Manipulating quadratic and exponential expressions

1. The following function gives the amount of money owed on a short-term loan after *t* weeks.

$$A(t) = 100(1.75)^{\frac{t}{4}}$$

Which numerical expression best approximates the profit gained from interest after one year, excluding any late fees? (1 year = 52 weeks.)

A) 75
B) $100((1.75)^{13} - 1)$
C) 13×0.75
D) 13×1.75

2. The deer population in an isolated grassland depends on the population of predators. Within the year 2000, the population, *p*, in thousands, *m* months after January 1, 2000 is:

$$p = 0.5(m - 2.5)(m - 8) + 12$$

The population reached five thousand sometime in March. At what time, given as months after January 1, 2000, did the rabbit population reach twelve thousand for the second time in the year? *(Calculator Allowed)*

A) 2.5
B) 5
C) 8
D) 12

3. James throws a baseball vertically upward from the ground. The height, in meters, of the baseball above the ground at time *t* can be modeled by the quadratic function:

$$h(t) = -4.9t^2 + 14.7t$$

After how many seconds does the baseball hit the ground?

A) 1 second
B) 2 seconds
C) 3 seconds
D) 5 seconds

4. Jimmy was playing basketball when he threw a basketball into the air. The height, *h(t)*, in inches, that the ball reaches *t* seconds after it left his hand is modeled by the equation below:

$$h(t) = -4t^2 + 24t + 64$$

How many seconds after leaving Jimmy's hand does the ball reach its maximum height? Assume the ball leaves his hand at $t = 0$.

A) 2
B) 3
C) 6
D) 8

5. Henry is a meteorologist measuring the movement of storm clouds using an airborne sensor. He finds that the elevation, *E*, in meters of a particular storm cloud in the air *t* seconds after the start of recording is approximately:

$$E = 28 + 0.5(t - 8)^2$$

What was the elevation in meters of the volume of air at the start of recording? *(Calculator)*

A) 50
B) 28
C) 60
D) 32

6. Frank is replacing his old silo with a new one. The new silo will have a larger radius than the old one. However, the new silo will be the same height as the old one due to county regulations. The approximate volume, in m^3, of the new silo is given by the equation

$$V(x) = \pi(6x^2 + 36x + 54)$$

, where *x* is the additional length of the new radius in meters. What is the approximate radius of the old silo in meters? *(Calculator)*

A) 3
B) 6
C) 9
D) 45

7. Jenny owns a cryptocurrency option whose profit, *P*, in thousands of dollars depends on the coin market price after one year, *s*, in dollars. Assuming $0 \leq s \leq 24$ and a negative profit represents a positive loss, then the value of *P* is:

$$P = \frac{1}{4}s^2 - 6s + 24$$

For which coin market price after one year, in dollars, will Jenny incur the greatest loss? *(Calculator)*

A) 4
B) 6
C) 12
D) 24

8. *Arc de Triomphe*, is a world-renowned parabolic structure. The height (in meters) of the structure is given by

$$P(x) = -\frac{1}{5}x^2 + 11.6x$$

where *x* is the distance in meters from the left side of the structure at the ground level.

What is the maximum height of the *Arc de Triomphe* in meters?

A) 4
B) 5
C) 29
D) 168.2

9. A parabolic tunnel was recently built to provide railroad access for express trains as well as maintain pedestrian mobility in road above. The parabolic structure has a large open central arc that can be modeled by the quadratic equation $h(x) = -0.25x^2 + 12x$ where *h* is the height in meters, and *x* is the distance from the left end of the parabolic tunnel at ground level. Approximately how wide is the arch in meters at ground level?

A) 0.25
B) 12
C) 30
D) 48

10. The "break-even point" for a company is defined by the following equation:
$\text{Profit} = \text{Revenue} - \text{Cost}$
This means production is only profitable when revenue is greater than cost.

Given this information, the monthly profit of a company selling *x* units is given by the quadratic function:

$$P(x) = -\frac{1}{5}x^2 + 5.8x$$

Which of the following values gives the number of units that need to be sold to reach the break-even point?

A) 10 units
B) 15 units
C) 24 units
D) 29 units