Lesson 17 – Zeroes of Quadratic Relations Date:

(A) Lesson Objectives

a. Introduce the factored form of the equation of a quadratic relation by means of investigations
b. Determine how to calculate the key features of a parabola from its equation in factored form
c. Present real world applications involving zeroes or parabola

(B) Investigation #1 – Optimizing Profit/Loss Problem

Recall in Station #5, you gathered data for a revenue question ➔ A hockey arena seats 1600 people. The cost of a ticket is $10. At this price, every ticket is sold. To increase revenue, the arena management plans to increase ticket prices. They conduct a survey and determine that for 50 cent increase in price, 50 less people will attend.

a. Complete a data here

"x" ➔ # of increments	0	2	4	6	8	10	12	14	16
"y" ➔ revenue									

b. Include a sketch of the data and draw the curve of best fit

c. Determine the equation for this quadratic relation.

d. Graph the equation on your TI-84 in an appropriate window (one that allows you to see the zeroes and the optimal point)

e. Why are 2 zeroes in this relation?

f. Only one of the zeroes has a meaning in the context of the question. Which one and why?

g. What is the optimal revenue and when does it occur?

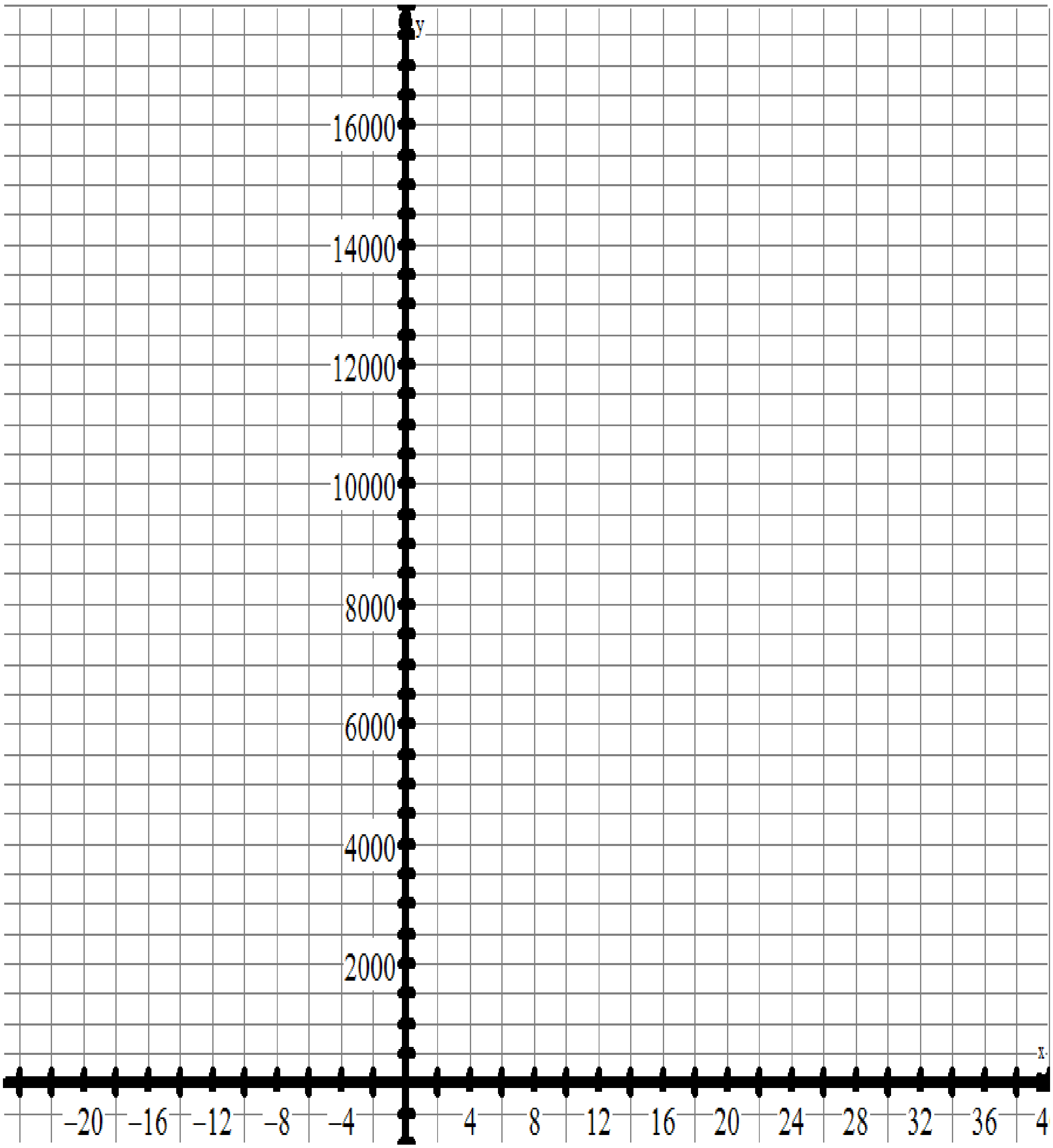
h. Suppose that the team becomes really popular (because Mr. S is playing on the team!!!) So new research now shows that a $0.50 increase in ticket price will only result in 5 less people attending.

