

ASTRONOMY 3: INTRODUCTORY ASTRONOMY: THE SOLAR SYSTEM  
WINTER 2010  
MIDTERM EXAM

Professor Jonathan Fortney  
TA Kate Dallas  
Thursday, February 11, 2010  
2-3:45 p.m.

You are allowed one 8 ½ x 11 inch sheet of paper, with whatever you want on it, both sides. Calculators are allowed.

TURN IN THIS EXAM AND THE SCANTRON SHEET TOGETHER

Name \_\_\_\_\_



"We succeeded in taking that picture [from deep space], and, if you look at it, you see a dot. That's here. That's home. That's us. On it, everyone you ever heard of, every human being who ever lived, lived out their lives. The aggregate of all our joys and sufferings, thousands of confident religions, ideologies and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilizations, every king and peasant, every young couple in love, every hopeful child, every mother and father, every inventor and explorer, every teacher of morals, every corrupt politician, every superstar, every supreme leader, every saint and sinner in the history of our species, lived there on a mote of dust, suspended in a sunbeam.

"The earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that in glory and in triumph they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of the dot on scarcely distinguishable inhabitants of some other corner of the dot. How frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds. Our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light.

"Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity -- in all this vastness -- there is no hint that help will come from elsewhere to save us from ourselves. It is up to us. It's been said that astronomy is a humbling, and I might add, a character-building experience. To my mind, there is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly and compassionately with one another and to preserve and cherish that pale blue dot, the only home we've ever known."

--Carl Sagan

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 1) The mass of Jupiter can be calculated by 1) \_\_\_\_\_
  - A) measuring the orbital speed of one of Jupiter's moons.
  - B) measuring the orbital period and distance of one of Jupiter's moons.
  - C) knowing the Sun's mass and measuring how Jupiter's speed changes during its elliptical orbit around the Sun.
  - D) knowing the Sun's mass and measuring the average distance of Jupiter from the Sun.
  - E) measuring the orbital period and distance of Jupiter's orbit around the Sun.
  
- 2) Kepler's third law,  $p^2=a^3$ , means that 2) \_\_\_\_\_
  - A) a planet's period does not depend on the eccentricity of its orbit.
  - B) planets that are farther from the Sun move at slower average speeds than nearer planets.
  - C) all orbits with the same semimajor axis have the same period.
  - D) the period of a planet does not depend on its mass.
  - E) All of the above are correct.
  
- 3) When someone on Earth observes the Moon in the first-quarter phase, someone on the Moon facing Earth observes Earth in the 3) \_\_\_\_\_
  - A) first-quarter Earth phase.
  - B) new Earth phase.
  - C) full Earth phase.
  - D) crescent Earth phase.
  - E) third-quarter Earth phase.
  
- 4) Orion is visible on winter evenings but not summer evenings because of 4) \_\_\_\_\_
  - A) interference from the full Moon.
  - B) the precession of Earth's axis.
  - C) the location of Earth in its orbit.
  - D) the tilt of Earth's axis.
  - E) baseball on television.
  
- 5) Which of the following is not a pattern of motion in our solar system? 5) \_\_\_\_\_
  - A) Planets all orbit the same direction as the Sun's spin.
  - B) Planets all orbit in the same direction.
  - C) Large planets all have many moons orbiting them.
  - D) Planets all rotate in the same direction.
  
- 6) Where are most of the known asteroids found? 6) \_\_\_\_\_
  - A) between the orbits of the terrestrial planets
  - B) between the orbits of the jovian planets
  - C) in the Oort cloud
  - D) in the Kuiper belt
  - E) between the orbits of Mars and Jupiter
  
- 7) Imagine we've discovered a planet orbiting another star at 1 AU every 6 months. The planet has a moon that orbits the planet at the same distance as our Moon, but it takes 2 months. What can we infer about this planet? 7) \_\_\_\_\_
  - A) It is more massive than Earth.
  - B) It is less massive than Earth.
  - C) We cannot answer the question without knowing the mass of the moon.
  - D) It has the same mass as Earth.
  - E) We cannot answer the question without knowing the mass of the star.
  
