

# 2023 MCAS Sample Student Work and Scoring Guide

## Grade 8 Science and Technology/Engineering Question 7: Constructed-Response

**Reporting Category:** Physical Science

**Practice Category:** Evidence, Reasoning, and Modeling

**Standard:** [8.PS.2.2](#) - Provide evidence that the change in an object's speed depends on the sum of the forces on the object (the net force) and the mass of the object.

**Item Description:** Analyze steps of an investigation to determine how forces on objects and the masses of objects will affect the speed and kinetic energy of the objects and explain the reasoning.

[View item in MCAS Digital Item Library](#)

### Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
<a href="#">3A</a>	The response demonstrates a thorough understanding that the change in an object's speed depends on the sum of the forces acting on the object and the mass of the object. The response correctly identifies which block had less speed and clearly explains the reasoning. The response correctly determines which block had greater kinetic energy just after the student's push and clearly explains the reasoning. The response also correctly compares the speed of the two stacked blocks to the speed of block Y just after the blocks were pushed and clearly explains the reasoning.
<a href="#">3B</a>	
<a href="#">2</a>	The response demonstrates a partial understanding that the change in an object's speed depends on the sum of the forces acting on the object and the mass of the object.
<a href="#">1</a>	The response demonstrates a minimal understanding that the change in an object's speed depends on the sum of the forces acting on the object and the mass of the object.
<a href="#">0</a>	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

\*Letters are used to distinguish between sample student responses that earned the same score (e.g., 3A and 3B).

## Score Point 3A

During winter, a class of students in Massachusetts completed an investigation to determine how to make icy sidewalks safer. They tested four substances to see whether the substances could melt ice. The information the students gathered about each substance is shown in Table 1.

Table 1

	Substance			
	Sodium Chloride (NaCl)	Calcium Chloride (CaCl <sub>2</sub> )	Urea (CH <sub>4</sub> N <sub>2</sub> O)	Sand
How It Works	melts ice	melts ice	melts ice	makes ice less slippery
Cost per 50 lb. Bag	\$8	\$20	\$75	\$4

The students measured how long it took each substance to melt a different icy area on each of three

## This question has three parts.

To better understand the effect of sand on icy sidewalks, a student completed an investigation with two identical 0.6 kg blocks, X and Y, and two icy areas. The student completed the following steps:

1. Add a thin layer of sand to the top of one icy area.
2. Place block X on the icy area without sand. Place block Y on the icy area with sand. Make sure blocks X and Y are not moving.
3. Push both blocks with the same amount of force for 3 seconds and then let go.
4. Observe the speed of each block after it is let go.

## Part A

One block moved with less speed than the other. Identify which block had less speed. Explain your reasoning.

Block Y moved with less speed than block X, because Block Y was on a path that was covered in sand. This sand creates extra friction for the block to resist, which expends some of the energy that was put into the block. Both blocks had the same amount of force, so the side with less friction, which is the side with no sand, made the block go faster.

## Part B

Determine which block, X or Y, had the greater kinetic energy just after the student's push. Explain your reasoning.

Block X had greater Kinetic energy just after the student's push. This is because even right after the push for Y, there is sand on the surface. Block X could go faster due to the less friction from the ice, but Block Y had to resist the friction which was preventing the block to move as fast.

**Part C**

The student stacked another block on top of block Y. The student then pushed the two stacked blocks for 3 seconds with the same force as before.

Compare the speed of the two stacked blocks to the speed of only block Y just after the blocks were pushed. Explain your reasoning.

The speed of the two stacked blocks is less than the speed of only block Y, because there is more mass to move with two blocks compared to one. It all comes down to the amount of force behind each push, and because that force was the same the same amount of force was used to push double the mass, decreases the speed compared to that same amount of force pushing only one block.

[Back to Scoring Guide](#)

## Score Point 3B

During winter, a class of students in Massachusetts completed an investigation to determine how to make icy sidewalks safer. They tested four substances to see whether the substances could melt ice. The information the students gathered about each substance is shown in Table 1.

Table 1

	Substance			
	Sodium Chloride (NaCl)	Calcium Chloride (CaCl <sub>2</sub> )	Urea (CH <sub>4</sub> N <sub>2</sub> O)	Sand
How It Works	melts ice	melts ice	melts ice	makes ice less slippery
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The students measured how long it took each substance to melt a different icy area on each of three

## This question has three parts.

To better understand the effect of sand on icy sidewalks, a student completed an investigation with two identical 0.6 kg blocks, X and Y, and two icy areas. The student completed the following steps:

1. Add a thin layer of sand to the top of one icy area.
2. Place block X on the icy area without sand. Place block Y on the icy area with sand. Make sure blocks X and Y are not moving.
3. Push both blocks with the same amount of force for 3 seconds and then let go.
4. Observe the speed of each block after it is let go.

