Name: _____ **Date:** _____

Dare to Scale the Cosmic Horizon: 10th Grade Cosmology Challenge

Students calculate redshift, evaluate dark matter evidence, and analyze the nucleosynthesis ratios that define our understanding of the universe's evolution.

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1. In the context of Lambda-CDM cosmology, how does the discovery of the 'Bullet Cluster' (1E 0657-558) serve as critical evidence for the existence of dark matter over modified gravity theories?

A. It demonstrates that baryonic gas and gravitational lensing maps are perfectly aligned.
B. The spatial separation between the visible matter and the center of mass suggests non-interacting matter.
C. The cluster shows a significant decrease in the Hubble constant locally.
D. It proves that dark energy is a localized phenomenon rather than a universal constant.

2. True or False: According to the Big Bang Nucleosynthesis model, the observed 3:1 mass ratio of Hydrogen to Helium in the early universe is a primary piece of evidence for a hot, dense origin of the cosmos.

A. True
B. False

3. When observing a distant Quasar, an astronomer notes that the spectral lines are shifted toward longer wavelengths. This phenomenon, known as _____, suggests the space between galaxies is stretching.

A. Cosmological Redshift
B. The Doppler Effect
C. Gravitational Lensing
D. Stellar Parallax

4. How do Type Ia Supernovae serve as 'Standard Candles' to reveal the presence of Dark Energy?

A. Their varying color allows for precise measurement of galactic dust.
B. Their consistent peak luminosity allows scientists to calculate distance vs. redshift, proving accelerated expansion.
C. They emit radio waves that bypass the zone of avoidance.
D. They occur only in the center of elliptical galaxies, marking the age of the galaxy.

5. The theoretical 'Epoch of _____' refers to the moment roughly 380,000 years after the Big Bang when photons were finally able to travel freely through space.

A. Reionization
B. Inflation
C. Recombination
D. Nucleosynthesis

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6. True or False: The Cosmological Principle states that on a sufficiently large scale, the universe is both homogeneous (the same everywhere) and isotropic (the same in all directions).

A. True
B. False

7. Identify the primary difference between the behavior of Spiral galaxies and Elliptical galaxies regarding star formation.

A. Ellipticals contain more cold gas and high rates of star birth.
B. Spirals are composed mostly of ancient Population II stars with no gas.
C. Spirals maintain ongoing star formation in their disks; Ellipticals are largely 'red and dead' with little gas.
D. There is no difference; both types form stars at identical rates.

8. Vera Rubin's analysis of _____ suggested that galaxies must contain significant amounts of invisible mass because stars at the edges of galaxies orbit as fast as those near the center.

A. Galaxy Rotation Curves
B. Stellar Spectra
C. Black Hole Singularities
D. Solar Neutrinos

9. True or False: The 'Great Attractor' is a massive supermassive black hole at the exact center of the observable universe that all galaxies are orbiting.

A. True
B. False

10. What is the likely fate of the universe if the density of dark energy remains constant and continues to dominate the total energy density?

A. The Big Crunch: The universe will eventually stop expanding and collapse.
B. The Steady State: The universe will create new matter to maintain density.
C. The Big Freeze (Heat Death): The universe will expand forever, cooling until it reaches thermodynamic equilibrium.
D. The Solar Pulse: The universe will begin a cycle of oscillation every billion years.