

# Mathematics I Resources for EOC Remediation

## F.IF – Interpreting Functions:

HSF-IF.B.5

HSF-IF.B.6

HSF-IF.C.7

HSF-IF.C.8

The information in this document is intended to demonstrate the depth and rigor of the Nevada Academic Content Standards. The items are **not** to be interpreted as indicative of items on the EOC exam. These are a collection of standard-based items for students and **only** include those standards selected for the Math I EOC examination.

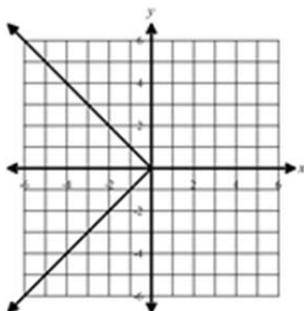
## IF Interpreting Functions Cluster

**HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function  $h(n)$  gives the number of person-hours it takes to assemble  $n$  engines in a factory, then the positive integers would be an appropriate domain for the function.*\*

1. Draw a graph that has the same domain as each of the given relations and a graph that has a different domain than each of the given relations.

**Part A:**  $y = 2 \cdot 3^x$

**Part B:**



**Answer: Part A:** Answers will vary. Same: Any graph with domain of all real numbers; i.e. parabolas, absolute value, lines, etc. Different: discrete graph, square root, etc.  
**Part B:** Answers will vary. Same: Any graph with a domain of less than or equal to 0. Different: varies

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2. The altitude at which we boil an egg affects how long it takes for the egg to achieve perfect hardness. It takes 201 seconds to boil a perfect egg at Death Valley (California), which has an altitude of 86 meters below sea level. The highest place possible is the summit of Mount Everest which has an altitude of 8848 meters. It takes 209 seconds to boil a perfect egg.

What is the appropriate domain for this situation?

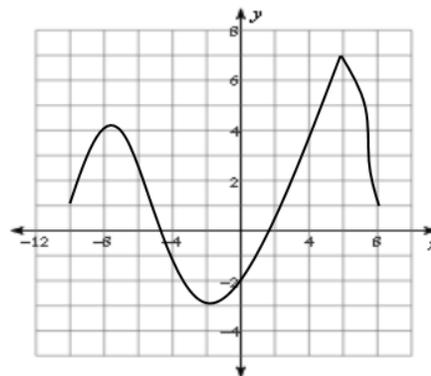
**Answer:**  $-86 \leq x \leq 8848$

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## IF Interpreting Functions Cluster

3. Identify the domain for the function. Choose **ALL** that apply.

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| A) $\{x \mid -10 \leq x \leq 8\}$ | F) $\{y \mid -3 \leq y \leq 7\}$ |
| B) All real numbers               | G) $-10 \leq x \leq 8$           |
| C) $[-10, 8]$                     | H) All real numbers              |
| D) $-3 \leq y \leq 7$             | I) $y \geq -3$                   |
| E) $x \geq -10$                   | J) $[-3, 7]$                     |



**Answer:** A, C and G

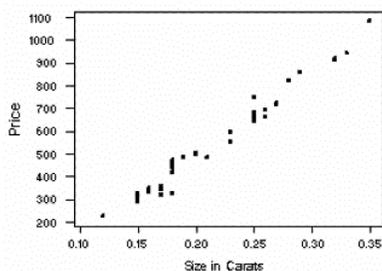
4. Use the following equations and graphs below (A – E) to answer questions I – V.

A.  $y = 5x + 2$

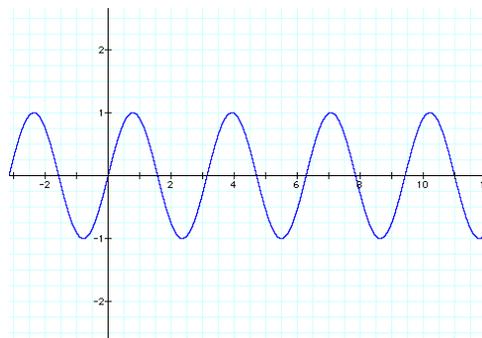
B.  $y = -3x^2$

C.  $y = |x + 7| - 2$

D.



