Spring 2011 **Astronomy – Final Exam** **Test form E**

Name _____

Do not forget to write your name on your answer sheet and above as well, and fill in your student ID bubbles and test form bubble **E** on your answer sheet. You have 120 minutes. For each question, mark the best answer. The formulas you may want are:

$$F = \frac{GMm}{d^2} \qquad F = ma \qquad P^2 = a^3 \qquad (M + m)\,P^2 = a^3$$

$$c = \lambda f \qquad c = 3\times10^8 \text{ m/sec} \qquad E = hf \qquad P = knT$$

$$\sin\left(\frac{\theta}{2}\right) = \frac{\ell}{2d} \qquad \frac{v_{\text{rad}}}{c} = \frac{\lambda_{\text{shift}} - \lambda_{\text{rest}}}{\lambda_{\text{rest}}} \qquad \lambda_{\text{Peak}}T = 2900 \text{ K}\cdot\mu\text{m}$$

$$d = \frac{3.26 \text{ ly}}{p} \qquad \frac{L}{L_\odot} = \left(\frac{T}{T_\odot}\right)^4 \left(\frac{R}{R_\odot}\right)^2 \qquad L = 4\pi d^2 B$$

$$v = H_0 d \qquad H_0 = 22 \text{ km/s/Mly}$$

1. The sketch at right is probably a galaxy of type
   A) E0 B) E6 C) SBa D) Sd E) Irr

2. What crucial observation allows us to use Cepheid Variable stars to measure the distance to something?
   A) These stars all have about the same luminosity
   B) These stars are all at about the same distance
   C) These stars all have about the same angular size
   D) There is a relationship between the period of pulsation and the luminosity for these stars
   E) There is a relationship between the spectral class and the luminosity for these stars

3. The reason that one hemisphere of Mars has rather mild climates, while the other has a more extreme climate, is because
   A) Mars occasionally tilts one pole towards or away from the Sun, but not the other pole
   B) Mars's orbit is very eccentric, so sometimes it is closer to the Sun and sometimes farther away
   C) Internal heat from within Mars keeps the temperature relatively warm, even in winter
   D) There is more atmosphere in the northern hemisphere, so the temperature can't fluctuate as much
   E) One hemisphere has massive dust storms, which blocks out the light in the summer and holds in the heat in winter

4. Which of the following is the best description of Hubble's Law?
   A) All galaxies are moving away from us, and the farther they are, the faster they are moving
   B) All galaxies are moving away from us, and the closer they are, the faster they are moving
   C) All galaxies are moving away from us, and all at about the same speed
   D) All galaxies are moving towards us, and the farther they are, the faster they are moving
   E) All galaxies are moving towards us, and all at about the same speed

5. Saturn's rings are composed primarily of
   A) Rock B) Dust C) Ice D) Hydrogen E) Metal

6. What is the biggest contributor to the total mass of a galaxy like our own?
   A) Mysterious matter called dark matter
   B) Stars in the disk
   C) Gas and dust in the disk
   D) Stars in the bulge
   E) The nucleus

7. Which of the following is the best guess for the value of the density parameter Ω, including everything?
   A) 0.035 B) 0.27 C) 0.73 D) 1.00 E) 1.85

8. In the distant future, which stars will be the last ones to run out of fuel and die?
   A) The most massive, which have the most fuel
   B) The least massive, which use their fuel the slowest
   C) The ones that formed in elliptical galaxies, which have the most hot gas
   D) The ones that formed in spiral galaxies, which have the least hot gas
   E) The ones that are careful to eat right and exercise regularly

9. Which of the following factors in Drake's Equation do we have pretty much no clue about what they are?

A) The rate at which stars form (only)
B) The fraction of stars with planets (only)
C) The probability that a suitable planet for life will actually develop life (only)
D) Both A and B are unknown, but C is pretty well known
E) We have no clue about A, B, nor C

10. What is a cluster diagram?
    A) A chart illustrating the position of all the stars in a cluster on a Hertzsprung-Russell diagram
    B) A plot of mass versus luminosity for every star in a cluster
    C) A sketch of the position of every star in a cluster as viewed from Earth
    D) A plot of radial versus transverse velocities for every star in a cluster
    E) A plot of radius versus composition for every star in a cluster

