

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Cosmic Forensics: Senior Seminar on Galactic Evolution

Evaluate the complex dynamics of dark matter halos and baryonic feedback through high-level synthesis and quantitative analysis of extragalactic phenomena.

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**1. When analyzing the 'missing baryon problem' in the circumgalactic medium (CGM), which mechanism is currently considered the primary driver for preventing the overcooling of gas in massive galactic halos?**

- A. Gravitational heating from infalling substructures
- B. Kinetic and thermal feedback from Active Galactic Nuclei (AGN)
- C. Photoionization from the cosmic UV background
- D. Magnetic pressure from the intergalactic medium

**2. The Tully-Fisher relation specifically correlates the luminosity of elliptical galaxies with their central velocity dispersion to determine distance.**

- A. True
- B. False

**3. In the context of the Lambda Cold Dark Matter ( $\Lambda$ CDM) model, identify the phenomenon that best explains why dwarf galaxies appear less abundant than predicted by N-body simulations.**

- A. The Saslaw-Hamilton distribution effect
- B. The Lyman-alpha forest suppression
- C. Supernova-driven gas expulsion (The Missing Satellites Problem)
- D. Thermal decoupling of WIMPs

**4. The \_\_\_\_\_ represents the maximum mass of a white dwarf star (~1.4 solar masses), a critical value used in calibrating Type Ia supernovae as standard candles for measuring universal expansion.**

- A. Eddington Limit
- B. Chandrasekhar Limit
- C. Schwarzschild Radius
- D. Jeans Mass

**5. What does the observation of 'red nuggets' at high redshifts ( $z \sim 2$ ) imply about the evolutionary path of massive elliptical galaxies?**

- A. They represent the first stage of spiral arm formation.
- B. They are the progenitors of modern giant ellipticals that grew through dry mergers.
- C. They prove that dark energy was weaker in the early universe.
- D. They indicate that star formation occurs primarily in the halo.

**6. The \_\_\_\_\_-\_\_\_\_\_ effect describes the spectral distortion of the Cosmic Microwave Background (CMB) as photons inverse-Compton scatter off high-energy electrons in hot galaxy cluster gas.**

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- A. Sachs-Wolfe
- B. Sunyaev-Zeldovich
- C. Gunn-Peterson
- D. Alcock-Paczynski

**7. The 'Great Attractor' is a gravitational anomaly located within the Laniakea Supercluster that demonstrates the influence of dark matter on peculiar velocities across hundreds of millions of light-years.**

- A. True
- B. False

**8. Which specific observation provides the most robust evidence that the universe shifted from a matter-dominated epoch to a dark energy-dominated epoch roughly 5-6 billion years ago?**

- A. The discovery of Population III stars in the reionization era
- B. Measurements of the integrated Sachs-Wolfe effect
- C. The transition from deceleration to acceleration in the expansion rate ( $z \sim 0.6$ )
- D. The detection of primordial gravitational waves

**9. The \_\_\_\_\_ profile is a widely used mathematical model that describes the mass density distribution of dark matter halos as determined by N-body cosmological simulations.**

- A. Vaucouleurs
- B. Sersic
- C. Einstein-de Sitter
- D. Navarro-Frenk-White

**10. Baryon Acoustic Oscillations (BAO) act as a 'cosmic ruler' because they provide a fixed length scale based on the distance sound waves traveled in the photon-baryon plasma before recombination.**

- A. True
- B. False