

Astronomy Qualifier - August 2011

Lots of necessary (and some unnecessary) “constants” and possibly useful integrals at end.

Problem 1: Wang

The inflationary theory of the very early Universe solves the horizon problem of standard cosmology.

- a) [2 pts] What is the horizon problem?
- b) [2 pts] Show that inflation solves the horizon problem if $a(t) \propto t^\alpha$ during inflation, with $\alpha > 1$.
- c) [4 pts] Derive the requirement from inflation on the equation of state of the matter-energy in the universe.
- d) [2 pts] Does any matter-energy component that has been studied in cosmology satisfy this requirement?

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#1

a) What is the horizon problem?

The horizon problem is an issue in cosmology where parts of the universe are not causally connected yet share the same properties. For example, if we look at two points of the CMB separated by 180° , we have no reason to suspect that they share any common properties, as it takes information roughly 27.199 billion years to travel b/w the two points. Yet we know that both of these CMB points share the same temperature even though they are not causally connected.