11. Most planets have substantial atmospheres. What about moons?
    A) No moons have atmospheres
    B) Very few moons have atmospheres
    C) All large moons have atmospheres, but small and medium sized usually do not
    D) All large and medium sized moons have atmospheres, but small ones usually do not
    E) Almost all moons, even the small ones, have substantial atmospheres

12. How many spacecraft have been used to view our galaxy from the outside?
    A) 0 B) 1 C) 2 D) 3 E) 4 or more

13. When two galaxies collide, how long does it typically take?
    A) A few years
    B) A few decades
    C) A few centuries
    D) A few thousand years
    E) Millions of years

14. Which of the following happened latest in the history of the universe?
    A) The Planck era, when gravity was united with other forces
    B) The GUT scale, when strong, electromagnetic, and weak interactions were joined together
    C) The first structure in the universe forms, the first stars and galaxies
    D) The ratio of protons to neutrons “freezes out”
    E) Inflation

15. Suppose the Moon went around the Earth in exactly the same plane as the Earth goes around the Sun, rather than tilted at a 5 degree angle. Which of the following would be true?
    A) Solar eclipses would be significantly longer

B) Lunar eclipses would be significantly longer
C) Solar eclipses would be a lot more common, but not lunar eclipses
D) Lunar eclipses would be a lot more common, but not solar eclipses
E) Both solar and lunar eclipses would be a lot more common

16. Which of the following is the smallest?
A) Jupiter B) Saturn C) Earth D) Uranus E) Neptune

17. Which of the following would make an object worthless as a standard candle?
A) If it had different spectral classes
B) If it came in a variety of masses
C) If all such objects had different luminosities
D) If these objects are especially common
E) If these objects were scattered over a wide range of distances

18. Giant elliptical galaxies (called central dominant or CD galaxies in the book) are believed to be caused by
A) Giant black holes that produce exceptionally large galaxies
B) The merger of large numbers of smaller galaxies
C) The formation of galaxies in the centers of vast voids
D) Compression of giant molecular clouds from supernova explosions
E) Accumulation of matter caused by large intergalactic magnetic fields

19. Which of the following methods is best at measuring the distance to some of the most distant objects in the Universe?
A) Radar distancing
B) White dwarf supernovae
C) Parallax
D) Spectroscopic parallax
E) Cepheid variable stars

20. A star that has not yet begun fusion in its center is called a
A) Red giant
B) Protostar
C) Main Sequence
D) Planetary Nebula
E) None of the above

21. Which of the following is not a type of electromagnetic wave?
A) X-rays B) Visible light C) Ultraviolet D) Gravity E) Gamma rays
22. It is believed that all active galactic nuclei are ultimately powered by
A) Gas falling into a black hole
B) Numerous supernova explosions all occurring at once
C) Supermassive O and B stars
D) Violent galactic collisions

E) Energizer batteries

23. The best guess for the composition of dark energy is
    A) Black holes
    B) Neutrinos
    C) Jupiter-like planets
    D) Dust bunnies
    E) Actually, we have no idea what dark energy is

24. On the largest scale, the universe is arranged how?
    A) Galaxies are scattered nearly uniformly throughout the universe
    B) Galaxies are spread out in giant, approximately evenly spaced sheets
    C) Mostly large voids, with concentrations of galaxies between the voids
    D) Small voids interrupt an otherwise nearly uniform universe
    E) We have mapped so little of the universe, we really have no idea

25. What is the name of the galaxy we live in?
    A) Andromeda Galaxy
    B) Large Magellanic Cloud
    C) Small Magellanic Cloud
    D) Milky Way
    E) Virgo

26. What is the name of the stellar cluster the Sun is in?
    A) The Milky Way
    B) Andromeda
    C) The Local Group
    D) Virgo
    E) The sun is not currently a member of any stellar cluster

27. If I give you an atom, which type of atom (element) it is depends only on
    A) The charge of the nucleus
    B) The mass of the nucleus
    C) The charge of the electrons
    D) The mass of the electrons
    E) The number of electrons

28. The only thing that it is believed can escape from a black hole is
    A) Light B) X-rays C) Neutrinos D) Dark matter E) None of the above

