Astronomy 123
Test 2
February 16, 2012

Name _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. There are 25 multiple choice questions, each question worth 2 points.

1) The age of the Universe may be estimated from: 1) _____
    A) the Anthropic Principle
    B) the Perfect Cosmological Principle
    C) Hubble's Law
    D) the Cepheid period–luminosity relationship
    E) the ages of white dwarfs

2) In a lobe radio galaxy, the ultimate energy source for the entire galaxy is thought to reside: 2) _____
    A) in the galaxy's active nucleus.
    B) in the spiral arms.
    C) in the extended magnetic halo.
    D) in the dual lobes.
    E) in the relativistic jets.

3) What property is common to all spiral galaxies?   3) _____
    A) ongoing star formation, chiefly in the spiral arms
    B) richer in heavier elements than are ellipticals
    C) abundant gas and dust, chiefly in the spiral arms
    D) a disk of stars, which is very flat compared to the dimensions of the halo
    E) All of the above are correct.

4) The cosmic microwave background is important because: 4) _____
    A) it confirmed a major prediction made by the Big Bang theory.
    B) its detection lead to the discovery of dark energy.
    C) it showed that the universe is closed.
    D) its detection opened a new form of radiation to observation.
    E) it showed that the universe is open.

5) Collisions between galaxies can: 5) _____
    A) cause large numbers of stars to collide and explode.
    B) hardly ever occur; like stars, galaxies are far apart, compared to their sizes.
    C) leadto the formation of large star cluseters composed primarily of Type Ia Supernovas
    D) turn disk galaxies into elliptical galaxies.
    E) cause both galaxies to collapse into a single, supermassive black hole.

6) Which relation matches the rotation of a spiral galaxy to its luminosity?   6) _____
    A) Cepheid PL relation
    B) Hubble's Law
    C) The Tuning Fork Diagram
    D) the Chandrasekhar Limit
    E) the Tully–Fisher Relation

7) The Universe has three possible futures. Which one is correct depends only on the average density of matter in the Universe. Why is this?   7) _____
    A) The density of matter determines the rate of formation of black holes which will eventually collapse the Universe.
    B) The density of visible matter must exactly equal the dark force energy.
    C) The density of matter determines the strength of gravity, which decelerates the expansion over time.
    D) The density of matter tells astronomers whether new matter is constantly forming, thereby producing a steady–state.
    E) If the density is sufficiently high, the geometry of space may be curved.

8) The astronomer who first classified galaxies into spirals, ellipticals, and irregulars was: 8) _____
    A) Karl Schwarzschild.
    B) Harlow Shapley.
    C) Vesto M. Slipher.
    D) Edwin Hubble.
    E) William Herschel.

9) What does the Hubble law imply about the history of the universe?   9) _____
    A) The Univwerse is much older than previously thought because the Universe is static
    B) The universe started expanding at some time in the past; the universe has an age.
    C) Before the universe started to this expansion, it had collapsed and expanded many times before.
    D) The universe has been expanding forever; it is infinitely old.
    E) The Milky Way Galaxy is at the focus where the universe started to expand.

10) The Schwarzschild radius for the 3.7 million solar mass black hole at the center of the Milky Way galaxy is: 10) _____
    A) about 3 meters
    B) about 3 kilometers
    C) about 11.1 million kilometers.
    D) a little larger than the Solar System
    E) impossible to determine without a theory which explains dark energy

11) Which of the following are attracted by gravity?   11) _____
    A) anti–matter
    B) neutrinos
    C) any object with mass
    D) electromagnetic radiation
    E) all of the above

12) QSO spectral lines are: 12) _____
    A) nonexistent, the gas so hot as to be totally ionized, so no lines are seen.
    B) fuzzy absorption lines from the merged light of the billions of stars.
    C) thought arise in the explosions of Type Ia supernovas.
    D) too complex for any interpretation.
    E) highly redshifted, suggesting QSOs are at great distances.

13) The longer the period of pulsation of a Cepheid variable star,   13) _____
    A) the greater is its average luminosity.
    B) the older is the Cepheid.
    C) the younger is the Cepheid.
    D) the more likely it will produce a Type Ia supernova.
    E) the more likely that it will be found in an Elliptical galaxy.

14) Why is the energy source of Seyfert galaxies thought to be compact?   14) _____
    A) Their nuclei appear to us as point sources.
    B) Seyferts lack dust, so we can see clearly that the energy source is compact.
    C) Their spectra are like those produced by ordinary star emission lines.
    D) They vary on rapid time scales.
    E) They show high-speed flows, gas moving at speeds of around 5,000 kilometers per
       second.

15) Why are supermassive galaxies often found at the cores of rich galaxy clusters?   15) _____
    A) Such a large galaxy attracted smaller galaxies around it to form a cluster.
    B) Large galaxies, passing a cluster, get captured into the center.
    C) Many globular clusters swarmed together to form it.
    D) They are the result of many galactic mergers; one galaxy growing at the expense of others.
    E) Most of the matter forming the cluster fell into the center to form one large galaxy.

16) The current best information suggests that our Universe is: 16) _____
    A) closed.
    B) open.
    C) flat.
    D) oscillatory.
    E) in ateady-state.

