

29:52 Exploration of the Solar System

Final Exam
May 12, 2008
Form A

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

“The fault, dear Brutus, lies not with our stars but with ourselves”

1. Neptune is most similar to which other planet?
 - (a) Jupiter
 - (b) Saturn
 - (c) Uranus *
 - (d) Mars
 - (e) Venus
2. One of the following sets of coordinates is sometimes the position of the Sun. It is never at the other 4 sets of coordinates. Pick the right one.
 - (a) RA=21h, Dec=+28d
 - (b) RA=22h, Dec=-12d *
 - (c) RA=3h, Dec=0d
 - (d) RA=8h, Dec=-5d
 - (e) RA=18h, Dec=+23d
3. The planet Uranus cannot be seen with the naked eye. The reason for this is
 - (a) its albedo is lower than other planets, so it reflects very little light.
 - (b) the fact that it is made of methane means it is dark.
 - (c) it is very cold, and so radiates at a very long wavelength.
 - (d) it is at too great a distance from the Earth. *
 - (e) its light is absorbed by material in the interplanetary medium.
4. Roughly how large is the astronomical unit?
 - (a) 1340 kilometers, or 830 miles
 - (b) 13000 kilometers, or 8100 miles
 - (c) 150 million kilometers, or 100 million miles *
 - (d) 2 billion kilometers, or 1.2 billion miles
 - (e) 430 billion kilometers, or 270 billion miles

5. How far from the Sun is the most distant major planet?
- (a) 30 a.u. *
 - (b) 1.5 a.u.
 - (c) 5 a.u.
 - (d) 0.55 a.u.
 - (e) 700 a.u.
6. What astronomical object or objects is found between the orbits of Mars and Jupiter?
- (a) asteroids *
 - (b) Venus
 - (c) Titan and Enceladus
 - (d) Earth
 - (e) Kuiper Belt objects
7. Sixty five million years ago, most species of life on Earth, including the dinosaurs, became extinct. Many scientists think this was caused, at least partially, by an astronomical phenomenon. What was it?
- (a) A large solar flare, at least 5 million times more intense than the most powerful observed in the space age, subjected the Earth to intense radiation for a period of weeks.
 - (b) The Earth passed through the tail of a large comet. The tail was composed mainly of cyanide gases which poisoned living things.
 - (c) An asteroid, resonantly perturbed from its orbit, entered the inner solar system and collided with the Earth. *
 - (d) The Sun, in its galactic orbit, moved through a dark cloud, which greatly diminished the sunlight at Earth, causing temperatures to plummet.
 - (e) A supernova occurred on a star only a few light years away and subjected the solar system to a withering blast of gamma rays.
8. When a celestial object *transits*, it
- (a) is eclipsed by the moon.
 - (b) passes through the meridian. *
 - (c) rises.
 - (d) sets.
 - (e) Appears in the constellation of Leo.
9. There are many ways in which the Earth is unique among the terrestrial planets. One of these is listed below. Pick it.
- (a) It has an atmosphere with carbon dioxide in it.
 - (b) It is in orbit around the Sun.
 - (c) It has a moon comparable in size to those of Jupiter and Saturn. *

