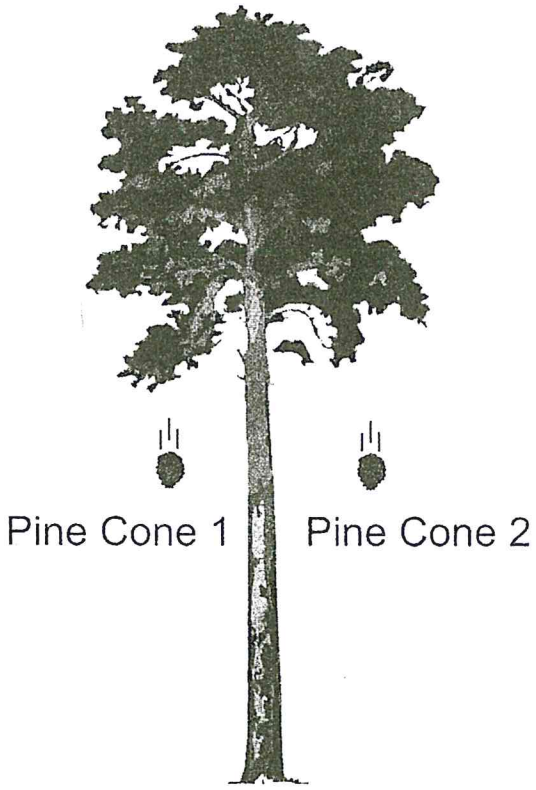
_____ Hour: _____ Date:_____

Note to teachers on classroom use:
Each item below lists an individual code at the beginning (e.g. *MST070109*) that allows the Mi-STAR project to track these assessment items internally. Please feel free to delete these codes prior to printing these for your students. You will want to check to make sure that this does not change the location of page breaks after doing so.

Instructions: You have one class period to complete the assessment below, which contains a total of ten questions. Good luck!

1. *MST070109.* Two pine cones are falling from a pine tree. Both pine cones are falling at the same speed.[1]



If Pine Cone 1 weighs less than Pine Cone 2, which pine cone has more kinetic energy?
   a. Pine Cone 1 has more kinetic energy.
   b. Pine Cone 2 has more kinetic energy.
   c. Both pine cones have the same amount of kinetic energy.
   d. Neither pine cone has any kinetic energy.

2. *MST070107.* A balloon with a static electric charge is placed near a student's hair, causing the hair to stand up. Which of the following would increase the attractive force that the balloon exerts on the student's hair?
   a. Changing the side of the balloon facing the hair.
   b. Increasing the strength of the charge on the balloon.
   c. Increasing the size of the balloon.
   d. The force remains the same if the balloon is moved or the charge is changed.

3. *MST070102.* A system you are studying contains four parts:
   - The Earth's surface (the ground)
   - A tree
   - A Frisbee stuck in the tree
   - A Frisbee resting on the Earth's surface

   a. In the space provided, draw a model of the described system.

   b. Label the Frisbee with the **least potential energy** with an **A**.

   c. Label the Frisbee with the **greatest potential energy** with a **B.**

SYSTEM MODEL

   d. The Frisbee in the tree falls to the ground. As the Frisbee is falling:
      i. Kinetic energy of the Frisbee is increasing and potential energy is decreasing.
      ii. Kinetic energy of the Frisbee is decreasing and potential energy is increasing.
      iii. Both kinetic energy and potential energy of the Frisbee are increasing.
      iv. Kinetic energy and potential energy of the Frisbee both stay the same.

   e. You throw one of the Frisbees back up into the tree, where it becomes stuck. Which of the following is true about the effect this has on the potential energy of the system, compared to when both Frisbees were on the ground? (Remember, *only* the four parts in the model above are part of the system.)
      i. Potential energy of the system increases.
      ii. Potential energy of the system decreases.
      iii. Potential energy of the system does not change.
      iv. Potential energy of the system increases and then decreases.

   f. Which cause best explains the effect on the energy of the system that you chose in part (e)?
      i. The effect on energy is due to the friction on the Frisbee as it is thrown.
      ii. The effect on energy is due to the force applied to the Frisbee to throw it back in the tree.
      iii. The effect on energy is due to the changes in kinetic energy as the Frisbee lands in the tree and stops.
      iv. The effect on energy is due to the transfer of energy from the Frisbee to the tree.

