kepler’s 3rd law tell you about the orbit of Mars?
(a) the orbital period will be 1 year, like the Earth which also orbits the Sun
(b) the orbital period is less than a year
(c) the line of nodes of the orbit of Mars will precess at a rate of 2.3 degrees per year
(d) Mars exerts a gravitational force on the Earth
(e) it has an orbital period greater than a year*

14. When we want to specify the position of an astronomical object in the horizon coordinate system, we give the
(a) right ascension and declination
(b) latitude and longitude
(c) heliocentric distance and ecliptic coordinate
(d) altitude and azimuth*
(e) action variable and angle variable

15. When we want to specify the position of an astronomical object in the equatorial coordinate system (i.e. fixed with respect to the stars), we give the
(a) right ascension and declination*
(b) latitude and longitude
(c) heliocentric distance and ecliptic coordinate
(d) altitude and azimuth
(e) action variable and angle variable
16. Consider a total eclipse of the Moon. Which of the following is a correct description of what happens?
   (a) the Moon moves into the shadow of the Earth*
   (b) the Moon casts a shadow on the Earth
   (c) the New Moon blocks out the light of the Sun
   (d) the internal energy sources of the Moon that make it shine temporarily fade out
   (e) the Moon is at its greatest distance from the Sun, and as a result is dimmer than usual

17. Think about the SC1 chart that we used in several of the homework exercises. What is the wavy, "sine function" line across the chart?
   (a) celestial equator
   (b) meridian
   (c) zenith
   (d) ecliptic*
   (e) line of nodes

18. Which of the following attributes of the solar system is responsible for the phenomenon of seasons here on Earth (a topic of great interest in Iowa right now)
   (a) the changing distance between the Earth and Sun during the year
   (b) the tilt of the Earth’s axis with respect to the plane of the ecliptic*
   (c) a gravitational "tug" exerted on the Earth by Jupiter
   (d) annual variations in the length of the day
   (e) small, periodic variations in the luminosity of the Sun

19. Which of the following sets of numbers (astronomical data) would be sufficient to measure your latitude anywhere on Earth?
   (a) the declination of a star and its altitude angle at transit*
   (b) the time of day that a star transits and its declination
   (c) the apparent magnitude of a star and the constellation in which it is located
   (d) the right ascension of a star and its altitude angle at transit
   (e) the right ascension and declination of a star

20. Which of the following correctly describes the path of the Moon across the sky?
   (a) the path is the same as the ecliptic
   (b) the Moon is always very close to the celestial equator
   (c) the Moon is always very close to the meridian
   (d) a great circle on the celestial sphere, inclined by 5 degrees from the ecliptic*
   (e) a great circle on the celestial sphere, inclined by 30 degrees from the ecliptic

21. Why are total solar eclipses very rare phenomena at a given location on Earth?
   (a) the shadow cast by the Moon on the Earth is relatively small, and covers a small
fraction of the daytime hemisphere
(b) the Moon is very rarely in the ecliptic
(c) the Moon is very rarely between the Earth and Sun
(d) the Moon moves fastest in its orbit when it is between the Earth and Sun
(e) the Moon moves fastest in its orbit when it is on the opposite side of the Earth from the Sun

22. The major axis of an ellipse tells us
   (a) how big it is (what is its largest dimension)*
   (b) how elongated, or egg-shaped it is
   (c) what the angle of inclination is with respect to the plane of the ecliptic
   (d) how many focuses it has
   (e) the mathematical equation that describes the ellipse

23. The eccentricity of an ellipse tells us
   (a) how big it is (what is its largest dimension)
   (b) how elongated, or egg-shaped it is*
   (c) what the angle of inclination is with respect to the plane of the ecliptic
   (d) how many focuses it has
   (e) the mathematical equation that describes the ellipse

24. Which of the following is a statement contained in Newton’s Laws of Motion?
   (a) planets move on hyperbolic orbits around the Sun
   (b) all of the planets have orbits which are in nearly the same plane
   (c) there are limits to how precisely we can simultaneously measure the position and momentum of an object
   (d) a time-varying magnetic field will produce a voltage in a circuit
   (e) when an object is subjected to a force, it accelerates*

25. Which of the following is the correct formula for the force between two objects having masses $m_1$ and $m_2$, separated by a distance $r$?
   (a) $F = Gm_1m_2r^2$
   (b) $F = \frac{Gm_1m_2}{r^2}$*
   (c) $F = \frac{m_1m_2}{4\pi\varepsilon_0r}$
   (d) $F = Gm_1m_2\sin(r^3)$
   (e) $F = G(m_1 + m_2)/r^2$

26. During the course of the year, the global average flux of energy from the Sun varies very little. This is a good thing for those of us who live on this planet. This fact is due to one of the following properties of the Earth’s orbit. Which is it?
(a) the eccentricity of the Earth’s orbit is a small number
(b) the orbit of the Earth is a perfect circle
(c) the period of the Earth’s orbit is one year
(d) the Earth orbits in the plane of the ecliptic
(e) the Earth rotates on its axis while it orbits the Sun

27. Approximately how old (i.e. what is the age of formation) of the oldest moon rocks collected by the Apollo missions?
   (a) 100,000 years
   (b) 2.5 million years
   (c) 375 million years
   (d) 4.5 billion years
   (e) 14 billion years

28. What is the synodic period of the Moon (defined as the length of time between successive appearances of the same phase of the Moon)?
   (a) 365.25 days
   (b) 7.43 days
   (c) 18.6 years
   (d) 75.9 days
   (e) 29.5 days

29. What is the technical term for the lunar features that we can see with the naked eye as the “man in the Moon”?
   (a) craters and rays
   (b) maria and terrae
   (c) rilles and lunar domes
   (d) hot poles and warm poles
   (e) basaltic and anorthositic rocks

30. Determining the age of formation of rock samples from the different parts of the Moon allowed us to reach a major conclusion about the early history of the solar system. What was it?
   (a) an “Age of Bombardment” occurred throughout the solar system
   (b) At the time the solar system formed, the Sun was much more luminous than now
   (c) The Moon and similar objects formed first in the early solar system about 9.5 billion years ago, and the major planets formed 1-2 billion years later
   (d) The Moon formed earlier than any other known object in the Milky Way galaxy.
   (e) At the time the Moon formed, types of minerals existed that no longer were present at the time Earth rocks were formed