

Sample Exam Questions - Module 12

- 1) Hubble is generally credited as the discoverer of the expanding universe. Why is this unfortunate and unjustified? If you had to name a discoverer of the phenomenon of cosmic expansion, who would that be and for what reasons? The questions naturally invite reflection of the nature and meaning of “discovery.”
- 2) In 1932 MacMillan suggested a “tired light” explanation of the galactic redshifts. His explanation was arguably simpler and more economical than the alternative based on the expanding universe. And yet it was ignored by most physicists and astronomers. What was MacMillan’s hypothesis? Were there any good reasons why it was not considered attractive at the time (or, for that matter, today)?
- 3) The big-bang idea was first presented in Lemaître’s brief note in *Nature* of 9 May 1931. Although the argument is not very clear, the note introduces “the beginning of the world” as a concept belonging to science. Discuss the content and concept of the note. How does Lemaître conceive the original, pre-expansion state of the universe? Does he offer a kind of explanation of the initial explosion? At the end he refers to the principle of indeterminacy (or uncertainty). What is his point?
- 4) In their 1949 paper in *Physical Review*, Alpher and Herman argue from big-bang assumptions that there must exist a cosmic background radiation which presently is of temperature $T = \text{ca. } 5 \text{ K}$ (see p. 1093). They do not mention that it will be in the microwave area, but the peak wavelength of the blackbody radiation immediately follows. How? Give a brief account of the argument on p. 1093. Does the Alpher-Herman result qualify as a prediction of the CMB (cosmic microwave background) which was eventually detected in 1965? If yes, what reasons could there be that the prediction was largely ignored by cosmologists?
- 5) In his cosmological model of 1917, Einstein introduced the “cosmological constant” denoted Λ . What were his reasons? Was the constant necessary for his model of the universe? While Einstein eventually decided to put $\Lambda = 0$, Lemaître strongly believed in the reality of the constant, for other reasons because it helped in avoiding the “time-scale problem” concerning the age of the universe. What was this problem which for more than two decades plagued most relativistic models?
- 6) For about 15 years the steady-state (SS) model was a strong alternative to relativistic models of the big-bang (BB) type. What was the essence of the SS theory? Some people thought that the theory was preferable to the BB theory for philosophical reasons. What could they be? The SS theory rested on the “perfect cosmological principle” (PCP). What is the content of the PCP? Is it a metaphysical principle or can it be falsified by observations?