Functions

8.F.A and 8.F.B Conceptual Understanding & Application Mini-Assessment
by Student Achievement Partners

OVERVIEW

This mini-assessment is designed to illustrate the clusters 8.F.A and 8.F.B, which set an expectation for understanding functions and using functions to model relationships between quantities. This mini-assessment is designed for teachers to use either in the classroom, for self-learning, or in professional development settings to:

- Evaluate students' understanding of 8.F.A and 8.F.B in order to prepare to teach this material or to check for student ability to demonstrate understanding and application of these concepts;
- Gain knowledge about assessing function application problems; and
- Illustrate CCSS-aligned assessment problems.

MAKING THE SHIFTS

This mini-assessment attends to focus as it addresses understanding of functions and using functions to model relationships between quantities, which is at the heart of the grade 8 standards and a key component of the major work of the grade.[1] It addresses coherence across grades as students formally work with functions and function notation in grade 8, but build from previous work on algebraic patterns, input/output rules, and ratios and proportional relationships, before ever learning the term "function." Function learning in grade 8 lays the foundation for a topic that is a widely applicable prerequisite for college and careers. The Functions domain in grade 8 and this mini-assessment target *conceptual understanding* and *application*, two of the three elements of rigor.

A CLOSER LOOK

At the heart of this mini-assessment is the concept of a function as a rule that assigns to each input exactly one output. Students spend extensive time in grade 8 developing this understanding using functions to model real-world situations. This mini-assessment requires students to show both a strong understanding of functions and the ability to apply function concepts in

> **8.F.A.**
> Define, evaluate, and compare functions.

context-free and context-rich questions. In grade 8, students synthesize learnings around patterns and ratios and proportional relationships to work with functions expressed as equations, tables, and graphs. Through this work, students see different contexts and representations of functions.

The distinction between function and equation is an important one as the two terms are often conflated by students and teachers. Equations answer a question: "For what values of the variable(s) is the equation true?" Functions, on the other hand, are neither true nor false. Confusion may arise when graphing: the graph of the solutions to an equation in two variables (an infinitude of (u, v) pairs that satisfy the equation) can often look the same as the graph of a function (or picture of how the output changes as the input changes).

> **8.F.B.**
> Use functions to model relationships between quantities.

Real-world examples are concrete ways for students to understand linear and non-linear functions. For example, the distance a car drives as a function of time is non-linear because cars do not move at the same speed continuously; they accelerate, decelerate, and have periods of no movement (e.g., at a red light). Asking students to graph this function will help them to better understand how to interpret the graph's features. This is not only important for linear functions in grade 8, but will be a critical skill in high school as well.

The situations in grade 8 should be more robust than those in previous grades, including more real-world data, using rational numbers, and students needing to construct their own functions and define their own variables.

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[1] For more on the Major Work of the grade, see achievethecore.org/emphases.

For a direct link, go to: http://www.achievethecore.org/page/1100/functions

Note that concepts like domain, range, and zeroes, as well as formal function notation, are all saved for high school.

This mini-assessment should follow work with radicals, the Pythagorean Theorem, and solving linear equations. It is designed to take one class period or less. Whether or not to use calculators on this mini-assessment is at the discretion of the teacher. Not allowing a calculator gives students the opportunity to practice work with rational numbers and ensure students sketch their own graphs. Allowing a calculator would minimize the computational demand and allow students to use technology strategically.
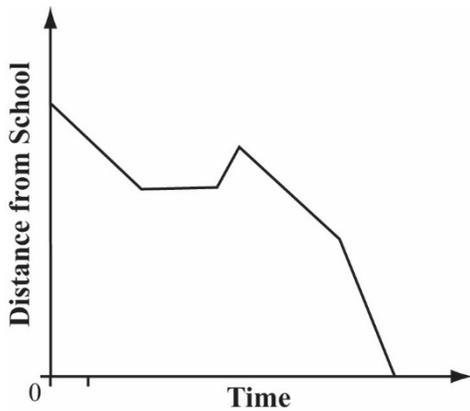
Name:_____Date:_____

1. For what value of a does the following function, F, equal 2.375?

$$F = 2.75a - 7.25$$

2. The graph below shows Jonas' commute to school this morning.

    Use the data to describe what is happening as carefully as you can. You do not need to measure anything accurately.

3. A machine makes granola bars from long strips of granola. The function below shows that *M* meters of granola makes *B* granola bars.

$$B = 25\left(\frac{M}{10} + \frac{3}{4}\right)$$

How many granola bars are made from 2.5 meters of granola?

4. Mrs. Garner is designing a soda factory that will run 24 hours a day using three shifts of employees. Each shift produces cans of sodas at different rates.

Shift	Amount Produced
8am – 4pm	Normal production rate
4pm – 12am	$\frac{1}{2}$ of normal production rate
12am – 8am	$\frac{1}{4}$ of normal production rate

She needs to determine what the normal production rate of the factory has to be so the factory produces 200,000 cans of soda each day.

Write how many cans of soda the factory will produce from 8am to 9am in order to produce 200,000 cans each day.

Show your work.

5. Maureen and Shannon decide to rent stand-up paddleboards while on vacation. Shop A rents paddleboards for $7.75 per hour. Shop B's prices are shown on the poster to the right.

Which shop offers a cheaper hourly rental rate? Justify your answer.