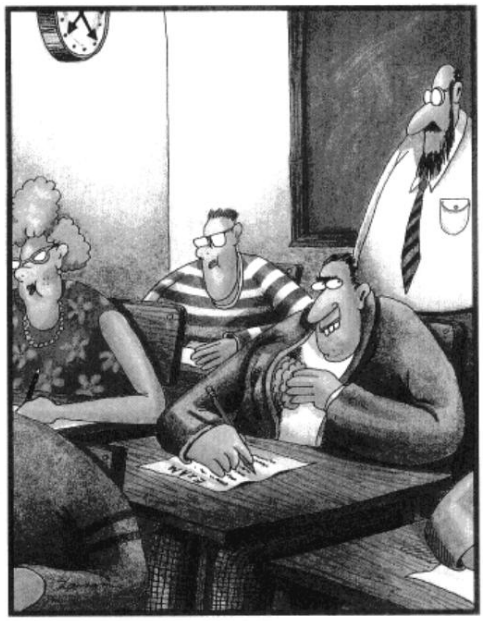
29. Which of the following was *not* one of the likely causes of the ultimate demise of humanity on the Earth that was discussed in class?
    A) Fracturing of the Earth from massive earthquakes
    B) Collision by giant asteroids
    C) Runaway global warming caused by the Sun's gradual increase in luminosity
    D) Melting of the Earth by the Sun during giant stages

E) Actually, all of these were discussed

30. How much total power might be coming from a typical quasar?
    A) About the power of the Sun
    B) About the power of 100 Suns
    C) About the power of 10,000 Suns
    D) As much or more power than our entire galaxy
    E) We actually have no measurements of such power

31. Which of the following has the most known moons?
    A) Earth B) Venus C) Mercury D) Mars E) Uranus

32. How old, roughly, are the oldest stars we find anywhere in our galaxy?
    A) 5 million years
    B) 13 million years
    C) 500 million years
    D) 5 billion years
    E) 13 billion years



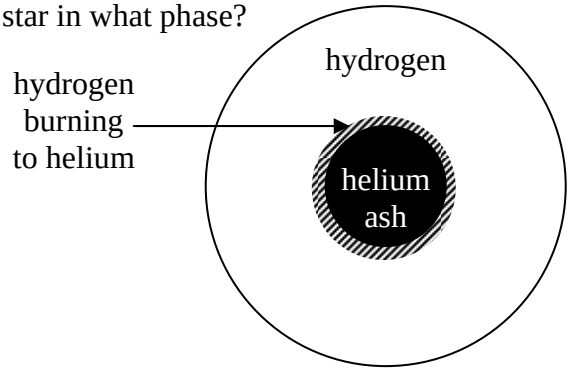
Midway through the exam, Allen pulls out a bigger brain.

33. The most common types of living stars are
    A) Core helium burning
    B) Double shell burning
    C) Red giant
    D) Protostars
    E) Main sequence

34. The cosmic microwave background radiation (CMBR) originated where or when?
    A) It is the light from very distant stars, very red-shifted
    B) It originated early in the universe, from the recombination of electrons with atoms
    C) It is thermal energy coming from dust that has been heated by stars
    D) It comes from the flipping over of the spin of the electron in hydrogen atoms
    E) It is evaporation radiation from early black holes

35. The galaxy classification of the galaxy we live in is most likely
    A) Irr B) SBb C) Sd D) E1 E) E7

36. The illustration at right is a sketch of a star in what phase?
    A) Main sequence
    B) White dwarf
    C) Core helium burning
    D) Red giant
    E) Double shell burning



37. Which of the following is surprising about Blazars, a type of active galaxy?
    A) They can change their brightness in as little as a day, or even less
    B) They are remarkably dim
    C) They contain black holes, unlike other active galaxies
    D) They have spectral lines from hydrogen
    E) They often occur far from the centers of galaxies

38. The Sun's position and orbit in the galaxy tells us it is
    A) A disk star, and very near the center
    B) A disk star, and very near the edge
    C) A disk star, not near the center nor the edge
    D) A bulge star
    E) A halo star

39. How would Hubble's law look different if we were sitting on a galaxy far away from here?
    A) The expansion rate would be slower
    B) The expansion rate would be faster
    C) The galaxies would be moving towards us on one side and away on the other
    D) The expansion rate would be slower on one side of us and faster on the other
    E) There would be no change; it would look the same

