The Universe

CLASS NOTES

• Universe - 
  • Came into existence approximately ___________ billion years ago with the Big Bang

• Big Bang - 

• Evidence of the Big Bang:
  1. Background Radiation - 
     • Scientists have found evidence of long wave radiation [microwaves] that come from all directions in the Universe
  2. Doppler Effect - 

• Electromagnetic Energy - 

Earth Science Reference Tables - Electromagnetic Spectrum
• Each element gives off an electromagnetic spectral line [signature]

- [Image of spectral line for hydrogen]

Spectral Line for Hydrogen

• When scientists study energy coming off a celestial object they can infer:
  - ______________________________________________________________________
  - ______________________________________________________________________

• Positions of the colored lines [spectral lines] shift as they studied stars and galaxies
  • **Blue Shift** - when Earth and the celestial object are ________________ the spectral lines move towards the ________________ wavelength
  • **Red Shift** - when Earth and the celestial object are moving ________________ the spectral lines move ________________ the red wavelength

- [Images of red shift and blue shift]

• Example of a “Red Shift”

- [Images of spectral lines for hydrogen in a laboratory and from a distant star]
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PART I QUESTIONS: MULTIPLE CHOICE

The diagram below shows the standard dark-line spectrum for an element. The spectral lines of the same element are observed in light from four distant galaxies.

1. Which spectral lines most likely represent the galaxy farthest from the Earth?

2. Based on the red-shift data on galaxies, most astronomers infer that the universe is currently
   a. fixed and stationary
   b. moving randomly
   c. contracting
   d. expanding

3. Background radiation detected in space is believed to be evidence that
   a. the Universe is contracting
   b. galaxies are evenly spaced throughout the Universe
   c. the Universe began with a primeval explosion
   d. all matter in the Universe is stationary

4. A comparison of the age of the Earth obtained from radioactive dating and the age of the Universe
   based on galactic Doppler shifts suggests that
   a. the Earth was formed after the Universe began
   b. the Earth is immeasurably older than the Universe
   c. the two dating methods contradict one another
   d. the Earth is about the same age as the Universe

5. In which group are the parts listed in order from oldest to youngest?
   a. universe, Milky Way, solar system
   b. solar system, Milky Way, universe
   c. universe, solar system, Milky Way
   d. Milky Way, solar system, universe
6. Which diagram represents the wavelengths of visible light, ultraviolet energy, and infrared energy?

![Diagram Options]

7. The red shift of light from distant galaxies provides evidence that these galaxies are
   a. decreasing in size
   b. increasing in size
   c. decreasing in distance from Earth
   d. increasing in distance from Earth

8. Scientists infer that the Big Bang occurred approximately
   a. 4.6 billion years ago
   b. 7 billion years ago
   c. 9 billion years ago
   d. 13.8 billion years ago

9. Evidence that the universe is expanding is best supported by the observation that the wavelengths
   of light from distant galaxies are shifted toward the
   a. red end of the spectrum because they are shortened
   b. red end of the spectrum because they are lengthened
   c. blue end of the spectrum because they are shortened
   d. blue end of the spectrum because they are lengthened

10. Based on the red-shift data on galaxies, most astronomers infer that the universe is currently
    a. fixed and stationary
    b. moving randomly
    c. contracting
    d. expanding

11. Which evidence best supports scientists’ inferences about the origin and age of the universe?
    a. the existence of planets
    b. cosmic background radiation
    c. formation of star constellations
    d. similar composition of Earth and the Moon