E.



- I. List all relations that have a domain of all real numbers.
- II. List all relations which have a range of all real numbers.
- III. List all relations that are functions.
- IV. List all functions that have no real solutions.
- V. List all functions that have a vertex at  $(-7, -2)$

**Answer:**

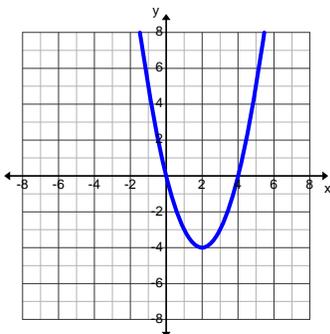
- I. A, B, C and E
- II. A
- III. A, B, C and E
- IV. None
- V. C

## IF Interpreting Functions Cluster

5. Graph the function  $y = (x - 2)^2 - 4$ .
- State the domain over which the function is increasing.
  - State the range of the function.

**Answer:**

- See graph,  $x > 2$
- $y \geq -4$



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6. Graph the Asher is building dog houses to raise money for Christmas presents. It takes him 6 hours to assemble 4 houses. Asher charges \$22 per hour to build a dog house. Write a function to describe the amount of money,  $m$ , Asher will make if he builds  $d$  houses. What is a reasonable domain for the function if Asher can only build houses after school and on the weekends?

**Answer:**  $m = 33d$ , Domain: Positive integers

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7. Avery is standing on the 6<sup>th</sup> step of a vertical ladder. The ladder has 20 steps and the height difference between consecutive steps is 0.7m, with the first step being 0.8m from the ground. He can move up, down, or stay where he is. What is the domain of this function?

**Answer:** The domain is the integer values in the interval:  $-6 \leq x \leq 14$

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## IF Interpreting Functions Cluster

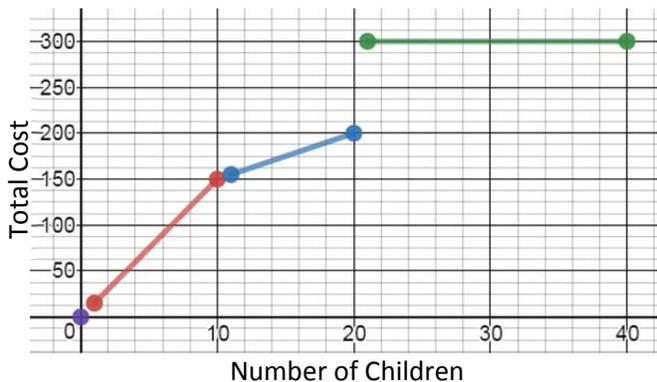
8. Amy was planning a roller skating party for her 9-year old son. The pricing is as follows:

2 hour Roller Skating Children's Party (includes skate rentals, balloons, glow necklaces, two slices of pizza per kid, and unlimited soda and juice): For 1-10 children, it costs \$15/kid. Additional kids above 10 and up to 20 are \$5 each. More than 20 to 40 children requires renting the entire rink at a flat rate of \$300.

- Graph the relation of number of kids attending to total cost
- Is this a function? Explain.
- What is the independent variable?
- What is the dependent variable?
- What is the domain of this function?
- What is the range?
- What is the total cost for 9 kids?
- What is the total cost for 30 kids?
- What is the total cost for 16 kids?

**Answer:**

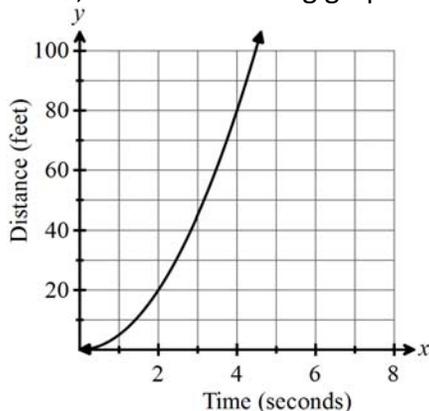
- See graph.
- Yes, it is a function. There is exactly one  $y$  value for each  $x$  value.
- The number of children,  $x$ , is the independent variable.
- The total cost of the skating party,  $y$ , is the dependent variable.
- The domain is the positive integers from 0 to 40
- The range is  $\{0, 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 300\}$
- \$135.00
- \$300.00
- \$180.00



## IF Interpreting Functions Cluster

**HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\*

1. An egg is dropped from the top of a tall building. The distance it has fallen after  $t$  seconds is recorded, and the following graph of distance versus time obtained.