40. Our Sun is currently in which stage of its life?
    A) Planetary nebule
    B) Supernova
    C) Main sequence
    D) Core helium burning
    E) Double shell burning

41. How come the space station continues circling the Earth, even though Earth's gravity is pulling on it?
    A) The Moon's gravity counteracts the Earth's
    B) Since it is in space (vacuum), there is no gravity
    C) It is far enough from the Earth that the gravity is very weak
    D) It is moving so fast that the gravitational effect is negligible
    E) The fact that it is going in a circle is actually a sign of the Earth's gravity; otherwise, it would go in a straight line

42. The gas in Earth's atmosphere that is being increased by man's activity and is believed to be causing increasing global warming is called

A) Sulfuric acid
B) Carbon monoxide
C) Carbon dioxide
D) Chlorofluorocarbons
E) Nitrogen oxides

43. Which of the following is not a characteristic of a typical elliptical galaxy?
A) They often have very diffuse, hot gas
B) They contain mostly older stars
C) They show a prominent spiral structure
D) They look like a sphere or flattened sphere
E) Actually, these are all characteristics of typical elliptical galaxies

44. What produces the 21 cm line that is so useful in astronomy?
A) Ionized regions where there are no atoms
B) Regions with isolated atoms of hydrogen
C) Regions with hydrogen atoms joined into molecules
D) Interstellar dust
E) Atoms that are heated by ultraviolet light from hot nearby stars

45. What determines if a planet has the right temperature to harbor life?
A) It has to be not too young and not to old
B) It has to be the right distance from the star
C) It has to have approximately the right mass
D) It must be about the right distance from the center of the galaxy
E) It must have the right composition

46. What is the approximate distance of the Earth from the Sun?
A) 0.47 AU B) 1.0 AU C) 2.5 AU D) 1.0 ly E) 4.3 ly

47. When the universe was only a few seconds old, it contained about seven protons for every neutron. What became of all the neutrons?
A) They ultimately decayed, so there are none left
B) They are still there, but spread throughout the universe
C) Weak interactions ultimately converted them all to protons
D) They lost mass and became neutrinos
E) They got combined with protons to make helium nuclei

48. Why is it easier to determine the mass of stars that are in binaries than, say, single stars?
A) The distortion in the shape of one star caused by the other allows us to measure the mass

B) Since binary stars always have the same mass, and it is easier to measure when there is TWICE as much mass, this makes it easier
C) The relative ages of the two stars can be compared, which gives you an estimate of their masses
D) The period of the orbit is related to the mass and the separation, and hence the masses can be determined
E) The gravitational pull of one distorts the spectrum from the other, allowing the mass to be determined

49. Ionization nebulae occur in the vicinity of hot stars producing ultraviolet light. What causes these clouds to glow in visible light?
A) Fusion that is induced by the ultraviolet light
B) Electrons that have been knocked out of their atoms and then fall back in
C) Light produced after the ultraviolet light scatters from free electrons
D) Thermal emission from hot gas as it is absorbed into these stars
E) Collisions between energetic pairs of free electrons

50. It is known that the Earth used to rotate more quickly than it does now. What is the cause of this slowdown?
A) The Moon (and Sun) pulling on the tidal bulges on the rotating Earth
B) Friction of the Earth with the interplanetary medium
C) Decrease of the Sun's mass, so that the period of rotation changes
D) Expansion of the Earth over time, caused by gradual warming of the Earth
E) Gradual expulsion of the Earth's atmosphere, carrying off the rotation of the Earth

51. How did ancient astronomers figure out that the planets were different from the stars?
A) The planets are much brighter than the stars
B) The planets moved compared to the background stars
C) The planets were not points, even to the naked eye
D) The planets only shone when the Sun shone on them
E) The planets showed phases like the Moon, visible to the naked eye

52. Measurements of the cosmic microwave background radiation (CMBR) indicate, as viewed by us, it is slightly hotter on one side, and slightly cooler in the opposite direction. Why?
A) Dust clouds in one direction are absorbing the light, making it look cooler
B) The universe has a slight gradient, so there was more stuff on one side of us and less on the other
C) We are moving compared to the universe, and the direction we are moving looks *hotter*
D) We are moving compared to the universe, and the direction we are moving looks *colder*
E) The solar wind causes the general direction of the Sun to look hotter

