INVESTIGATION 1 *I-Check*

INVESTIGATION 1 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

1. A controlled experiment is an experiment that _____.

   (Mark the one best answer.)

   - ○ **A** is repeated several times
   - ◉ **B** allows only one variable to be changed at a time
   - ○ **C** includes a data table and a graph
   - ○ **D** uses tools to take measurements

2. A student is using a controlled experiment to study how the number of passengers affects the distance a paper airplane can fly. Another student tells him that he needs to set a standard first. What is a standard?

   (Mark the one best answer.)

   - ◉ **F** The starting condition of each variable used to compare to future trials
   - ○ **G** A graph that shows how the independent variable changed over time
   - ○ **H** A procedure that tells scientists how to set the variables for each trial
   - ○ **J** A set of variables used to predict future trials in an experiment

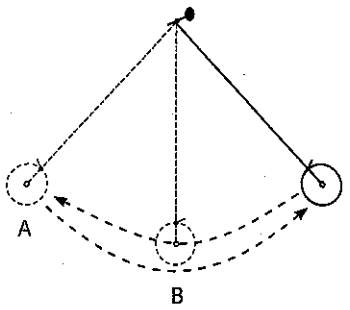
3. a. A Force is a push or a pull.

   b. Applying a push or a pull to an object always changes its motion.

INVESTIGATION 1 I-CHECK
MOTION, FORCE, AND MODELS

ANSWERS

4. Look at the diagram at the right.



   a. Which force or forces are acting at Position A?

   (Mark the one best answer.)

   - ○ **A** Gravity only
   - ○ **B** Force applied by the string
   - ◎ **C** Gravity and force applied by the string
   - ○ **D** Centrifugal force

   b. Which force or forces are acting at Position B?

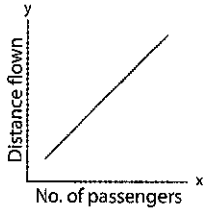
   (Mark the one best answer.)

   - ○ **F** Gravity only
   - ○ **G** Force applied by the string
   - ◎ **H** Gravity and force applied by the string
   - ○ **J** Centrifugal force

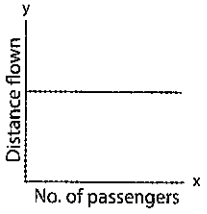
5. Which graph below shows the relationship: "As the number of paper-clip passengers increases, the distance the paper airplane flies decreases (doesn't go as far)."

   (Mark the one best answer.)

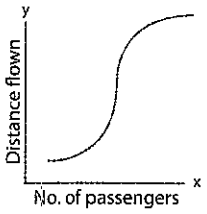
○ **A**



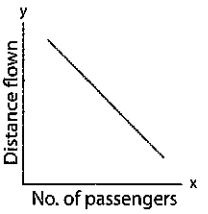
○ **B**



○ **C**



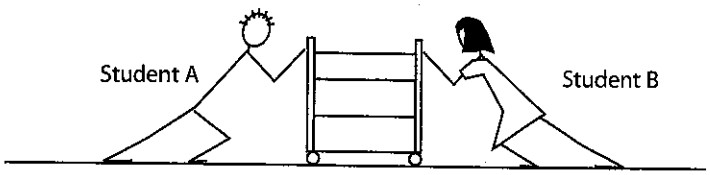
◎ **D**



INVESTIGATION 1 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS



6. Student A pushes on a cart with 500 newtons (N) of force. Student B pushes on the other side of the cart. The cart doesn't move. How much force is Student B applying?

(Mark the one best answer.)

- ○ **F** Student B is applying more than 500 N of force.
- ◎ **G** Student B is applying 500 N of force.
- ○ **H** Student B is applying less than 500 N of force.
- ○ **J** There is not enough information to know for sure.

7. Write a letter on each blank line to match the word to its meaning.

U Variable	**R** The variable you are testing (changing)
R Independent variable	**S** What you find out by doing the experiment
S Dependent variable	**T** A variable you always keep the same
T Controlled variable	**U** Anything you can change in an experiment that might affect the outcome

INVESTIGATION 1 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

8. A student wants to investigate how the mass of the paper clip passengers affects how long it takes a parachute to float to the ground. These are the materials she used to make her first parachute.