Calculate the average rate of change between  $t = 2$  seconds and  $t = 4$  seconds.

**Answer:** 30 ft/sec

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2. Find the average rate of change of  $f(x) = 2x - 1$  from  $x = -1$  to  $x = 2$ .

**Answer:** 2

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3. Summa Corporation stock was purchased in 1988 at \$100/share. It increased 12% the first year, decreased 42% the second year, and then increased again 36% the third year.

**Part 1:** What was the price of Summa Corporation stock at the end of the third year?

**Part 2:** Calculate the average percent gain or loss per year over the first three years.

**Answer:** **Part 1:** Year 1 (12% increase):  $100(1+.12) = 112$

Year 2 (42% decrease):  $112(1-.42) = 64.96$

Year 3 (36% increase):  $64.96(1+.36) = 88.3456$

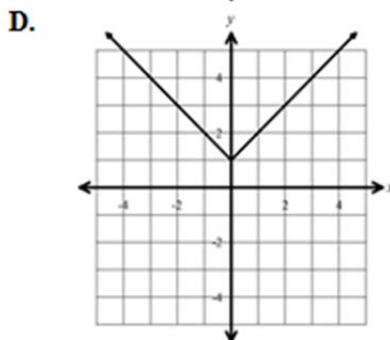
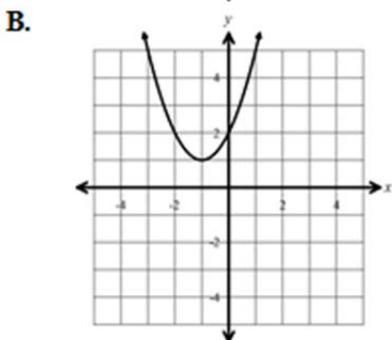
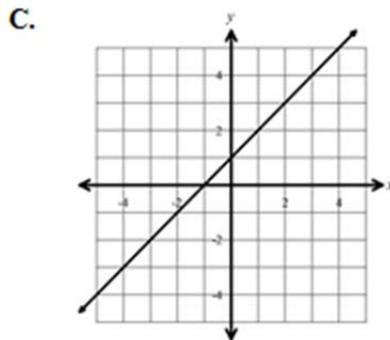
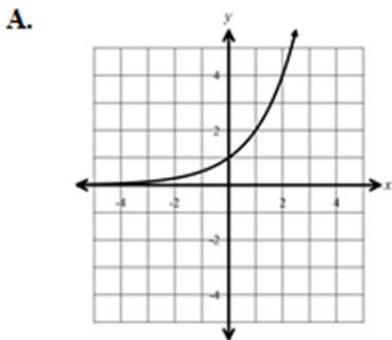
The price of Summa Corporation stock at the end of the third year is \$88.35

**Part 2:**  $\frac{88.35-100}{3} \approx -3.88$ . The average % loss over the first three years was 3.88.

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**IF Interpreting Functions Cluster**

4. Which has the greatest average rate of change over the interval  $x = -1$  to  $x = 1$ ?



**Answer: B**

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5. The height (in feet) of one of the model rockets launched by the Rocketry Club can be determined using the equation  $f(t) = -16t^2 + 200t$ , where  $t$  is the number of seconds after the rocket is launched.

**Part 1:** What is the average rate of change from one second to four seconds?

**Part 2:** Choose another interval and find the average rate of change. Is the average rate of change for your interval the same? If yes, will it always be the same? If no, will it ever be the same?

**Answer: Part 1:** 120 feet per second , **Part 2:** Since the function is not linear the average rate of change over different intervals will not be the same.

