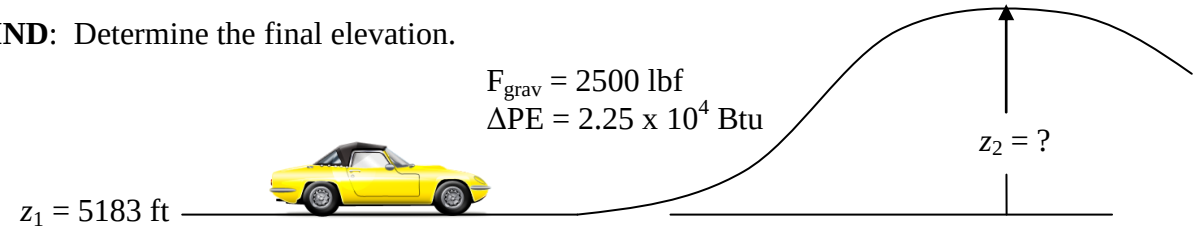
Problem 2.5

A automobile weighing 2500-lbf increases its gravitational potential energy by 2.25 x 10^4 Btu in going from an elevation of 5,183 ft in Denver to the highest elevation on Trail Ridge road in the Rocky Mountains. What is the elevation at the high point of the road, in ft?

KNOWN: An automobile of known weight increases its gravitational potential energy by a given amount. The initial elevation is known.

FIND: Determine the final elevation.



ENGINEERING MODEL: (1) The automobile is the closed system. (2) The acceleration of gravity is constant.

ANALYSIS: The change in gravitational potential energy is: $\Delta PE = mg(z_2 - z_1)$. With $F_{grav} = mg$, we get

$$\Delta PE = F_{grav}(z_2 - z_1)$$

Solving for z_2

$$z_2 = \frac{\Delta PE}{F_{grav}} + z_1 = \frac{(2.25\ x\ 10^4\ \text{Btu})}{(2500\ \text{lbf})}\left|\frac{778\ \text{ft·lbf}}{1\ \text{Btu}}\right| + 5183\ \text{ft} = 12{,}185\ \text{ft}$$