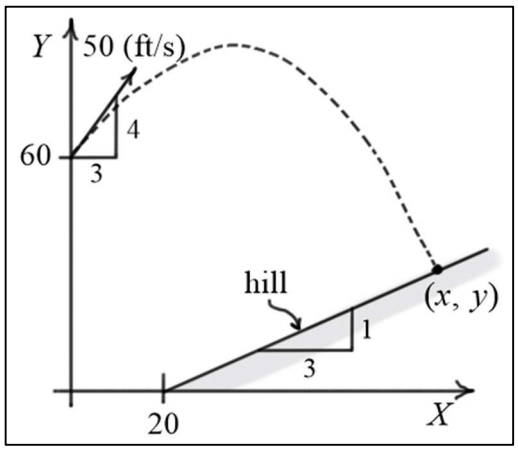
Elementary Engineering Mathematics
Exercises #2 – Quadratic Equations

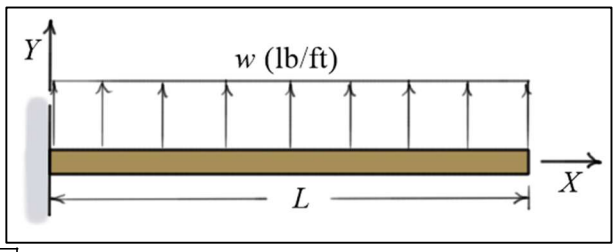
1. A ball is thrown off a tower at a height of 60 (ft) at a speed of 50 (ft/s) and strikes the hill at some point (x, y) as shown. The X and Y positions of the ball are given as functions of time.



$$\boxed{x(t) = 30t \ \text{(ft)}} \qquad \boxed{y(t) = 60 + 40t - 16.1t^2 \ \text{(ft)}}$$

(a) By using the quadratic formula and completing the square, find the times when $y = 65$ (ft); (b) Find y_{max} the maximum height of the ball; (c) By eliminating t from the equations, find $y(x)$; (d) Find the equation for the line representing the hill; and (e) Find the point where the ball strikes the hill.

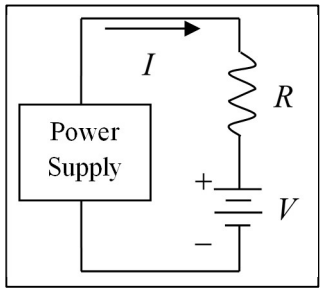
2. A beam of length $L = 10$ (ft) is cantilevered into a wall. It is subjected to a constant upward distributed load of $w = 100$ (lb/ft). As a result of this load, the internal bending moment in the beam is found to be a function of x.



$$\boxed{M(x) = \tfrac{1}{2} w x^2 - wLx + \tfrac{1}{2} wL^2 = 50x^2 - 1000x + 5000 \ \text{(ft-lb)}}$$

(a) Find the moments at the ends of the beam, $x = 0$ and $x = L$; (b) By using the quadratic formula and completing the square, find the X coordinates of the points where $M = 1000$ (ft-lb); (c) Find the location and value of the maximum bending moment in the beam; and (d) Convert the maximum bending moment to Newton-meters (N-m).

3. The power P supplied to a single-loop circuit can be written as follows: $\boxed{P = RI^2 + VI}$. Given $R = 8$ (ohms), $V = 16$ (volts) and $P = 64$ (watts), find the current I by (a) factoring, (b) completing the square, and (c) the quadratic formula.



4. In the circuit shown, the single equivalent resistance for the three resistors R_1, R_2 and R_3 is $\boxed{R_{eq} = \left(\dfrac{R_1 R_2}{R_1 + R_2} \right) + R_3}$. Given $R_{eq} = 20$ (ohms), $R_2 = R_1 - 5$, and $R_3 = R_1 + 8$, find the values of the resistors R_1, R_2 and R_3.