Name: Key Date: ____________

Quadratic and Linear Applications Homework

1. Marina is a set designer. She plans movie sets using freehand sketches and her computer. In one scene, a banner will hand across a parabolic archway. To make it look interesting, she has decided to put the banner on an angle. She sets the banner along a line defined by the linear equation: $y = 0.24x + 7.2$, with x representing the horizontal distance and y the vertical distance, in meters, from one foot of the archway. The archway is modeled by the quadratic equation: $y = -0.48x^2 + 4.8x$. How can Marina use the equations to determine the points where the banner needs to be attached to the archway and the length of the banner?

$.24x + 7.2 = -0.48x^2 + 4.8x$

$0 = -0.48x^2 + 4.56x - 7.2$

$x = \dfrac{-4.56 \pm \sqrt{(4.56)^2 - 4(-0.48)(-7.2)}}{2(-.48)}$

$x = \dfrac{-4.56 \pm \sqrt{6.9696}}{-.96}$

$x = 2$ $x = 7.5$

$y = 0.24(2) + 7.2 = 7.68$ 2 feet Horizontally 7.68 feet vertically

$y = 0.24(7.5) + 7.2 = 9$ 7.5 feet Horizontally 9 feet verticall

2. One side of a rectangle is 3 feet shorter than twice the other side. Find the sides if the area is $209 ft^2$.

$2x - 3$

x

$(2x-3)(x) = 209$

$2x^2 - 3x - 209 = 0$

$x = \dfrac{3 \pm \sqrt{(-3)^2 - 4(2)(-209)}}{2(2)}$

$x = \dfrac{3 \pm \sqrt{1681}}{4}$

$x = 11$ $x = -9.5$

$\boxed{x = 11 \quad \text{otherside} = 19}$

3. Dudley Do-Right is riding his horse at a top speed of 10 m/s toward the bank and is 100 m away when the bank robber begins to accelerate away from the bank going in the same direction as Dudley Do-Right. The robber's distance, d, in meters, away from the bank after t seconds can be modeled by the equation: $d = 0.2t^2$. Will Dudley Do-Right catch the bank robber? If he does, find the time and position where it happens. If not, explain why not.

$d = 10t + 100$

$d = 0.2t^2$

$0.2t^2 = 10t + 100$

$0.2t^2 - 10t - 100 = 0$

$x = \dfrac{10 \pm \sqrt{(-10)^2 - 4(0.2)(-100)}}{2(0.2)}$

$x = \dfrac{10 \pm \sqrt{180}}{.4}$

$x = 58.54$ $x = -8.54$

$d = 10(58.54) + 100$

$\boxed{d = 685.4 \text{ meters} \quad t = 58.54 \text{ seconds}}$

4. The path of an underground stream is given by the function: $y = 4x^2 + 17x - 32$. Two new houses need wells to be dug. On the area plan, the houses lie on the line defined by the equation: $y = -15x + 100$. Determine the coordinates where the two new wells should be dug.

$-15x + 100 = 4x^2 + 17x - 32$

$0 = 4x^2 + 32x - 132$

$0 = 4(x^2 + 8x - 33)$

$0 = 4(x + 11)(x - 3)$

$x = -11$ $x = 3$

$y = -15(3) + 100$

$y = 55$

$(3, 55)$

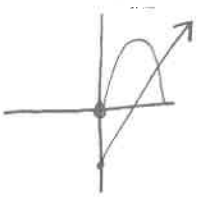
$y = -15(-11) + 100$

$y = 265$

$(-11, 265)$

5. Andrea's supervisor at the actuarial firm has asked her to determine the safety zone needed for a fireworks display. She needs to find out where the safety fence needs to be placed on a hill. The fireworks are to be launched from a platform at the base of the hill. Using the top of the launch platform as the origin and taking some measurements, in meters, Andrea comes up with the following equations: Cross-section of the slope and one side of the hill: $y = 4x - 12$ and the path of the fireworks: $y = -x^2 + 15x$.

   a. Illustrate the situations on the same set of axes.



   b. Calculate the coordinates of the point where the function that describes the path of the fireworks will intersect the equation for the hill.