17) What is the most likely source of energy for active galaxies and quasars?   17) _____
    A) a single supermassive, superluminous star
    B) the outbursts of numerous Type Ia supernovas
    C) large clusters of very massive, luminous stars
    D) supermassive H II regions.
    E) accretion onto a supermassive black hole

18) Which of the following can actually escape from inside a black hole's event horizon? 18) _____
    A) photons
    B) neutrinos
    C) electrons
    D) very high energy gamma-rays
    E) none of the above

19) What is the Great Wall?

    A) It is the distance beyond which astronomers cannot view any more galaxies or even quasars.

    B) It is a large sheet of galaxies measuring around 700 million light years across.

    C) It is a ridge on the Moon near the crater Birt.

    D) It is the time before the universe started expanding, about which we can never know anything.

    E) It is an enormous intergalactic cloud of dust and gas that hides more distant galaxies.

20) The critical evidence suggesting an increasing cosmic expansion rate came from teams of astronomers observing:

    A) the rotation curves of galaxies

    B) Cepheid varia ble stars

    C) type I supernovas.

    D) the ages of white dwarf stars

    E) the ages of globular clusters.

21) If the mass (density) of the Universe is less than critical, then:

    A) the Universe on average must be less than 2.73K in temperature.

    B) the Universal expansion must stop within about twenty billion years.

    C) the Universe must be static.

    D) the Universe will begin contracting immediately into the "Big Crunch."

    E) the Universe will "survive" to expand forever.

22) Which statement about active galaxies (AGNs) is FALSE?

    A) They are thought to be phases in the evolution of normal galaxies.

    B) The peak of their energy is not in the visible range.

    C) Most of their energy comes from normal starlight, as with the Milky Way.

    D) Seyfert galaxies, radio galaxies, and QSOs are types of bright active galaxies.

    E) Many AGNs show high–speed radio jets.

23) Of the following galaxies, which shows the most evidence for recent star formation?

    A) E0   B) SB0   C) S0   D) Sc   E) E6

24) QSOs are found only at large redshift. This is taken as evidence:

    A) that QSOs are early phases in the evolution of galaxies.

    B) that QSOs formed very recently in the Universe.

    C) that QSOs are small in size.

    D) that QSOs are the caused of the expansion of the Universe.

    E) that QSOs were not produced in our Universe, they formed in a parallel universe and entered ours when the two universes collided.

25) In studying the large scale distribution of galaxies in the Universe, we find that:

    A) the Milky Way is a member of a small cluster of galaxies comprised of around 50 members, the Local Group

    B) galaxies often times cluster in large filaments and sheets, around large empty regions (voids)

    C) as expected, galaxies are distributed in a homogeneous and totally random manner.

    D) supermassive spiral galaxies are always found at the cores of rich clusters of galaxies.

    E) A & B are both correct.

SHORT ANSWER. Write your answer in the spaces provided. There are five (5) equally weighted questions. Each question is worth 10 points.

26) Olbers's Paradox. (10 points)

a. What are the four assumptions given in class made when formulating Olbers' paradox? (4 points)

    i.

    ii.

    iii.

    iv.

b. What result follows from these four simple assumptions about the Universe, that is, what is the incorrect conclusion to which one is forced from these four assumptions? (2 points)

c. Olbers's Paradox is naturally resolved from consequences of the Big Bang Theory . Give the three ideas presented in class which resolve Olbers's Paradox. (4 points)

    i.

    ii.

    iii.

27) Structure in the Universe (10 points)

    a. There is structure in the Universe on scales ranging from the Solar System to large structures of galaxies. What force is believed to produce the observed structure (clustering) in the Universe? Explain. (4 points)

    b. What is the largest structure observed in the Universe? Roughly, how large is this structure? (2 points)

    c. How is the observed structure in the Universe, structures which are clearly **not** homogeneous and isotropic, consistent with the Cosmological Principle? (4 points)

28) MACHOs (10 points)

    a. What are MACHOs? (3 points)

    b. Describe the method used to detect MACHOs. (4 points)

    c. Do MACHOs account for all of the dark matter in the Milky Way galaxy? If not, how much of the dark matter of the Milky Way Galaxy can be attributed to MACHOs? (3 points)

29) Hubble's Law (10 points)

   a. Schematically, sketch Hubble's Law for nearby galaxies on the following axes. You need not label the axes. (2 points)

   b. The _____ is(are) used to find distances to nearby galaxies. (2 points)

   c. The _____ is(are)used to find distances to the most distant galaxies. (2 points)

   d. On your plot in Part a, show how the Hubble relation is changed at large redshift if the expansion rate of the Universe is slowing. Next, show how the Hubble relation is changed at large redshift if the expansion rate of the Universe is speeding up. Mark clearly which line corresponds to each possibility. (4 points)

30) Models for the Universe. (10 points)

   a. Of the Perfect Cosmological Principle, the Cosmological Principle, and the Anthropic Principle which did Friedman take as one of the assumptions which underlay his models fo the Universe? (2 points)

   b. What are the three Friedman models for the structure and evolution of the Universe? What is the ultimate fate for the universe in each model? (6 points)

      i.

ii.

iii.

c. Describe one test which could allow us to determine the Friedman model which best describes our Universe. (2 points)

1) C
2) A
3) E
4) A
5) D
6) E
7) C
8) D
9) B
10) C
11) E
12) E
13) A
14) D
15) D
16) C
17) E
18) E
19) B
20) C
21) E
22) C
23) D
24) A
25) E