Answer Key: Lambda-CDM & The Great Attractor: 12th Grade Cosmology Quiz

Calculate cosmic expansion rates and analyze galactic motion across 10 high-level questions covering mass-to-light ratios and baryonic acoustic oscillations.

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1. The 'Great Attractor' is a gravity anomaly in intergalactic space that reveals the motion of the Laniakea Supercluster. What is the primary method used to determine the mass of such structures when visible matter is insufficient?

Answer: B) Analysis of peculiar velocities

> Peculiar velocity is the component of a galaxy's motion that deviates from the smooth Hubble flow. By measuring these deviations, astronomers can map the underlying gravitational potential of dark matter.

2. According to the Cosmological Principle, the universe is both homogeneous and isotropic when viewed on a sufficiently large scale.

Answer: A) True

> The Cosmological Principle is a fundamental tenet of modern cosmology, stating that the universe has no center and looks the same in every direction on scales larger than 100 Megaparsecs.

3. The Tully-Fisher relation is a critical 'standard candle' tool that establishes a correlation between a spiral galaxy's luminosity and its _____.

Answer: A) Rotational velocity

> The Tully-Fisher relation specifically links the rotational speed of a spiral galaxy (determined via line-broadening) to its intrinsic luminosity, allowing for distance calculations.

4. Which of the following describes the 'Recombination' epoch approximately 380,000 years after the Big Bang?

Answer: C) Electrons and protons forming neutral hydrogen atoms

> During Recombination, the universe cooled enough for neutral atoms to form, allowing photons to travel freely, which we now observe as the Cosmic Microwave Background (CMB).

5. If the density parameter (Omega) of the universe is exactly equal to 1, what is the predicted geometric shape of the universe in the Friedmann-Lemaître-Robertson-Walker (FLRW) metric?

Answer: C) Euclidean (Flat)

> When the density of matter and energy equals the critical density (Omega=1), the curvature of space-time is zero, resulting in a flat, Euclidean geometry.

6. Quasars are powered by the accretion disks of supermassive black holes. They are most commonly found in the center of galaxies undergoing _____.

Answer: D) Mergers or interactions

> Galactic mergers provide the huge influx of gas and dust necessary to 'feed' a supermassive black hole, triggering the intense luminosity associated with an Active Galactic Nucleus (AGN) or Quasar.

7. Dark energy is a force that acts to slow down the expansion of the universe over time due to gravitational tension.

Answer: B) False

> Dark energy is actually the driver of the accelerated expansion of the universe; it acts as a repulsive force that overcomes gravity on cosmological scales.

8. Which piece of evidence suggests that the centers of most large galaxies contain supermassive black holes, even if they aren't currently active?

Answer: A) High orbital velocities of stars near the galactic core

> By applying Kepler's Laws to the orbits of stars in the innermost regions of galaxies (like the S-stars in our own Milky Way), we can calculate that a massive, non-luminous object must reside there.

9. The 'Lyman-alpha forest' observed in the spectra of distant quasars provides data regarding the distribution of _____ in the intergalactic medium.

Answer: A) Neutral hydrogen clouds

> As light from a quasar travels toward Earth, it passes through pockets of neutral hydrogen at different redshifts, creating a 'forest' of absorption lines in the spectrum.

10. The 'Heat Death' of the universe is a theoretical end-state where entropy reaches a maximum and no more work can be extracted from energy transfers.

Answer: A) True

The Heat Death (or Big Freeze) is the most widely accepted fate of an accelerating universe, where galaxies move apart until they're isolated and all stars eventually burn out.