Big Bang Theory Test Practice:

1. According to big bang theory which of the following occurs first?

 A. Formation of neutral atoms

 B. Formation of hydrogen and helium nuclei

 C. Formation of primordial gas clouds

 D. Formation of hadrons (protons and neutrons)

 E. Formation of quarks

1. According to big bang theory which of the following occurs last?

 A. Formation of neutral atoms

 B. Formation of hydrogen and helium nuclei

 C. Formation of primordial gas clouds

 D. Formation of hadrons (protons and neutrons)

 E. Formation of quarks

1. According to big bang theory what elements should be most abundant in the universe?

 A. carbon and oxygen

 B. nitrogen and oxygen

 C. oxygen and hydrogen

 D. hydrogen and helium

 E. neon and xenon

1. According to the big bang theory how are small to medium (helium to iron) nuclei formed?

 A. They were all formed during the first 3 minutes after the big bang.

 B. They are formed by nuclear fusion in the interior of stars.

 C. They are formed during super-novae of stars.

 D. They are formed by the red-shift of distant stars.

 E. They are formed by chemical processes on Earth

1. Which of the following allows astronomers to measure the greatest distance?

 A. Radar signals

 B. Cepheid variables

 C. Stellar parallax

 D. Orbital periods of planets

 E. Red-shift

1. Which of the following allows astronomers to determine the speed of distant stars and galaxies?

 A. Radar signals

 B. Cepheid variables

 C. Stellar parallax

 D. Orbital periods of planets

 E. Red-shift

1. Which of the following is not a type of electromagnetic radiation?

A. x-rays

B. gamma rays

C. radio waves

D. cosmic background radiation

E. alpha radiation

1. Quarks are the building blocks of which of the following particles?

A. Protons

B. Neutrons

C. Electrons

D. Both A and B

E. A, B and C

1. During which phase of the big bang does the force of gravity become an important factor?

A. Phase 1

B. Phase 2

C. Phase 3

D. Phase 4

E. Phase5

1. During what phase of the evolution of the universe did the Earth form?

A. Phase 1

B. Phase 2

C. Phase 3

D. Phase 4

E. Phase5

Consider the Following Graph for Questions 11 - 14



1. According to the graph what type of correlation exists between velocity and distance?

A. positive linear

B. positive non-linear

C. negative linear

D. negative non-linear

E. no correlation

1. Which statement below best describes what is shown by this graph?

A. planets that are closer to the Sun orbit more quickly

B. planets that are farther from the Sun orbit more quickly

C. more distant galaxies move away from Earth more quickly

D. less distant galaxies move away from the Earth more quickly

E. temperature decreases as the universe expands

1. The above graph was critical evidence for which of the following?

A. the solar system is heliocentric

B. the solar system is geocentric

C. the Earth is at the center of the universe

D. the universe is expanding

E. Einstein’s theory of gravitation

1. According to the graph what is the speed of a galaxy 300 megaparsecs from Earth?

A. 20000km/s

B. 30000km/s

C. 10000km/s

D. 5000km/s

E. 40000km/s

1. Which of the following is a major issue with the big bang theory?

A. It is incompatible with Einstein’s general relativity

B. It incorrectly predicts the abundance of hydrogen and helium in the universe

C. It cannot explain the formation of stars

D. Scientists cannot find the dark matter that should make up a large part of the universe

E. Scientists cannot detect the cosmic background radiation predicted by the theory

1. Which of the following types of electromagnetic radiation has the highest energy?

A. Ultra violet

B. Infra-Red

C. Microwaves

D. Radar

E. Radio waves

1. Each element on the periodic table will produce a unique pattern of lines if it is energized. These patterns are known as:

A. red-shift

B. blue-shift

C. electromagnetic spectrum

D. spectral lines

E. Hubble lines

1. What is the Copernican Revolution?

A. The major shift from a geocentric view to a heliocentric view of the solar system from the 1500 to the 1700s

B. The major shift from a heliocentric view to a geocentric view of the solar system from the 1500 to the 1700s

 C. The shift in view from a static universe to an expanding universe from 1900 to 1970

 D. The shift in view from an expanding universe to a static universe from 1900 to 1970

 E. The war that saw the United States gain independence from England

1. What is a Cepheid Variable?

A. A galaxy that is travelling toward the Earth rather than away

B. A star that has undergone super-nova

C. A star that periodically changes its brightness

D. A galaxy in which the majority of the stars have burned out\

E. A type of black hole

1. Complete the following summary of the 5 stages of the history of the universe as outlined in our notes.

STAGE 1:

Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Conditions:

Final Conditions:

STAGE 2:

Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Conditions:

Final Conditions:

STAGE 3:

Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Conditions:

Final Conditions:

STAGE 4:

Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Conditions:

Final Conditions:

STAGE 5:

Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Conditions:

Final Conditions:

2. List and explain four pieces of evidence that indicate that the Sun is at the center of the solar system.

3. Briefly explain why Einstein’s theory of General Relativity was important to the development of the Big Bang Theory.

4. Explain why Newton has a **LAW** of gravity, while Einstein has a **THEORY** of gravity

5. Complete the following Unit Conversions. SHOW ALL CONVERSION FACTORS!

Given: 1 astronomical unit (AU) = 150 000 000km

1 parsec (pc) = 206 000 AU

1 light year (ly) = 0.307 pc

Convert the following, showing correct conversion factors. Leave any unneeded factors blank:

1. 6.66x106 pc to AU

6.66x106 pc x $\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ AU

1. 9.33x10-12pc to ly

9.33x10-12pc x $\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ly

1. 777 ly to AU

777 ly x $\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ AU

6A. Briefly explain what Cosmic Background Radiation is.

6B. Why is CBR such a powerful piece of evidence for the Big Bang?

7. Explain how Cepheid variables can be used to measure astronomical distances.

8. What is the meaning of “Doppler red-shift”?

9. Explain 2 ways in which Galileo’s discovery of moons orbiting Jupiter provide evidence of a heliocentric solar system.

Big Bang Theory Test Practice KEY:

1. E
2. C
3. D
4. B
5. B
6. E
7. E
8. D
9. C
10. E
11. A
12. C
13. D
14. A
15. D
16. A
17. D
18. A
19. C

1. Complete the following summary of the 5 stages of the history of the universe as outlined in our notes.

STAGE 1:

Time: 0-3 minutes Temperature: 1040 K – 1012 K

Initial Conditions: Extremely small (smaller than an atom) dense hot pure energy, no matter

Final Conditions: Larger (size unknown) quarks have formed and conditions are cool enough for quarks to fuse into protons and neutrons. All of the ingredients for the formation of all matter now exist.

STAGE 2:

Time: 3 minutes -240 000years Temperature: 109 K – 104 K

Initial Conditions: Hot dense soup of photons and hadrons. Still incredibly dense. The matter in the universe includes electrons protons and neutrons, but it is too hot for these combine.

Final Conditions: The universe has cooled to the point that protons and neutrons can fuse to form the smallest nuclei. Hydrogen (deuterium) and helium and a very few lithium nuclei.

STAGE 3:

Time: 240 000years – 1 billion years Temperature: 3700oC to -200oC

Initial Conditions: Hot dense “soup” of photons protons, neutron and electrons.

Final Conditions: neutral atoms have formed. Gravity has pulled matter together to form primordial gas clouds. Clouds of hydrogen that become hot and dense in their centers.

STAGE 4:

Time: 1-billion years-present (13.8 billion years) Temperature: -250oC to -270oC

Initial Conditions: Mostly empty space, universe is low density. Large clouds of hydrogen gas have formed

Final Conditions: The earliest stars have formed and are fusing hydrogen to helium and some litium.

STAGE 5:

Time: 8.5 billion years to 13.8 billion years Temperature: -260oC to -270oC

Initial Conditions: Early stars have formed. Only elements present are Hydrogen Helium Lithium. Early stars are reaching end of life.

Final Conditions: Current universe. Stars collect into galaxies, second and third generation stars are formed producing more heavy elements. Stars explode (super-nova) producing very heavy elements (larger than iron). Solar systems and galaxy clusters form.

2. List and explain four pieces of evidence that indicate that the Sun is at the center of the solar system.

* Aristarchus determines that the Sun is many times larger than the Earth. Logic would dictate that the smaller object should orbit the larger object.
* Retrograde motion of planets. Retrograde motion requires very complex motions of every planet in a geocentric model, but can be explained simply in a heliocentric model.
* Copernicus. Copernicus comes up with a system that accurately describes the motion of all planets. It also correctly predicts the order of planets from the Sun, and shows that planets closer to the sun orbit more quickly than planets further from the Sun. It is the first model to accurately predict the position of all of the observed planets. However his model still required small epicycles.
* Kepler modifies the Copernican model giving the planets elliptical orbits, rather than circles. This eliminates the need for epicycles and provides a mathematical system to describe the motion for the first time. This model also places the Sun at the center.
* Galileo observes moons around Jupiter marking the first direct observations of objects orbiting another body. Also, Galileo shows that the moons obey Kepler’s laws, providing further evidence for their validity.
* Newton publishes his laws of gravitation, explaining the motion of all objects using the force of gravity. His calculations are all based on the Sun centered model. His law provides one single rule than matched all planets and moons as well as explaining gravity on Earth. Newton’s laws also made predictions about planets that had not yet been discovered as well as predicting that artificial satellites should be possible. These predictions have all come true.
* Radar distance measurements. Radar signals can be bounced off of “nearby” objects like the moon or other planets. This provided direct and accurate measurements of distances and speeds of all of the objects in our solar system. These measurements confirm the heliocentric model.