    1 30 cm square, cotton fabric
    4 25 cm pieces of string
    10 paper clips

    a. What materials should she use to make the next parachute?

    (Mark the one best answer.)

    ○ **A** 1 30 cm square, cotton fabric
    4 15 cm pieces of string
    15 paper clips

    ◉ **B** 1 30 cm square, cotton fabric
    4 25 cm pieces of string
    20 paper clips

    ○ **C** 1 30 cm square, silk fabric
    4 25 cm pieces of string
    20 paper clips

    ○ **D** 1 30 cm round, cotton fabric
    4 25 cm pieces of string
    20 paper clips

    b. What was the standard number of passengers used in this experiment?

    (Mark the one best answer.)

    ○ **F** A square of cotton fabric

    ○ **G** 20 paper clips

    ○ **H** 25 cm pieces of string

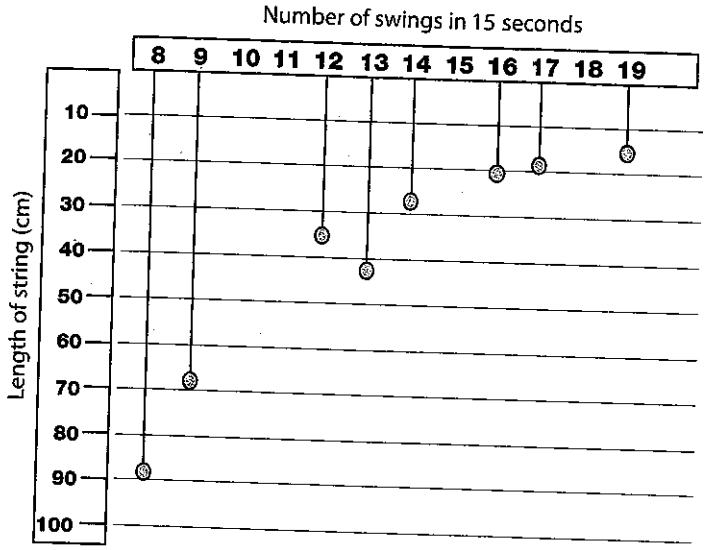
    ◉ **J** 10 paper clips

9. Gravity is the force that pulls objects toward the center of Earth.

INVESTIGATION 1 I-CHECK
MOTION, FORCE, AND MODELS

ANSWERS

10. A class made pendulums out of string. Each string was a different length. The students put the same mass on each string. They tested the pendulums to see how many swings each would make in 15 seconds. Then the students hung the pendulums on a number line (shown below).



a. The pendulum hanging on the number line at _____ should be tested again.

○ **A** 9 ○ **B** 12 ◉ **C** 13 ○ **D** 19

b. How many swings should the pendulum you chose in item a make in 15 seconds? 11

c. How long would you make a pendulum to swing 15 times in 15 seconds? 22-25 cm

d. What is the relationship between the length of the string and the number of swings a pendulum makes in 15 seconds?

(Mark the one best answer.)

◉ **F** The longer the string, the fewer times the pendulum swings.

○ **G** The shorter the string, the less force it takes to swing.

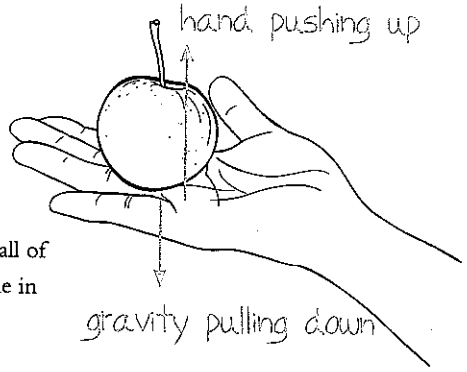
○ **H** The longer the string, the less time it takes to swing.

○ **J** The shorter the string, the slower the pendulum moves.

INVESTIGATION 1 I-CHECK
MOTION, FORCE, AND MODELS

ANSWERS

OPEN-RESPONSE QUESTION



11. Explain why the apple is not moving. Describe all of the forces at work when you are holding an apple in your hand as you see in the picture.

