Name: key Date: Band:

Algebra 2

Unit 4: Quadratic Applications PBA Practice

1. In a football game, a defensive player jumps up to block a pass by the opposing team's quarterback. The function $h(t) = -16t^2 - 50t + 7$ models the height of the football, $h(t)$, in feet t seconds after being thrown by the quarterback.

A. What is $h(0)$? What does $h(0)$ represent in this situation? (y-int)

$h(0) = -16(0)^2 - 50(0) + 7$

$\boxed{h(0) = 7}$

h(0) represents the initial or starting height of the football at t=0s.

B. What is the maximum height of the football? (vertex y-coordinate)

$t = \frac{+50}{2(-16)} = -1.5625$

$h(-1.5625) = -16(-1.5625)^2 - 50(-1.5625) + 7$

$h(-1.5625) = \boxed{46.0625 \text{ ft}}$

C. How long does the defensive player's teammates have to intercept the ball before it hits the ground? (x-intercepts → larger one)

$0 = -16t^2 - 50t + 7$

$t = \frac{50 \pm \sqrt{(-50)^2 - 4(-16)(7)}}{2(-16)}$

$t = \frac{50 \pm \sqrt{2948}}{-32}$

$t = \frac{50 + \sqrt{2948}}{-32} \approx \cancel{-3.2}$

$t = \frac{50 - \sqrt{2948}}{-32} \approx \boxed{0.134 s}$

2. While marching, a drum major tosses a baton into the air and catches it. The height $h(t)$ (in feet) of the baton after t seconds can be modeled by $h(t) = -16t^2 + 48t + 4$.

A. What is $h(0)$? What does $h(0)$ represent in this situation? (y-int)

$h(0) = -16(0)^2 + 48(0) + 4$

$\boxed{h(0) = 4}$

h(0) represents the initial or starting height of the baton at t=0s.

