UNIT 3: MODELING AND ANALYZING QUADRATIC FUNCTIONS

$a^2 - b^2 = (a+b)(a-b)$

A) *Unit 3: Interpret the Structure of Expressions*

1. **Which expression is equivalent to $121x^2 - 64y^2$?**

$a = 11x$

$b = 8y$

   A. $(11x - 16y)(11x + 16y)$
   B. $(11x - 16y)(11x - 16y)$
   C. $(11x + 8y)(11x + 8y)$
   D. $(11x + 8y)(11x - 8y)$

2. **What is a common factor for the expression $24x^2 + 16x + 144$?**

8

   A. 16
   B. $8x$
   C. $3x^2 + 2x + 18$
   D. $8(x - 2)(3x^2 + 9)$

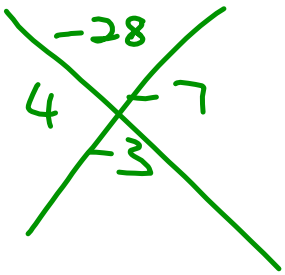
3. **Which of these shows the complete factorization of $6x^2y^2 - 9xy - 42$?**

$3(2x^2y^2 - 3xy - 14)$

   A. $3(2xy^2 - 7)(xy^2 + 2)$
   B. $(3xy + 6)(2xy - 7)$
   C. $3(2xy - 7)(xy + 2)$
   D. $(3xy^2 + 6)(2xy^2 - 7)$

$a = 2 \quad b = -3 \quad c = -14$

$ac = -28$



	$2xy$	-7
xy	$2x^2y^2$	$-7xy$
2	$4xy$	-14

$= 3(2xy - 7)(xy + 2)$

B) Unit 3: Write Expressions in Equivalent Forms to Solve Problems

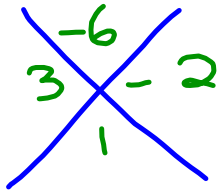
1. What are the zeros of the function represented by the quadratic expression $2x^2 + x - 3$?

A. $x = -\frac{3}{2}$ and $x = 1$

B. $x = -\frac{2}{3}$ and $x = 1$

C. $x = -1$ and $x = \frac{2}{3}$

D. $x = -1$ and $x = -\frac{3}{2}$



$a=2\ b=1\ c=-3$

$ac=-6$

	x	-1
$2x$	$2x^2$	$-2x$
3	$3x$	-3

$x-1=0$, $x=1$

$2x+3=0$, $x=-\frac{3}{2}$

$(x-1)(2x+3)=0$

2. What is the vertex of the graph of $f(x) = x^2 + 10x - 9$?

A. (5, 66)

B. (5, –9)

C. (–5, –9)

D. (–5, –34)

$a=1\ b=10$

$x=\frac{-b}{2a}=\frac{-10}{2(1)}=-5$

$f(-5)=(-5)^2+10(-5)-9$

$25-50-9$

3. Which of these is the result of completing the square for the expression $x^2 + 8x - 30$?

A. $(x + 4)^2 - 30$

B. $(x + 4)^2 - 46$

C. $(x + 8)^2 - 30$

D. $(x + 8)^2 - 94$

$x^2+8x-30=0$

$+30\quad +30$

$x^2+8x=30$

$\frac{8}{2}=(4)^2=16$

$x^2+8x+16=30+16$

$(x+4)^2=46$

$(x+4)^2-46$

4. The expression $-x^2 + 70x - 600$ represents a company's profit for selling x items. For which number(s) of items sold is the company's profit equal to \$0?

   A. 0 items
   B. 35 items
   C. 10 items and 60 items
   D. 20 items and 30 items

$-x^2+70x-600=0$

C) *Unit 3: Create Equations That Describe Numbers or Relationships*

1. A garden measuring 8 feet by 12 feet will have a walkway around it. The walkway has a uniform width, and the area covered by the garden and the walkway is 192 square feet. What is the width of the walkway?

   A. 2 feet
   B. 3.5 feet
   C. 4 feet
   D. 6 feet

2. The formula for the area of a circle is $A = \pi r^2$. Which equation shows the formula in terms of r?

   A. $r = \frac{2A}{\pi}$
   B. $r = \frac{\sqrt{A}}{\pi}$
   C. $r = \sqrt{\frac{A}{\pi}}$
   D. $r = \frac{A}{2\pi}$

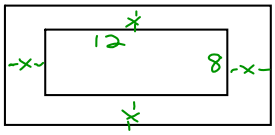
(14) $(-x^2+70x-600=0)-1$

$x^2-70x+600=0$

600 → −60, −10; −60 + −10 = −70

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

(1)