Key Points:

- There are two main forces working in opposite directions.
- One force is gravity. Gravity pulls the apple toward the center of Earth (down).
- The other force is the hand pushing up on the apple.
- In order for the apple to stay in place without moving, the hand has to be pushing up with an equal amount of force as gravity is pulling down.

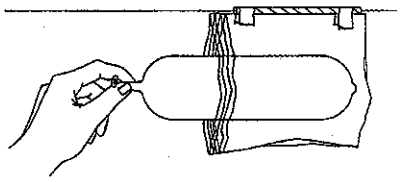
INVESTIGATION 1 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

OPEN-RESPONSE QUESTION

12. Two students made a balloon rocket like the one in the picture. Their focus question was "How does the amount of air in the balloon affect the distance it will fly down the line?" To measure the amount of air they put into each balloon, they counted the number of times they pushed in the plunger on the air pump that blew air into the balloon.



a. Describe the independent and dependent variables in this experiment. Then describe the other variables that need to be controlled.

Key Points:

- The independent variable is the number of pumps of air put into the balloon. That is the variable that students are testing/changing to see if the amount of air in the balloon affects how far the balloon travels.
- The dependent variable is the distance that the balloon travels (what they wanted to find out).
- Other variables that need to be controlled are starting position, slope of the line, type of string, and type of plastic-bag-and-straw system to carry the balloon along the string.

(Item 12 continues on the next page.)

INVESTIGATION 1 I-CHECK

ANSWERS

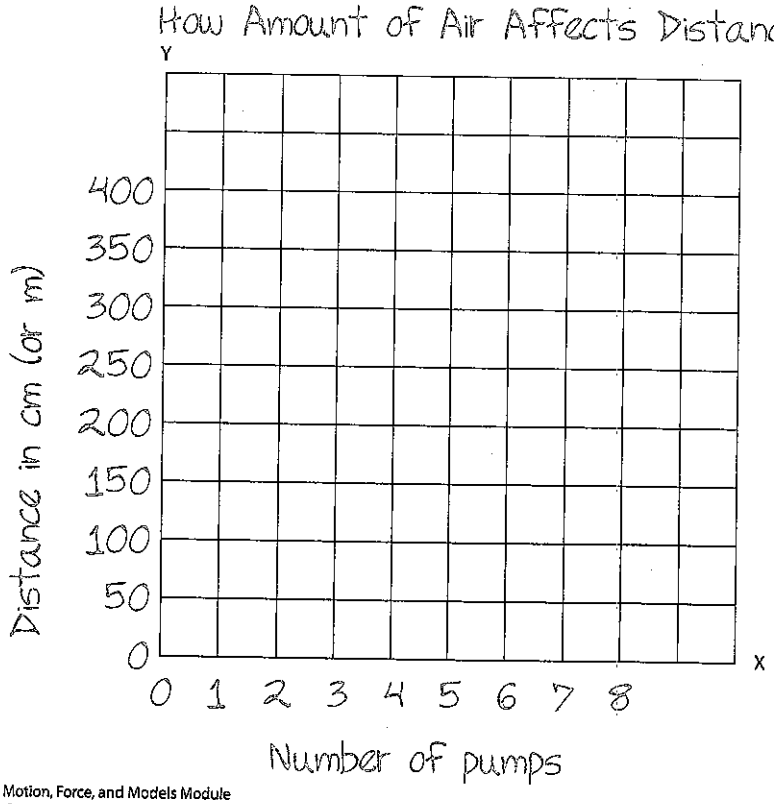
MOTION, FORCE, AND MODELS

OPEN-RESPONSE QUESTIONS (Item 12 continued)

b. Set up a T-table that the students can use to gather data during their investigation.

number of pumps	distance in cm (or m)

c. Set up the grid below, so the students will be able to graph the data entered in the T-table.



INVESTIGATION 2 *I-Check*

INVESTIGATION 2 I-CHECK
MOTION, FORCE, AND MODELS

1. A bowling ball starts at Position 1, rolls down a ramp, across the floor, and stops at Position 4.

a. At which position does the bowling ball have the most kinetic energy?

(Mark the one best answer.)

- ○ **A** Position 1
- ○ **B** Position 2
- **C** Position 3
- ○ **D** Position 4

b. At which position does the ball have the most potential energy?