- 8) Which of the following is largest? 8) \_\_\_\_\_
  - A) size of a typical galaxy
  - B) 1 light-year
  - C) distance to the nearest star (other than our Sun)
  - D) size of Pluto's orbit

- 9) When we see Venus in its full phase, what phase would Earth be in as seen by a hypothetical Venetian? (Remember that we can see Venus in the daytime.) 9) \_\_\_\_\_
- A) new
  - B) first quarter
  - C) waning crescent
  - D) full
  - E) third quarter
- 10) What percentage of the mass of the solar nebula consisted of elements other than hydrogen and helium? 10) \_\_\_\_\_
- A) 0.1 percent
  - B) 2 percent
  - C) 80 percent
  - D) 0 percent
  - E) 20 percent
- 11) Why does Carl Sagan say that we are *star stuff*? 11) \_\_\_\_\_
- A) The composition of most stars (mostly hydrogen and helium) is about the same as the composition of our bodies.
  - B) Cosmic rays reaching Earth from distant astronomical sources may be one source of mutations that help evolution along.
  - C) Nearly every atom from which we are made was once inside our star, the Sun.
  - D) Sagan thought that all of us have the potential to be movie (or TV) stars like he was.
  - E) Nearly every atom from which we are made once (before the solar system formed) was inside of a star.
- 12) Which of the following statements best describes the two principal advantages of telescopes over eyes? 12) \_\_\_\_\_
- A) Telescopes have much more magnification and better angular resolution.
  - B) Telescopes can collect far more light with far better angular resolution.
  - C) Telescopes can collect far more light with far greater magnification.
  - D) Telescopes can see farther without image distortion and can record more accurate colors.
  - E) Telescopes collect more light and are unaffected by twinkling.
- 13) Why does Venus have such a great difference in temperature between its "no atmosphere" temperature and its actual temperature? 13) \_\_\_\_\_
- A) It has a slow rotation.
  - B) It is so close to the Sun.
  - C) It has a large amount of greenhouse gases in its atmosphere.
  - D) It has no cooling effects from oceans.
  - E) It has a high level of volcanic activity.
- 14) Which of the following is *not* evidence for plate tectonics on Earth? 14) \_\_\_\_\_
- A) some continental boundaries fit together like pieces of a jigsaw puzzle
  - B) high ocean ridges between the continents
  - C) earthquakes
  - D) similar rocks and fossils are found in different continents
  - E) existence of volcanoes
- 15) Which of the following is furthest from the Sun? 15) \_\_\_\_\_
- A) Pluto
  - B) a comet in the Oort cloud
  - C) Neptune
  - D) an asteroid in the asteroid belt
  - E) a comet in the Kuiper belt
- 16) If you drop a rock from a great height, about how fast will it be falling after 5 seconds, neglecting air resistance? 16) \_\_\_\_\_
- A) 15 m/s
  - B) 50 m/s
  - C) It depends on what shape it is.
  - D) 10 m/s
  - E) It depends on how heavy it is.

- 17) Which of the following are relatively unchanged fragments from the early period of planet building in the solar system? 17) \_\_\_\_\_
- A) the moons of Mars
  - B) asteroids
  - C) Kuiper belt comets
  - D) Oort cloud comets
  - E) all of the above
- 18) Why do we see essentially the same face of the Moon at all times? 18) \_\_\_\_\_
- A) because the Moon does not rotate
  - B) because the Sun illuminates only one half at a time
  - C) because the Moon's rotational and orbital periods are equal
  - D) because the Moon has a nearly circular orbit around Earth
  - E) because the other face points toward us only at new Moon, when we can't see the Moon
- 19) Which of the following best describes *convection*? 19) \_\_\_\_\_
- A) It is the process in which warm material expands and rises while cool material contracts and falls.
  - B) It is the process by which rocks sink in water.
  - C) It is the process in which warm material gets even warmer and cool material gets even cooler.
  - D) It is the process in which bubbles of gas move upward through a liquid of the same temperature.
  - E) It is the process in which a liquid separates according to density, such as oil and water separating in a jar.
- 20) The age of the universe is 20) \_\_\_\_\_
- A) between 100 million and 160 million years.
  - B) between 100 billion and 160 billion years.
  - C) between 10 million and 16 million years.
  - D) between 10 billion and 16 billion years.
  - E) between 1 billion and 1.6 billion years.
- 21) Why do we think Mercury has so many tremendous cliffs? 21) \_\_\_\_\_
- A) They were probably formed by tectonic stresses when the entire planet shrank as its core cooled.
  - B) They are almost certainly volcanic in origin, carved by flowing lava.
  - C) They represent one of the greatest mysteries in the solar system, as no one has suggested a reasonable hypothesis for their formation.
  - D) They were probably carved in Mercury's early history by running water.
  - E) They probably formed when a series of large impacts hit Mercury one after the other.
- 22) Earth's stratosphere is heated primarily by which process? 22) \_\_\_\_\_
- A) Ozone is broken apart by ultraviolet radiation.
  - B) Ozone absorbs visible sunlight.
  - C) Atoms and molecules absorb infrared sunlight.
  - D) Greenhouse gases absorb infrared radiation.
  - E) Greenhouse gases are broken apart by X rays.
- 23) The polar caps on Mars are composed of 23) \_\_\_\_\_
- A) pure solid carbon dioxide.
  - B) pure water ice.
  - C) mostly solid carbon dioxide and some water ice.
  - D) mostly water ice and some solid carbon dioxide.
  - E) There are no polar caps on Mars.
- 24) Which of the following is an example in which you are traveling at constant speed but not at constant velocity? 24) \_\_\_\_\_
- A) jumping up and down, with a period of exactly 60 hops per minute
  - B) driving around in a circle at exactly 100 km/hr
  - C) driving backward at exactly 50 km/hr
  - D) rolling freely down a hill in a cart, traveling in a straight line
  - E) none of the above

