Application Problems 2

1. The number of bacteria in a refrigerated food is given by $n(t) = 30t^2 - 20t + 160$ where *"t"* is the temperature of the food in Celsius. At what temperature will the number of bacteria be minimal?
   $$\frac{4ac - b^2}{4a} = \frac{4(30)(160) - (-20)^2}{4(30)} = \frac{470}{3} = 156.66$$
2. The height *"h"* in feet of an object above the ground is given by $h(t) = -16t^2 + 64t + 220$ where *"t"* is the time in seconds. Find the maximum height of the object and at what time it reaches the maximum height.
   $$\frac{4ac - b^2}{4a} = \frac{4(-16)(220) - (64)^2}{4(-16)} = 284$$
3. Patti hits a golf ball of the tee. The height of the ball is given by $y(x) = -16x^2 + 4300x + 3650$ where *"y"* is the height in yards above the ground and *"x"* is the horizontal distance from the tee in yards. What is the maximum height of the ball?
   $$\frac{4ac - b^2}{4a} = \frac{4(-16)(3650) - (4300)^2}{4(-16)} = \frac{1170225}{4} = 292556.25$$
4. The number of board feet in a 16 foot long tree is approximated by the model $F(d) = 0.8d^2 - 1.4d - 9.6$ where *"F"* is the number of feet and *"d"* is the diameter of the log. How many board feet are in a log with diameter 12 inches?
   $$F(d) = 0.8d^2 - 1.4d - 9.6$$
   $$F(d) = 0.8(12)^2 - 1.4(12) - 9.6$$
   $$F(d) = \frac{444}{5} = 88.8$$
   What is the diameter that will produce the minimum number of board feet?
   $$\frac{-b}{2a} = \frac{-(-1.4)}{2(.8)} = \frac{1.4}{1.6} = 0.875$$
5. For the years of 1986 to 1998, the number of mountain bike owners *"m"* (in thousands) in Canada can be approximated by the model where $m(t) = 0.35t^2 - 2.36t + 4.24$. In what year was the number of mountain bike owners at a minimum?
   $$\frac{-b}{2a} = \frac{-(-2.36)}{2(.35)} = \frac{118}{35} = 3.371 = \text{3rd year}$$
   $$1986 + 3 = 1989$$
6. A manufacturer of tennis balls has a daily cost of $C(x) = 240 - 15x + 0.01x^2$ where *"C"* is the total cost in dollars and *"x"* is the number of tennis balls produced. What number of tennis balls will produce the minimum?
   $$\frac{-b}{2a} = \frac{-(-15)}{2(.01)} = \frac{15}{.02} = 750$$
7. The value of Ahmed's stock portfolio is given by the function $v(t) = 70 + 85t - 3t^2$ where *"v"* is the value of the portfolio in hundreds of dollars and *"t"* is the time in

months. When will the value of Ahmed's portfolio be at a maximum?

$$\frac{-b}{2a}=\frac{-(8.5)}{2(-3)}=\frac{8.5}{6}=1.4167$$

8. The value of Kim's stock portfolio is given by the function $v(t)=60+80t+3t^2$ where *"v"* is the value of the portfolio in hundreds of dollars and *"t"* is the time in months. How much money did Jon start with?

   60

   What is the minimum value of Jon's portfolio?

   $$\frac{4ac-b^2}{4a}=\frac{4(3)(60)-(80)^2}{4(3)}=\frac{-1420}{3}=-473.33$$

9. Find the number of units that produce the maximum revenue, where $R(x)=860-0.2x^2$ is the total revenue (in dollars) and "x" is the number of units sold.

   $$\frac{-b}{2a}=\frac{-(0)}{2(-.2)}=0$$

10. A textile manufacturer has daily production costs of $C(x)=9{,}000-100x+0.06x^2$, where *"C"* is the total cost (in dollars) and *"x"* is the number of units produced. How many units should be produced each day to yield a minimum cost?

    $$\frac{-b}{2a}=\frac{-(-100)}{2(.06)}=\frac{100}{.12}=\frac{2500}{3}=333.33$$

11. A manufacturer of light fixtures has daily production costs of $C(x)=900-8x+0.3x^2$ where *"C"* is the total cost (in dollars) and *"x"* is the number of units produced. How many units should be produced every day to yield a minimum cost?

    $$\frac{-b}{2a}=\frac{-(-8)}{2(.3)}=\frac{8}{.6}=\frac{80}{6}=13.33$$

12. The height *"h"* in feet of a projectile launched vertically upward from the top of a 96-foot tall bridge is given by $h(t)=110+16t-16t^2$ where *"t"* is time in seconds. What is the maximum height and how long will it take the projectile to strike the ground?

    $$\frac{4ac-b^2}{4a}=\frac{4(-16)(110)-(16)^2}{4(-16)}=114$$

    $-\frac{b}{2a}=\frac{-(16)}{2(-16)}=\frac{1}{2}$ time to reach max height

    let $t=3 \Rightarrow h(t)=110+16(3)-16(3)^2 \Rightarrow 14$

    let $t=4 \Rightarrow h(t)=110+16(4)-16(4)^2 \Rightarrow -82$

    $\therefore$ the projectile strikes the ground between 3 and 4 seconds because a positive h(t) indicates being above the ground and a negative h(t) value indicates that the object is below the ground which is not possible.