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## IF Interpreting Functions Cluster

6. The table shows the distance a group of bikers traveled from the starting line.

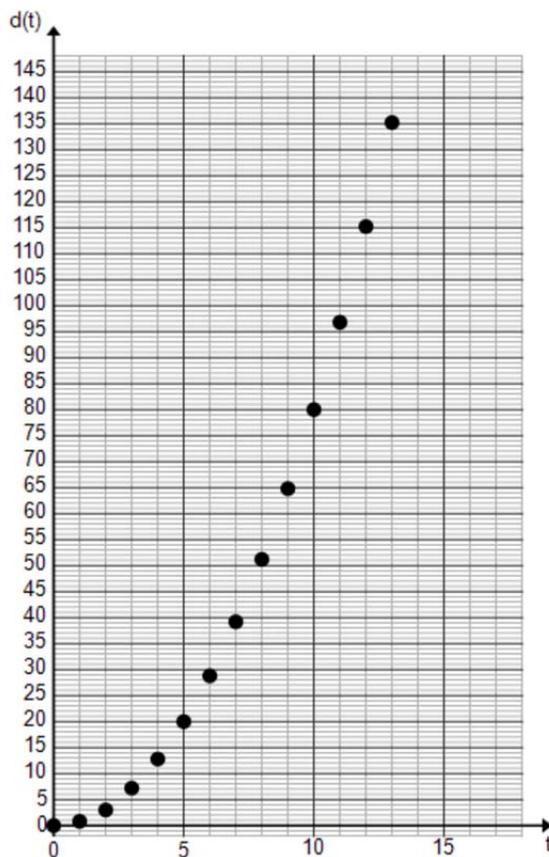
Time (hr)	0.5	1	2	3
Distance (km)	3	5	8	14

In which interval is the average rate of change the greatest?

**Answer:** 2 to 3 hours

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7. Neil Armstrong drops a moon rock off the edge of a cliff on the Moon. The distance,  $d(t)$ , in meters, the rock travels after  $t$  seconds can be modeled by the function  $d(t) = 0.8t^2$ . What is the average speed, in meters per second, of the rock between 7 and 15 seconds after it was dropped?



**Answer:** The average speed is 17.6 meters per second.

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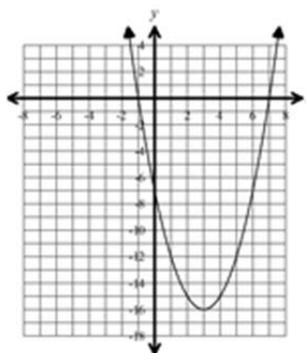
## IF Interpreting Functions Cluster

HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*

HSF-IF.C.7.a Graph linear and quadratic functions and show intercepts, maxima, and minima.

1. Graph the function:  $h(x) = x^2 - 6x - 7$ . From the graph, identify the vertex, axis of symmetry, minimum/maximum, y-intercept, and x-intercepts.

**Answer:** Vertex:  $(3, -16)$ , Axis of Symmetry:  $x = 3$ , Minimum:  $y = -16$ , y-intercept:  $(0, -7)$ , x-intercepts:  $(-1, 0)$ ,  $(7, 0)$



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2. Sketch the graph of  $y = x^2 + 3$  and  $y = |x| + 3$  on the same axis. Compare the key features of the functions and describe two ways in which they are alike and two ways in which they differ.

**Answer:** Answers will vary. Possible answers for alike: both open upwards, vertical stretch factor of 1, same y-intercept, no x-intercepts, both vertically translated up 3 units, same domain and range, same vertices. Possible answers for different: different parent functions (absolute value vs. quadratic, different rates of change, different shapes).

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## IF Interpreting Functions Cluster

3. Use the function,  $f(x) = -2x^2 + 4x + 6$  to respond to the following questions in Parts A - F:

**Part A:** Using only the given function, identify the parent function and describe the shape and find the  $y$ -intercept.