- 25) Which of the following worlds has the greatest difference in temperature between its "no atmosphere" temperature and its actual temperature? 25) \_\_\_\_\_
- A) Mars
  - B) Mercury
  - C) the Moon
  - D) Venus
  - E) Earth
- 26) Why are the inner planets made of denser materials than the outer planets? 26) \_\_\_\_\_
- A) 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.
  - B) The Sun's gravity pulled denser materials toward the inner part of the solar nebula, while lighter gases escaped more easily.
  - C) 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.
  - 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) Denser materials were heavier and sank to the center of the nebula.
- 27) How does the Sun's mass compare with that of the planets? 27) \_\_\_\_\_
- A) It is about as massive as all the planets combined.
  - B) It is a thousand times more massive than Earth.
  - C) It is a thousand times more massive than all the planets combined.
  - D) It is a hundred times more massive than all the planets combined.
  - E) It is a hundred times more massive than Earth.
- 28) Why do we have seasons on Earth? 28) \_\_\_\_\_
- A) As Earth goes around the Sun and Earth's axis remains pointed toward Polaris, the Northern and Southern hemispheres alternately receive more and less direct sunlight.
  - B) The tilt of Earth's axis constantly changes between 0 and  $23\frac{1}{2}^\circ$ , giving us summer when Earth is tilted more and winter when it is straight up.
  - C) Seasons are caused by the influence of the planet Jupiter on our orbit.
  - D) Earth's distance from the Sun varies, so that it is summer when we are closer to the Sun and winter when we are farther from the Sun.
- 29) Suppose you live on the Moon. How long is a day (i.e., from sunrise to sunrise)? 29) \_\_\_\_\_
- A) 24 hours
  - B) a year
  - C) a lunar month
  - D) about 18 years
  - E) 23 hours 56 minutes
- 30) According to the *universal law of gravitation*, if you triple the distance between two objects, then the gravitational force between them will 30) \_\_\_\_\_
- A) increase by a factor of 3.
  - B) decrease by a factor of 6.
  - C) decrease by a factor of 9.
  - D) decrease by a factor of 3.
  - E) increase by a factor of 9.
- 31) Consider an atom of gold in which the nucleus contains 79 protons and 118 neutrons. What is its atomic number and atomic weight? 31) \_\_\_\_\_
- A) The atomic number is 79, and the atomic weight is 197.
  - B) The atomic number is 118, and the atomic weight is 79.
  - C) The atomic number is 79, and the atomic weight is 118.
  - D) The atomic number is 118, and the atomic weight is 197.
- 32) What is meant by a *hypothesis*? 32) \_\_\_\_\_
- A) an explanation for a phenomenon that makes a prediction
  - B) a natural phenomenon that requires explanation
  - C) a tentative understanding of a natural phenomenon
  - D) a pseudoscientific idea