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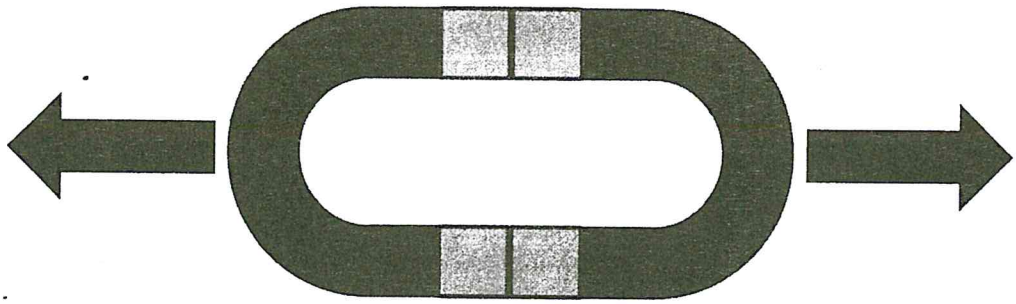
4. *MST070110.* The kinetic energy of Object 1 is greater than the kinetic energy of Object 2. How does the speed of Object 1 compare to the speed of Object 2?1
   a. To know which object is moving faster, you must also know the mass of each object.
   b. Object 1 is moving faster than Object 2.
   c. Object 1 is moving slower than Object 2.
   d. Object 1 is moving at the same speed as Object 2.

5. *MST070105.* Two magnets are at rest on a table, as shown in the diagram below. In order to get the two ends of the magnets marked N to touch, which of the following is true?
   a. A force must be applied, since the two ends marked N repel each other.
   b. A force must be applied, since the two ends marked N attract each other.
   c. The magnets will touch without any force being added.
   d. The magnets can only be made to touch if one of the magnets is reversed.

6. *MST070111.* Which of the following statements about electric and magnetic forces is TRUE?
   a. Both electric and magnetic forces can be attractive.
   b. Magnetic forces can be repulsive, but electric forces cannot.
   c. Electric forces are not affected by distance, but magnetic forces are.
   d. Magnetic and electric forces do not interact.

7. *MST070106.* Two strong magnets are attracted to each other and are touching, as shown in the diagram below. You pull them apart. What will happen to the force the magnets exert on each other as they move apart?
   a. Because the magnets are not touching, they don't exert a force.
   b. As they move apart, the force exerted will increase.
   c. As they move apart, the force exerted will decrease.
   d. As they move apart, no change in force will occur.



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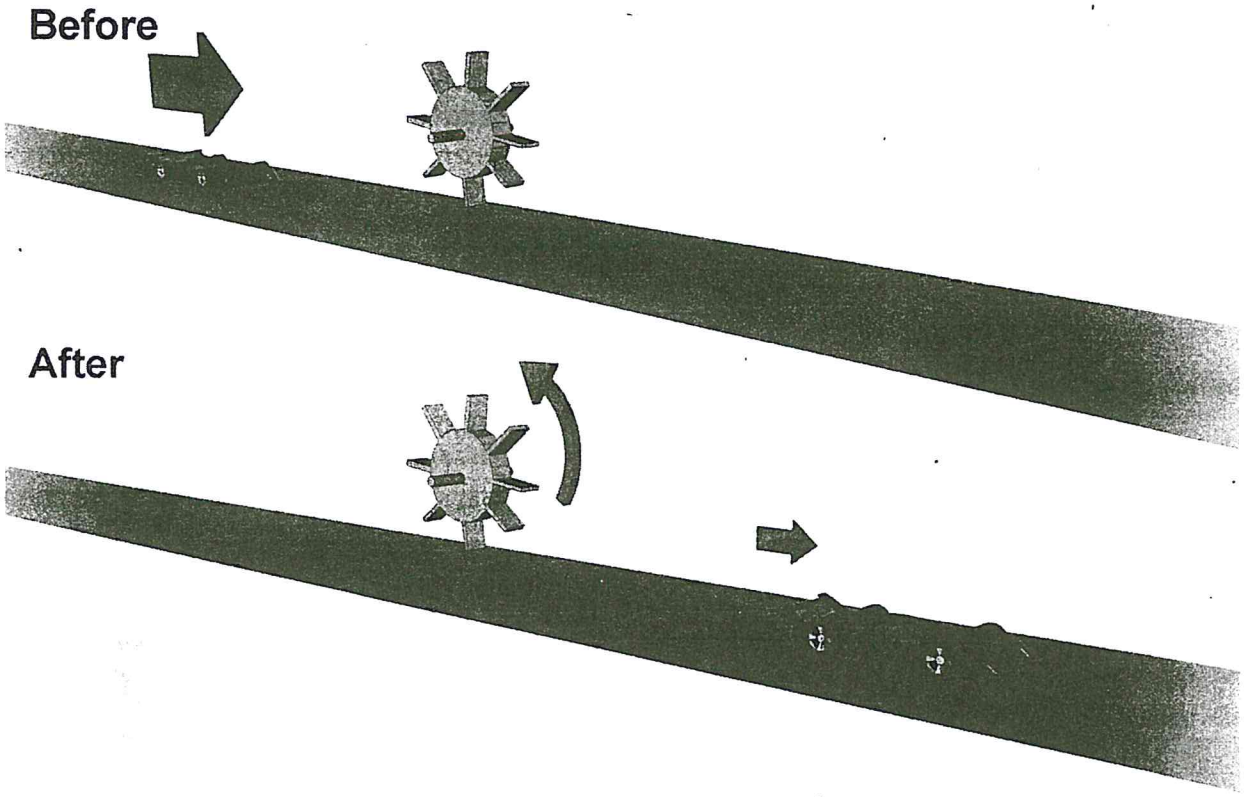
8. *MST070103.* Examine the system model below, which shows a car moving along a track at two different points in time. Assume there is no friction between the car and the track.
   - In the **before** image, a car is moving along a track at a constant speed towards a motionless wheel.
   - In the **after** image, the car has contacted the wheel, which begins to spin. The car continues to travel along the track at a slower speed.



