ASTRONOMY 1010 **Exam 1** **September 21, 2007**

Name_____

Please write and mark your name and student number in the Scantron answer sheet. FILL THE BUBBLE IN THE "TEST FORM" BOX CORRESPONDING TO YOUR TEST VERSION (listed as an alphabet prefix to the page number at the bottom). Mark all answers in the Scantron sheet. Answer the optional bonus questions in the space provided. When you are done, turn in your Scantron answer sheet and the bonus questions page. Please DO NOT staple the two pages.

Each multiple choice question carries 6 points. Each TRUE/FALSE question carries 3 points. For the TRUE/FALSE questions, answer (A) for TRUE and (B) for FLASE. Some questions will require calculations to determine the answer and you may use the space provided in this paper to work these out, but you need not turn this work in. You may use a calculator, but cannot use your notes, textbook, cell phones, neighbor, or any other source to help your work on this test.

Good Luck!

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

1) Which of the following has your "address" in the correct order?
A) you, Earth, solar system, Local Group, Milky Way, Local Supercluster
B) you, Earth, solar system, Milky Way, Local Supercluster, Local Group
C) you, Earth, solar system, Local Group, Local Supercluster, Milky Way
D) you, Earth, solar system, Milky Way, Local Group, Local Supercluster
E) you, Earth, Local Group, Local Supercluster, solar system, Milky Way

2) Which of the following statements about the ecliptic plane is *not* true?
A) It is the plane of the earth's orbit around the Sun.
B) The nodes of the Moon's orbit lie in the ecliptic plane.
C) During a lunar eclipse, the Moon lies in the ecliptic plane.
D) It is the plane of the Moon's orbit around the earth.
E) During a solar eclipse, the Moon lies in the ecliptic plane.

3) What is an *astronomical unit*?
A) the length of time it takes the Earth to revolve around the Sun
B) the average distance from the Earth to the Sun
C) the diameter of the Earth's orbit around the Sun
D) any basic unit used in astronomy
E) the average speed of the Earth around the Sun

4) Roughly how many stars are in the Milky Way Galaxy?
A) 10 billion B) 100 trillion C) 100 billion D) 1 billion E) 100 million

5) The Earth is made mostly of metals and rocks. Where did this material come from?
A) It was produced by nuclear fusion in prior generation stars.
B) It was made by our Sun.
C) It was made by nuclear fission of uranium and other radioactive materials.
D) It was created by chemical reactions in interstellar space.
E) It was produced in the Big Bang.

6) Which of the following correctly describes the *meridian* in your sky?
A) the point directly over your head
B) a half–circle extending from your horizon due east, through your zenith, to your horizon due west
C) the boundary between the portion of the celestial sphere you can see at any moment and the portion that you cannot see
D) a half–circle extending from your horizon due north, through your zenith, to your horizon due south
E) a half–circle extending from your horizon due east, through the north celestial pole, to your horizon due west

7) The Sun is rising in the east and will be on your meridian in 2 hours. What time is it?
A) noon B) 2 P.M. C) 2 A.M. D) 10 P.M. E) 10 A.M.

8) How many arcseconds are in 1°?
A) 3,600 B) 60 C) 10,000 D) 360 E) 100

9) Which of the following statements does *not* use the term *angular size* or *angular distance* correctly?
A) The angular size of the Sun is about the same as that of the Moon.
B) The angular size of the Moon is about 1/2 degree.
C) You can use your outstretched hand to estimate angular sizes and angular distances.
D) The angular distance between those two houses in the distance is 30°.
E) The angular distance between those two bright stars in the sky is about 2 meters.

10) Which of the following best describes the Tropic of Cancer?
A) It is another name for the equator.
B) It is a place where the Sun is directly overhead at noon on the spring equinox.
C) It is a place where the Sun appears to remain stationary in the sky.
D) It is a place where the Sun is directly overhead at noon on the summer solstice.
E) It is any place where it is always very warm.

11) What makes the North Star, Polaris, special?
A) It is the star directly on your northern horizon.
B) It is the star straight overhead.
C) It can be used to determine your longitude on Earth.
D) It is the brightest star in the sky.
E) It appears very near the north celestial pole.