E) a historical theory that has been proved inaccurate

- 33) What effect or effects would be most significant if the Moon's orbital plane were exactly the same as the ecliptic plane? 33) \_\_\_\_\_  
A) Solar eclipses would be much rarer.  
B) Solar eclipses would be much more frequent.  
C) Solar eclipses would last much longer.  
D) both A and C  
E) both B and C
- 34) If your mass is 60 kg on Earth, what would your mass be on the Moon? 34) \_\_\_\_\_  
A) 10 kg                      B) 10 lb                      C) 60 lb                      D) 60 kg                      E) 50 kg
- 35) What is *differentiation* in planetary geology? 35) \_\_\_\_\_  
A) any process by which a planet's surface evolves differently from another planet's surface  
B) any process by which one part of a planet's surface evolves differently from another part of the same planet's surface  
C) any process by which a planet evolves differently from its moons  
D) the process by which gravity separates materials according to density  
E) the process by which different types of minerals form a conglomerate rock
- 36) At approximately what time would a first quarter Moon rise? 36) \_\_\_\_\_  
A) 6 A.M.                      B) 9 A.M.                      C) noon                      D) 6 P.M.                      E) midnight
- 37) From Kepler's third law, a hypothetical planet that is twice as far from the Sun as Earth should have a period of 37) \_\_\_\_\_  
A) 1/2 Earth year.  
B) more than 2 Earth years.  
C) 2 Earth years.  
D) 1 Earth year.  
E) It depends on the planet's mass.
- 38) Which of the following is *not* one of the four major factors that can cause a long-term change in a planet's climate? 38) \_\_\_\_\_  
A) a change in the strength of the planet's magnetic field  
B) a change in the amount of dust particles suspended in the planet's atmosphere  
C) the fact that the Sun has gradually grown brighter over the past 4 billion years  
D) a change in the planet's abundance of greenhouse gases  
E) a change in the planet's axis tilt
- 39) According to the *universal law of gravitation*, if you double the masses of *both* attracting objects, then the gravitational force between them will 39) \_\_\_\_\_  
A) not change at all.  
B) increase by a factor of 2.  
C) increase by a factor of 4.  
D) decrease by a factor of 2.  
E) decrease by a factor of 4.
- 40) The most recent ice age ended 40) \_\_\_\_\_  
A) about 1000 years ago.  
B) hundreds of millions of years ago.  
C) about 10,000 years ago.  
D) about 100,000 years ago.  
E) about one million years ago.
- 41) Which two geological processes appear to have been most important in shaping the present surface of Venus? 41) \_\_\_\_\_  
A) tectonics and erosion  
B) volcanoes and erosion  
C) impacts and volcanoes  
D) impacts and tectonics  
E) volcanoes and tectonics

- 42) You are standing on Earth's equator. Which way is Polaris, the North star? 42) \_\_\_\_\_  
A) 30 degrees up, due West  
B) on the northern horizon  
C) directly overhead  
D) The answer depends on whether it's winter or summer.  
E) The answer depends on what time of day (or night) it is.
- 43) The most metal-rich terrestrial planet is 43) \_\_\_\_\_  
A) the Moon.  
B) Mars.  
C) Venus.  
D) Earth.  
E) Mercury.
- 44) If part of the full Moon passes through Earth's umbra, we will see a(n) 44) \_\_\_\_\_  
A) total lunar eclipse.  
B) annular eclipse.  
C) partial solar eclipse.  
D) penumbral lunar eclipse.  
E) partial lunar eclipse.
- 45) Which of the following is *not* evidence supporting the giant impact theory for the formation of the Moon? 45) \_\_\_\_\_  
A) Computer simulations show that the Moon could really have formed in this way.  
B) The Moon is depleted of easily vaporized materials, as we would expect from the heat of an impact.  
C) Scientists have found several meteorites that appear to be the remains of the object that caused the giant impact.  
D) The composition of the Moon is similar to that of Earth's outer layers.
- 46) From lowest energy to highest energy, which of the following correctly orders the different categories of electromagnetic radiation? 46) \_\_\_\_\_  
A) infrared, visible light, ultraviolet, X rays, gamma rays, radio  
B) radio, X rays, visible light, ultraviolet, infrared, gamma rays  
C) radio, infrared, visible light, ultraviolet, X rays, gamma rays  
D) visible light, infrared, X rays, ultraviolet, gamma rays, radio  
E) gamma rays, X rays, visible light, ultraviolet, infrared, radio
- 47) The three principal sources of internal heat of terrestrial planets are 47) \_\_\_\_\_  
A) accretion, differentiation, and eruption.  
B) convection, differentiation, and eruption.  
C) accretion, differentiation, and radioactivity.  
D) conduction, convection, and eruption.  
E) conduction, differentiation, and accretion.
- 48) Which of the following best describes why the smaller terrestrial worlds have cooler interiors than the larger ones? 48) \_\_\_\_\_  
A) They had more volcanic eruptions in the past, which released their internal heat.  
B) They have relatively more surface area compared to their volumes.  
C) The smaller ones are farther from the Sun.  
D) They were cooler when they formed.  
E) They have relatively fewer radioactive elements.
- 49) Kepler's second law, which states that as a planet moves around its orbit it sweeps out equal areas in equal times, means that 49) \_\_\_\_\_  
A) a planet's period does not depend on the eccentricity of its orbit.  
B) a planet travels faster when it is nearer to the Sun and slower when it is farther from the Sun.  
C) planets have circular orbits.  
D) the period of a planet does not depend on its mass.  
E) planets that are farther from the Sun move at slower average speeds than nearer planets.