**Part B:** Use two different methods to find the vertex of the function.

**Part C:** What key feature of the graph does the  $x$ -coordinate of the vertex represent?

**Part D:** What key feature of the graph does the  $y$ -coordinate of the vertex represent?

**Part E:** Use two different methods to solve the equation  $-2x^2 + 4x + 6 = 0$ .

**Part F:** What does your answer from Part E represent on the graph of the function?

**Part G:** Compare the function the function  $g(x) = x^2 - 2x - 3$  to the function  $f(x) = -2x^2 + 4x + 6$  from the above. Decide whether the following key features of each graph are the same or different. Provide justifications for any differences.

Key Features: vertex,  $x$ -intercepts,  $y$ -intercept, domain, range, axis of symmetry, minimum/maximum, vertical stretch/compression factor

### Answer:

**Part A:** parent function:  $f(x) = x^2$ , shape: parabola, opens down, vertical stretch factor of 2,  $y$ -intercept:  $(0, 6)$

**Part B:** Use  $x = \frac{-b}{2a}$  or complete the square to find vertex form or put in intercept form and find the axis of symmetry

**Part C:** Axis of symmetry, **Part D:** Maximum point

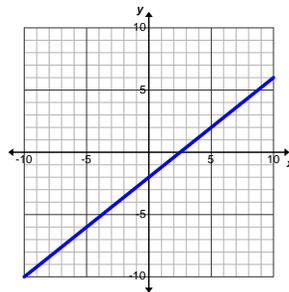
**Part E:** Factor or Quadratic formula or square roots from vertex form  $x = -1, 3$

**Part F:**  $x$ -intercepts

**Part G:** The  $x$ -intercepts, domain and axis of symmetry are the same. The  $y$ -intercepts differ  $(0, -3)$  vs.  $(0, 6)$ , the vertices differ  $(1, -4)$  vs.  $(1, 8)$ ,  $g(x)$  has a min at  $y = -4$  and  $f(x)$  has a max at  $y = 8$ , the ranges differ:  $g(x): y \geq -4$ ,  $f(x): y \leq 8$ , and  $g(x)$  has a vertical stretch factor of 1 whereas  $f(x)$  has a vertical stretch by a factor of 2.

4. For the following function, determine the intercepts, then graph the function and identify the slope.  $4x - 5y = 10$

**Answer:**  $x$ -intercept  $\left(\frac{5}{2}, 0\right)$ ,  $y$ -intercept  $(0, -2)$ , slope:  $-\frac{4}{5}$



## ***IF Interpreting Functions Cluster***

5. These three equations all describe different aspects of linear equations. Use these equations to answer the following:

1.  $5x + 2y = 8$

2.  $6x + 3y = -18$

3.  $y = \frac{1}{4}x - 1$

**Part 1:** Which equation has a y-intercept of (0,4)?

**Part 2:** Which equation has an x-intercept of (4,0)?

**Part 3:** Which equation has a slope of -2 and y-intercept of -6?

**Answer: Part 1:** (1.) has a y-intercept of (0,4)

**Part 2:** (3.) has an x-intercept of (4,0)

**Part 3:** (2.) has a slope of -2 and a y-intercept of -6

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6. Let  $f(x) = x^2 + 2$  and  $g(x) = 2x + 2, x \geq 2$ . Compare the functions and determine which of the two following statements is correct. Select all that apply.

A. The y-intercept of  $f(x)$  is greater than the y-intercept of  $g(x)$ .

B. The x-intercept of  $g(x)$  is greater than the x-intercept of  $f(x)$ .

C. The functions have the same y-intercept.

D. There are two intersecting points.

E. The graphs of  $f(x)$  and  $g(x)$  lie solely in Quadrants I and II.

F. The rate at which  $g(x)$  increases twice as fast as the rate of  $f(x)$  increases.

G. The functions have the same range.

**Answer:** C, D, E and G

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## IF Interpreting Functions Cluster

7. **Part 1:** Graph  $y = -4(x + 2)^2$  and  $y = -3|x + 2|$  on the same coordinate plane.

