2.6 - Applications of Quadratics Homework
MCR 3U

1. The following function gives the height, h metres, of a batted baseball as a function of the time, t seconds, since the ball was hit. $h = -6(t - 2.5)^2 + 38.5$
   a) What was the maximum height of the ball?
   b) What was the height of the ball when it was hit?
   c) How many seconds after it was hit did the ball hit the ground, to the nearest second?
   d) Find the height of the ball 1 s after it was hit.

2. The equation shows the height of a soccer ball, h metres, as a function of the horizontal distance, d metres, the ball travels until it first hits the ground. $h = -0.025(d - 20)^2 + 10$
   a) What is the maximum height of the ball?
   b) What is the horizontal distance of the ball form the kicker when it reaches its maximum height?
   c) How far does the ball travel horizontally from when it was kicked until it hits the ground?
   d) What is the height of the ball when it is 10 m horizontally from the kicker?
   e) Would an opposing player positioned under the path of the ball 34 m from the kicker be able to head the ball? Explain.
   f) If the origin were placed at the vertex of the parabola, what would be the equation of the cuve?

3. A touch football quarterback passed the ball to the receiver 40 m downfield. The path of the ball can be described by the function $h = -0.01(d - 20)^2 + 6$ where h is the height of the ball, in metres, and d is the horizontal distance of the ball from the quarterback, in metres.
   a) What was the maximum height of the ball?
   b) What was the horizontal distance of the ball from the quarterback at its maximum height?
   c) What was the height of the ball when it was thrown? When it was caught?
   d) If a defensive back was 2 m in front of the receiver, how far was the defensive back from the quarterback?
   e) How high would the defensive back have needed to reach to knock down the pass?

4. The path of the ball for many golf shots can be modelled by a quadratic function. The path of a golf ball hit at an angle of about 10° to the horizontal can be modelled by the function $h = -0.002d^2 + 0.4d$ where h is the height of the ball, in metres, and d is the horizontal distance the ball travels, in metres, until it first hits the ground.
   a) What is the maximum height reached by the ball?
   b) What is the horizontal distance of the ball from the golfer when the ball reaches its maximum height?
   c) What distance does the ball travel horizontally until it first hits the ground?

5. The path of a basketball shot can be modelled by the equation $h = -0.09d^2 + 0.9d + 2$ where h is the height of the basketball, in metres, and d is the horizontal distance of the ball from the player, in metres.
   a) What is the maximum height reached by the ball?
   b) What is the horizontal distance of the ball from the player when it reaches its maximum height?
   c) How far from the floor is the ball when the player releases it?

6. A natural bridge is a stone arch formed over a river or stream. The longest natural bridge in the world is Rainbow Bridge in Utah. If the origin is placed at one end of the arch, the curve of the arch can be modelled by the equation $h = -0.0425d^2 + 3.57d$ where h metres represents the height and d metres represents the horizontal distance.
   a) What is the width of the arch at the base?
   b) What is the maximum height of the arch, to the nearest metre?
   c) At a horizontal distance of 10 m from the vertex, what is the height of the arch, to the nearest metre?

electronics store sells an average of 60 entertainment systems per month at an average of $800 more than the cost price. For every $20 increase in the selling price, the store sells one fewer system. What amount over the cost price will maximize profit?

8. Last year, a banquet hall charged $30 per person, and 60 people attended the hockey banquet dinner. This year, the hall's manager has said that for every 10 extra people that attend the banquet, they will decrease the price by $1.50 per person. What size group would maximize the profit for the hall this year?

9. Adam has 24 m of fencing to surround a garden, bounded on one side by the wall of his house. What are the dimensions of the largest rectangular garden that he can enclose?

10. The length of a rectangle is 2 m more than the width. If the area of the rectangle is 20 m^2, what are the dimensions of the rectangle, to the nearest tenth of a metre?

11. Find the two numbers whose difference is 12 and whose product is a minimum.

12. The sum of the squares of two consecutive integers is 685. What could the integers be? List all possibilities.

13. Determine an equation of each of the following quadratics (in the most appropriate form) given it:
    a) has x-intercepts of 3 and -8 and passes through the point (4,-5)
    b) has x-intercepts of $1+\sqrt{5}$ and $1-\sqrt{5}$ and passes through the point (2,5)
    c) has x-intercepts of -4 and -7 and a y-intercept of 10
    d) has an x-intercept of 9 and a minimum value of -15 when $x = -4$
    e) has an x-intercept of $4-\sqrt{3}$ and $4+\sqrt{3}$ a maximum value of 108

14. A soccer ball is kicked from the ground. After travelling a horizontal distance of 35 m, it just passes over a 1.5 m tall fence before hitting the ground 37 m from where it was kicked.
    a) Determine an equation of a quadratic function that can be used to model the path of the ball.
    b) Find the maximum height of the ball

Answers:

1. a) 38.5 m b) 1 m c) 5 s d) 25 m

2. a) 10 m b) 20 m c) 40 m d) 7.5 m e) No, the ball would be at a height of 5.1 m, which is too high to jump.
   f) $h = -0.025d^2$
3. a) 6 m b) 20 m c) 2 m; 2 m d) 38 m e) 2.76 m
4. a) 20 m b) 100 m c) 200 m
5. a) 4.25 m b) 5 m c) 2 m
6. a) 84 m b) 75 m c) 71 m
7. $1000
8. 130
9. 12 m by 6 m
10. Width: 3.6 m; length 5.6 m
11. 6 and -6
12. -19, -18 or 18, 19
13. a) $y = -\frac{5}{12}(x-3)(x+8)$ b) $y = -\frac{5}{4}(x^2-2x-4)$ c) $y = \frac{5}{14}(x+4)(x+7)$ d) $y = \frac{15}{169}(x+17)(x-9)$
    e) $y = -36x^2 + 288x - 468$

14. a) $h = -\frac{3}{140}d(d-37)$ b) 7.3 m

Unit 2: Quadratics – Take Home Quiz (2.1-2.5)
MCR 3U

1. Simplify the following radicals.

a) $\sqrt{125}$ b) $\sqrt{720}$ c) $\frac{4\sqrt{2}}{\sqrt{8}}$ d) $2\sqrt{7}\times 3\sqrt{1}\times\sqrt{7}$ e) $\frac{-12+\sqrt{48}}{4}$ f) $3\sqrt{2}\left(2\sqrt{6}+\sqrt{10}\right)$

g) $\left(2\sqrt{2}-\sqrt{5}\right)^2$ h) $\frac{2\sqrt{5}}{5\sqrt{2}}$ i) $\frac{3}{\sqrt{5}-1}$ j) $\sqrt[3]{72}$ k) $2\left(\sqrt[3]{128}\right)-\sqrt[3]{2}$ l) $\frac{30\sqrt{3}+9\sqrt{6}}{6}$

2. Express $5\sqrt{14}$ as an entire radical.

3. Use completing the square to find the max or min value of the function and the value of x when it occurs. No decimals.

a) $y=x^2+12x-7$ b) $y=3x^2+12x+2$ c) $y=-2x^2+3x-2$ d) $y=-\frac{3}{2}x^2-\frac{1}{6}x+\frac{7}{9}$

4. Solve. (Choose an appropriate/efficient method). Exact answers only.

a) $9x^2-3x-2=0$ b) $6x^2+12=0$ c) $-8x=4x^2-1$

d) $x^2-3x+17=0$ e) $-(x-1)^2=-9$ f) $2x^2+20x=-50$

5. How many zeros do these quadratics have? DO NOT SOLVE!

a) $y=x^2+9x+20$ b) $y=x^2-6x+13$ c) $2x^2-6x=-\frac{18}{4}$

6. Graph using the indicated method. Show work as dictated by the method.

a) $y=2x^2-4x+1$ (by partial factoring)

b) $y=-3(x+1)^2+6$ (using vertex form)

c) $y=x^2-4$ (by factoring)

7. Find the equation of the axis of symmetry of $y=6x^2+13x+6$

8. Putting it together. Given $y=-3x^2-24x+32$, find the vertex and the x-intercepts (if any exist). Exact answers only. Extend your understanding by finding the vertex in a variety of ways.

Answers:

1. a) $5\sqrt{5}$ b) $12\sqrt{5}$ c) 2 d) 42 e) $-3+\sqrt{3}$ f) $8\sqrt{3}+6\sqrt{5}$ g) $13-4\sqrt{10}$ h) $\frac{\sqrt{10}}{5}$

i) $\frac{3\sqrt{5}+3}{4}$ j) $2\sqrt[3]{9}$ k) $7\sqrt[3]{2}$ l) $\frac{10\sqrt{3}+3\sqrt{6}}{2}$ **2.** $\sqrt{350}$ **3.** a) min is - 43 when x = - 6

b) min is 38 when x = 2 c) max is $-\frac{7}{8}$ when x = $\frac{3}{4}$ d) min value is $\frac{169}{216}$ when x = $-\frac{1}{18}$

4. a) $x=-\frac{1}{3},\frac{2}{3}$ b) no real roots c) $x=\frac{-2+\sqrt{5}}{2},\frac{-2-\sqrt{5}}{2}$ d) no real roots e) $x=-2,4$

f) $x=-5$ **5.** a) 2 b) 0 c) 1 **6.** a) points (0,1) and (2,1), vertex (1,-1)

b) vertex (-1, 6), other points (0,3),(-2,3),(1,-6),(-3,-6) c) zeros (2,0) and (-2,0), vertex (0,-4)

7. $x=-\frac{13}{12}$ **8.** vertex (-4,80) x-intercepts: $\frac{-12-4\sqrt{15}}{3}$ and $\frac{-12+4\sqrt{15}}{3}$