$-x^2+15x=4x-12$

$0=x^2-11x-12$

$(x-12)(x+1)$

$x=12 \quad x=-1$

$(12, 36) \quad (-1,-16)$

6. A parachutist jumps from an airplane and immediately opens his parachute. His altitude, y, in meters, after t seconds is modeled by the equation: $y = -4t + 300$. A second parachutist jumps 5 seconds later and freefalls for a few seconds. Her altitude in meters, during this time is modeled by the equation: $y = -4.9(t-5)^2 + 300$. When does she reach the same altitude as the first parachutist?

$-4t+300= -4.9(t-5)^2+300$

$-4t+300 = -4.9(t^2-10t+25)+300$

$-4t+300 = -4.9t^2+49t-122.5+300$

$0=-4.9t^2+53t-122.5$

$x=\dfrac{-53 \pm \sqrt{(53)^2-4(-4.9)(-122.5)}}{2(-4.1)}$

$x=\dfrac{-53 \pm \sqrt{408}}{-9.8}$

$\boxed{x=3.35 \text{ Seconds} \quad x=7.47 \text{ Seconds}}$

7. The height, h, of a baseball, in meters, at time t seconds after it is tossed out of a window is modeled by: $h = -5t^2 + 20t + 15$. A boy shoots at the baseball with a paintball gun. The trajectory of the paintball is given by the equation: $h = 3t + 3$. Will the paintball hit the baseball? If so, when? At what height will the baseball be?

$-5t^2+20t+15=3t+3$

$-5t^2+17t+12=0$

$x=\dfrac{-17 \pm \sqrt{(17)^2-4(-5)(12)}}{2(-5)}$

$x=\dfrac{-17 \pm \sqrt{529}}{-10}$

$x=-.6 \quad x=4 \quad h=3(4)+3$

yes, it will at 4 seconds and at 15 feet.

8. The revenue for a company producing electronic components is given by: $y = -20x^2 - 50x + 200$, where x is the price in dollars for each component. The cost for the production is given by: $y = 60x - 10$. Determine the price that will allow the production to break even.

$-20x^2 - 50x + 200 = 60x - 10$

$-20x^2 - 110x + 210 = 0$

$-10(2x^2 + 11x - 21) = 0$

$-10(2x^2 + 14x)(-3x - 21) = 0$

$-10(2x(x+7) - 3(x+7)) = 0$

$-10(2x-3)(x+7) = 0$

$x = 3/2$ $\quad x = -7$

$\boxed{= \$1.5}$

$y = 60(1.5) - 10$

$\boxed{\$80 \text{ revenue}}$

9. A punter kicks a football. Its height, h, in meters, t seconds after the kick is given by the equation: $h = -4.9t^2 + 18.24t + 0.8$. The height of an approaching blocker's hands in given by the equation: $h = -1.43t + 4.26$, using the same time. Can the blocker knock down the punt? If so, at what point will it happen?

$-4.9t^2 + 18.24t + 0.8 = -1.43t + 4.26$

$-4.9t^2 + 19.67t - 3.46 = 0$

$x = .18$ $\quad x = 3.83$

yes. At .18 seconds, 4 meters

$$x = \frac{-19.67 \pm \sqrt{(19.67)^2 - 4(-4.9)(-3.46)}}{2(-4.9)}$$

$$x = \frac{-19.67 \pm \sqrt{319.0929}}{-9.8}$$

$h = -1.43(.18) + 4.26 = 4.0026$

10. The price of a stock, A(x), over a 12-month period decreased and then increased according to the equation: $A(x) = 0.75x^2 - 6x + 20$, where x equals the number of months. The price of another stock, B(x), increased to the equation: $B(x) = 2.75x + 1.50$ over the same 12-month period. When will both stock values be the same price and how much is the stock worth when they are the same?