- 50) What was the *frost line* of the solar system? 50) \_\_\_\_\_
- A) the distance from the Sun where temperatures were low enough for rocks to condense, between the present-day orbits of Mercury and Venus
  - B) the distance from the Sun where temperatures were low enough for asteroids to form, between the present-day orbits of Venus and Earth
  - C) the distance from the Sun where temperatures were low enough for metals to condense, between the Sun and the present-day orbit of Mercury
  - D) the distance from the Sun where temperatures were low enough for hydrogen compounds to condense into ices, between the present-day orbits of Mars and Jupiter
  - E) the distance from the Sun where temperatures were low enough for hydrogen and helium to condense, between the present-day orbits of Jupiter and Saturn
- 51) Suppose you find a rock that contains some potassium-40 (half-life of 1.3 billion years). You measure the amount and determine that there are 5 grams of potassium-40 in the rock. By measuring the amount of its decay product (argon-40) present in the rock, you realize that there must have been 40 grams of potassium-40 when the rock solidified. How old is the rock? 51) \_\_\_\_\_
- A) 2.6 billion years
  - B) 3.9 billion years
  - C) 5.2 billion years
  - D) 1.3 billion years
  - E) none of the above
- 52) Which of the following *best* describes the origin of ocean tides on Earth? 52) \_\_\_\_\_
- A) Tides are caused primarily by the gravitational force of the Sun.
  - B) Tides are caused on the side of Earth nearest the Moon because the Moon's gravity attracts the water.
  - C) Tides are caused by the  $23\ 1/2^\circ$  tilt of the earth's rotational axis to the ecliptic plane.
  - D) The Moon's gravity pulls harder on water than on land, because water is less dense than rock.
  - E) Tides are caused by the difference in the force of gravity exerted by the Moon across the sphere of the earth.
- 53) Radiative energy is 53) \_\_\_\_\_
- A) energy used to power home radiators.
  - B) energy of motion.
  - C) energy from nuclear power plants.
  - D) heat energy.
  - E) energy carried by light.
- 54) How do asteroids differ from comets? 54) \_\_\_\_\_
- A) Asteroids are rocky bodies and are less dense than the comets, which are made of icy material.
  - B) Asteroids are rocky bodies and are denser than the comets, which are made of icy material.
  - C) Asteroids and comets are both made of rocky and icy material, but asteroids are smaller in size than comets.
  - D) Asteroids are made of icy material and are denser than the comets, which are more rocky.
  - E) Asteroids are made of icy material and are less dense than the comets, which are rockier.
- 55) Each of the following lists two facts. Which pair can be used with Newton's version of Kepler's third law to determine the mass of the Sun? 55) \_\_\_\_\_
- A) The mass of Earth is  $6 \times 10^{24}$  kg, and Earth orbits the Sun in 1 year.
  - B) Earth rotates in 1 day and orbits the Sun in 1 year.
  - C) Earth is 150 million km from the Sun and orbits the Sun in 1 year.
  - D) Mercury is 0.387 AU from the Sun, and Earth is 1 AU from the Sun.
  - E) Jupiter is the most massive planet and has a mass of  $1.9 \times 10^{27}$  kg.