(Mark the one best answer.)

- **F** Position 1
- ○ **G** Position 2
- ○ **H** Position 3
- ○ **J** Position 4

c. At which position is the bowling ball moving fastest?

(Mark the one best answer.)

- ○ **A** Position 1
- ○ **B** Position 2
- **C** Position 3
- ○ **D** Position 4

FOSS

[illegible]N 2 I-CHECK

ANSWERS

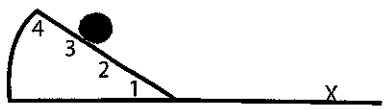
[illegible]D MODELS

[illegible]s are exactly the same, but sit at different starting positions. Which ball [illegible] the largest force to bring it to a stop when it reaches Position X?

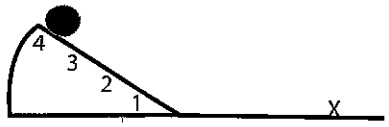
(Mark the one best answer.)

○ F

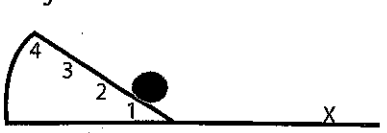
○ G



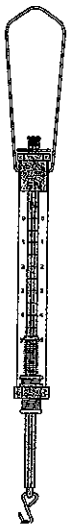
◉ H



○ J



3. a. The tool shown in the picture is a _____.



(Mark the one best answer.)

○ **A** graduated cylinder

○ **B** thermometer

○ **C** force meter

◉ **D** spring scale

b. The tool measures _____.

(Mark the one best answer.)

○ **F** potential energy in newtons

◉ **G** force in newtons

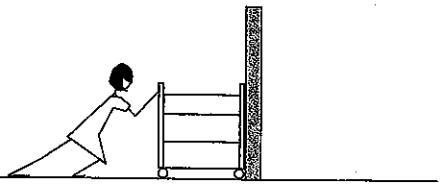
○ **H** kinetic energy in centimeters per second

○ **J** force in grams

FOSS

2 I-CHECK
MODELS

ANSWERS



4. A girl pushes on a cart against a wall with 650 newtons (N) of force. The cart doesn't move. How do you explain what's happening?

(Mark the one best answer.)

- ○ **A** The wall pushes back with more than 650 N of force.
- ◎ **B** The wall pushes back with 650 N of force.
- ○ **C** The wall pushes back with less than 650 N of force.
- ○ **D** Walls don't move, so it doesn't matter how much force is used.

5. Write a letter on each blank line to match the word to its meaning.

T Energy	**R** Energy of position
R Potential energy	**S** Energy of motion
S Kinetic energy	**T** The ability to do work

6. Momentum is _____.

(Mark the one best answer.)

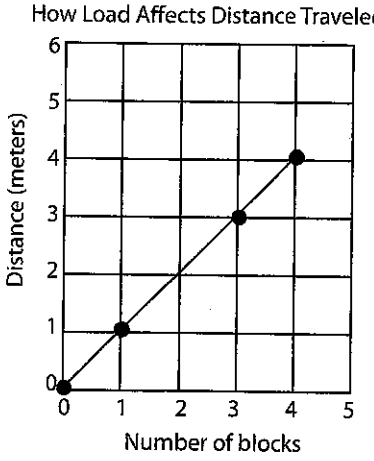
- ○ **F** how fast an object goes on level ground
- ○ **G** the result of a collision between two objects
- ◎ **H** the property of a moving object that keeps it going
- ○ **J** sideways motion

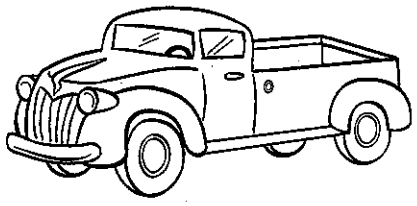
INVESTIGATION 2 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

7. A student had a toy truck that he planned to launch down a ramp, and let roll across a flat floor. He wanted to know if the truck would travel the same distance from the ramp no matter how heavy a load the truck carried. He placed one or more 500-gram blocks in the back of the truck and recorded his results. The graph below displays his results.





a. How far will the truck most likely travel with a two-block load? 2 meters

b. What is the relationship between the number of blocks and the distance traveled?