53. Rocky/metal objects that orbit the Sun and are too small to be considered planets are called

A) Moons B) Asteroids C) Comets D) Plutoids E) Meteors

54. Low mass stars (less than 8 solar masses) end their lives as
    A) White dwarfs (only)
    B) Neutron stars (only)
    C) Black holes (only)
    D) White dwarfs or neutron stars, but not black holes
    E) White dwarfs, neutron stars, or black holes

55. The center of Earth is believed to be almost all metal. Why is the metal concentrated at the center?
    A) The metal condensed first, and therefore formed the first part of Earth
    B) It was attracted by the Earth's magnetic field, which is strongest there
    C) It is heavier than rock or water, and sunk to the bottom
    D) Metal is the strongest, so it was able to hold together at the center when the collision that formed the Moon occurred
    E) Volcanoes spew out molten rock (not metal) from the core of the Earth, leaving the metal behind

56. The Moon goes through its cycle of phases approximately once a
    A) Day B) Week C) Fortnight (two weeks) D) Month E) Year

57. Which moon has the tiger striped region and is probably responsible for creating Saturn's E ring?
    A) Enceladus B) Iapetus C) Titan D) Callisto E) Triton

58. The bulge of a spiral galaxy tends to look redder than the disk because
    A) It is moving away from you, causing red shift
    B) It contains more giant stars, especially red giant stars
    C) It is surrounded by dust, which makes things look redder
    D) It contains a larger fraction of helium, which lends a red tint to it
    E) It contains mostly older stars, and all the young hot blue stars have long since died

59. What is the approximate temperature of the universe today?
    A) 10^9 K B) 4000 K C) 30 K D) 2.7 K E) 0 K

60. Which of the following regions is most likely to produce new stars?
    A) Hot bubbles that have been produced by supernovae
    B) Atomic hydrogen clouds
    C) Reflection nebulae

D) Ionization nebulae
E) Molecular clouds

61. What technique is most commonly used by scientists to search for evidence of extraterrestrial civilization?
A) Searching for radio signals coming from aliens
B) Studying patterns in UFO sightings
C) Interviewing people who claim to have been abducted by UFO's
D) Searching for structures built throughout the galaxy by aliens
E) Searching for gravity wave signals from aliens

62. The early universe was nearly uniform, but now it is much more lumpy. What caused this transition?
A) Gravity caused high density regions to attract more mass from lower density regions
B) Supernova explosions swept everything into regions that ultimately became galaxies and so on
C) Chemical bonds caused atoms to start attracting each other
D) Magnetic fields forced the plasma to follow magnetic field lines, causing it to accumulate
E) Stellar winds collected it into dense regions

63. If a star is behind a dust cloud, that star is harder to see, of course. What other distortion is the dust cloud likely to have on the appearance of the star?
A) It can magnify it, making it seem bigger than it really is
B) It can shift the apparent position of the star
C) It can make the star appear bluer than it should be
D) It can make the star appear redder than it should be
E) It can distort the shape of the star

64. What is the relevance of the horizon in the discussion of multiple universes?
A) The horizon refers to the earliest times we can see, and other universes may have existed before then
B) The horizon is the maximum distance you can see because of all the dust in the universe, and there may be other universes beyond that
C) The horizon represents the boundaries between the multiple universes in the many worlds interpretation of quantum mechanics
D) The horizon represents the fact that you can't see beyond a certain distance because the universe has a finite age, and there may be universes beyond that
E) The horizon represents the smallest scale that can be studied, even with a microscope, and the universe may be filled with submicroscopic universes

65. The stars with the highest surface temperature can be found on the Hertzsprung-Russell on the
A) Top

B) Bottom
C) Right
D) Left
E) Position on the H-R diagram doesn't tell you anything about surface temperature

66. The Earth is a sphere because of the balance of two forces acting on it. What are they?
A) Gravity and rotation
B) Gravity and pressure
C) Pressure and rotation
D) The Earth's gravity and the Sun's gravity
E) The Earth's gravity and the Moon's gravity