**Part 2:** Compare the key features of the functions and describe two ways they are alike and two ways they differ.

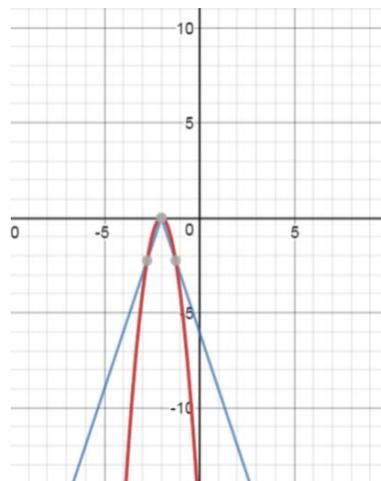
**Answer:** **Part 1:** See the graph.

**Part 2:**

Alike: Same vertex and both open downwards.

They both have the same  $x$ -intercept of  $(-2, 0)$ .

Differ: One is a parabola and one is a “V” shape, and one is a quadratic function and the other is an absolute value function. The absolute value function has a  $y$ -intercept of  $-6$  and the quadratic function has a  $y$ -intercept at  $-16$ .



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8. Let  $f(x) = (2)6^x$  and  $g(x) = (2)3^x$ . Compare the functions and determine which of the following statement(s) are correct. Select **ALL** that apply.

- A. The  $x$ -intercept of  $g(x)$  is greater than  $f(x)$ .
- B. The functions have the same  $x$ -intercepts.
- C. The  $f(x)$  function increases at a faster rate than  $g(x)$ .
- D. The functions have the same  $y$ -intercept.
- E. The functions have a point in common.

**Answer:** B, C and E

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## ***IF Interpreting Functions Cluster***

9. Let  $f(x) = 5x + 1$  and  $g(x) = \frac{1}{4}x + 1$ . Compare the functions and determine which of the following statements is correct. Select **ALL** that apply.
- A. The  $x$ -intercept of  $f(x)$  is greater than the  $x$ -intercept of  $g(x)$ .
  - B. The  $x$ -intercept of  $g(x)$  is greater than the  $x$ -intercept of  $f(x)$ .
  - C. The functions have the same  $x$ -intercept.
  - D. The  $y$ -intercept of  $f(x)$  is greater than the  $y$ -intercept of  $g(x)$ .
  - E. The  $y$ -intercept of  $g(x)$  is greater than the  $y$ -intercept of  $f(x)$ .
  - F. The functions have the same  $y$ -intercept.
  - G.  $f(x)$  has a greater rate of change than  $g(x)$ .
  - H.  $g(x)$  has a greater rate of change than  $f(x)$ .
  - I. The functions have the same rate of change.

**Answer:** A, F and G

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10. Consider the following linear equations. Match the equation with the characteristics of the function being described.
- 1.  $5x + 2y = 8$
  - 2.  $9x + 6y = 3$
  - 3.  $3x + 4y = 15$

**Part 1:** What equation has an  $x$ -intercept of  $(5,0)$ ?

**Part 2:** Which equation has a slope of  $-\frac{3}{2}$  and a  $y$ -intercept of 1?

**Part 3:** Which equation has a  $y$ -intercept of  $(0,4)$ ?

**Answer:** Part 1: (3.), Part 2: (2.), Part 3: (1.)

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## IF Interpreting Functions Cluster

**HSF-IF.C.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

**HSF-IF.C.8.a** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

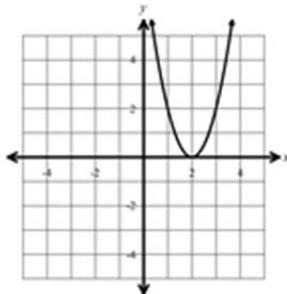
**HSF-IF.C.8.b** Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as  $y = (1.02)^t$ ,  $y = (0.97)^t$ ,  $y = (1.01)12^t$ ,  $y = (1.2)^t/10$ , and classify them as representing exponential growth or decay.

1. Find the vertex for each of the following:

**Part 1:**  $y = 5(x - 2)^2 + 3$

**Part 2:**  $y = (x + 3)(x - 6)$

**Part 3:**



**Part 4:**  $y = 2x^2 - 3x + 4$

**Answer: Part 1:** (2, 3), **Part 2:** (1.5, -20.25), **Part 3:** (2, 0), **Part 4:** (0.75, 2.875)

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2. Determine which of the following equations represent exponential growth or decay.

