Maine Department of Education

New Meridian

Maine Science Assessment

Released Items (2022)
High School

Included in this document are items and their associated stimuli that were operationally administered on the Maine Science Assessment. The stimulus is on the left and the item is on the right, consistent with how the information is presented online in ADAM.
For each item, the correct answer is provided, along with the Next Generation Science Standards (NGSS) to which it aligns. This includes the disciplinary core idea (DCI), science and engineering practice (SEP), and cross-cutting concept (CCC). In some cases, one of these dimensions may not apply.

A note on achievement levels: An achievement level of either Well Below State Expectations, Below State Expectations, At State Expectations, or Above State Expectations is defined by the earned scaled score for entire assessment for each student. For example, for the High School assessment, a scaled score of 42 would be associated with the achievement level of At State Expectations.

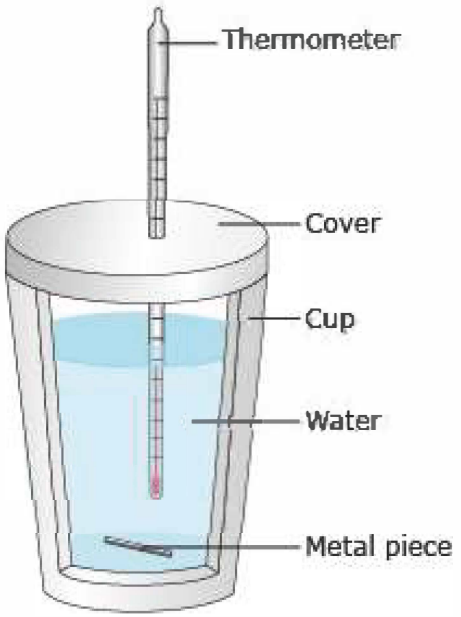
Each of these released items has an achievement level listed with it. This simply represents where in the range of required student knowledge, skills, and abilities that particular item fell. It can be used as an example of what a student performing at that particular level can do. However, it is the sum of the performance of the student on the entirety of the assessment that determines their achievement level, not their ability to correctly answer one particular item.

Calorimetry

On a cold day, Maria fills two mugs with hot water and places each container on the table. The mugs are identical, except that one is made of aluminum and the other copper. After some time, she finds that the aluminum mug feels hotter to the touch than the copper mug. The mugs are the same shape and size and contain water at the same temperature. Maria wonders why one mug feels hotter than the other. She thinks it has to do with the type of metal each mug is made of.

Maria sets up a calorimetry experiment to investigate how the different metals might affect the temperature of the water. She creates a calorimeter by pouring water into an insulated cup fitted with a cover and a thermometer. Pieces of hot aluminum and copper of a known mass are dropped into the calorimeter. She records the initial and final temperatures of each piece of metal.

Cross Section of the Calorimeter



Investigation Record			
Component	**Mass (g)**	**Initial Temperature (°C)**	**Final Temperature of Water + Metal (°C)**
water	100	25	-----
aluminum	100	100	38.17
copper	100	100	31.25

To compare and quantify the amount of heat transfer between various substances and water, Maria collects data on specific heat values of common substances used to make containers.

Specific Heat Values of Common Substances	
Substance	**Specific Heat Values (J/g ° C)**
steel	0.47
copper	0.38
iron	0.41
silver	0.23
tempered Glass	0.75

1. Which statements can be supported by the calorimetry experiment?

Select True or False for each statement.

Water has transferred energy to the metal.	○ True	◉ False
The metal transferred energy to the water.	◉ True	○ False
The aluminum transferred less energy than the copper.	○ True	◉ False
The copper has transferred less energy than the aluminum.	◉ True	○ False

