• Ball 1 is thrown downward toward the ground a distance D below at $v(0)$. At the same instant, ball 2 is thrown upward from ground level on the same vertical line, at $v(0)$. Show that the balls will collide at

$$y = \frac{D}{2}\left[1 - \frac{gD}{4v_0^2}\right].$$

• Suppose a particle follows the path $x(t) = x(0) - b_1 t^2 + b_2 t^3$, where constants b_1 and b_2 are both positive. At what $t > 0$ is the particle closest to $x = 0$ and what is its position at that time?

Solution: $x_{\min} = x(0) - 0.148(b_1^3/b_2^2)$, at $t = 2b_1/3b_2$.

• Suppose two particles move independently according to $x_1(t) = b_1 t^2$ and $x_2(t) = b_2 t^3$. Here b_1 and b_2 are positive constants. (a) Is there a time when both particles have the same velocity? (b) If the answer is yes, what is that velocity?

Answers: (a) $t = (2b_1)/(3b_2)$. (b) $v_x = (4b_1^2)/(3b_2)$.