Astronomy 102 PRACTICE Mid-Term #2 Solutions

Fall Semester 2009

You really don't want to look at these solutions until you have attempted the practice mid-term exam, since the mid-term exam questions will be different than on the practice exam, "memorizing" these solutions is somewhat worthless.

Multiple Choice Questions Solution Key: Correct answers in **bold face** text.

DON'T CONCENTRATE ON MEMORIZING THE ANSWERS YOU GET WRONG, INSTEAD FIGURE OUT WHY THE ANSWERS ARE CORRECT! YOU WILL BE BETTER PREPARED IF YOU DO THIS.

1. The planets never travel in a straight line as they orbit the Sun. According to Newton's second law of motion, this must mean that:
   a. a force is acting on the planets.
   b. the planets will eventually fall into the Sun.
   c. the planets are always accelerating.
   d. the planets have angular momentum.
   e. the planets have gravity.

2. The Hubble Space Telescope while in orbit around the Earth has mass but no weight. Why is this?
   a. There is no gravity in space.
   b. An object in orbit is moving so fast that gravity has little effect on it.
   c. An object in orbit is in a constant state of free fall.
   d. Weight depends on Earth's gravity; so being in space means the object is not affected by Earth's gravity.
   e. None of the above.

3. According to Newton's Universal Law of Gravitation which of the following statements are true?
   a. The gravitational force between two objects depends on the masses of both objects and how far apart they are.
   b. There is no gravity in space.
   c. You are gravitationally attracted to your classmates.
   d. Both (a) and (b)
   e. Both (a) and (c)

4. The mass of Saturn can be calculated by
   a. measuring the orbital speed of one of Saturn's moons.
   b. measuring the orbital period and distance (from Saturn) of one of Saturn's moons.
   c. knowing the Sun's mass and measuring how Saturn's speed changes during its elliptical orbit around the Sun.
   d. knowing the Sun's mass and measuring the average distance of Saturn from the Sun.

5. The kind of spectra you looked at in the lab activity when electricity was passed through a glass tube containing a gas in order to excite the electrons in the gas atoms, which then spontaneously de-excited, emitting light, was
   a. an emission spectra.
   b. an absorption spectra.
   c. a continuous spectra.
   d. a platinum spectra.
   e. a molecular spectra.

6. Which of the following statements about X rays and Infrared is **NOT** true?
   a. X rays have shorter wavelengths than infrared light.
   b. X rays have higher frequency than infrared light.
   c. X rays travel through space faster than radio waves.
   d. X rays and infrared light are both forms of light, or electromagnetic radiation.
   e. X rays have higher energy than radio waves.

7. Which of the following is ***not*** an observed pattern of motion in our solar system?
   a. Most planetary orbits lie nearly in the same plane.
   b. All planets orbit the Sun in the same direction.
   c. Most planets orbit at the same speed.
   d. Almost all moons orbit their planet in the same direction as the planet's rotation.
   e. Most planets rotate about their axes in the same direction in which they orbit.

8. The 8 planets in the solar system all lie in nearly the same plane and orbit in the same direction. This is believed to be the case
   a. because the original solar nebula collapsed into a spinning disk, due to conservation of angular momentum.
   b. because Jupiter's gravity pulled all the other planets to the plane of its orbit.
   c. because the planets formed in a spherical distribution and then their mutual gravitational attraction pulled them in to a flat distribution.
   d. because the sun's magnetic field pulled the solar nebula into a disk.
   e. because of chance, planets around other stars actually show non-disk-like distributions.

9. Why are the inner planets made of denser materials than the outer planets?
   a. The Sun's gravity pulled denser materials toward the inner part of the solar nebula, while lighter gases escaped more easily.
   b. In the inner part of the nebula only metals and rocks were able to condense because of the high temperatures, whereas hydrogen compounds, although more abundant, were only able to condense in the cooler outer regions.
   c. Denser materials were heavier and sank to the center of the nebula.
   d. In the beginning, when the protoplanetary disk was spinning faster, centrifugal forces flung the lighter materials toward the outer parts of the solar nebula.
   e. When the solar nebula formed a disk, materials naturally segregated into bands, and in our particular solar system the denser materials settled nearer the Sun while lighter materials are found in the outer part.

10. According to the nebular theory, what are asteroids and comets?
   a. They are the shattered remains of collisions between planets.
   b. They are chunks of rock or ice that condensed long after the planets and moons had formed.
   c. They are the shattered remains of collisions between moons.
   d. They are chunks of rock or ice that were expelled from planets by volcanoes.
   e. They are leftover planetesimals that never accreted into planets.

11. Mercury and Mars are geologically dead worlds whereas Venus and Earth are not. This likely because Earth and Venus
   a. are chemically very different from the other terrestrial planets.
   b. possess magnetic fields whereas Mars and Mercury do not.
   c. are too large for their interiors to have completely cooled off yet, whereas the interiors of Mars and Mercury have cooled off more.
   d. All of the above.
   e. Both (b) and (c).

