Pitch Diameter (D_m): 1.8 in
Lead (L): 1 in
Screw Efficiency (ε): 65% = 0.65
Collar Friction (f_c): Neglected ($f_c = 0$)

<u>Step 1:</u> Calculate the Lead Angle (α)

The lead angle of a power screw represents the angle of inclination of the threads relative to a plane perpendicular to the screw axis. It is calculated by unwrapping one turn of the thread, forming a right-angled triangle where the rise is the lead (L) and the base is the circumference at the pitch diameter (πD_m). In the provided material, this angle is designated as α. The tangent of the lead angle is defined by the following expression:

$$tan\,\alpha = \frac{L}{\pi\, D_m} = \frac{1\ in}{\pi\,(1.8\ in)} = 0.176839$$

<u>Step 2:</u> Establish the Power Screw Efficiency Equation

The fundamental efficiency equation for a power screw accounting for both thread and collar friction is given by standard mechanical design references (such as Faires or Shigley) as follows:

$$\varepsilon = \frac{tan\,\alpha(1 - f\,tan\,\alpha)}{tan\,\alpha + f + \left[\frac{f_c D_c}{D_m}\right](1 - f\,tan\,\alpha)} * 100\%$$

Because the problem statement explicitly instructs to **neglect collar friction**, the term containing f_c becomes zero ($f_c = 0$). This simplifies the denominator significantly, isolating the mechanical losses strictly to the thread interface:

$$\varepsilon = \frac{tan\,\alpha(1 - f\,tan\,\alpha)}{tan\,\alpha + f} * 100\%$$

$$0.65 = \frac{0.176839(1 - 0.176839f)}{f} * 100\%$$

$$f = 0.09085$$

In this specific problem, $tan\,\alpha$ = 0.1768 while f = 0.0908. Because f < $tan\,\alpha$, **this screw is not self-locking**. It will experience "back-driving" or "overhauling," meaning the load will cause the screw to spin backward automatically if the driving torque is removed. To make a power screw self-locking, an engineer must either lower the lead angle (decrease pitch/lead) or accept a lower efficiency value (typically under 50%). This demonstrates the classic engineering trade-off: you must balance mechanical efficiency against inherent system safety.