$L=12+2x \quad w=8+2x$

$(2x+12)(2x+8)$

	2x	+12
2x	$4x^2$	24x
+8	16x	96

$4x^2+40x+96=192$

$-192 \quad -192$

$4x^2+40x-96=0$

$4(x^2+10x-24)=0$

−24 → 12, −2; 12 + −2 = 10

−24	
−2	12
2	−12
3	−8
−3	8
4	−6
−4	6

$4(x+12)(x-2)=0$

$x+12=0$ or $x-2=0$

$-12 \quad -12 \qquad +2 \quad +2$

$x=-12$ X or $x=2$ ✓

(2) $A=\pi r^2$

$\frac{A}{\pi}=\frac{\pi r^2}{\pi}$

$\sqrt{\frac{A}{\pi}}=\sqrt{r^2}$

$\sqrt{\frac{A}{\pi}}=r$

D) Unit 3: Solve Equations and Inequalities in One Variable

1. What are the solutions to the equation $2x^2 - 2x - 12 = 0$?

   A. $x = -4, x = 3$
   B. $x = -3, x = 4$
   C. $x = -2, x = 3$
   D. $x = -6, x = 2$

$2(x^2 - x - 6) = 0$

-6, 2, -3, -1

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

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

2. What are the solutions to the equation $6x^2 - x - 40 = 0$?

   A. $x = -\frac{8}{3}, x = -\frac{5}{2}$
   B. $x = -\frac{8}{3}, x = \frac{5}{2}$
   C. $x = \frac{5}{2}, x = \frac{8}{3}$
   D. $x = -\frac{5}{2}, x = \frac{8}{3}$

$a = 6 \quad b = -1 \quad c = -40$

$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(6)(-40)}}{2(6)}$

$x = \frac{1 \pm 31}{12} = x = \frac{1+31}{12}$ or $\frac{1-31}{12}$

$= x = \frac{8}{3}$ or $-\frac{5}{2}$

3. What are the solutions to the equation $x^2 - 5x = 14$?

   A. $x = -7, x = -2$
   B. $x = -14, x = -1$
   C. $x = -2, x = 7$
   D. $x = -1, x = 14$

$-14 \quad -14$

$x^2 - 5x - 14 = 0$

-14, 2, -7, -5

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

$x = -2 \quad x = 7$

$a=-4.9$ $b=5$ $c=9$

4. **An object is thrown in the air with an initial velocity of 5 m/s from a height of 9 m. The equation $h(t) = -4.9t^2 + 5t + 9$ models the height of the object in meters after t seconds.**

   About how many seconds does it take for the object to hit the ground? Round your answer to the nearest tenth of a second.

   Use Quadratic Formula

   $t = \frac{-5 \pm \sqrt{5^2 - 4(-4.9)(9)}}{2(-4.9)}$

   $t = \frac{-5 \pm 14.2}{-9.8} = -0.94$ or $1.96 \simeq 2$ seconds

   A. 0.940 second
   B. 1.50 seconds
   C. 2.00 seconds
   D. 9.00 seconds

E) *Unit 3: Build a Function That Models a Relationship between Two Quantities*

1. **Which statement BEST describes the graph of $f(x + 6)$?**
   A. The graph of $f(x)$ is shifted up 6 units.
   B. The graph of $f(x)$ is shifted left 6 units.
   C. The graph of $f(x)$ is shifted right 6 units.
   D. The graph of $f(x)$ is shifted down 6 units.

2. **Which of these is an even function?**
   A. $f(x) = 5x^2 - x$
   B. $f(x) = 3x^3 + x$
   C. $f(x) = 6x^2 - 8$
   D. $f(x) = 4x^3 + 2x^2$

3. **Which statement BEST describes how the graph of $g(x) = -3x^2$ compares to the graph of $f(x) = x^2$?**
   A. The graph of $g(x)$ is a vertical stretch of $f(x)$ by a factor of 3.
   B. The graph of $g(x)$ is a reflection of $f(x)$ across the x-axis.
   C. The graph of $g(x)$ is a vertical shrink of $f(x)$ by a factor of $\frac{1}{3}$ and a reflection across the x-axis.
   D. The graph of $g(x)$ is a vertical stretch of $f(x)$ by a factor of 3 and a reflection across the x-axis.

F) Unit 3: Interpret Functions That Arise in Applications in Terms of the Context

1. A flying disk is thrown into the air from a height of 25 feet at time $t = 0$. The function that models this situation is $h(t) = -16t^2 + 75t + 25$, where t is measured in seconds and h is the height in feet. What values of t best describe the times when the disk is flying in the air?

