**Astronomy Assessment and TPS Questions:**

**Expansion of the Universe**

*The drawing below represents the same group of galaxies at two different times during the history of the Universe. Use this drawing to answer the following two questions.*

Early Universe

Universe Some Time Later

**A**

**B**

**D**

**E**

**C**

**A**

**B**

**D**

**E**

**C**

1. Which of the following is the best ranking for the speeds (from fastest to slowest) at which galaxies A, C, and D would be moving away from an observer in galaxy B?
   1. A > C > D
   2. D > A > C
   3. C > D > A
   4. D > C > A
2. Which one of the following conclusions can you draw about the expansion of the universe from the drawing shown?
   1. Galaxy C is the center of the universe.
   2. All galaxies move the same amount during the expansion of the universe.
   3. Nearby galaxies move more during the expansion of the universe.
   4. All galaxies appear to move away from each other during the expansion of the universe.
3. Consider three widely separated galaxies in an expanding universe. Imagine that you are located in galaxy 1 and observe that both galaxies 2 and 3 are moving away from you. If you asked an observer in galaxy 3 to describe how galaxy 2 appears to move, what would he or she say?
   1. “Galaxy 2 is not moving.”

****

****

****

* 1. “Galaxy 2 is moving toward me.”
  2. “Galaxy 2 is moving away from me.”

1. How do we know that galaxies farther away from us are moving faster than nearby galaxies?
   1. by measuring the masses of galaxies
   2. by measuring the redshifts of galaxies
   3. by measuring the brightness of galaxies
   4. by measuring the sizes of galaxies
   5. by measuring the temperature of galaxies
2. Hubble’s observation that galaxies farther away from us are moving faster implies that

a. the universe is expanding.

b. the universe is contracting.

c. we are located at the center of the universe.

d. our Galaxy repels other galaxies.

1. Which of the following most accurately describes the Big Bang theory for the beginning of our Universe?
   1. An event that instantaneously created all the matter in the universe
   2. The explosive event that forced matter to expand throughout the universe
   3. An enormous explosion that organized pre-existing matter into the current arrangement of galaxies and stars
   4. An event that marks the beginning of the universe as a tiny dot of enormously high energy and temperature but no matter
   5. A gigantic sphere containing all the matter and energy of the current universe
2. Observations of the microwave background radiation supports the idea that
   1. the Universe was once much hotter.
   2. there were times during the early universe when light could not freely travel through space.
   3. the Universe began during an event we call the Big Bang.
   4. the Universe is approximately 13.7 billion years old.
   5. All of the above
3. From the observation of the microwave background radiation we know that…   
   *Choose all that are correct*.
   1. The Universe was once much hotter.
   2. There were times during the early universe when light could not freely travel through space.
   3. The Universe began during an event we call the Big Bang.
   4. The Universe is approximately 14 billion years old.
4. According to modern ideas and observations, what can be said about the location of the center of our expanding universe?
   1. Earth is at the center.
   2. The Sun is at the center.
   3. The Milky Way Galaxy is at the center.
   4. The universe does not have a center.
5. Which of the following best describes what the microwave background radiation is?
6. The shockwave or echo that travels throughout the Universe that marks the event we call the Big Bang.
7. The total light we observe when we look at the blackbody curve for all the wavelengths of light given off by all the stars in the Universe.
8. Light that is present everywhere in the Universe that came from the time when light first was able to travel through the early universe without being absorbed.
9. The particles that move throughout the Universe that were created during the Big Bang and thrown out in all directions.
10. In Einstein’s theories about the universe, how is the concept of gravity described?
11. by the amount of expansion of space time
12. by the density of space time
13. by the curvature of space time
14. by the size of tension in space time
15. Plots A-C, below, show how fast galaxies are moving away versus their distance from us. Which of these plots predicts an **old** universe?