B. What is the maximum height of the baton? (vertex y-coordinate)

$t = \frac{-48}{2(-16)} = 1.5$

$h(1.5) = -16(1.5)^2 + 48(1.5) + 4$

$h(1.5) = \boxed{40 \text{ ft}}$

C. How long is the baton in the air? (x-int → larger one)

$0 = -16t^2 + 48t + 4$

$0 = -4t^2 + 12t + 1$

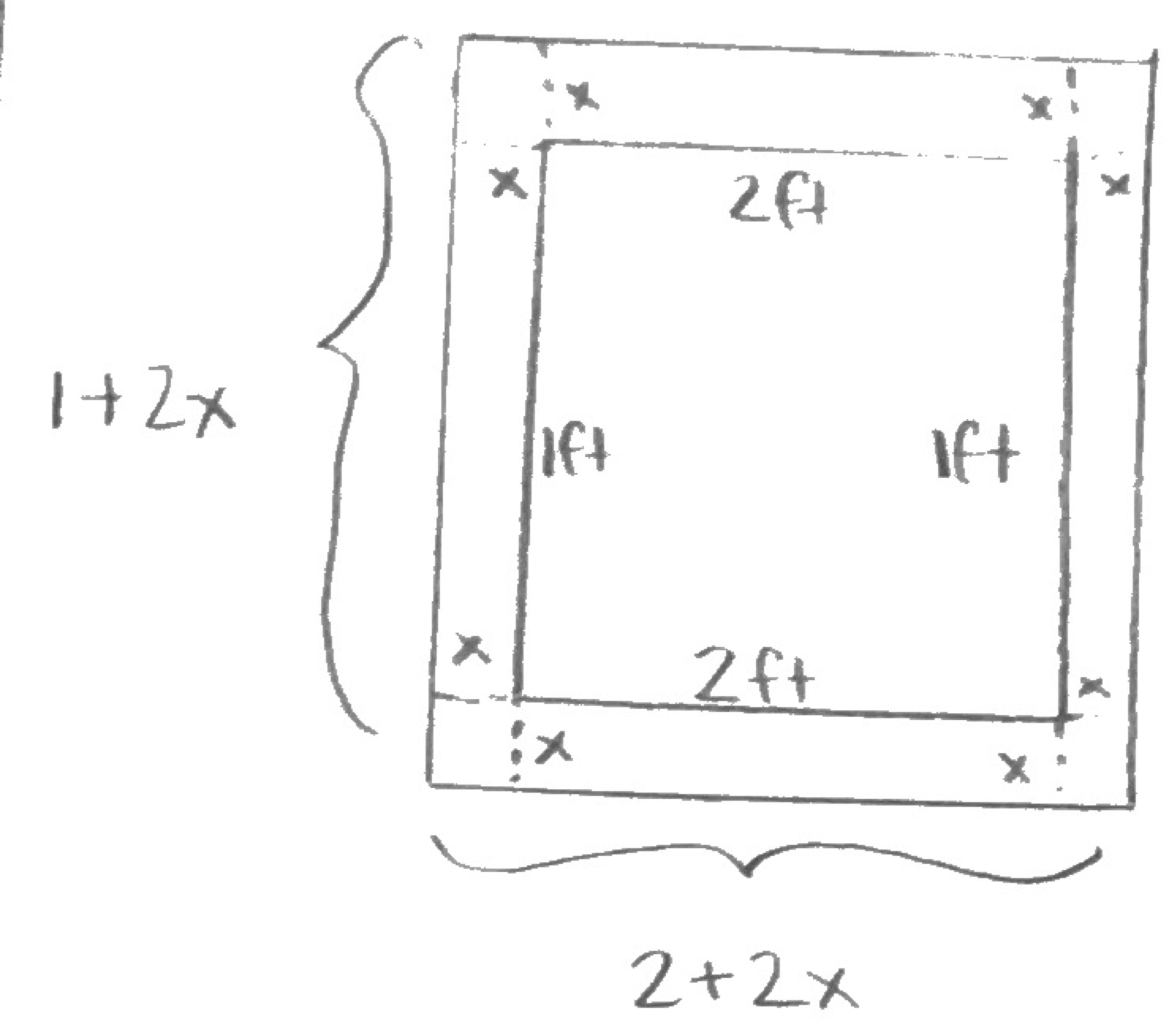
$t = \frac{-12 \pm \sqrt{(12)^2 - 4(-4)(1)}}{2(-4)}$

$t = \frac{-12 \pm \sqrt{160}}{-8}$

$t = \frac{-12 + \sqrt{160}}{-8} \approx \cancel{-0.081}$

$t = \frac{-12 - \sqrt{160}}{-8} \approx \boxed{3.081 s}$

3. You have a rectangular stained glass window that measures 2 feet by 1 foot. You have 4 square feet of glass with which to make a border of uniform width around the window. What should the width of the border be?