1 point for all four correct responses

Standards alignment
Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

SEP4: Analyzing and interpreting data

CCC5: Energy and matter: Flows, cycles, and conservation

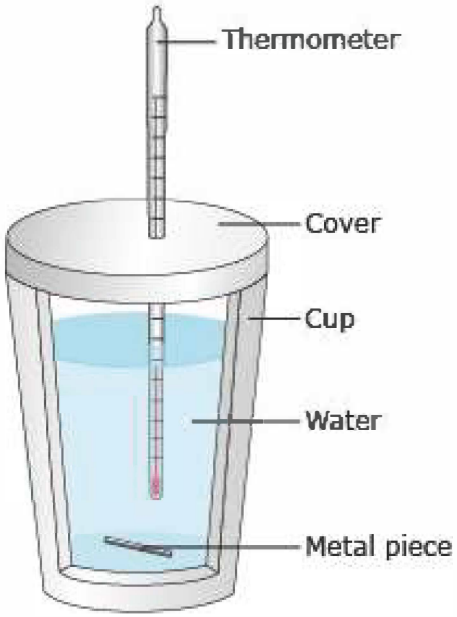
Achievement Level: Above State Expectations

Calorimetry

On a cold day, Maria fills two mugs with hot water and places each container on the table. The mugs are identical, except that one is made of aluminum and the other copper. After some time, she finds that the aluminum mug feels hotter to the touch than the copper mug. The mugs are the same shape and size and contain water at the same temperature. Maria wonders why one mug feels hotter than the other. She thinks it has to do with the type of metal each mug is made of.

Maria sets up a calorimetry experiment to investigate how the different metals might affect the temperature of the water. She creates a calorimeter by pouring water into an insulated cup fitted with a cover and a thermometer. Pieces of hot aluminum and copper of a known mass are dropped into the calorimeter. She records the initial and final temperatures of each piece of metal.

Cross Section of the Calorimeter



Investigation Record			
Component	**Mass (g)**	**Initial Temperature (°C)**	**Final Temperature of Water + Metal (°C)**
water	100	25	-----
aluminum	100	100	38.17
copper	100	100	31.25

To compare and quantify the amount of heat transfer between various substances and water, Maria collects data on specific heat values of common substances used to make containers.

Specific Heat Values of Common Substances	
Substance	**Specific Heat Values (J/g ° C)**
steel	0.47
copper	0.38
iron	0.41
silver	0.23
tempered Glass	0.75

2. Maria analyzes the data from the calorimetry experiment related to the 100 grams of copper and 100 grams of water.

How does thermal energy transfer between the copper and the water inside the insulated cup? Describe what happens to the thermal energy of copper, water, and the closed system of the calorimetry cup.

This item is worth 2 points, partial credit may be awarded.

See next page for rubric.

Standards alignment
Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B-HG5
Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).

SEP3: Planning and carrying out investigations

CCC5: Energy and matter: Flows, cycles, and conservation

Achievement Level:
1 point = Below State Expectations
2 points= Above State Expectations

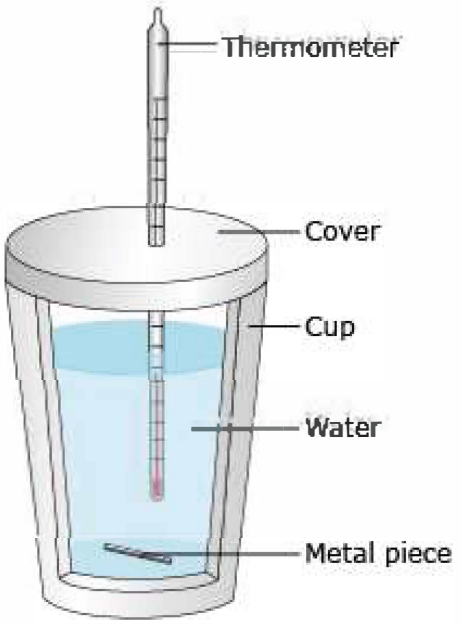
Points	Qualities of the Student Response
2	The response must demonstrate an understanding that, because the system is closed, the decrease in temperature of the copper can be accounted for by the increase in temperature of the water. **Example Student Response:** The thermal energy of the copper transfers to the water in the insulated cup. Because it is insulated and the system is closed, the thermal energy stays in the cup.
1	The response demonstrates a partial understanding of the prompt. Response may: • Identify the direction of the energy transfer, which is from the copper to the water, but does not provide a sufficient description of the process. • Include a description but does not specify the direction of energy transfer.
0	The response demonstrates minimal understanding of the prompt. The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Calorimetry

On a cold day, Maria fills two mugs with hot water and places each container on the table. The mugs are identical, except that one is made of aluminum and the other copper. After some time, she finds that the aluminum mug feels hotter to the touch than the copper mug. The mugs are the same shape and size and contain water at the same temperature. Maria wonders why one mug feels hotter than the other. She thinks it has to do with the type of metal each mug is made of.