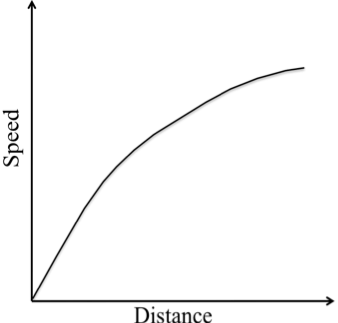


1. The Hubble plot below implies that the rate of expansion of the universe a long time ago was:
2. faster than it is today
3. **slower than it is today**
4. neither “a” nor “b” since the expansion rate of the universe is constant

Distance

Speed

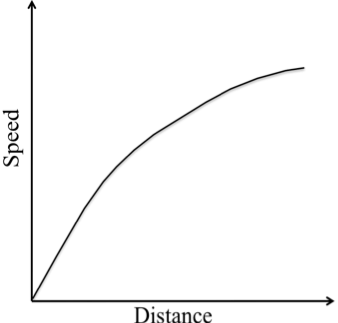
Use the diagram at right to answer the next 3 questions



A

B

1. Which point on the graph, A or B, shows a galaxy moving faster?
   1. Point A
   2. Point B
   3. Galaxies at both points are moving with the same speed
   4. There is insufficient information to determine this.
2. Which point on the graph, A or B, corresponds with a time when the rate of expansion of the universe was faster
   1. Point A
   2. Point B
   3. The rate of expansion of the universe is the same for both points
   4. There is insufficient information to determine this.
3. Which point on the graph, A or B, corresponds with an earlier time in the universe
   1. Point A
   2. Point B
   3. Both points are from the same time.
   4. There is insufficient information to determine this.
4. Which point on the graph, A, B or B, best corresponds the present day?



A

B

C

* 1. Point A
  2. Point B
  3. Point C
  4. All the points are from the same time.
  5. There is insufficient information to determine this.

For the next question use the following diagram which represents two galaxies in an **expanding universe**:



**5**

1. A supernova explodes in Galaxy A. How long will it take this light to travel from Galaxy A to Galaxy B.
2. less than 5 billion years
3. exactly 5 billion years
4. more than 5 billion years
5. What do astronomers mean by “the universe is expanding”?
6. New matter is constantly being created causing the universe to get bigger.
7. The older the universe gets, the more galaxies we can see since their light will have had more time to reach us.
8. Space-time is expanding, causing the universe to get bigger and galaxies to be further apart from each other.
9. Our knowledge of the universe is expanding, because of better telescopes, which allow us to see more of the universe.
10. Which of the following Hubble Plots (A-E) represents a universe that has an expansion rate that is getting faster with time?



The Hubble Plots A-C shown at right each represent a different set of observations for the motion of galaxies in our universe. Use these Hubble Plots to answer the next two questions.

1. Which of the Hubble Plots A-C would predict the youngest age for our universe?
2. Which of the Hubble Plots A-C would predict that our universe is largest?

Use the Hubble Plot at right, to answer the next two questions.

Galaxy B

Galaxy C

Galaxy A

1. The expansion rate of the universe represented in this Hubble Plot is:
2. remaining constant
3. increasing with time
4. decreasing with time
5. From which one of the three galaxies (A, B or C) do we receive light that took the longest amount of time to reach Earth?
6. Consider three galaxies that are very far apart from each other in an expanding universe, as shown in the diagram below. Imagine you are in Galaxy A and observe that both Galaxy B and Galaxy C are moving away from you. If you asked an inhabitant of Galaxy C to describe how Galaxy B appears to move, would she say that:
   1. B is moving towards her.
   2. B is moving away from her.
   3. B does not appear to be moving.
7. Which one of the graphs at right shows a universe that is expanding at a constant rate?