Area of border = Area of rectangle + border − area of rectangle

$4 = (1+2x)(2+2x) - (2)(1)$

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

$4 = 4x^2 + 6x$

$0 = 4x^2 + 6x - 4$

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

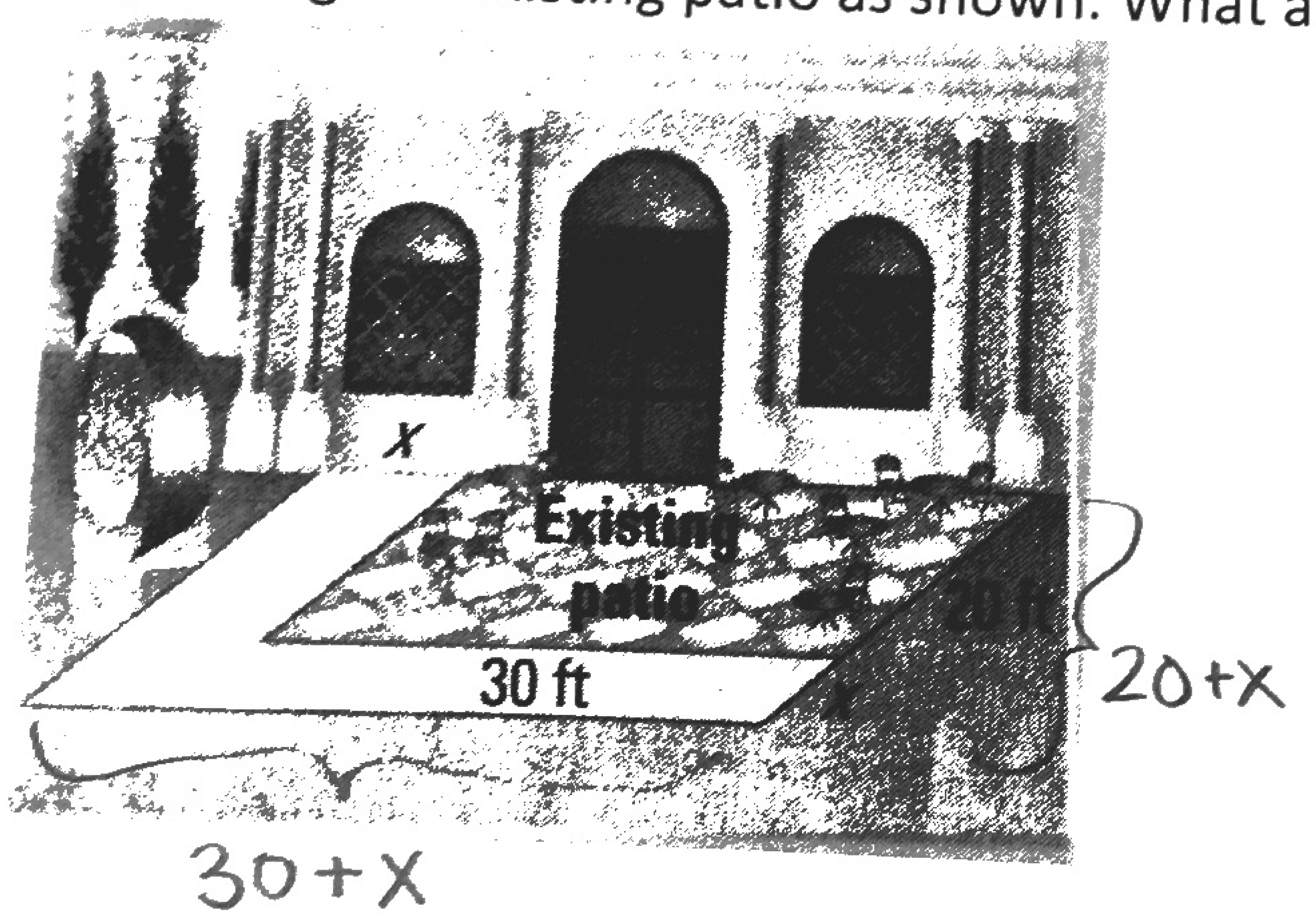
$0 = (2x - 1)(x + 2)$

$2x - 1 = 0$ $\quad$ $x + 2 = 0$

$2x = 1$ $\quad$ $x = \cancel{-2}$

$\boxed{x = \frac{1}{2}\text{ ft}}$

4. A museum has a café with a rectangular patio. The museum wants to double the area of the patio by expanding the existing patio as shown. What are the dimensions of the new patio?