12) Why is it summer in the Northern Hemisphere when it is winter in the Southern Hemisphere?
A) The Northern Hemisphere is tilted toward the Sun and receives more direct sunlight.
B) The Northern Hemisphere is tilted away from the Sun and receives more indirect sunlight.
C) The Northern Hemisphere is "on top" of the earth and therefore receives more sunlight.
D) The Northern Hemisphere is closer to the Sun than the Southern Hemisphere.
E) It isn't: both hemispheres have the same seasons at the same time.

13) Which of the following is *not* a phase of the Moon?
A) half moon
B) full moon
C) third–quarter moon
D) new moon
E) first–quarter moon

14) If the Moon is setting at 6 A.M., the phase of the Moon must be
A) third quarter.
B) first quarter.
C) full.
D) new.
E) waning crescent.

15) Why do we see essentially the same face of the Moon at all times?
A) because the Moon does not rotate
B) because the other face points toward us only at new moon, when we can't see the Moon
C) because the Moon has a nearly circular orbit around the earth
D) because the Sun illuminates only one half at a time
E) because the Moon's rotational and orbital periods are equal

16) All of the following statements are true. Which one explains the reason why there is *not* a solar eclipse at every new moon?
A) The nodes of the Moon's orbit precess with an 18–year period.
B) The Moon rotates synchronously with its revolution about the earth.
C) The orbital plane of the Moon is tilted by about 5° to the ecliptic plane.
D) The Moon is the primary cause of tides on the earth.
E) The sidereal month is shorter than the lunar month.

17) If the Moon is relatively far from the earth, so that the umbra does not reach the earth, someone directly behind the umbra will see
A) a partial solar eclipse.
B) an annular eclipse.
C) no eclipse.
D) a penumbral lunar eclipse.
E) a partial lunar eclipse.

18) What causes the apparent retrograde motion of the planets?
A) Apparent retrograde motion is an illusion created by turbulence in the earth's atmosphere.
B) As the earth passes another planet, its gravitational pull slows down the other planet so that it appears to be traveling backward.
C) The other planets never really appear to move backward; the background stars shift due to the earth's revolution around the Sun.
D) As the earth passes another planet, the other planet appears to move backward with respect to the background stars, but the planet's motion does not really change.
E) When planets are farther from the Sun, they move slower than when they are nearer the Sun; it is during this slower period that they appear to move backwards.

19) Which of the following statements about parallax is *not* true?
A) The existence of stellar parallax is direct proof that the earth orbits the Sun.
B) You can demonstrate parallax simply by holding up a finger and looking at it alternately from your left and right eyes.
C) Measurement of stellar parallax allows us to determine distances to nearby stars.
D) The technique of stellar parallax was used by Hubble to determine that the Andromeda Galaxy (M 31) is about 2 million light–years away.
E) Ancient astronomers were unable to measure parallax and used the absence of observed parallax as an argument in favor of an Earth–centered universe.

20) How did the Ptolemaic model explain the apparent retrograde motion of the planets?
A) It held that the planets moved along small circles that moved on larger circles around the earth.
B) It held that sometimes the planets moved backward along their circular orbits.
C) It held that the planets moved along small circles that moved on larger circles around the Sun.
D) It varied the motion of the celestial sphere so that it sometimes moved backward.
E) It placed the Sun at the center so that the planets' apparent retrograde motion was seen as the earth passed each one in its orbit.

21) Which of the following is *not* one of, nor follows directly from, Kepler's laws?
A) More distant planets move at slower speeds.
B) The orbit of each planet about the Sun is an ellipse with the Sun at one focus.
C) A planet travels faster when it is nearer to the Sun and slower when it is farther from the Sun.
D) As a planet moves around its orbit, it sweeps out equal areas in equal times.
E) The force of attraction between any two objects decreases with the square of the distance between their centers.

22) Which of the following was *not* observed by Galileo?
A) Jupiter's moons
B) stellar parallax
C) craters on the Moon
D) sunspots
E) phases of Venus

23) He discovered what we now call Newton's first law of motion.
A) Galileo B) Tycho Brahe C) Copernicus D) Kepler E) Ptolemy

24) He discovered that the orbits of planets are ellipses.
A) Kepler B) Copernicus C) Tycho Brahe D) Ptolemy E) Galileo

25) From Kepler's third law, an asteroid with an orbital period of 8 years lies at an average distance from the Sun equal to
A) 2 astronomical units.
B) 8 astronomical units.
C) 4 astronomical units.
D) 16 astronomical units.
E) It depends on the asteroid's mass.