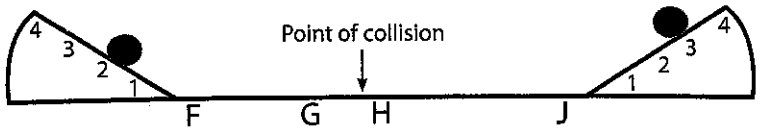
(Mark the one best answer.)

- ◎ **A** The more blocks, the farther the truck travels.
- ○ **B** The fewer blocks, the faster the truck travels.
- ○ **C** The fewer blocks, the farther the truck travels.
- ○ **D** The more blocks, the faster the truck travels.

INVESTIGATION 2 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS



8. Two identical balls are released on ramps at the same time. Where will the ball on the right most likely come to a stop after the balls collide?

(Mark the one best answer.)

- ○ **F** Position F
- ◉ **G** Position G
- ○ **H** Position H
- ○ **J** Position J

9. A snowboarder starts at Position 1 on a hill and stops at Position 4.

a. At what position will she have the most potential energy?

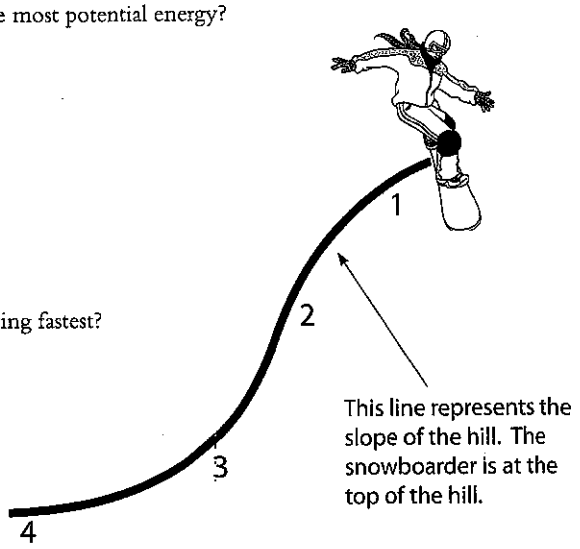
(Mark the one best answer.)

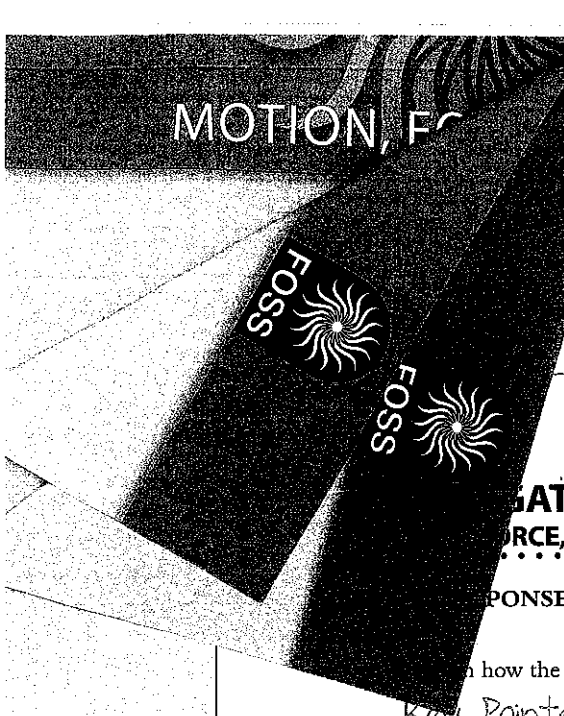
- ◉ **A** Position 1
- ○ **B** Position 2
- ○ **C** Position 3
- ○ **D** Position 4

b. At what position will she be moving fastest?

(Mark the one best answer.)

- ○ **F** Position 1
- ○ **G** Position 2
- ◉ **H** Position 3
- ○ **J** Position 4





[illegible]GATION 2 I-CHECK

ANSWERS

[illegible]RCE, AND MODELS

[illegible]PONSE QUESTION

[illegible] how the helmet a football player wears during a game helps prevent head injury.