Use your knowledge of the transfer of energy to make a claim about what causes the wheel to spin after contact with the car.

i. Claim: *The wheel begins to spin because* _____

_____

ii. Evidence (*What information do I have that can support my claim?*):

_____

_____

iii. Reasoning (*How and why does my evidence support my claim?*):

_____

_____

_____

_____

_____

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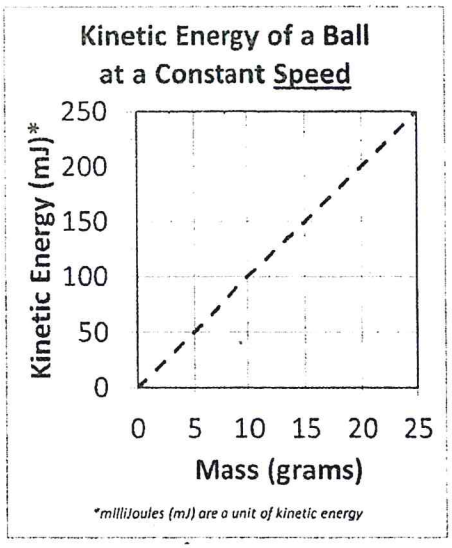
9. *MST070101.* A student is investigating the kinetic energy of a ball that has been thrown.



a. In the first experiment, the ball is thrown at the same speed every time. On each throw the student increases the mass of the ball. The results are shown at right.

When a ball with a mass of **10 grams** is thrown, what is the kinetic energy of the ball?

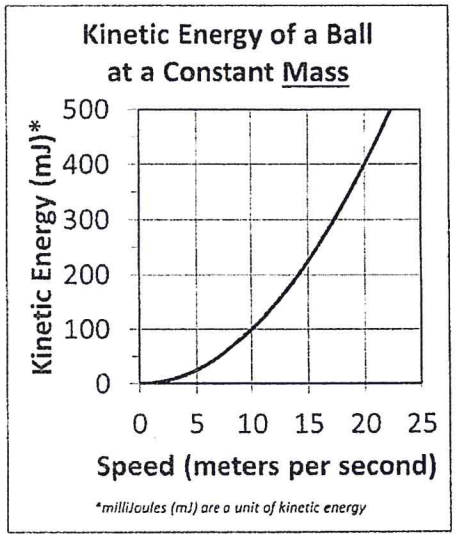
_____

When a ball with a mass of **20 grams** is thrown at the same speed, what is the kinetic energy of the ball?

_____

Compared to a ball with a mass of **10 grams**, which statement describes the proportional change in kinetic energy of a ball with a mass of **20 grams** thrown at the same speed?

i. The kinetic energy of the **20 gram** ball is half the kinetic energy of the **10 gram** ball.
ii. The kinetic energy of the **20 gram** ball is double the kinetic energy of the **10 gram** ball.
iii. The kinetic energy of the **20 gram** ball is the same as the kinetic energy of the **10 gram** ball.
iv. The kinetic energy of the **20 gram** ball is quadruple the kinetic energy of the **10 gram** ball.



b. In the second experiment, a ball of the same mass is used every time. On each throw the student increases the speed of the ball. The results are shown at right.