Maria sets up a calorimetry experiment to investigate how the different metals might affect the temperature of the water. She creates a calorimeter by pouring water into an insulated cup fitted with a cover and a thermometer. Pieces of hot aluminum and copper of a known mass are dropped into the calorimeter. She records the initial and final temperatures of each piece of metal.

Cross Section of the Calorimeter



Investigation Record			
Component	**Mass (g)**	**Initial Temperature (°C)**	**Final Temperature of Water + Metal (°C)**
water	100	25	-----
aluminum	100	100	38.17
copper	100	100	31.25

To compare and quantify the amount of heat transfer between various substances and water, Maria collects data on specific heat values of common substances used to make containers.

Specific Heat Values of Common Substances	
Substance	**Specific Heat Values (J/g ° C)**
steel	0.47
copper	0.38
iron	0.41
silver	0.23
tempered Glass	0.75

3. Based on Maria's setup of the calorimetry investigation, which variable is the dependent variable?

A the mass of the metal

B the mass of the water

C the final temperature

D the initial temperature

Standards Alignment
Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B-HG1
Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.

SEP3: Planning and carrying out investigations

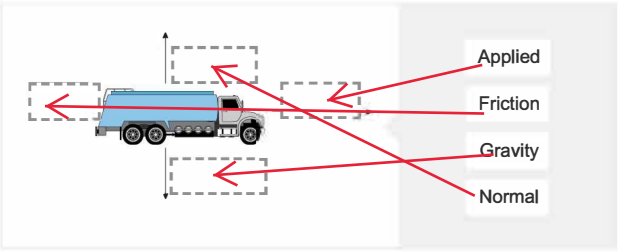
No CCC

Achievement Level: At State Expectations

Toy Truck

Andrea pushes a toy truck across the rug of her living room. She also pushes the same truck using the same amount of force across the tile in her kitchen. She wonders why the truck travels farther on certain surfaces.

4. What forces are acting on the truck? Move the correct label into each box in the diagram.



1 point for all 4 forces in the correct place

Standards Alignment

Discipline: Physical Science
NGSS Topic: Forces and Interactions

DCI: PS2.A
The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.

SEP2: Developing and Using Models

CCC4: Systems and System Models

Achievement Level: At State Expectations

Toy Truck

Andrea pushes a toy truck across the rug of her living room. She also pushes the same truck using the same amount of force across the tile in her kitchen. She wonders why the truck travels farther on certain surfaces.

5. Which statement explains why the truck travels farther on certain surfaces?

A	The normal force is less.
B	The air resistance is less.
C	The force of friction is less.
D	The force of gravity is less.

1 point for the correct answer

Standards Alignment
Discipline: Physical Science
NGSS Topic: Forces and Interactions

DCI: PS2.A
The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.

No SEP

CCC7: Stability and change

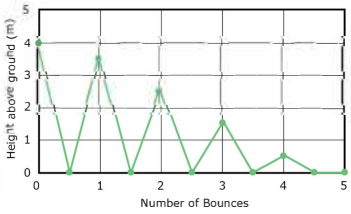
Achievement Level: Well Below State Expectations

Bouncing Balls

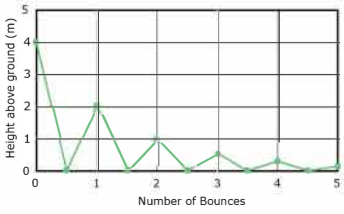
Tamara and Donna are carrying out an investigation to determine the bounciness of five volleyballs of different brands in order to make a recommendation of which ball to use for the volleyball team. The five balls all have similar masses and sizes. They begin by releasing the first ball from a height of 4 meters. They take digital recordings of the height of each bounce for five bounces. They then repeat this process for the remaining four balls. To record their findings, they draw five graphs, each showing the bounce results for one of the five balls.