Key Points

- As football players run toward each other, their brains are moving at high speed along with the rest of their bodies.
- When two players hit, their bodies stop immediately, but the brain inside the skull continues to move because of momentum.
- When players crash into each other, the outside of the helmet stops immediately, but the padding inside compresses. Compressing the padding extends the time it takes for the motion to stop, so there is less force (impact) between the brain and the skull.
- Reduced force means less injury.

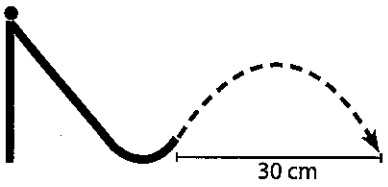
INVESTIGATION 2 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

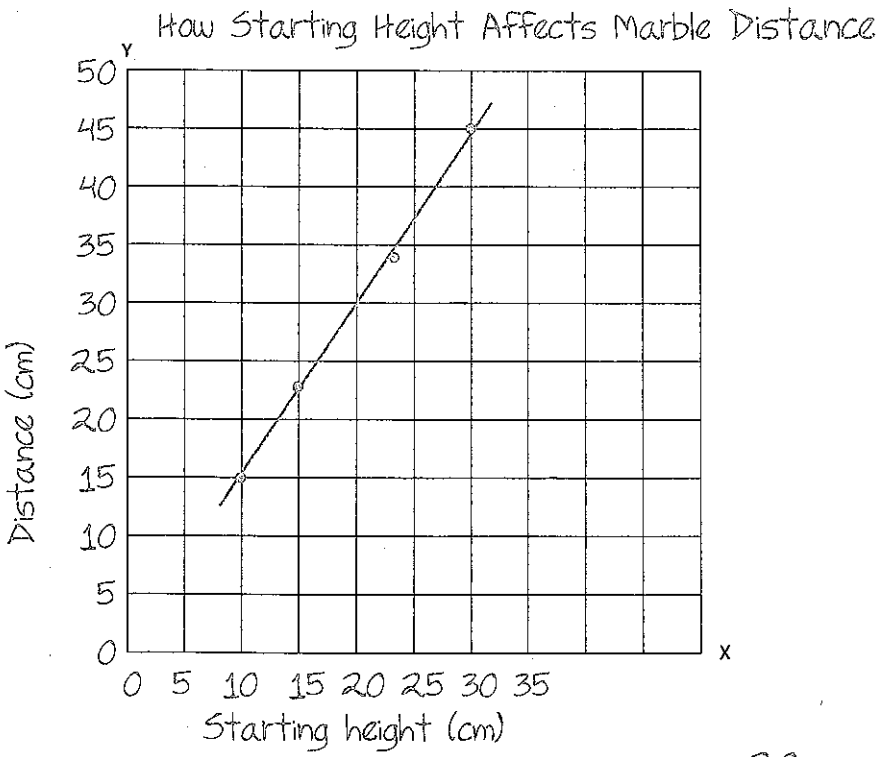
OPEN-RESPONSE QUESTIONS

11. A student is building a toy contraption. She wants to include a ramp that a marble will run down and fly through the air for 30 centimeters (cm). She needs to test the ramp-marble system to find out how high the marble should be placed on the ramp. Here is a data table she made of her test runs so far.



Starting height	Distance
10 cm	15 cm
30 cm	45 cm
15 cm	23 cm
23 cm	34 cm

a. On the grid below, draw a graph of the data collected so far.



