ENGR 1990 Engineering Mathematics
Homework #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.

\[
x(t) = 30t \text{ (ft)} \quad y(t) = 60 + 40t - 16.1t^2 \text{ (ft)}
\]

(a) By using the quadratic formula and completing the square, find the times when \(y = 65 \text{ (ft)}\);
(b) Find \(y_{\text{max}}\) 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 \(L = 10 \text{ (ft)}\) is cantilevered into a wall. It is subject to a constant distributed load of 100 (lb/ft). As a result of this load, the internal bending moment in the beam is found to be a function of \(x\).

\[
M(x) = \frac{1}{2}w x^2 - wL x + \frac{1}{2}wL^2 = 50x^2 - 1000x + 5000 \text{ (ft-lb)}
\]

(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 \(M = 1000 \text{ (ft-lb)}\); (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 current can be written as follows: \(P = RI^2 + VI\). Given \(R = 8 \text{ (ohms)}\), \(V = 16 \text{ (volts)}\) and \(P = 64 \text{ (watts)}\), 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 \(R_{\text{eq}} = \left(\frac{R_1 R_2}{R_1 + R_2}\right) + R_3\). Given \(R_{\text{eq}} = 20 \text{ (ohms)}\), \(R_2 = R_1 - 5\), and \(R_3 = R_1 + 8\), find the values of the resistors \(R_1, R_2\) and \(R_3\).