Distance

Velocity

Distance

Velocity

Distance

Velocity

Distance

Velocity

A

B

C

D

* 1. A
  2. B
  3. C
  4. D

1. Which one of the graphs at right shows a universe that is contracting at a constant rate?

A

B

C

D

Distance

Velocity

Distance

Velocity

Distance

Velocity

Distance

Velocity

* 1. A
  2. B
  3. C
  4. D

A

B

C

D

Distance

Velocity

Distance

Velocity

Distance

Velocity

Distance

Velocity

1. Which one of the graphs at right shows a universe that is expanding at a faster and faster rate over time?
   1. A
   2. B
   3. C
   4. D
2. Which one of the graphs at right shows a universe that is expanding at a slower and slower rate over time?
   1. A
   2. B

A

B

C

D

Distance

Velocity

Distance

Velocity

Distance

Velocity

Distance

Velocity

* 1. C
  2. D

1. Which of the following does the universe not have?
   1. A finite age
   2. Expansion of the space between galaxies
   3. An edge
   4. A fixed speed of light
2. When you look at an expanding universe, what is expanding?
   1. The galaxies
   2. The distance between the galaxies
   3. The stars
   4. The space in between the stars within a galaxy
   5. All of the above
3. Which of the following is expanding in our universe?
   1. the space between galaxies
   2. the space between stars in a galaxy
   3. the space between our solar system and the center of the Milky Way Galaxy
   4. the black holes at the center of galaxies
   5. more than one of the above
4. From Earth, which of the following would appear to have the smallest redshift?
   1. A galaxy 5 billion light-years away
   2. A galaxy 7 billion light-years away
   3. A galaxy 10 billion light-years away
   4. None would exhibit a redshift
   5. They would all have the same redshift
5. Galaxy A is 4 billion light years away from the Milky Way. Galaxy B is also 4 billion light years away but is located in a close group of galaxies. In 2 billion years, which one will have moved further?
   1. Galaxy A
   2. Galaxy B
   3. They both will have moved the same distance
6. The planet Zee is in a galaxy at the edge of Earth’s observable universe. Scientists on Zee studying the expansion of the universe would likely find which of the following to be true?
   1. The galaxies closest to them would appear to be moving away from them the fastest, while the galaxies that were the farthest away would appear to be moving away the slowest.
   2. The Milky Way would be one of the galaxies from which they observed the greatest redshift, while the galaxies closer to them would exhibit smaller redshifts.
   3. The Milky Way would be one of the galaxies from which they observed the greatest blueshift, while the galaxies closer to them would exhibit smaller blueshifts.
   4. All of the galaxies they observed would show the same redshift because they are at the edge of the universe and are moving away from everything with the same speed that the edge is moving.
   5. None of the above
7. Star B is 2 times the size of the sun and is located in a galaxy 1 billion light years away. In an expanding universe, how big will Star B be after 2 billion years?
   1. Half the size of the sun
   2. 2 times the size of the sun
   3. 4 times the size of the sun
   4. 5 times the size of the sun
8. You watch 3 widely separated galaxies getting farther away from the Milky Way Galaxy. What is true about the movement of all four galaxies?
   1. The other three galaxies are only moving away from the Milky Way Galaxy and not from each other
   2. The other three galaxies are moving away from the stable Milky Way Galaxy and each other
   3. The Milky Way Galaxy is moving away from the other three galaxies, which are not moving
   4. The other three galaxies and the Milky Way Galaxy are all moving away from each other

|  |  |
| --- | --- |
| Galaxy | Distance from the Milky Way Galaxy  (in light years) |
| H | 13 billion |
| I | 9 billion |
| J | 1. illion |

1. Rank the speeds that the above galaxies (H - J) would appear to be moving away from the Milky Way Galaxy, from slowest to fastest speed.
   1. J<H<I
   2. I<H<J
   3. H<I<J
   4. None of the above
2. If you were on a planet within a galaxy in the Virgo Galaxy Cluster (which does not include the Milky Way Galaxy), which of the following would you see moving away from you?
   1. A star within your galaxy
   2. A nearby galaxy in the same cluster
   3. The Earth
   4. A galaxy outside of your observable universe
   5. More than one of the above