b. At what height does she need to start the marble for it to fly 30 cm? ~20 cm

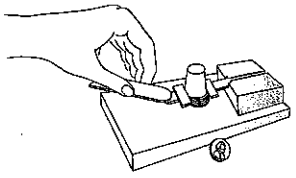
INVESTIGATION 3 *I-Check*

INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

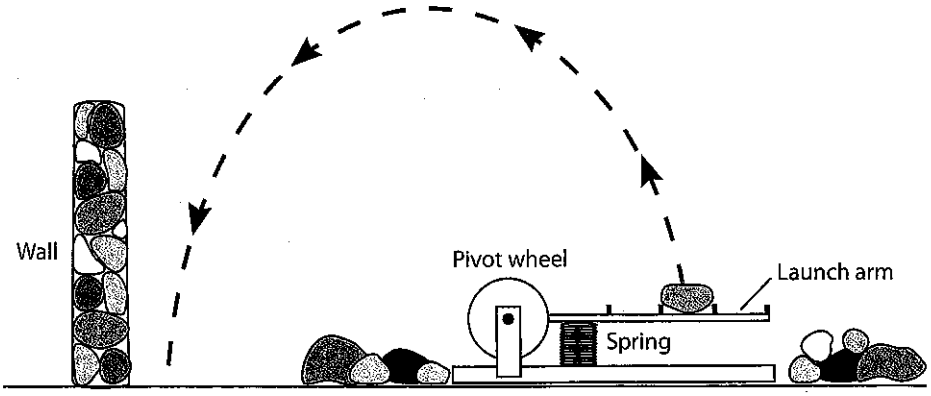
1. When you put pennies underneath a leaf spring (flip stick) to control how far it can bend, you are controlling the amount of _____ you are putting into the system.



(Mark the one best answer.)

- ◉ **A** potential energy
- ○ **B** gravitational pull
- ○ **C** newtons
- ○ **D** kinetic energy

2. The catapult shown below launched a stone.



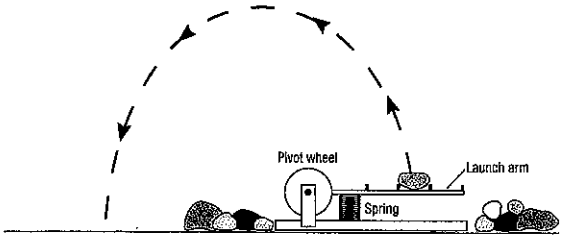
Mark an **X** next to each word that describes part of the catapult system.

X a. Stone	_____ b. Air temperature
X c. Spring	X d. Launch angle
_____ e. Wall	X f. Pivot wheel

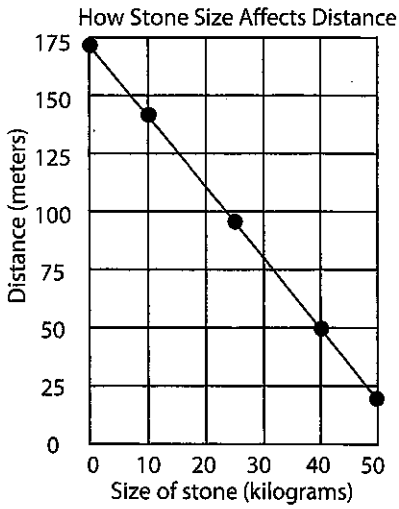
INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS



3. A student wanted to see if the size of a stone affects the distance it will travel when launched by a catapult. He did an experiment and graphed his results.



a. What distance would a stone weighing 30 kilograms travel? 75-80 meters

b. What size stone would most likely travel 115 meters? 18-23 kg

c. What is the relationship between the weight of the stone launched and the distance it travels according to the graph?

(Mark the one best answer.)

- ○ **F** The larger the stone, the farther it travels.
- ○ **G** The larger the stone, the more force needed to launch it.
- ◉ **H** The smaller the stone, the farther it travels.
- ○ **J** The smaller the stone, the faster it travels.

INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

4. A basketball rolls down a ramp and across the floor.

a. At what position would the ball have the greatest potential energy if it started at that point?

- ○ **A** Position A
- ○ **B** Position B
- ○ **C** Position C
- ◎ **D** Position D

b. If the ball crashes with a force of 200 newtons into a wall that doesn't move, how much force does the wall push back with? 200 N

c. If a ball slightly larger than the basketball rolled down the same ramp, it would roll _____ the basketball.

(Mark the one best answer.)

- ○ **F** faster than
- ○ **G** slower than
- ◎ **H** at the same speed as

d. If a ball slightly smaller than the basketball rolled down the same ramp, it would roll _____ the basketball.

(Mark the one best answer.)

- ○ **A** faster than
- ○ **B** slower than
- ◎ **C** at the same speed as

INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

OPEN-RESPONSE QUESTIONS

5. A class investigated flippers. Each group conducted several standard launches with a rubber stopper. Then each group placed pennies between the flip stick and base to change how far down they could push the stick. Each group did three trials with one or more pennies under the stick. The distances the stopper traveled are shown in the table below.

