**Unit 4 - Worksheet 4**

**Pairs of Forces**

Adapted from AMTA 2018

For each of the scenarios below:

1. Fill in the table with a system schema.
2. Identify the Newton’s 3rd Law pairs, using agent-object notation.
3. Construct a force diagram for each object.

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| 1. One book lies on top of a second book, which rests on a table. | Newton’s 3rd Law Pairs: |
| System Schema: | Force Diagrams: |

|  |  |
| --- | --- |
| 1. A person exerts an upward force of 40 N to hold a bag of groceries. | Newton’s 3rd Law Pairs: |
| System Schema: | Force Diagrams: |

|  |  |
| --- | --- |
| 1. A magnet is suspended from the ceiling by a string. A second magnet is held up by the first magnet. | Newton’s 3rd Law Pairs: |
| System Schema: | Force Diagrams: |

1. Suppose you are sitting on a chair that stands on the ground. Draw separate well-labeled force diagrams for your body, the chair, and the whole earth. Show the relative sizes of the forces by using a longer arrow for a larger force and equal length arrows for forces equal in magnitude. Identify the force pairs.
2. Suppose you are standing on the ground in a shed and pulling vertically downward on a string that is attached to the bottom of a block that hangs from the ceiling on a rope. Draw a physical diagram of this situation. Draw separate, well-labeled force diagrams for your body, the string, the block, the rope, the shed, and the whole earth. Label all force pairs that occur in your diagrams
3. For each of the positions described below, draw a physical diagram of the situation, and separate, well-labeled force diagrams for the jumper and the earth. Label any force pairs that occur in your diagrams.
4. Suppose you are in the act of jumping vertically upward. Your legs are flexed and pushing on the floor so that your body is being accelerated upward and have not yet left the ground.
5. Draw the force diagrams for the situation just after your body leaves contact with the floor and you are on your way up.
6. Repeat for the situation for some point on the way down before you have reached the ground.
7. Repeat for the situation just after you hit the ground and your bent legs are slowing you down.
8. A horse, who has been reading in his physics book about force pairs, questions whether he can actually pull the wagon full of produce to the farmer’s market. When the farmer says “Giddyup”, the horse replies “Sorry, there is just no way I can do it. If I pull on the wagon, the wagon will pull back on me just as hard. The forces will cancel, and we won’t be able to move.”
9. Draw a force diagram for a system that consists of only the wagon. Explain how it is possible for the wagon to accelerate.
10. Draw a force diagram for a system that consists of only the horse. Explain how it is possible for the horse to accelerate.
11. Draw a force diagram for a system that includes both the horse and the cart. Explain how it is possible for the whole system to move.
12. Explain the flaw in the horse’s reasoning about Newton’s 3rd Law.
13. For each situation shown below, draw a force diagram for block A, a force diagram for block B, and a force diagram for a system that includes both blocks.

a.

constant **v**



# A

# B

50 g

50 g



# B

50 g

constant **a**

# A

50 g

b.



constant **a**

# A

50 g

# B

100 g

c.