new area = newlength × newwidth

$2(30)(20) = (30+x)(20+x)$

$1200 = 600 + 30x + 20x + x^2$

$1200 = x^2 + 50x + 600$

$0 = x^2 + 50x - 600$

$0 = (x + 60)(x - 10)$

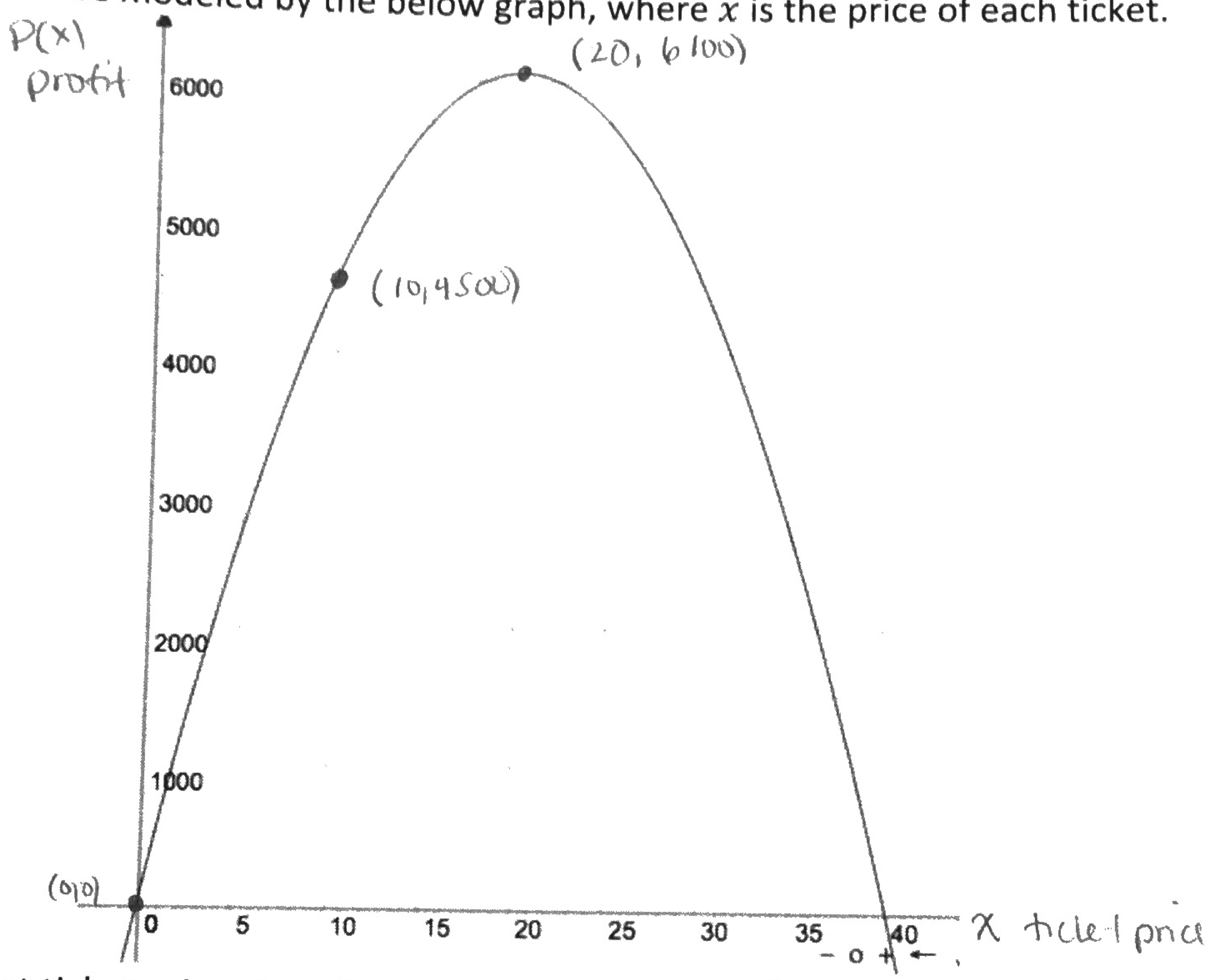
$x + 60 = 0$ $\quad$ $x - 10 = 0$

$x = \cancel{-60}$ $\quad$ $x = 10$

newlength = $20 + 10 = \boxed{30\text{ft}}$

new width = $30 + 10 = \boxed{40\text{ft}}$

5. The profit, $P(x)$, from selling local ballet tickets depends on the ticket price. Using past receipts, we find that the profit can be modeled by the below graph, where x is the price of each ticket.



A. Approximately what ticket price gives the maximum profit? (vertex x-coordinate)

Approximately $20.

B. What is $P(0)$ approximately? What does this value mean in this situation and why is it possible? (y-int.)

P(0) = 0 approximately. It means if you charge $0 then you make $0 profit because you need to charge $ to earn $.

C. At approximately what ticket price should the ballet charge to make a profit of about $4500?

Approximately $10.