26) Which of the following statements about scientific theories is *not* true?
A) If even a single new fact is discovered that contradicts what we expect according to a particular theory, then the theory must be revised or discarded.
B) A theory cannot be taken seriously by scientists if it contradicts other theories developed by scientists over the past several hundred years.
C) A theory must make predictions that can be checked by observation or experiment.
D) A theory can never be proved beyond all doubt; we can only hope to collect more and more evidence that might support it.
E) A theory is a model designed to explain a number of observed facts.

27) Which of the following is an example in which you are traveling at constant speed but not at constant velocity?
A) jumping up and down, with a period of exactly 60 hops per minute
B) driving backward at exactly 50 km/hr
C) driving around in a circle at exactly 100 km/hr
D) rolling freely down a hill in a cart, traveling in a straight line
E) none of the above

28) If you drop a rock from a great height, about how fast will it be falling after 5 seconds, neglecting air resistance?
A) 15 m/s
B) It depends on how heavy it is.
C) It depends on what shape it is.
D) 10 m/s
E) 50 m/s

29) If your mass is 60 kg on Earth, what would your mass be on the Moon?
A) 10 kg B) 50 kg C) 10 lb D) 60 lb E) 60 kg

30) If an object's velocity is doubled, its momentum is
A) dependent on its acceleration.
B) unchanged.
C) halved.
D) quadrupled.
E) doubled.

31) The fact that the Voyager spacecraft continue to speed out of the solar system, even though its rockets have no fuel, is an example of
A) Newton's first law of motion.
B) Newton's third law of motion.
C) the universal law of gravitation.
D) Newton's second law of motion.
E) none of the above

32) Which of the following statements is *not* one of Newton's laws of motion?
A) In the absence of a net force, an object moves with constant velocity.
B) What goes up must come down.
C) For any force, there always is an equal and opposite reaction force.
D) The acceleration of an object is directly proportional to the net force applied on the object.
E) All of the above are Newton's laws of motion.

33) Which of the following statements correctly describes the *law of conservation of energy*?
A) An object always has the same amount of energy.
B) It is not really possible for an object to gain or lose potential energy, because energy cannot be destroyed.
C) Energy can change between many different forms, such as potential, kinetic, and thermal, but it is ultimately destroyed.
D) The total quantity of energy in the universe never changes.
E) The fact that you can fuse hydrogen into helium to produce energy means that helium can be turned into hydrogen to produce energy.

34) According to the *universal law of gravitation*, if you triple the distance between two objects, then the gravitational force between them will
A) decrease by a factor of 6.
B) decrease by a factor of 9.
C) increase by a factor of 9.
D) decrease by a factor of 3.
E) increase by a factor of 3.

35) Which of the following *best* describes the origin of ocean tides on Earth?
A) Tides are caused primarily by the gravitational force of the Sun.
B) The Moon's gravity pulls harder on water than on land, because water is less dense than rock.
C) Tides are caused by the difference in the force of gravity exerted by the Moon across the sphere of the earth.
D) Tides are caused on the side of the earth nearest the Moon because the Moon's gravity attracts the water.
E) Tides are caused by the 23 1/2° tilt of the earth's rotational axis to the ecliptic plane.

36) At which lunar phase(s) are tides most pronounced (*e.g.*, the highest high tides)?
A) new moon
B) full moon
C) first quarter
D) both new and full moons
E) both first and third quarters

37) How are wavelength, frequency, and energy related for photons of light?
A) Longer wavelength means lower frequency and lower energy.
B) Longer wavelength means higher frequency and higher energy.
C) Longer wavelength means higher frequency and lower energy.
D) There is no simple relationship because different photons travel at different speeds.
E) Longer wavelength means lower frequency and higher energy.

