Cosmology: Quiz 2

IUCAA-NCRA Graduate School

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1. Consider a spatially flat cosmological model with only non-relativistic matter. A telescope observes an object which is found to be from an epoch when the CMBR blackbody radiation was 9 times hotter than its present state. The *comoving* distance to the object is

   (a) $\dfrac{2c}{3H_0}$

   (b) $\dfrac{c}{H_0}$

   (c) $\dfrac{4c}{3H_0}$

   (d) $\dfrac{5c}{3H_0}$

   (e) $\dfrac{2c}{H_0}$

   [*Correct: +5, Incorrect: -1, No attempt: 0*]

2. For a flat universe containing non-relativistic matter with density parameter Ω_{m0} and a cosmological constant $\Omega_\Lambda = 1 - \Omega_{m0}$, the scale factor is related to the time coordinate as

   (a) $a(t) = \left(\dfrac{\Omega_{m0}}{1-\Omega_{m0}}\right)^{1/3} \left[\sinh\left(\dfrac{3}{2}\sqrt{1-\Omega_{m0}}\ H_0 t\right)\right]^{2/3}$

   (b) $a(t) = \dfrac{2}{3}\left(\dfrac{\Omega_{m0}}{1-\Omega_{m0}}\right)^{1/3} \left[\sinh\left(\sqrt{1-\Omega_{m0}}\ H_0 t\right)\right]^{2/3}$

   (c) $a(t) = \left[\sinh\left(\sqrt{1-\Omega_{m0}}\ H_0 t\right)\right]^{2/3}$

   (d) $a(t) = \left(\dfrac{\Omega_{m0}}{\Omega_{m0}-1}\right)^{1/3} \left[\sinh\left(\dfrac{3}{2}\sqrt{\Omega_{m0}-1}\ H_0 t\right)\right]^{2/3}$

   (e) $a(t) = \dfrac{2}{3}\left(\dfrac{\Omega_{m0}}{\Omega_{m0}-1}\right)^{1/3} \left[\sinh\left(\sqrt{\Omega_{m0}-1}\ H_0 t\right)\right]^{2/3}$

   You may find the following result useful: $\displaystyle\int \mathrm{d}x\ \frac{\sqrt{x}}{\sqrt{1+Kx^3}} = \frac{2}{3\sqrt{K}}\ \sinh^{-1}\left(\sqrt{K}\ x^{3/2}\right)$.

   [*Correct: +5, Incorrect: -1, No attempt: 0*]