Part D (10 points): Besides $y = 0$, at what other position will the particle be instantaneously at rest? Express your answer in terms of the constants a, b, and c.

$$V_y = \sqrt{\frac{2}{m}(-a(y-b)^2 + cy)} \qquad (y-b)^2 = y^2 - 2by + b^2$$

$$V_y = 0 \qquad \frac{\cancel{2}}{\cancel{m}}(-a(y-b)^2 + cy) = 0$$

$$-ay^2 + 2aby - ab^2 + cy = 0$$

$$-ay^2 + (2ab + c)y - ab^2 = 0$$

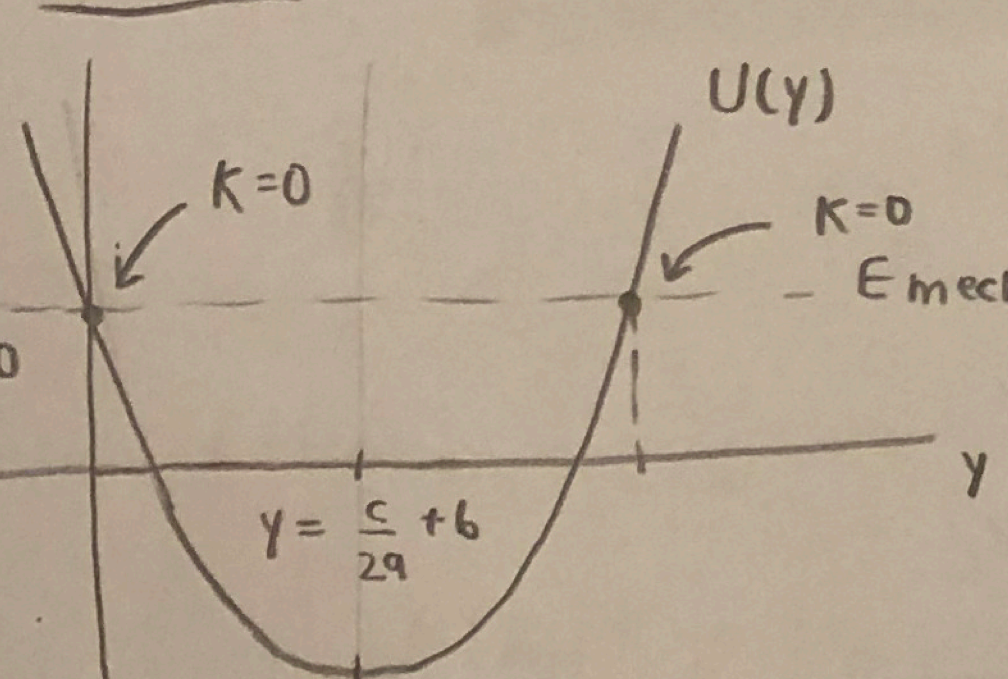
$$y = \frac{-(2ab+c) \pm \sqrt{(2ab+c)^2 - 4(-a)(-ab^2)}}{2(-a)} \qquad (2ab+c)^2 = 4a^2b^2 + 4abc + c^2$$

$$= \frac{\cancel{-}(2ab+c) \pm \sqrt{\cancel{4a^2b^2} + 4abc + c^2 - \cancel{4a^2b^2}}}{\cancel{-}2a}$$

$y > 0$

$$y = \frac{-2ab - c - \sqrt{4abc + c^2}}{-2a} = \boxed{b + \frac{c}{2a} + \frac{\sqrt{4abc+c^2}}{2a}} \quad //$$

Solution:



$$y = 0 \quad U(0) = ab^2$$

$$E_{mech} = \overset{0}{\cancel{K_i}} + U_i = ab^2$$

$$a(y-b)^2 - cy = ab^2$$

$$a(y^2 - 2yb + b^2) - cy = ab^2$$

$$ay^2 - (2ab + c)y + \cancel{ab^2} = \cancel{ab^2}$$

$$y(ay - 2ab + c) = 0$$

$$y = 0 \quad \text{or} \quad y = \frac{2ab + c}{a} = 2b + \frac{c}{a} \quad //$$