$a=-16\ b=75\ c=25$

$t=\frac{-75\pm\sqrt{75^2-4(-16)(25)}}{2(-16)}=\frac{-75\pm 85}{-32}$

$=-0.3125$ or 5

A. $0 < t < 5$
B. $0 < t < 25$
C. all real numbers
D. all positive integers

2. Use this table to answer the question.

$AROC=\frac{y_2-y_1}{x_2-x_1}$

x	$f(x)$	
−2	15	y_1
−1	9	
0	5	y_2
1	3	
2	3	

x_1 x_2

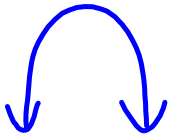
$=\frac{5-15}{0-(-2)}$

$=\frac{-10}{2}=-5$

What is the average rate of change of x over the interval $-2 \leq x \leq 0$?

A. −10
B. −5
C. 5
D. 10

3. What is the end behavior of the graph of $f(x) = -0.25x^2 - 2x + 1$?



A. As x increases, $f(x)$ increases.
As x decreases, $f(x)$ decreases.

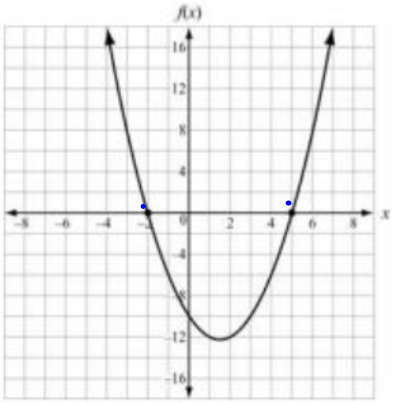
B. As x increases, $f(x)$ decreases.
As x decreases, $f(x)$ decreases.

C. As x increases, $f(x)$ increases.
As x decreases, $f(x)$ increases.

D. As x increases, $f(x)$ decreases.
As x decreases, $f(x)$ increases.

G) Unit 3: Analyze Functions Using Different Representations

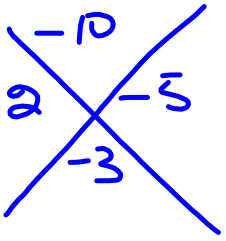
1. Use this graph to answer the question.



roots are $x = -2, 5$

Which function is shown in the graph?

A. $f(x) = x^2 - 3x - 10$
B. $f(x) = x^2 + 3x - 10$
C. $f(x) = x^2 + x - 12$
D. $f(x) = x^2 - 5x - 8$



$(x+2)(x-5)=0$

$x=2$ $x=5$

2. **The function $f(t) = -16t^2 + 64t + 5$ models the height of a ball that was hit into the air, where t is measured in seconds and h is the height in feet.**

This table represents the height, $g(t)$, of a second ball that was thrown into the air.

Time, t (in seconds)	Height, $g(t)$ (in feet)
0	4
1	36
2	36
3	4

Which statement BEST compares the length of time each ball is in the air?

A. The ball represented by $f(t)$ is in the air for about 5 seconds, and the ball represented by $g(t)$ is in the air for about 3 seconds.

B. The ball represented by $f(t)$ is in the air for about 3 seconds, and the ball represented by $g(t)$ is in the air for about 5 seconds.

C. The ball represented by $f(t)$ is in the air for about 3 seconds, and the ball represented by $g(t)$ is in the air for about 4 seconds.

D. The ball represented by $f(t)$ is in the air for about 4 seconds, and the ball represented by $g(t)$ is in the air for about 3 seconds.

UNIT 4: MODELING AND ANALYZING EXPONENTIAL FUNCTIONS

A) *Unit 4: Create Equations That Describe Numbers or Relationships*

1. A certain population of bacteria has an average growth rate of 2%. The formula for the growth of the bacteria's population is $A = P_0 \cdot 1.02^t$, where P_0 is the original population and t is the time in hours.

   If you begin with 200 bacteria, about how many bacteria will there be after 100 hours?

   .02 + 1

   $A = 200(1.02)^{100}$

   A. 7
   B. 272
   C. 1,449
   D. 20,000

B) *Unit 4: Build a Function That Models a Relationship Between Two Quantities*

1. Which function represents this sequence?

   $a_n = a_1 \cdot (r)^{n-1}$

n	1	2	3	4	5	...
a_n	6	18	54	162	486	...

   $a_n = a_1 \cdot r^{n-1}$

   $a_1 = 6 \quad r = \frac{18}{6} = 3$

   A. $f(n) = 3^{n-1}$
   B. $f(n) = 6^{n-1}$
   C. $f(n) = 3(6^{n-1})$
   D. $f(n) = 6(3^{n-1})$

   a_n or $f(n) = 6 \cdot 3^{n-1}$

2. The points (0, 1), (1, 5), (2, 25), and (3, 125) are on the graph of a function. Which equation represents that function?