## Part A

One block moved with less speed than the other. Identify which block had less speed. Explain your reasoning.

the block on the sand moved slower because sliding on the sand created more friction and drag than the block without the sand.

## Part B

Determine which block, X or Y, had the greater kinetic energy just after the student's push. Explain your reasoning.

X had more energy because it was moving faster than the Y block

## Part C

The student stacked another block on top of block Y. The student then pushed the two stacked blocks for 3 seconds with the same force as before.

Compare the speed of the two stacked blocks to the speed of only block Y just after the blocks were pushed. Explain your reasoning.

the two stacked blocks would move even slower because of the increased mass

## Score Point 2

During winter, a class of students in Massachusetts completed an investigation to determine how to make icy sidewalks safer. They tested four substances to see whether the substances could melt ice. The information the students gathered about each substance is shown in Table 1.

Table 1

	Substance			
	Sodium Chloride (NaCl)	Calcium Chloride (CaCl <sub>2</sub> )	Urea (CH <sub>4</sub> N <sub>2</sub> O)	Sand
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To better understand the effect of sand on icy sidewalks, a student completed an investigation with two identical 0.6 kg blocks, X and Y, and two icy areas. The student completed the following steps:

1. Add a thin layer of sand to the top of one icy area.
2. Place block X on the icy area without sand. Place block Y on the icy area with sand. Make sure blocks X and Y are not moving.
3. Push both blocks with the same amount of force for 3 seconds and then let go.
4. Observe the speed of each block after it is let go.

## Part A

One block moved with less speed than the other. Identify which block had less speed. Explain your reasoning.

Block X would move faster. Block Y would move more slowly because the sand would cause more friction. Sand only makes ice less slippery, so it would cause more friction and Block Y would not move as quickly.

## Part B

Determine which block, X or Y, had the greater kinetic energy just after the student's push. Explain your reasoning.

They had the same amount of kinetic energy. They were both being pushed with the same force for the same amount of time.

## Part C

The student stacked another block on top of block Y. The student then pushed the two stacked blocks for 3 seconds with the same force as before.

Compare the speed of the two stacked blocks to the speed of only block Y just after the blocks were pushed. Explain your reasoning.

The speed of the two stacked blocks would be less than the speed of just Block Y. There is more mass that needs to be moved when there are two blocks stacked on top of each other, so if the blocks are pushed with the same force as before, the speed will be slower. One would need to apply a greater force if they want the two blocks to go at the same speed as Block Y.

## Score Point 1

During winter, a class of students in Massachusetts completed an investigation to determine how to make icy sidewalks safer. They tested four substances to see whether the substances could melt ice. The information the students gathered about each substance is shown in Table 1.

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1. Add a thin layer of sand to the top of one icy area.
2. Place block X on the icy area without sand. Place block Y on the icy area with sand. Make sure blocks X and Y are not moving.
3. Push both blocks with the same amount of force for 3 seconds and then let go.
4. Observe the speed of each block after it is let go.

## Part A

One block moved with less speed than the other. Identify which block had less speed. Explain your reasoning.

Y, this is because the added friction from the sand caused it to slow down.

## Part B

Determine which block, X or Y, had the greater kinetic energy just after the student's push. Explain your reasoning.

X, because of how much less friction the ice has without sand.

## Part C

The student stacked another block on top of block Y. The student then pushed the two stacked blocks for 3 seconds with the same force as before.

Compare the speed of the two stacked blocks to the speed of only block Y just after the blocks were pushed. Explain your reasoning.

The two stacked blocks will move faster but for a short amount of time because the two stacked blocks have double the mass of Y alone.

## Score Point 0

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## Part A

One block moved with less speed than the other. Identify which block had less speed. Explain your reasoning.

I think it would be block X because it said that sand makes it less slippery so that means it wouldnt be moving a lot.

## Part B

Determine which block, X or Y, had the greater kinetic energy just after the student's push. Explain your reasoning.

I think block Y would have more kinetic energy because its not moving around and its connecting through the sand.

## Part C

The student stacked another block on top of block Y. The student then pushed the two stacked blocks for 3 seconds with the same force as before.

Compare the speed of the two stacked blocks to the speed of only block Y just after the blocks were pushed. Explain your reasoning.

I think the speed would speed up because now you have force melting it even more.