# Unit 4 – Exercise 3 - Energy Transfer through Force

Directions: For each of the scenarios described below draw a system schema diagram and two pie charts to describe energy storage and transfer. **For this exercise you should leave the student outside of your system boundary.**

1. A cart starts from rest and is pushed by a student as shown in the diagram below with a force of magnitude **F** across a level surface a displacement of **Δx**. The cart is displaced to the right. **Assume there is no friction between the cart and the floor.**

$F_{student/cart}$ $v_{i =} 0$ m/s

Δx
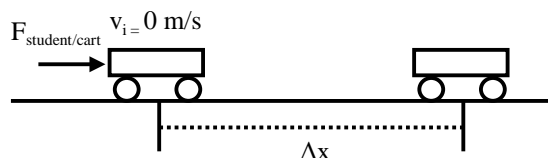
SYSTEM SCHEMA	ENERGY PIE CHARTS

2. A cart is moving to the right and is pushed by a student as shown in the diagram below with a force of magnitude **F** across a level surface a displacement of **Δx**. The cart is displaced to the right. **Assume there is no friction between the cart and the floor.**
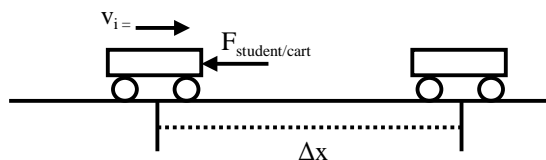
$F_{student/cart}$

$v_{i =}$ →

Δx
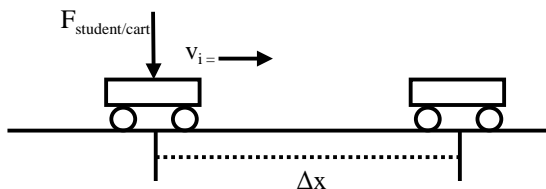
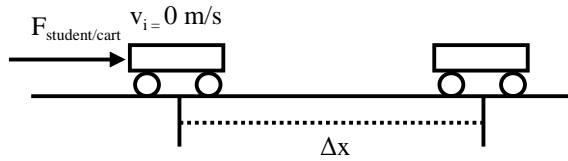| SYSTEM SCHEMA	ENERGY PIE CHARTS

3. A cart is moving to the right and is pushed by a student as shown in the diagram below with a force of magnitude **F** across a level surface a displacement of **Δx**. The cart is displaced to the right and is still moving to the right after the push. **Assume there is no friction between the cart and the floor.**

$v_{i=}$ →
$F_{student/cart}$ ←

Δx

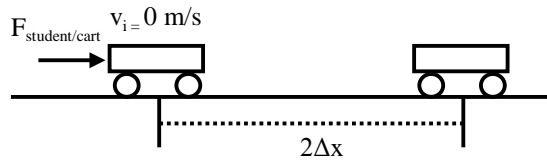| SYSTEM SCHEMA	ENERGY PIE CHARTS

4. In which of the above scenarios (1-3) is energy transferred into the system. Justify your answer.

5. In which of the above scenarios (1-3) is energy transferred out of the system. Justify your answer.

6. In which of the above scenarios (1-3) is no energy transferred into or out of the system. Justify your answer.

7. Based on your answers to question 4-6, develop some rules that relate energy transfer into/out of a system by an object external to the system exerting a force on the system.

8. Suppose the student from scenario 1 now pushes the cart with a force of magnitude **2F** across a level surface a displacement of **Δx**. The cart is displaced to the right. **Assume there is no friction between the cart and the floor.**

F$_{student/cart}$ v$_{i =}$ 0 m/s

Δx

SYSTEM SCHEMA	ENERGY PIE CHARTS

9. Suppose the student from scenario 1 pushes the cart with a force of magnitude **F** across a level surface a displacement of **2Δx**. The cart is displaced to the right. **Assume there is no friction between the cart and the floor.**
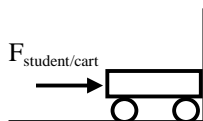
F$_{student/cart}$ v$_{i =}$ 0 m/s

2Δx

SYSTEM SCHEMA	ENERGY PIE CHARTS

10. A student from scenario 1 pushes on the cart with a force of magnitude **F** as shown below. The cart is up against a wall and does not move.

$F_{student/cart}$

SYSTEM SCHEMA	ENERGY PIE CHARTS

11. Based on your answers to questions 8-10 update the rules you developed earlier that relate energy transfer into/out of a system by an object external to the system exerting a force on the system.