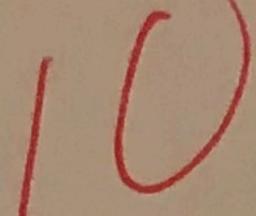**Problem 2 (40 points):**

A particle of mass m is free to move along the y-axis. The particle is subjected to a conservative force described by the potential energy function

$$U(y) = a(y - b)^2 - cy \quad ,$$

where y is the coordinate of the particle and a, b, and c are positive constants. For this problem, assume that only this <u>conservative force</u> does work on the particle.

Part A (10 points): Find the equilibrium position of this particle in terms of the constants a, b, and c and state whether this is a stable or unstable equilibrium.

Equilibrium $\dfrac{dU}{dy} = 0$

$\dfrac{dU}{dy} = 2a(y-b) - c$

$0 = 2a(y-b) - c$

$\dfrac{c}{2a} + b = y$

$\dfrac{d^2U}{dy^2} = 2a > 0$ $\quad \therefore$ | The equilibrium is stable at $y = b + \dfrac{c}{2a}$ //