12. Which of the following does ***not*** have a major effect in shaping planetary surfaces?
   a. magnetism
   b. volcanism
   c. impact cratering
   d. tectonics
   e. erosion

13. Which of a planet's fundamental properties has the greatest effect on its level of volcanic and tectonic activity?
   a. size
   b. distance from the Sun
   c. rotation rate
   d. all of the above
   e. none of the above

14. Of the planets Mercury, Venus, and Earth, which has the most extensive impact craters?
   a. Mercury
   b. Venus
   c. Earth

15. The difference between infrared light and visible light is that
   a. Visible light moves faster.
   b. Visible light has shorter wavelength.
   c. Visible light has longer wavelength.
   d. Visible light moves faster.

16. The terrestrial planets, which are composed primarily of rock, are located
   a. Some in the inner solar system, some in the outer.
   b. In the inner solar system (close to the sun).
   c. In the outer solar system (far from the sun).

17. The structure of the Earth's interior is studied by
   a. Drilling holes into the core of the earth.
   b. Measuring properties of lava coming from volcanoes
   c. Observing the timing and pattern of waves from an earthquake

18. The earth's interior is differentiated, which means that
   a. The earth is not the same as the other terrestrial planets.
   b. The earth's interior is a uniform mixture of materials
   c. Dense materials are at the center of the earth, with lighter materials on the surface
   d. Dense materials are on the surface of the earth, with lighter materials in the core

19. The theory that individual pieces of the Earth's crust move is called the theory of
   a. Earthquake activity
   b. Relative motion
   c. Plate tectonics
   d. Plate stagnation

20. The planets in the inner solar contain little ice because
   a. there was never any ice present in that part of the solar system
   b. whatever ices were present were rapidly evaporated by the sun

21. How common do disks of dust and gas seem to be around young stars?
   a. They are very common.
   b. They are very uncommon.
   c. They never occur

22. The large objects in the solar system (the sun, planets, and large moons) tend to rotate in _____ direction.
   a. all in a different
   b. the same
   c. alternating

23. One difference between the terrestrial planets and the jovian planets is size; another is
   a. age
   b. density
   c. direction of rotation

24. An emission spectrum looks like a
   a. smooth rainbow of colors.
   b. smooth rainbow of colors with a few thin dark gaps in it.
   c. few narrow bright lines at specific colors.

25. The choices below list four different types of electromagnetic radiation. In which list are the types in order of *decreasing* wavelength (in other words from longest to shortest wavelength)?
   a. Radio waves, Infrared light, Visible light, X-rays
   b. Radio waves, Visible light, Infrared light, X-rays
   c. Visible light, X-rays, Infrared light, Radio Waves
   d. X-rays, Visible light, Infrared light, Radio Waves

26. Which has longer wavelength, red light, or blue light?
   a. Red light has longer wavelength.
   b. Blue light has longer wavelength.

27. As the temperature of a light source increases, the light becomes
   a. redder and dimmer
   b. redder and brighter
   c. bluer and dimmer
   d. bluer and brighter

28. Which of the choices below is ***not*** one of the things that can be learned by studying the spectrum of an object like a planet?
   a. The temperature of the planet.
   b. The mass of the planet.
   c. What elements the planet is composed of.
   d. The speed of the planet.

29. An atom contains an electron in an excited state (say the 2nd state). When the electron moves to the lowest state (the 1st state), it
   a. Never emits light.
   b. Always emits light, but different colors at different times.
   c. Always emits the same color of light.
   d. Sometimes emits light, and sometimes does not.

30. An absorption spectrum is
   a. A smooth rainbow of colors without breaks.
   b. Mostly dark with colors at a few specific wavelengths.
   c. A smooth rainbow of colors with breaks at a few specific wavelengths.
   d. Also called a blackbody spectrum.

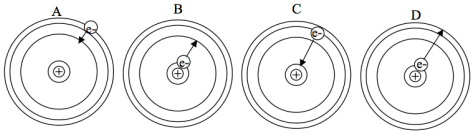
31. The spectrum of hydrogen includes lines that are red and teal (blue-green). The teal lines come about when
- **a. An electron changes energy by an amount greater than the energy change for the red line.**
- b. The hydrogen is at very low temperatures.
- c. An electron changes energy by an amount less than the energy change for red light.
- d. The hydrogen is at very high temperatures.

32. Suppose you discover a new moon of Jupiter. The radius of the orbit is much larger than the radius of the orbit of Io. From this you can conclude that the period of the orbit of your satellite is
- a. the same as Io's period.
- **b. much larger than Io's period.**
- c. much smaller than Io's period.

33. You are looking at a distant hot and dense object; between you and the object is a cloud of gas cooler than the object. The type of spectrum you will probably observe is
- a. emission
- b. continuous
- **c. absorption**

34. The most important difference between the sun and the other objects in our solar system is that
- a. The sun is made mostly of hydrogen and helium
- **b. Fusion occurs in the sun.**
- c. The sun is in equilibrium

35. Electron transitions in for atoms are shown below. In which case is the atom absorbing light with the greatest energy?



- a. A
- b. B
- c. C
- **d. D**

36. Objects appear to float in the Space Shuttle because
- a. There is no gravity in space.
- **b. All objects fall at the same rate.**
- c. Gravity is weaker in space.
- d. There is no air resistance in space.

