

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

## Stellar Synthesis: Superlative Senior-Level Space Survey

Examine the Lambda-CDM model and baryon acoustic oscillations to decode the gravitational evolution of large-scale structures in our expanding cosmos.

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**1. In the context of the  $\Lambda$ CDM model, what specific role does the Integrated Sachs-Wolfe (ISW) effect play in our understanding of the universe's evolution?**

- A. It proves the existence of sterile neutrinos in the early universe.
- B. It provides evidence for dark energy by observing photon energy shifts as they traverse evolving potential wells.
- C. It explains the rapid cooling of Population III stars during the reionization epoch.
- D. It accounts for the discrepancy in the Hubble constant derived from Cepheid variables.

**2. The GZK (Greisen-Zatsepin-Kuzmin) limit suggests that ultra-high-energy cosmic rays from distant galaxies are suppressed due to interactions with the Cosmic Microwave Background.**

- A. True
- B. False

**3. The \_\_\_\_\_ relation is a correlation for spiral galaxies that links their rotational velocity to their total luminosity, effectively serving as a distance indicator.**

- A. Faber-Jackson
- B. Sersic Profile
- C. Tully-Fisher
- D. Schechter Luminosity

**4. Which mechanism is primarily responsible for the 'quenching' of star formation in massive elliptical galaxies located within dense galaxy clusters?**

- A. Gravitational microlensing by MACHOs
- B. AGN feedback and ram-pressure stripping
- C. The cooling flow regulated by Hawking radiation
- D. The depletion of primordial lithium isotopes

**5. The \_\_\_\_\_ epoch refers to the period between roughly 150 million to 1 billion years after the Big Bang when the neutral hydrogen in the intergalactic medium became ionized.**

- A. Recombination
- B. Reionization
- C. Nucleosynthesis
- D. Hadronization

**6. According to the Jeans Criterion, a molecular cloud will collapse only if its internal gas pressure exceeds its self-gravitational potential energy.**

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- A. True
- B. False

**7. What does the 'Flatness Problem' in classical Big Bang cosmology refer to?**

- A. The fact that the Earth appears flat from a terrestrial perspective.
- B. The extreme fine-tuning required for the initial density of the universe to result in the near-critical density observed today.
- C. The uniform distribution of galaxies across the cosmic web.
- D. The lack of observed magnetic monopoles in the observable universe.

**8. The \_\_\_\_\_ field is a scalar field theorized to have driven the exponential expansion of the universe during the first fraction of a second after the Big Bang.**

- A. Higgs
- B. Inflaton
- C. Einstein
- D. Quintessence

**9. Which of the following describes the 'Laniakea' structure in the local universe?**

- A. A supercluster of galaxies defined by the flow lines of cosmic velocity fields.
- B. A void containing no detectable dark matter.
- C. The theoretical center of the Great Attractor.
- D. A specific type of high-redshift galaxy with high metallicity.

**10. In the hierarchical model of galaxy formation, large elliptical galaxies are formed primarily through the 'monolithic collapse' of a single, giant gas cloud rather than mergers.**

- A. True
- B. False