Assume a critical density of radiation \( \Rightarrow \Omega_r = 1, \ \Omega_k = 0 \Rightarrow \Omega = 0 \)

The Friedmann equation is then

\[
\left( \frac{\dot{a}}{a} \right)^2 = \frac{8\pi G}{3} \rho = \frac{8\pi G \rho_{\text{crit}}}{3} a^{-4}, \quad \text{since} \quad \rho = \rho_r \propto a^{-4}
\]

\[
\Rightarrow \frac{\dot{a}}{a} = H_0 a^{-1} \quad \Rightarrow \int \dot{a} \, dt = \int H_0 a^{-1} \, dt \quad \Rightarrow \quad t = \frac{1}{2} H_0^{-1} a^2
\]

Thus the age of the universe is today \((a=1)\):

\[
t_0 = \frac{1}{2} H_0^{-1} = \frac{1}{2} h^{-1} \cdot 9.78 \times 10^9 \text{ years}
\]

\[
t_0 \approx 6.99 \times 10^9 \text{ years for } h = 0.7
\]

The age of the universe at \( z = 3 \times 10^8 \) (BBN) is

\[
t_{\text{BBN}} = \frac{1}{2} H_0^{-1} \frac{1}{(1+z)^2} = \frac{t_0}{(1+z)^2} = 7.36 \times 10^8 \text{ years} \approx 2.45 \text{ s}
\]

Observations to rule out this model and

1) There are stars that are older than \( t_0 \).

2) The observations of Type Ia supernovae give a different relation between luminosity distance and redshift, \( d_L(z) \). They show accelerating expansion, whereas this model has decelerating expansion, \( \ddot{a}(t) = \sqrt{2H_0 t} \)

\[
\Rightarrow \dot{a} = \sqrt{\frac{H_0}{2} t} \quad \Rightarrow \quad \ddot{a} = -\frac{H_0^2}{4} t^{-3/2}
\]

3) Big Bang Nucleosynthesis time scale is very short in this model. \( z = 3 \times 10^8 \) corresponds to \( T = (1+z) \cdot 2.725 K = 8.2 \times 10^8 K = 70 \text{ keV} \). (In the standard cosmological model this temperature is reached about 100 hours later). Thus, we would probably produce very different light element isotope abundances than what we observe.