- 56) Why did Ptolemy have planets orbiting Earth on circles upon circles in his model of the universe? 56) \_\_\_\_\_
- A) to explain the fact that planets sometimes appear to move westward, rather than eastward, relative to the stars in our sky
  - B) to explain why Venus goes through phases as seen from Earth
  - C) to explain why the Greeks were unable to detect stellar parallax
  - D) to explain why more distant planets take longer to make a circuit through the constellations of the zodiac
- 57) Which of the following wavelength regions cannot be studied with telescopes on the ground? 57) \_\_\_\_\_
- A) radio waves
  - B) X rays
  - C) ultraviolet
  - D) both B and C
  - E) both A and C
- 58) Which of the following is the origin of almost all the *large* moons around the jovian planets? 58) \_\_\_\_\_
- A) They are captured planets.
  - B) They are captured comets.
  - C) They are captured asteroids.
  - D) They were formed by giant impacts.
  - E) They were formed by condensation and accretion in a disk of gas around the planet.
- 59) How are wavelength, frequency, and energy related for photons of light? 59) \_\_\_\_\_
- A) Longer wavelength means higher frequency and higher energy.
  - B) Longer wavelength means lower frequency and higher energy.
  - C) Longer wavelength means lower frequency and lower energy.
  - D) Longer wavelength means higher frequency and lower energy.
  - E) There is no simple relationship because different photons travel at different speeds.
- 60) Ridges in the middle of the ocean are places where 60) \_\_\_\_\_
- A) hot mantle material rises upward and spreads sideways, pushing the plates apart.
  - B) hot mantle material rises upward, creating volcanic islands.
  - C) plates push together, creating ocean mountain chains.
  - D) plates slip sideways relative to one another.
- 61) TWO planets, B and C, are recently found around the nearby exactly-sun-like star AY3. Each planet orbits around the star with periods of 8 yrs and 216 yrs, respectively. The distance of planet B and C's circular orbits around AY3 are thus, respectively: 61) \_\_\_\_\_
- A) 8 and 216 AU
  - B)  $1/8$  and  $1/216$  AU
  - C) 2 and 6 AU
  - D) 4 and 36 AU
- 62) Planet B emits 16 times more thermal radiation than planet C. The temperature of planet B is: 62) \_\_\_\_\_
- A) two times higher than on planet C
  - B) four times higher than on planet C
  - C) eight times higher than on planet C
  - D) sixteen times higher than on planet C
- 63) If planet B has twice the radius and eight times the mass of planet C, an astronaut would weigh: 63) \_\_\_\_\_
- A) 2 times more on planet B than on planet C
  - B) 8 times more on planet B than on planet C
  - C) 4 times more on planet B than on planet C
  - D) half as much on planet B than on planet C
64. A catastrophic collision causes planet C to speed away from the host star AY3 while B continues to orbit AY3. The spectrum of C immediately after the collision appears to be 64) \_\_\_\_\_
- A) blue shifted
  - B) red shifted
  - C) remained the same
  - D) no longer observable

NAME \_\_\_\_\_

SHORT ANSWER.

1) Explain how we can estimate the geological age of a planetary surface from its number of impact craters.

2) Summarize some of the evidence suggesting that Mars once had flowing water.

3) Briefly describe how the greenhouse effect makes a planetary surface warmer than it would be otherwise.

4) Draw a diagram showing how temperature varies with altitude in a generic planetary atmosphere. Label each of the major layers (i.e., thermosphere, stratosphere, troposphere).

5) Briefly describe the modern theory of how our Moon formed.

6) Suppose you discovered a meteorite that contains small amounts of potassium-40, which has a half-life of 1.3 billion years, and its decay product argon-40. You determine that  $1/16$  of the original potassium-40 remains; the other  $15/16$  has decayed into argon-40. How old is the meteorite? Based on your answer, *is this rock from our solar system?*

7) In order for us to understand how the solar system got to be that way it is, we must identify the major solar system patterns that our formation theory must explain. Name 3 patterns of motion or planetary arrangement/location that our theory should be able to explain.

- 8) a) Briefly explain why spectral lines are useful in determining the chemical composition of their source.  
b) Is a star with the peak of its thermal emission in blue wavelength hotter or colder than a star that has its peak emission in red wavelengths?

9) Imagine another solar system, with a star of the same mass as the Sun. Suppose there is a planet in that solar system with a mass of  $2M_{\text{Earth}}$  orbiting at a distance of 1 AU from the star. What (approximately) is the orbital period of this planet? Explain your answer.

10) Suppose a solar system has a star that is four times more massive than our Sun. If that solar system has a planet the same size as Earth, orbiting at a distance of 1 AU, what is the orbital period of the planet? Explain.