While Tamara and Donna make their presentation to the volleyball team, a team member, Todd, tells them there is an error in two of their graphs.

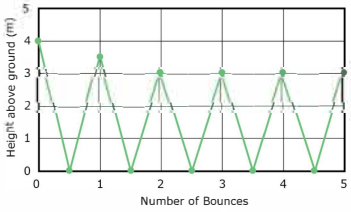
A.



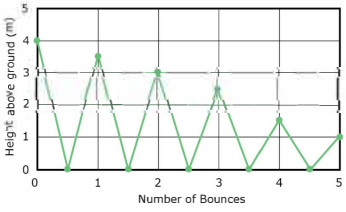
B.



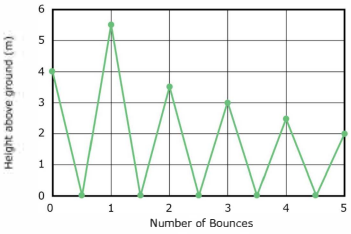
C.



D.



E.



6. Which graphs have an error? Select all that apply.

- A graph A
- B graph B
- C graph C
- D graph D
- E graph E

1 point for both correct answers

Standards alignment
Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B
Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.

SEP5: Using mathematics and computational thinking

No CCC

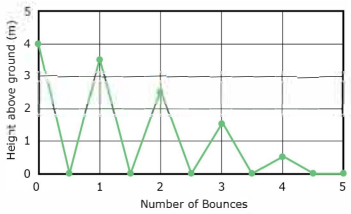
Achievement Level: At State Expectations

Bouncing Balls

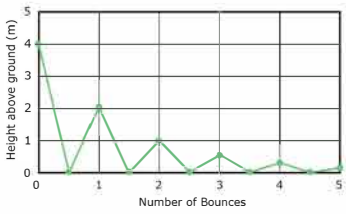
Tamara and Donna are carrying out an investigation to determine the bounciness of five volleyballs of different brands in order to make a recommendation of which ball to use for the volleyball team. The five balls all have similar masses and sizes. They begin by releasing the first ball from a height of 4 meters. They take digital recordings of the height of each bounce for five bounces. They then repeat this process for the remaining four balls. To record their findings, they draw five graphs, each showing the bounce results for one of the five balls.

While Tamara and Donna make their presentation to the volleyball team, a team member, Todd, tells them there is an error in two of their graphs.

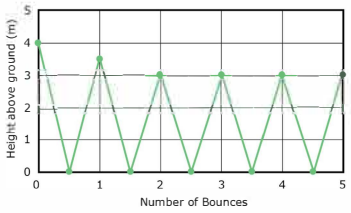
A.



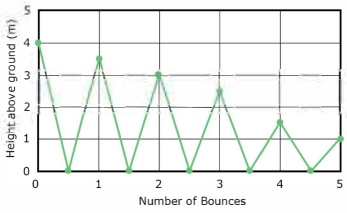
B.



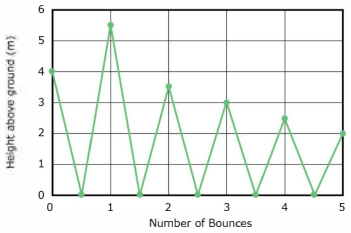
C.



D.



E.



7. How does Todd know there is an error in the graphs?

2 points possible, can earn partial credit

See next page for rubric.

Standards alignment
Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B
Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

SEP5: Using Mathematics and Computational Thinking

No CCC

Achievement Level:
1 point = Well Below State Expectations
2 points = Above State Expectations

Points	Qualities of the Student Response
2	Air friction and friction of the ball with the ground take away from the kinetic energy from the ball during each bounce. This decreased the potential energy (or height) the ball can reach on each consecutive bounce. Reasons for the loss of energy from the ball must be included. Reasons could be air friction, frictional forces with the ground, the sound the ball makes, the change of shape when the ball hits the ground. **Example Student Response:** The ball cannot have more potential energy from the height it was dropped because it loses energy through friction which cause the ball to eventually stop bouncing.
1	Show understanding that once a ball is dropped, it cannot reach a height higher than where it started or that it cannot consistently bounce up to the same height.
0	The response demonstrates minimal understanding of the prompt. The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.