1, 5, 25, 125 $r = 5$ $1 \cdot 5^x$

A. $f(x) = 2^x$
B. $f(x) = 3^x$
C. $f(x) = 4^x$
D. $f(x) = 5^x$

C) *Unit 4: Build New Functions from Existing Functions*

1. Which function shows the function $f(x) = 3^x$ being translated 5 units to the left?

A. $f(x) = 3^x - 5$
B. $f(x) = 3^{(x+5)}$
C. $f(x) = 3^{(x-5)}$
D. $f(x) = 3^x + 5$

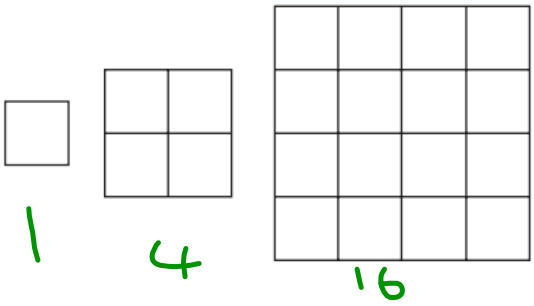
2. Which function shows the function $f(x) = 3^x$ being translated 5 units down?

A. $f(x) = 3^x - 5$
B. $f(x) = 3^{(x+5)}$
C. $f(x) = 3^{(x-5)}$
D. $f(x) = 3^x + 5$

D) *Unit 4: Understand the Concept of a Function and Use Function Notation*

$y = a \cdot b^x$

1. **Consider this pattern.**



Which function represents the sequence that represents the pattern?

$r = 4$

A. $a_n = (4)^{(n-1)}$
B. $a_n = (4)^{(a_n - 1)}$
C. $a_n = (a_n)(4)^{(n-1)}$
D. $a_n = (a_n)^4$

2. **Which function is modeled in this table?**

x	f(x)
1	1000
2	800
3	640
4	512

A. $f(x) = 1{,}000(0.80)^x$
B. $f(x) = 1{,}000(0.20)^x$
C. $f(x) = 1{,}000(0.80)^{x-1}$
D. $f(x) = 1{,}000(0.20)^{x-1}$

$r = \frac{800}{1000} = .80$

3. **Which explicit formula describes the pattern in this table?**

d	C
0	1
1	6
2	36
3	216

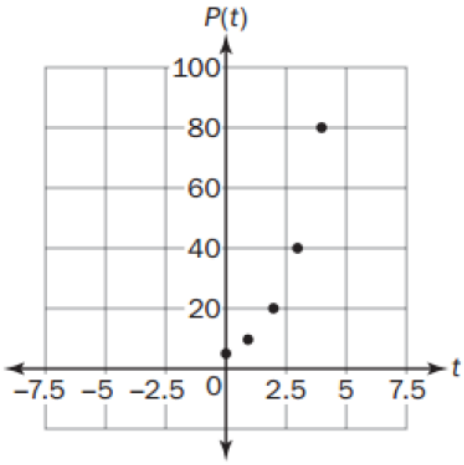
A. $C = 6d$
B. $C = d + 6$
C. $C = 6^d$
D. $C = d^6$

4. **If $f(12) = 100(0.50)^{12}$, which expression gives $f(x)$?**

A. $f(x) = 0.50^x$
B. $f(x) = 100^x$
C. $f(x) = 100(x)^{12}$
D. $f(x) = 100(0.50)^x$

E) *Unit 4: Interpret Functions That Arise in Applications in Terms of the Context*

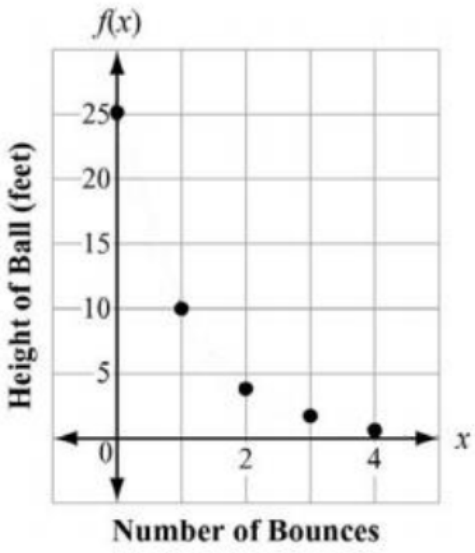
1. **A population of squirrels doubles every year. Initially, there were 5 squirrels. A biologist studying the squirrels created a function to model their population growth: $P(t) = 5(2^t)$, where t is the time in years. The graph of the function is shown.**



What is the range of the function?

A. any real number
B. any whole number greater than 0
C. any whole number greater than 5
D. any whole number greater than or equal to 5

2. The function graphed on this coordinate grid shows $f(x)$, the height of a dropped ball in feet after its xth bounce.



On which bounce was the height of the ball 10 feet?

A. bounce 1
B. bounce 2
C. bounce 3
D. bounce 4