3. Briefly explain why Einstein’s theory of General Relativity was important to the development of the Big Bang Theory.

* Provided new understanding of the nature of gravity.
* Gravity is a very important component in the evolution of the universe, understanding how it operates is key to determining time scales.
* Einstein’s theory changed the way we understand light. This is crucial in understanding the signals (light) that reaches us from distant stars.
* Changed the way that red-shift needed to be calculated
* Predicted an expanding universe before the data of Slipher and Hubble

Any 2 of these would get you full marks.

4. Explain why Newton has a **LAW** of gravity, while Einstein has a **THEORY** of gravity

Newton’s law said that gravity is a force that causes masses object to attract each other, but does not attempt to explain why. His law quantifies the force with a formula and is supported by huge amounts of evidence. It is still the way we calculate gravity in almost all situations, like launching communication satellites to sending rovers to Mars. BUT it makes no attempt to explain WHY masses attract.

Einstein describes HOW gravity works. A massive object creates a “dent” in space. Other massive objects will fall into the dent. The masses do not “pull” on one another, but instead the bend space, which will cause then to move toward eachother.

You don’t need to understand any of that. Just understand that:

 Newton’s Law says that there is gravity and how strong it is, but DOES NOT EXPLAIN WHY.

 Einstein’s Theory explains WHY gravity exists, and describes HOW it WORKS.

5. Complete the following Unit Conversions. SHOW ALL CONVERSION FACTORS!

Given: 1 astronomical unit (AU) = 150 000 000km

1 parsec (pc) = 206 000 AU

1 light year (ly) = 0.307 pc

Convert the following, showing correct conversion factors. Leave any unneeded factors blank:

1. 6.66x106 pc to AU

6.66x106 pc x $\left(\frac{206000 AU }{1pc}\right) ×\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_\_\_\_\_\_\_\_\_\_1.37x1012\_\_ AU

1. 9.33x10-12pc to ly

9.33x10-12pc x $\left(\frac{1 ly}{0.307 pc}\right) ×\left(\frac{ }{ }\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_\_\_3.04x10-11\_ ly

1. 777 ly to AU

777 ly x $\left(\frac{0.307pc}{1 ly}\right) ×\left(\frac{206000AU}{1 pc}\right) ×\left(\frac{ }{ }\right) $= \_\_\_\_4.91x107\_\_\_ AU

6A. Briefly explain what Cosmic Background Radiation is.

* Microwave radiation that comes to Earth from space in all directions, more or less evenly, from no apparent source.

6B. Why is CBR such a powerful piece of evidence for the Big Bang?

* The CBR was predicted by bib bang theory long before it was ever observed or detected.
* It is the remnants of the massive amount of gamma radiation that was released by the intensely hot hydrogen and sub-atomic particles in the first few minutes after the big bang.
* Because of red-shift the radiation has been stretched all the way from extremely short wavelength gamma, to long wavelength microwaves.
* The wavelength of the CBR that was measured matched almost perfectly the predictions made by the big bang theory.

7. Explain how Cepheid variables can be used to measure astronomical distances.

* A Cepheid variable is a star that varies brightness periodically, changing from bright to dim to bright to dim over a period of days to months.
* A clear and well defined relationship exists between the period (time) for a Cepheid to alter from bright to dim to bright AND the absolute brightness of the Cepheid.
* By measuring period you can determine the absolute brightness.
* The apparent brightness of an object diminishes with distance. Think of our Sun compared to a star, or a flashlight pointed straight into your eyes from a few centimeters compared to the same flashlight from across the room. There is a clear mathematical relationship between distance and relative brightness.
* Compare the absolute brightness, determined by period, to the apparent brightness, and you know the distance to the star.

8. What is the meaning of “Doppler red-shift”?

* If the source of a wave (sound, light, water, Earthquake) and the observer move away from another the observed frequency is less than the source frequency.
* With light this means the light will “shift” toward the red end of the spectrum (ROYGBIV).
* If a light source, like a star of galaxy, moves away from an onserver, like Earth, at high enough speed the observer can see the light from the star shifted to ward the red end of the spectrum or red-shifted.

9. Explain 2 ways in which Galileo’s discovery of moons orbiting Jupiter provide evidence of a heliocentric solar system.

* It proved that objects can orbit something other than Earth. This one of the rare cases where we can say “proved”.
* By using Kepler’s laws to make his predictions, Galileo helped to confirm Kepler’s Laws, which place the Sun firmly at the center of the solar system.