37. Which of the statements below best describes the other solar systems discovered so far by scientists?
- a. Other solar systems are like ours, with small planets close to the star and large planets far away.
- **b. Other solar systems have large planets close to the central star.**
- c. No pattern has been observed in other solar systems.

38. In the original version of the nebular hypothesis we studied, giant planets form far from the sun. If a giant planet was observed close to the central star in another solar system, it would mean that
- a. The nebular hypothesis is wrong; giant planets must form near the central star also.
- **b. The nebular hypothesis is incomplete; the must be some way for a planet to move within a solar system after it has formed.**
- c. There can be no single theory that describes the formation of every solar system.

39. A star moving towards us has a spectrum that is _____ an identical star that is not moving.
- a. The same as
- **b. Shifted toward blue**
- c. Shifted toward red

40. Suppose the sun had been hotter when the planets were forming, so that the temperature of each planet was twice as large. Jupiter would have turned out to be _____ it is now
- a. About the same mass
- **b. Much less massive than**
- c. Much more massive than

Discussion Questions Solutions for PRACTICE Mid-Term #2:

These solutions are very brief and just meant to point you in the right direction; we would likely expect you to be a bit more through in your explanations.

1. Explain how a continuous spectrum changes as the temperature of the object emitting the light changes.

   The continuous spectrum of an object depends on the temperature of the object. The hotter an object is, the more light it is, and the bluer the peak in the spectrum of the light. In other words, the wavelength at which most of the light is emitted goes down as the temperature increases.

2. Describe each of the three types of spectra and how they are produced.

   The three types of spectra are continuous, emission, and absorption. Continuous spectra are produced from the random thermal motions of atoms in any material. An emission spectrum is produced by a dilute gas when electrons in the gas move from one energy level to another. An absorption spectrum is produced when light from a continuous source passes through a gas. The gas absorbs light at wavelengths that correspond to the difference in energy levels of electrons in the gas. The colors at which the dark lines appear are the same as the colors at which the same gas would produce emission lines.

3. Describe how heat is generated inside a planet, and the mechanism by which that heat is transferred from the interior to the surface.

   There are two mechanisms for generating heat in a planet. One is through radioactive decay, and the other is through differentiation. On the Earth today differentiation is no longer occurring; essentially all of the dense materials have settled already. In the past, though, differentiation was an important source of heat in the Earth's interior. Heat is transferred from the interior to the surface through three processes: convection, conduction, and radiation. The first process, convection, is the motion of large currents in which hot material rises and cooler material sinks; it is the most important energy transfer process in the Earth's mantle. Conduction is the way heat transfers through a solid object; it is important in transferring heat through the upper mantle and crust of the Earth. Radiation—the emission of infrared light from the surface of the Earth—is the way heat is finally released into space.

4. Describe the processes that shape planetary surfaces. In addition to saying the names of the processes explain what they are.

Volcanism, tectonics, erosion and impact cratering shape planetary surfaces. Impact craters occur when objects from space hit the surface of a planet; this process is most important on Mercury and the Moon, and to a lesser extent on Mars. Volcanism is just the eruption of volcanoes or the release of lava from an objects interior. It has occurred on all of the terrestrial planets except Mercury, and in a limited way on the moon. Tectonics is the motion of large section of a planet's crust. It is occurring on the earth, and there is limited evidence it occurred in the past on Venus. Erosion, the wearing down of a feature over time, occurs because of either wind or liquids. Erosion is most obvious on Earth, where water causes extensive changes in surface features. There is also clear evidence of water erosion on Mars, and wind erosion occurs on both planets.

5. Compare and contrast our solar system with other solar systems discovered so far.

Other solar systems are similar to ours in that the planets appear to be in a disk as in our solar system. The evidence for this is indirect. Many proto-planetary disks (disk of material around a star that is forming planets) have been observed and there are large clumps of material in some of those disks. The solar systems we have observed contain planets from roughly the mass of Saturn up to several times the mass of Jupiter. [Although we didn't cover this, in a couple of cases there are spectra of the atmospheres of exoplanets, and they contain, among other things, water.]

The other solar systems differ from ours in that they have large gas giants very close to their central stars. These "hot Jupiters" have a density similar to Jupiter, but are currently in a very hot part of their solar systems. On its face this presents a challenge to the nebular hypothesis, but ends up only requiring a fairly natural modification, that planets can migrate, or spiral in, towards their central star after forming but before the initial disk of gas and dust is cleared.

6. Explain why the planets in the inner and outer solar system are so different in size and composition.

The main reason the inner and outer planets in our solar system different is the temperature of the disk out of which they formed. The inner planets, closer to the sun, formed from a part of the disk to hot to contain ice. The only raw materials for building the inner planets were dust and rock. At the distance of the outer planets the temperature was cool enough for ice to be present, and those planets built up larger masses because of the greater amount of raw material. Once they began to build and their mass increased, the gravitational field of the outer planets was large enough for the planets to begin collecting hydrogen and helium. The inner planets never accumulated much of these light gases because they are not massive enough to prevent hydrogen and helium from escaping into space.