Name: _____ **Date:** _____

Answer Key: Dissect Galactic Dynamics and Lamda-CDM: 12th Grade Advanced Astrophysics Quiz

Synthesize complex data regarding the Tully-Fisher relation, nucleosynthesis ratios, and dark matter halos to evaluate the current Friedmann-Lemaître-Robertson-Walker model.

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1. The 'Great Attractor' is a gravitational anomaly in intergalactic space that suggests the presence of a massive concentration of mass. Which structure is the Milky Way currently being drawn toward as part of this localized flow?

Answer: A) The Shapley Supercluster

The Laniakea Supercluster, which includes the Milky Way, is moving toward the Great Attractor, which itself is part of a larger flow toward the massive Shapley Supercluster.

2. In a 'Flat' Universe model where the density parameter (Ω) equals 1, the expansion rate of the universe will eventually decelerate to a complete stop at t = infinity, assuming dark energy is treated as a cosmological constant.

Answer: B) False

While a matter-only flat universe would stop at infinity, the presence of dark energy (cosmological constant) causes the expansion to accelerate, preventing the expansion rate from ever reaching zero.

3. The empirical relationship used to calculate the distance to spiral galaxies by correlating their intrinsic luminosity with their rotational velocity (spectral line width) is known as the _____ relation.

Answer: C) Tully-Fisher

The Tully-Fisher relation is specifically for spiral galaxies; the Faber-Jackson relation is used for elliptical galaxies.

4. Which specific observation provides the most robust evidence for the existence of Dark Matter within galaxy clusters, specifically by observing the warping of spacetime around massive foreground objects?

Answer: B) Weak and strong gravitational lensing

Gravitational lensing measures the total mass (baryonic + dark) by how much it bends light from background galaxies; the mass calculated often far exceeds the visible light mass.

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5. The Cosmological Principle asserts that on sufficiently large scales, the universe is both isotropic (looks the same in all directions) and homogeneous (looks the same from all locations).

Answer: A) True

This principle is a foundational assumption in modern cosmology, enabling the use of General Relativity to model the entire universe's evolution.

6. During the Era of Nucleosynthesis, the ratio of Hydrogen to Helium (by mass) was approximately _____%, providing a 'fossil' record of the early universe's temperature and density.

Answer: C) 75/25

Big Bang Nucleosynthesis predictions of roughly 75% Hydrogen and 25% Helium-4 match observations of primordial gas clouds, supporting the Big Bang theory.

7. Elliptical galaxies are generally thought to be 'red and dead.' What is the primary reason these galaxies have very little active star formation compared to late-type spirals?

Answer: C) They have exhausted their reservoir of cool interstellar gas

Elliptical galaxies are mostly composed of old, low-mass stars because they lack the cool gas and dust necessary to trigger new star-forming nebulae.

8. The 'Epoch of _____' refers to the time when the first stars and quasars emitted UV radiation that ionized the neutral hydrogen gas filling the intergalactic medium.

Answer: B) Reionization

Reionization occurred between 150 million and 1 billion years after the Big Bang, ending the 'Cosmic Dark Ages'.

9. The 'Big Rip' scenario is a theoretical end-state of the universe where the strength of dark energy increases over time (phantom energy), eventually overcoming all physical forces.

Answer: A) True

If the dark energy equation of state parameter (w) is less than -1, the accelerating expansion could eventually tear apart galaxies, solar systems, and atoms.

10. Quasars are extremely luminous active galactic nuclei (AGN). What mechanism releases the massive amounts of energy observed from these distant objects?

Answer: B) Gravitational energy released by matter in an accretion disk

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Quasars are powered by gas and dust falling into a supermassive black hole; the gravitational potential energy is converted into thermal radiation and kinetic energy.