When the ball is thrown at **10 meters per second**, what is the kinetic energy of the ball?

_____

When a ball of the same mass is thrown at **20 meters per second**, what is the kinetic energy of the ball?

_____

Compared to a ball thrown at **10 meters per second**, which statement describes the proportional change in kinetic energy of a ball of the same mass thrown at **20 meters per second**?

i. The kinetic energy of the ball thrown at **20 meters per second** is half the kinetic energy of the ball thrown at **10 meters per second**.
ii. The kinetic energy of the ball thrown at **20 meters per second** is double the kinetic energy of the ball thrown at **10 meters per second**.
iii. The kinetic energy of the ball thrown at **20 meters per second** is the same as the kinetic energy of the ball thrown at **10 meters per second**.
iv. The kinetic energy of the ball thrown at **20 meters per second** is quadruple the kinetic energy of the ball thrown at **10 meters per second**.

c. Circle the word that correctly completes the following sentence:
Doubling the mass of a moving object has a (GREATER / LESSER) effect on its kinetic energy than **doubling the speed**.

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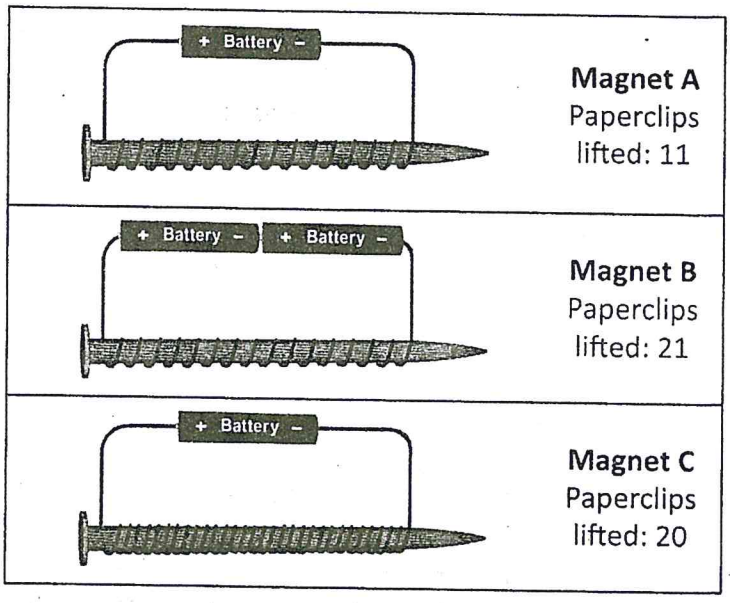
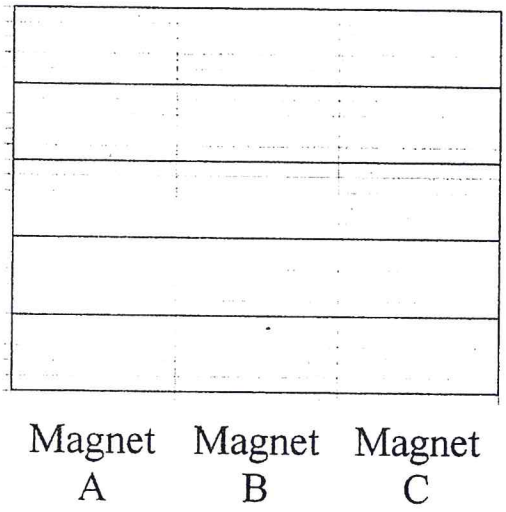
10. *MST070104.* In an experiment to test the design of electromagnets, the three electromagnets in the diagram were used to lift paperclips. The average number of paperclips each could lift is listed on the right of each diagram.





a. Examine the diagram for differences between the electromagnet designs. Describe all of the differences you observe in the space below.

b. In the space provided to the right of the diagrams, make a bar graph of the results of this experiment. The x-axis has been completed for you. Be sure to include a label and scale on the y-axis and provide a title for the graph.

c. The data from the electromagnet experiment suggest some relationships between a cause (the design of the electromagnet) and an effect (the number of paperclips lifted). Based on your observations of the three electromagnet designs shown above, think about what you could change to make a new, fourth design. Below, write a question that would help you understand how the design of the new electromagnet affects the electromagnet's strength (the number of paperclips lifted).

d. Write a hypothesis about how your new design will affect the number of paperclips that can be lifted. Use the data from the electromagnet designs of A, B, and C to write your hypothesis.

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