SURF SHOP
RENTAL RATES

Hours	Price
0.5	$3.80
4	$30.36
7	$53.13
8	$60.72

6. A graph includes (6, 3.5) and (1, –2.5).

    a. The *x*-coordinate is the input variable and the *y*-coordinate is the output variable. Write an equation that gives *y* in terms of *x*.

    b. Find another point on the graph with a negative *x*-coordinate.

1. **(8.F.A)** For what value of a does the following function, F, equal 2.375?
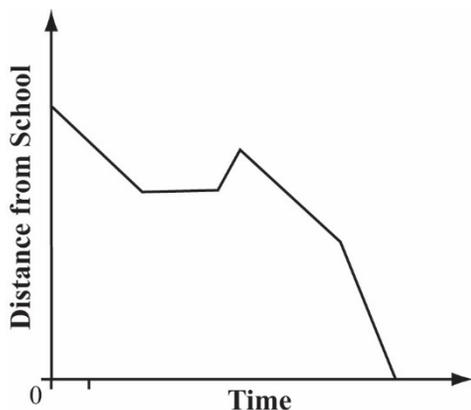
$$F = 2.75a - 7.25$$

Key: $a = 3.5$

Note: Formal function notation is not an expectation until high school, where a student may see this function as $f(x) = 2.75a - 7.25$.

2. **(8.F.B.5)** The graph below shows Jonas' commute to school this morning.

Use the data to describe what is happening as carefully as you can. You do not need to measure anything accurately.

Example description: Jonas began walking to school quickly at a constant rate. He stopped for a while before going backwards for a short time. Then, he headed back toward school at the same rate as when he first left. Jonas then finished his commute at a faster rate.

Rubric: Correct answers should include:
1. Noting that Jonas walked toward school first
2. Noting that Jonas has a period with no movement toward school and a period moving away from the school
3. Noting that the last leg of the commute to school is at the fastest rate

NOTE: The question asks for careful description to encourage precise language but students do not necessarily have to add contextual information (e.g., "Jonas stopped to pet a dog."), but they should include information about the varying rates during the commute.

3. **(8.F.A)** A machine makes cut granola bars from long strips of granola. The function below shows that *M* meters of granola makes *B* granola bars.

$$B = 25(\frac{M}{10} + \frac{3}{4})$$

How many granola bars are made from 2.5 meters of granola?

Key: $B = 25$ granola bars

> *Note: The variables M and B are defined for the student in the question stem. Students' ability to correctly answer questions like this relies on their ability to understand what these variables actually represent.*

4. **(8.F)** Mrs. Garner is designing a soda factory that will run 24 hours a day using three shifts of employees. Each shift produces cans of sodas at different rates.

Shift	Amount Produced
8am – 4pm	Normal production rate
4pm – 12am	$\frac{1}{2}$ of normal production rate
12am – 8am	$\frac{1}{4}$ of normal production rate

She needs to determine what the normal production rate of the factory has to be so the factory produces 200,000 cans of soda each day.

Write how many cans of soda the factory will produce from 8am to 9am in order to produce 200,000 cans each day.

Show your work.

> *Note: Defining variables is a key part of building functions. Both functions given as examples are correct based on differently defined variables.*

Key: approximately 14,286 cans of soda

Sample answer (where *a* is the number of cans produced in a normal 8-hour shift):

$$a + \frac{a}{2} + \frac{a}{4} = 200,000$$

So, that means $\frac{7}{4}a = 200,000$ and $a = 114,285.7$. So, in one hour they must produce $114,285.7 \div 8$ or about 14,286 cans of soda.

Sample answer (where *a* is the number of cans produced in 1 hour at the normal rate):

$$8a + \frac{8a}{2} + \frac{8a}{4} = 200,000, \text{ or } 14a = 200,000$$

So that means the number of cans produced from 8am to 9am is $200,000 \div 14$ or about 14,286 cans of soda.

5. **(8.F.A.2)** Maureen and Shannon decide to rent stand-up paddleboards (SUP) while on vacation. Shop A rents SUPs for $7.75 per hour. Shop B's prices are shown on the poster to the right.

   SURF SHOP RENTAL RATES

Hours	Price
0.5	$3.80
4	$30.36
7	$53.13
8	$60.72

   Which shop offers a cheaper hourly rental rate? Justify your answer.

   Key: Shop B (with appropriate justification)

   Sample answer: Shop B rents SUPs at a cheaper hourly rate, about $7.59 per hour. I found the amounts in the table to be in a proportional relationship: for every 1 hour, there is a cost of $7.59.

   > *Note: Depending on the values used from the table, a rate of $7.59 or $7.60 per hour is acceptable. In either case, Shop B offers cheaper rental rates. An answer showing clearly labeled calculations as justification should also be given full credit.*

6. **(8.F.B.4)** *L* is a linear function. The graph of *L* includes (6, 3.5) and (1, –2.5).
   a. Give the equation of *L*.

      > *Note: As a function, the two points can be thought of pairs of inputs and outputs. Finding the equation for the function amounts to calculating the slope between the two points and using that to find the y-intercept.*

      Key: $y = 1.2x - 3.7$

   b. Find another point on the graph of *L* with a negative *x*-coordinate.

      Key: Any point that makes the equation true is acceptable. Possible points include: (–1.5, –5.5); (–2, –6.1); (–2.75, –7); (–4, –8.5)