

**Objective 8:** Explain the Big Bang Theory and summarize supporting evidence.

**KEY TERMS:** Steady State Theory, Hubble's Constant, Redshift, Cosmic Microwave Background, Critical density, Open/Closed/Flat Universe

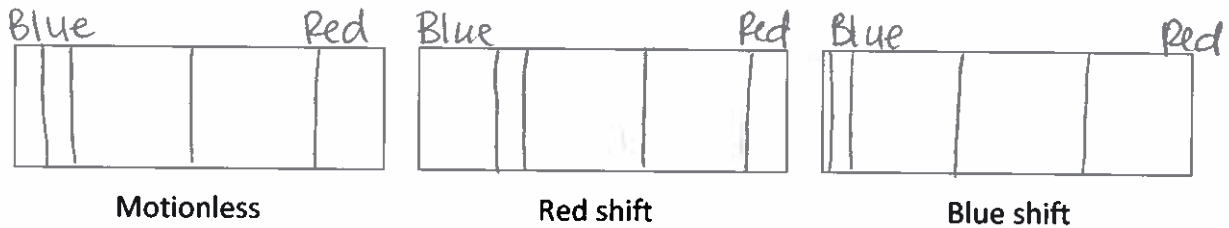
1. Describe the Big Bang Theory. (pg 847)

BBT is the theory that the universe began as a point and has expanding ever since -- the universe is finite as it had a beginning. 13.7 by

2. One observation that led to the BBT is the red-shift of galaxies. What does this mean? (pg 843-3) (pg B19 top)

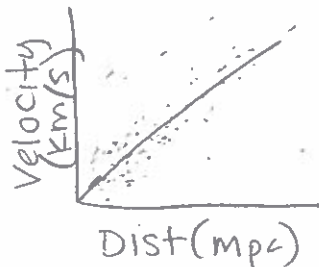
if a galaxy is moving away from the observer, the spectral lines are shifted toward the longer wavelengths (red). The higher the speed, the larger the shift.

3. Sketch a spectral fingerprint of a motionless object. Then sketch a spectral fingerprint showing red-shift and one showing blue-shift.



4. What is Hubble's Law? Include a graph, an equation, and an explanation of Hubble's constant. (pg 842-3)

The farther away the galaxy, the greater the redshift & the faster it is moving away.



$$v = Hd$$

$v$  (km/s) ← speed at which galaxy is moving away  
 $H$  (km/s/Mpc) ← Hubble's const. (expansion rate of universe)  
 $d$  (Mpc) ← dist to galaxy

- \* Tough to measure dist of remote galaxies
- \* More data = better value of H
- \* 70.0 km/sec/Mpc ( $\pm 2.2$ )

5. Penzias and Wilson stumbled upon the discovery of Cosmic Microwave Background radiation. Explain what it is and why it is significant. (pg 848)

Weak radiation from all over universe believed to be leftover E from Big Bang. Temp is  $\sim 2.735$  K ( $-270^\circ\text{C}$ ) as is predicted by BBT

<http://astronomy.swin.edu.au/cosmos/C/Critical+Density>

6. What is critical density? How does it relate to the Open/Closed/Flat Universe concepts? (pg 849)

$\sim 10^{-26} \text{ kg/m}^3$  → density of matter in universe that is the dividing point between a closed or open universe.

- If density is HIGHER ⇒ self-gravity slows expansion until it halts & ultimately re-collapses (CLOSED)
- If density is LOWER ⇒ self-gravity cannot stop expansion & the  $V$  expands forever (OPEN) - If density = critical density ⇒ FLAT expansion stops

7. Not all astronomers agree that the universe had a beginning, which led to an alternative theory. Explain. (pg 847)

Steady State Theory - universe looks the same to all observers & has always looked that way (doesn't change w/time)

If  $V$  is expanding, new matter is created and added which keeps density constant

\* model cannot explain CMB

→ observations of visible galaxies reveal an avg density of much less than critical density