- (d) It is largely composed of silicate rocks.
 - (e) It formed billions of years ago.
10. Imagine that you are looking up at a clear, dark night sky. You notice a particularly bright star high in the sky, and wonder whether it is one of the planets you studied in *Exploration of the Solar System*. How could you tell whether it is a planet or a bright star?
- (a) Notice if its color is reddish. If it is, it must be the planet Mars.
 - (b) Using averted vision, see if you can see the disk of the planet. Stars appear as points of light.
 - (c) Make observations on several nights. If it sets earlier every night, it is a planet.
 - (d) Notice if it moves during the night from east to west. If it does, it is a planet, not a star.
 - (e) Make observations on several nights. If it moves against the background stars, it is a planet. *
11. In the outer solar system (Saturn and more distant), temperatures on the surface of a moon or high in the atmosphere of a planet are of the order of
- (a) 2K
 - (b) 273K
 - (c) 290K
 - (d) 800K
 - (e) 80K *
12. In the last couple of years, the spacecraft Voyager 1 and Voyager 2 passed through the “heliospheric termination shock”. This is a boundary between
- (a) the atmosphere and magnetosphere of the Earth
 - (b) the solar wind and the interstellar medium *
 - (c) the solar wind and the atmosphere of Jupiter
 - (d) the solar corona and interplanetary space
 - (e) interplanetary space and the supersonic motion of the Moon
13. How do the moons Ganymede (Jupiter) and Titan (Saturn) compare with the Earth’s Moon?
- (a) They are larger and more massive than the Moon by about a factor of 10 in both diameter and mass.
 - (b) They are much smaller in diameter (about a factor of 5) and are only about 1 percent the mass of the Moon.
 - (c) They are larger in diameter, but only about half as massive as the Moon.
 - (d) They are slightly larger in diameter, and slightly more massive. *
 - (e) Within our ability to measure, they are identical in diameter and mass.

14. What are the three solar system objects most relevant to exobiology (the study of life in outer space)? That is, which three are most likely to teach us about the circumstances under which life arises (or does not arise) elsewhere in the universe?
 - (a) Venus, Saturn, Neptune
 - (b) Mars, Europa, Titan *
 - (c) Venus, Mars, Ganymede
 - (d) Mars, Saturn, Triton
 - (e) Mercury, Jupiter, Enceladus

15. Some of the moons in the solar system have densities of about 1.9 grams per cubic centimeter (grams/cc). What can you deduce from this number?
 - (a) The moons must be largely composed of ice. *
 - (b) Such moons are nearly entirely silicate rocks.
 - (c) The moons must have a composition which has rocks in the outer parts, and iron near the core.
 - (d) These moons must be largely composed of iron and heavy metals.
 - (e) The moons are entirely atmosphere, with no true surface that a person could stand on.

16. Europa is of particular interest to astronomers because it has
 - (a) a heavy atmosphere and a hydrological cycle based on methane.
 - (b) begun the process of turning into a star.
 - (c) the most widespread occurrence of cryovolcanism in the solar system.
 - (d) a surface crust of water ice with a possible ocean below the surface. *
 - (e) the strongest magnetic field possessed by any moon or satellite.

17. Which of the following statements about the Galilean satellites of Jupiter is correct?
 - (a) Each one is distinct, with properties determined by the amount of radioactive materials contained in the moon when it formed.
 - (b) The first and second (from Jupiter) are distinct objects, with properties determined by the strength of the Jovian magnetic field. The two outer ones are virtually indistinguishable from each other.
 - (c) All of the moons are very similar to each other, with no evidence of modification since the earliest times in the solar system.
 - (d) Each one is distinct, with properties determined by tidal stresses from Jupiter. *
 - (e) All of the moons are insignificantly different in their properties from the Earth's Moon.

18. The Galilean satellite Io is the closest to Jupiter. What is the most characteristic feature of Io?
 - (a) active, moon-wide volcanism *
 - (b) the acceleration of protons and electrons to extremely high energies.

- (c) It is the only moon in the solar system with a heavy atmosphere.
 - (d) heavily cratered plains which have not been changed since the first days of the solar system
 - (e) a surface crust of water ice with a possible ocean below the surface
19. There is only one moon of another planet which has had a spacecraft land on it. Which moon is it?
- (a) Titan *
 - (b) Europa
 - (c) Io
 - (d) Enceladus
 - (e) Mimas
20. Meteorites are
- (a) samples of the early Earth which were expelled into space
 - (b) pieces of asteroids *
 - (c) objects from deep space (beyond the orbit of Neptune) which become visible only when they get close to the Sun
 - (d) the technical, scientific term for moons of other planets
 - (e) pieces of comets
21. "Kirkwood's Gaps" refer to
- (a) regions of missing material in the rings of Saturn
 - (b) the spaces between major planets in the solar system
 - (c) orbits occupied by asteroids which were ejected due to resonant interactions with Jupiter *
 - (d) spaces of clear air between the clouds in the atmosphere of Jupiter
 - (e) regions of low energetic particle density in the Van Allen Belts
22. Titan is of particular interest to astronomers because it has
- (a) a heavy atmosphere and a hydrological cycle based on methane. *
 - (b) begun the process of turning into a star.
 - (c) the most widespread occurrence of cryovolcanism in the solar system.
 - (d) a surface crust of water ice with a possible ocean below the surface.
 - (e) the strongest magnetic field possessed by any moon or satellite.
23. The most abundant element in the Sun is
- (a) carbon dioxide
 - (b) hydrogen *
 - (c) oxygen