Equation 1:  $y = 1.5^{-x}$

Equation 2:  $y = 0.8^x$

Equation 3:  $y = 0.5^{-x}$

Equation 4:  $y = 2.7^x$

**Answer:** Equation 1 and 2 are decay, Equation 3 and 4 are growth

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### ***IF Interpreting Functions Cluster***

3. Find the vertex of each of the following equations, using a different method for each equation. Then, write each equation in vertex form.

**Part 1:**  $y = x^2 + 2x - 3$

**Part 2:**  $y = 3x^2 + 4x + 5$

**Answer:** Work may vary for finding the vertex. **Part 1:** Vertex  $(-1, -4)$ ,  $y = (x + 1)^2 - 4$ ,

**Part 2:** Vertex  $(-\frac{2}{3}, \frac{11}{3})$ ,  $y = (x + \frac{2}{3})^2 + \frac{11}{3}$

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4. What is the  $y$ -intercept of the graph of  $y = 2(x - 1)^2 + 3$ ? Show your work.

**Answer:** The  $y$ -intercept is  $(0, 5)$ .

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5. In 2014, Country A and Country B both have a population of approximately 3.5 million people. The growth rate of Country A is modeled by the function,  $A(x) = 3,500,000(2.04)^{t/5}$ . The growth rate of Country B is modeled by the function,  $B(x) = 3,500,000(2.0075)^{t/3}$ . Which country has the highest population after 2 years and by approximately how much?

**Answer:**  $A(2) = 3,500,000(2.04)^{\frac{2}{5}} = 4655004.6$ ,  $B(2) = 3,500,000(2.0075)^{\frac{2}{3}} = 5569784.8$

$B(x) - A(x) = 5569784 - 4655004 = 914780$ , therefore, Country B has the highest population with about 914,780 more people than Country A.

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## ***IF Interpreting Functions Cluster***

6. Show your work to find the  $x$ -intercepts for the function  $f(x) = (x + 2)^2 - 16$ .

**Answer:** Work may vary, students may convert to intercept-form, graph the function, or solve  $0 = (x + 2)^2 - 16$ . The  $x$ -intercepts are  $(-6, 0)$  and  $(2, 0)$ .

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7. When a volleyball player serves the ball, it travels in a parabolic arc over the net. The other team dives but misses the ball and it hits the ground. Let  $x$  be the horizontal distance, in feet, from the server to where the ball first touches the ground. Let  $y$  be the corresponding height, in feet, of the arc of the ball. The quadratic function that models this situation is:

$$y = -0.016x^2 + 0.5x + 4.5.$$

**Part 1:** What does 4.5 represent in the context of this problem?

**Part 2:** What is the maximum height the ball can reach?

**Part 3:** What is the horizontal distance from the server to where the ball first touches the ground.

**Part 4:** Will the ball clear the 6-foot high net located 28 feet from the server? Explain your reasoning.

**Answer: Part 1:** 4.5 is the  $y$ -intercept and represents the initial height the ball started at.

**Part 2:** Max height = 8.406 feet,

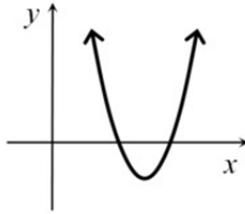
**Part 3:** Horizontal distance = 38.546 feet,

**Part 4:** No, when  $x = 28$  feet, the height will be 5.956 feet, which is slightly below the net height.

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## IF Interpreting Functions Cluster

8. Which of the following could be the function of a real variable,  $x$ , whose graph is shown below? Explain.



- A.  $f(x) = (x+12)^2 + 4$
- B.  $f(x) = -(x-2)^2 - 1$
- C.  $f(x) = (x+18)^2 - 40$
- D.  $f(x) = (x-12)^2 - 9$
- E.  $f(x) = -4(x+2)(x+3)$
- F.  $f(x) = (x+4)(x-6)$
- G.  $f(x) = (x-12)(-x+18)$
- H.  $f(x) = (24-x)(40-x)$

**Answer:** Only D and H are possible as both functions have positive  $x$ -intercepts, a vertex in the fourth quadrant and open up, having a minimum value.

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