   i. What is the new equation of the quadratic equation that models revenue?

   ii. What are the new zeroes of the parabola?

   iii. What ticket price will optimize the revenue?

   iv. What will the optimal value be?


y
16000
14000
12000
10000
8000
6000
4000
2000
x
−20
−16
−12
−8
−4
4
8
12
16
20
24
28
32
36

(C) *Investigation #2 – Investigating the Graphs of Quadratic Relations*

All of the quadratics you will graph are presented in the form of $y = \boldsymbol{a}(x - \boldsymbol{s})(x - \boldsymbol{t})$. How do the values of ***a***,***s***,***t*** affect the graph?

1. Use a graphing calculator to graph $y = \boldsymbol{a}(x - 2)(x + 3)$ when $\boldsymbol{a} = 3$. Describe what happens to the graph as you change the value of ***a*** to 2,1,-1,-2,-3. Include sketches.

2. Graph $y = 2(x - \boldsymbol{s})(x + 5)$ when $\boldsymbol{s} = -3$. Describe what happens to the graph as you change the value of ***s*** to 2,1,-1,-2,-3. Include sketches.

3. Graph $y = 2(x - 2)(x - \boldsymbol{t})$ when $\boldsymbol{t} = -3$. Describe what happens to the graph as you change the value of ***t*** to 2,1,-1,-2,-3. Include sketches. (Is this really any different than Q2??)

4. Which of the quantities ***a***, ***s***, or ***t*** affects whether the graph has a maximum or a minimum value? How can you PREDICT where a parabola has a maximum or minimum?

5. Which of the quantities ***a***, ***s***, or ***t*** affects where the graph has a zeroes? How can you PREDICT where a parabola has a its zeroes?

(D) *Consolidation of Investigations ➔ Key Points*

a. Equations in the form of $y = \boldsymbol{a}(x - \boldsymbol{s})(x - \boldsymbol{t})$ are______________________, provided that ____________.

b. The equation written the form $y = \boldsymbol{a}(x - \boldsymbol{s})(x - \boldsymbol{t})$ is said to be in ______________________________.

c. If $a > 0$, the parabola opens ______________________and has _______________________________.

d. If $a < 0$, the parabola opens ______________________and has _______________________________.

e. The zeroes of the quadratic can be determined by setting __________and solving__________________.

   The zeroes are then located _______________________________.

f. If the zeroes are known, then the axis of symmetry can be found ➔______________________________.

g. Once the axis of symmetry is known, the optimal value can be found ➔_________________________.

h. The value of ***a*** can be determined IF____________________________. All known values are substituted

   into $y = \boldsymbol{a}(x - \boldsymbol{s})(x - \boldsymbol{t})$ and then solve for ***a***.

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Examples

i. Ex 1 ➔ For the quadratic relation y = (x + 3)(x – 4), determine:
   - ***i.*** The direction of opening.
   - ***ii.*** The zeroes
   - ***iii.*** The optimal point.
   - ***iv.*** The y-intercept.
   - ***v.*** Sketch the parabola.

j. Ex 2 ➔ The zeroes of a parabola are -3 and 5. The graph crosses the y-axis at -75. Determine:
   - ***i.*** if the relation have a maximum or minimum value?
   - ***ii.*** the equation of the quadratic relation.
   - ***iii.*** the co-ordinates of the vertex.
   - ***iv.*** Sketch the parabola.

k. Ex 3 ➔ Mr. S throws a ball upward from the roof of the building that is 25m tall. The ball reaches a height of 45m above the ground after 2s and hits the ground 5s after being thrown.
   - ***i.*** Draw an accurate graph of the height of ball and the time in flight.
   - ***ii.*** What are the zeroes of the relation?
   - ***iii.*** What are the co-ordinates of the vertex?
   - ***iv.*** Determine an equation that models this situation.
   - ***v.*** What is the meaning of each zero?

l. Ex 4 ➔ Your friend has missed this lesson. Explain to your friend how the equation of a quadratic tells us where to find the zeroes and the vertex of a parabola.

(E) Homework

From the Nelson 10 textbook, Sec 3.4, p280, Q1adf, 2adf, 3, 4cd, 5dfh, 7efg