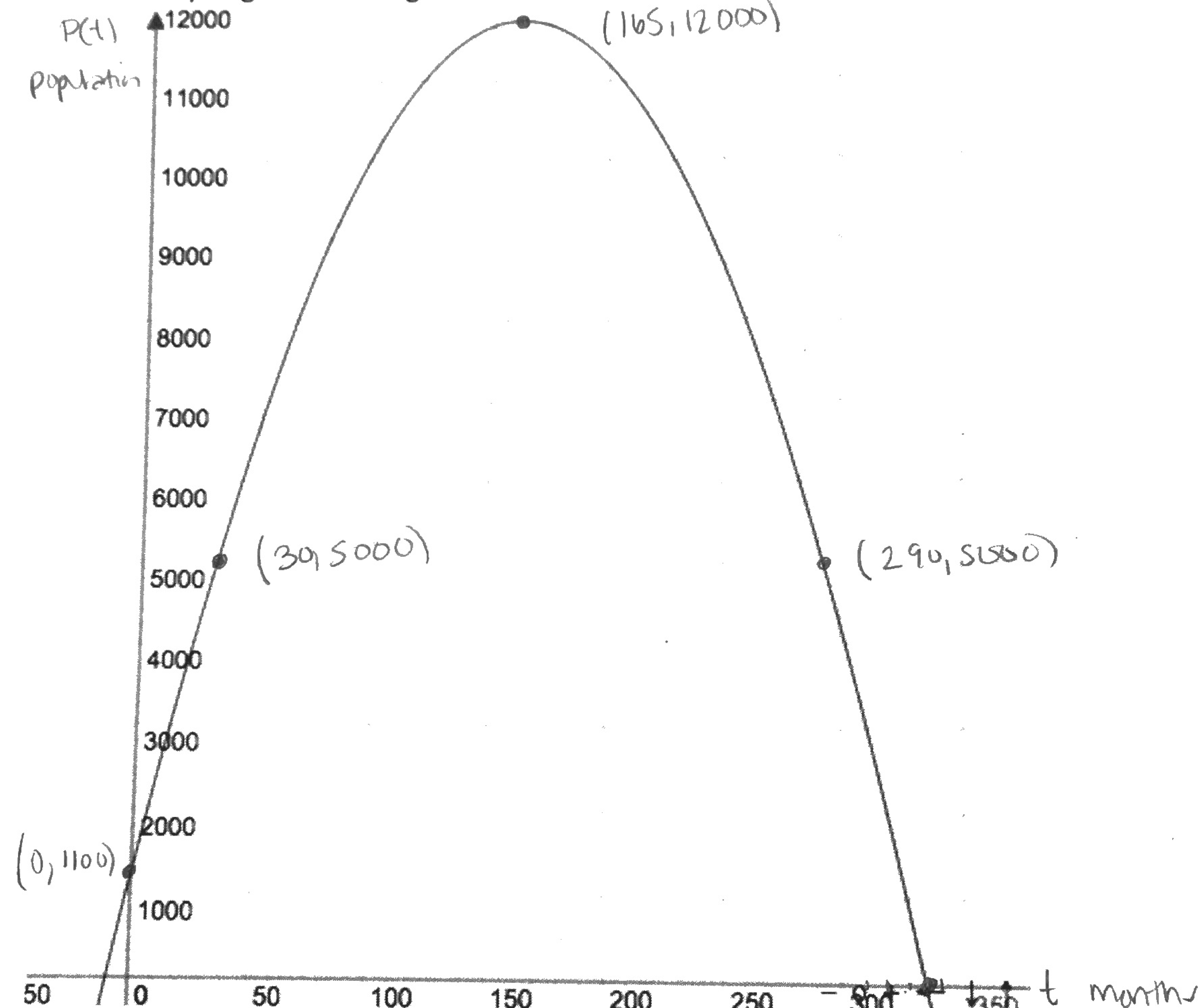
D. What is the minimum ticket price that the ballet needs to sell in order to make a positive profit?

$0.01

E. Approximately what is the maximum profit? (vertex y-coordinate)

Approximately $6100.

6. An observed bunny rabbit population, $P(t)$ on an island is shown in the graph below, where t is the time in months since they began observing the rabbits.



A. Approximately, when is the maximum population attained? (vertex x-coordinate)

Approximately. 165 months after they began observing the rabbits.

B. Approximately, what is the maximum population? (vertex y-coordinate)

Approximately 12000 rabbits.

C. Approximately when does the bunny rabbit population disappear form the island? (positive x-int)

Approximately 335 months after they began observing the rabbits.

D. Approximately what is $P(0)$? What does this value mean in the situation and why is it possible? (y-int)

Approximately $P(0) = 1100$. 1100 rabbits is the initial or starting population. This is possible because some rabbits existed on an island before observations began.

E. At approximately what time is the bunny population about 5000 bunnies?

Approximately 30 months after observations began and 290 months after observations began.