"General Science and Ability":

(2018)

Q1: (a) Describe different methods to estimate the age of the Universe.

There are several methods to estimate the age of the universe, each relying on different observational data and theoritical models:

1. **Cosmic Microwave Background Radiation Analysis:**

The CBM is the afterglow of the Big Bang and provides a snapshot of the universe when it was approximately 380,000 years old. By studing the tiny temperature fluctuations in the CMB, scientists can estimate the Universe age using the standard model of cosmology which includes the density of different components (dark matter, dark energy, normal matter) and the expansion rate.

2. Expansion Rate of the Universe (Hubble Law):

Hubble Law relates the speed at which galaxies are receding from us to their distance, suggesting that Universe is expanding. The Hubble Constant (Ho) measures this expansion rate. By determining Ho and extrapolating backwards, scientists can estimate the time since the Universe began expanding, which gives approximate age of the Universe.

"All the evidence seems to indicate that the universe has not existed forever, but that it had a beginning about 13·8 billion years ago" (Stephen Hawking)

(A Brief History of Time)(1988)

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3. Stellar Evolution models:

This method involves studying the oldest known stars, particularly in globular clusters. By understanding how stars evolve and determining the age of the oldest stars using their luminosity, temperature and composition, astronomers can set a lower limit on the age of the universe. The Universe must be at least as old as the oldest stars it contains.

"Stellar evolution models estimates the Universe age by dating the oldest stars, such as those in globular clusters, to about 12-13 billion years, providing minimum age of the universe"

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4. White Dwarf Cooling Theory:

White dwarf are the remnants of stars that have exhausted their nuclear fuel. By observing white dwarfs in the milky way, scientists can estimate their cooling rates.

White dwarf cooling rates provide an independent estimate of the universe age, suggesting it is at least 12-13 billion years old.

5- Cosmic Nucleosynthesis:

This method involves studing the abundance of light elements like hydrogen, helium and lithium which were formed in the first few minutes after the Big Bang theory. The relative abundances of these elements depend on the density and expension rate of the Universe.

(4.5)

Q1: (d) Define the term Black Hole. What is expected inside it?

Definition of a Black Hole:

A black hole is a region in space where gravity is so strong that nothing, not even light can escape from it. If forms when a massive star collapses under its own gravity at the end of its life cycle.

"Black holes are where God divided by zero."
(Stephen Wright)

What's Expected Inside a Black Hole?

Inside a black hole, it is expected that all matter is crushed into an infinity/infinitely small point called a singularity, where the laws of physics as we know them break down.

Discuss this part in more detail

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The surrounding area, known as the event horizon, marks the boundary beyond which nothing can return. Scientists theorize that time slows down and space becomes extremely distorted near this point, but what exactly happens inside remains unknown.

THE END