38) From lowest energy to highest energy, which of the following correctly orders the different categories of electromagnetic radiation?
A) visible light, infrared, X rays, ultraviolet, gamma rays, radio
B) radio, infrared, visible light, ultraviolet, X rays, gamma rays
C) radio, X rays, visible light, ultraviolet, infrared, gamma rays
D) gamma rays, X rays, visible light, ultraviolet, infrared, radio
E) infrared, visible light, ultraviolet, X rays, gamma rays, radio

39) When white light passes through a cool cloud of gas, we see
A) infrared light.
B) an emission line spectrum.
C) an absorption line spectrum.
D) visible light.
E) thermal radiation.

40) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 486.1 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 485.9 nm. What can we conclude?
   A) The star is getting colder.
   B) The star is moving away from us.
   C) The "star" actually is a planet.
   D) The star is moving toward us.
   E) The star is getting hotter.

TRUE/FALSE. Mark asnwer as (A) if TRUE, and (B) if FALSE

41) Our solar system is located in the center of the Milky Way Galaxy.

42) One light year is about 10 trillion kilometers.

43) The observable universe is the same size today as it was a few billion years ago.

44) We see all distant galaxies moving away from us. This proves that we are at the center of the universe.

45) Proxima Centauri, the closest known star (excluding the Sun) is about 4.2 light–years away. Hence, the sunlight we see now will reach Proxima Centauri in approximately 4.2 years.

46) The seasons on Earth are caused by its elliptical orbit around the Sun.

47) At midnight it is sometimes possible to observe the crescent moon on the meridian.

48) The Sun and the Moon have approximately the same angular size on our sky. Hence, they are in fact the same physical size.

49) A star with a larger parallax is closer than a star with a smaller parallax.

50) A lunar eclipse occurs only when the Moon is new.

51) If you lived on the Moon, you'd see full Earth when we see new moon.

52) Copernicus was the first person to suggest a Sun–centered solar system.

53) Galileo found "imperfections" on the Sun in the form of sunspots and "imperfections" on the Moon in the form of mountains and valleys.

54) *Speed* and *velocity* are the same thing.

55) The Moon is constantly falling toward the earth.

56) There is no gravity in space.

57) *Tidal friction* caused by the earth's stretching from the Moon's gravity is gradually slowing down the rotation of the earth.

58) Grass is green because it absorbs green light, reflecting all other colors.

59) X rays, because they have more energy, travel through space faster than visible light.

60) You are currently emitting electromagnetic waves.

Name: _____

BONUS QUESTIONS. Answer the following questions in the space provided. SHOW YOUR WORK for full credit.

61) Assuming that you are sitting perfectly still on your chair, list at least five ways in which you are moving right now. (10 points)

62) From Newton's generalization of Kepler's Third Law, we have the relationship

$$a^3 = \frac{G\left(M_1 + M_2\right)}{4\pi^2} p^2$$

The unit–specific version of this equation with masses in solar mass units, p in years, and a in AU is

$$a^3 = (M_1 + M_2)\, p^2$$

Use this relationship to determine the sum of the masses (in solar–mass units) of two stars that orbit each other with a period of 258 days and a semimajor axis of 1 AU. (10 points)

1) D
2) D
3) B
4) C
5) A
6) D
7) E
8) A
9) E
10) D
11) E
12) A
13) A
14) C
15) E
16) C
17) B
18) D
19) D
20) A
21) E
22) B
23) A
24) A
25) C
26) B
27) C
28) E
29) E
30) E
31) A
32) B
33) D
34) B
35) C
36) D
37) A
38) B
39) C
40) D
41) FALSE
42) TRUE
43) FALSE
44) FALSE
45) TRUE
46) FALSE
47) FALSE
48) FALSE
49) TRUE
50) FALSE

51) TRUE
52) FALSE
53) TRUE
54) FALSE
55) TRUE
56) FALSE
57) TRUE
58) FALSE
59) FALSE
60) TRUE
61) (1) Earth's rotation, (2) Earth's orbit around the Sun (revolution), (3) Precession of Earth's axis, (4) Sun's motion with respect to local stars, (5) Sun's orbit around the center of the Galaxy, (6) Milky Way's motion towards Andromeda, (7) Milky Way's recession from all distant galaxies, (8) Plate tectonics on Earth
62) a = 1 AU
p = 258//365 = 0.71 years
M1+M2 = a^3/p^2 = 1^3/0.71^2 = 1/0.5 = 2 solar masses