# of pennies	Trial 1 Distance (cm)	Trial 2 Distance (cm)	Trial 3 Distance (cm)	Average Distance (cm)
0 (standard)	244	271	265	260
1	211	225	218	218
2	140	151	159	150
3	66	68	61	65

a. In this experiment, what is the independent variable?

(Mark the one best answer.)

- ○ **F** Length of the flip stick
- ◎ **G** Number of pennies
- ○ **H** Angle of launch
- ○ **J** Distance traveled

b. What is the purpose for doing multiple trials?

Key Points:

- If you do the same experiment more than once and get the same results (or you average the results), you can be more confident that your answer is accurate (less error).

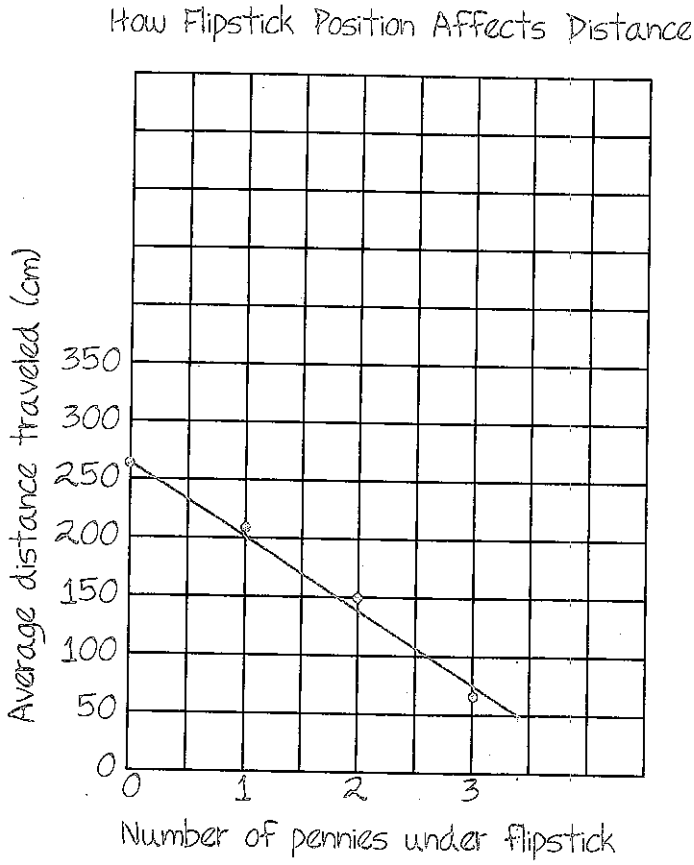
c. Graph the average results of this experiment on the next page.

INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

OPEN-RESPONSE QUESTION (Item 5 continued)

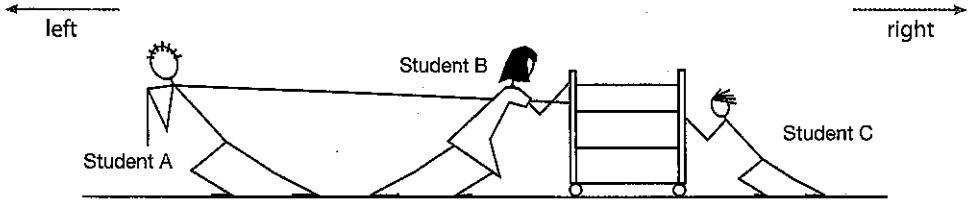


INVESTIGATION 3 I-CHECK

ANSWERS

MOTION, FORCE, AND MODELS

OPEN-RESPONSE QUESTION



6. Student B pushes on a cart with 1200 N of force. Student A pulls on a rope attached to the cart with 650 N of force. Student C pushes on the cart with 550 N of force. Will the cart move or remain in one place?

   Explain all the forces at work on the cart and what you think will happen.

Key Points:

- Students A and C are putting force on the cart in the same direction (A is pulling and C is pushing). Their combined force is 1200 N (650 N + 550 N).
- Student B is pushing on the cart with 1200 N of force (the same amount of force as A and C combined), but in the opposite direction.
- Because the forces are equal (balanced), the cart will not move.