

Mon. Oct. 16 & Wed. October 18, 2017

Notes: You may use notes written on **one** 3x5 inch file card, written in your own hand.

Great Discoveries 1-2. (Study Notes on website; Lect.-Tut. "The Parsec", "EM Spectrum of Light")

1. Discuss how the Copernican Revolution changed our understanding of the Universe.
2. Discuss three lines of evidence that the stars are distant suns.
3. Explain how astronomers measure the distance to stars using the method of **stellar parallax**.
4. Arrange the different kinds of **electro-magnetic waves** in order of **wavelength**. Compare their **frequency, energy** and **speed**.
5. Describe how astronomers determine what stars are made of by comparing **stellar spectra**.

Great Discoveries 3-5. (Study Notes on website; Lect.-Tut. "Doppler Shift", "Big Bang Theory", Reader 50 & 51)

1. Discuss how astronomers use the **inverse square law** and **standard candles** to determine distances to stars.
2. Discuss how **RR Lyrae stars** and **Cepheid variable stars** work as standard candles. Explain the **Period-Luminosity Relation**.
3. Explain how **Shapley** determined the size of the Galaxy.
4. Explain how **Hubble** proved that the Andromeda Nebula was a distant galaxy.
5. Explain how astronomers measure the speed of a star using the **Doppler Effect**.
6. Discuss how Hubble discovered that the galaxies are receding from each other.
7. Describe **Hubble's Law** and how it is used to estimate the distance to galaxies.
8. Compare the **expansion of the universe** to a loaf of raisin bread.

The Big Bang (Study Notes on website; Lecture-Tutorial "Big Bang")

1. Compare the **Steady State Theory** with the Big Bang Theory. What are the principles of the Big Bang Theory?
2. Discuss three lines of evidence for the Big Bang.
3. What were the two chemical elements created in the Big Bang?
4. Discuss the **Cosmic Microwave Background (3° Background)**, its current temperature, and what happens to its temperature as the Universe ages.

First Million Years (Study notes; Reader 30)

1. Contrast **pair production** with **annihilation**. Discuss how matter particles came into being. What happened to the **antimatter** particles?
2. Name the four fundamental particles and compare their properties.
3. Name the four fundamental forces and compare their properties.
4. Diagram the structure of the proton and the neutron. Calculate their electric charges.
5. Discuss the force that holds **nuclei** together and the force that tries to disrupt them.
6. What are elements number 1 and 2? When and how was element 2 created?
7. When did atoms first appear in the Universe? Discuss how this event affected the light that became the Cosmic Microwave Background.