- (d) iron
 - (e) silicon
24. Someone gives you the Right Ascension and Declination of an object, and you know the date (day of the year). From these two pieces of information, what can you deduce?
- (a) What time of the day or night the object is up in the sky. *
 - (b) How far the object is from the Earth.
 - (c) The age of formation of the object.
 - (d) Whether it is a planet, a moon, or a comet.
 - (e) The similarity of the object to our Sun.
25. Someone tells you the semimajor axis and the eccentricity of Planet X. With just this information, you know
- (a) the period of the orbit and its inclination with respect to the ecliptic.
 - (b) the inclination of the orbit to the ecliptic and the aphelion distance of the planet.
 - (c) the average distance of the planet and its chemical composition.
 - (d) the period of the orbit and the perihelion distance of the planet. *
 - (e) the perihelion distance and age of formation.
26. *Space Aliens* cleverly disguise themselves as your sorority sisters, and put knock-out pills in your diet Coke. They carry you aboard their spaceship and blast over for outer space. You wake up an indeterminate time later, and look through the porthole of the spaceship. You are clearly in orbit around a planet. You see unbroken clouds below, some of which are brownish-red, others, higher, are bright white. You look outward and see at least three objects that look like the Moon as seen from Earth, except they have different appearances and colors. You immediately realize where the fiends have taken you. You are at
- (a) Jupiter *
 - (b) Pluto
 - (c) Venus
 - (d) Mars
 - (e) Saturn
27. Asteroids are
- (a) large, gaseous planets in the outer solar system.
 - (b) young stars, similar to the Sun as it was at the beginning of the solar system.
 - (c) the largest objects in orbit around the planet Jupiter.
 - (d) small rocky planets with diameters less than 1000 kilometers. *
 - (e) small solid objects that are seen as shooting stars when they enter the Earth's atmosphere.

28. In words, Kepler's Third Law says that
- (a) planets will eventually spiral in closer to the Sun.
 - (b) planets move on the surface of a cone, with the Sun at the point.
 - (c) the further a planet is from the Sun, the longer is its orbital period. *
 - (d) planets move fastest when they are furthest from the Sun.
 - (e) the force between the Sun and a planet is inversely proportional to the fourth power of the distance.
29. Which of the following is an indicator that the climate of Mars might have been much different in the remote past from what it is now?
- (a) The fact that the semimajor axis of the Martian orbit is now 1.88 au
 - (b) The presence of dry water channels on the surface *
 - (c) The fact that it possesses a very tenuous carbon dioxide atmosphere
 - (d) The fact that the obliquity of the ecliptic for Mars is exactly 25.2 degrees
 - (e) We have discovered extensive deposits of carbonate rocks on the surface, dating from the earliest days of the solar system.
30. Here's one that you need to think about. To make it specific, think about observations of the Moon that you can make here at Iowa. About every 18 years you will find the Moon transiting at the highest altitude angle at which it will ever be observed. The *ascending node* of the Moon's orbit is where the Moon goes from below the ecliptic (south of it) to above the ecliptic (north of it). What will be the right ascension of the ascending node when the Moon is at its highest altitude angle?
- (a) 0h *
 - (b) 2h30m
 - (c) 6h
 - (d) 13h45m
 - (e) 23h