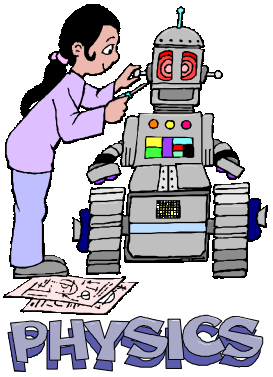
Science 9-Physics
Activity 19F—Pulley Systems



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Name _____

Due Date _____

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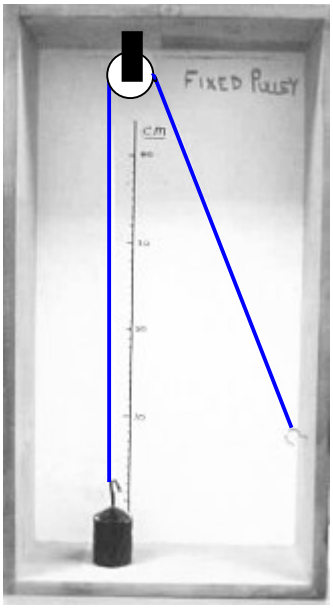
Purpose: To investigate five different types of **pulley systems** and determine the **mechanical advantage** of each of them.

Procedure:

Go to one of the five pulley systems set up in the lab. Find the section for this pulley system on this handout, follow the procedure and do the questions as indicated. When you have finished, go on to another pulley system and repeat until you've done all five systems.

Pulley System # 1—A Single Fixed Pulley



1. The mass hanging on the string is _____grams.

   This is _____ kg.

   The **Force of Gravity** on the mass is _____N

   The **Load Force** of this Simple Machine is _____N

2. Unhook the string from the hook and pull it with a spring scale. Measure the force needed to gently pull the mass up by pulling down on the string. This is called the Effort Force.

   The **Effort Force** of this simple machine is _____N

3. Calculate the **Mechanical Advantage** of this pulley system.

   MA = $\frac{\text{Load Force (N)}}{\text{Effort Force (N)}}$ = $\frac{\text{_____N}}{\text{N}}$ = _____

4. How many strings are **directly** holding up the black weight? _____string(s)

5. Remove the spring scale from the end of the string and hold the string in your hand. With a ruler, measure the distance you have to pull the string down in order to lift the weight up a distance of 10 cm. Record your answer here:

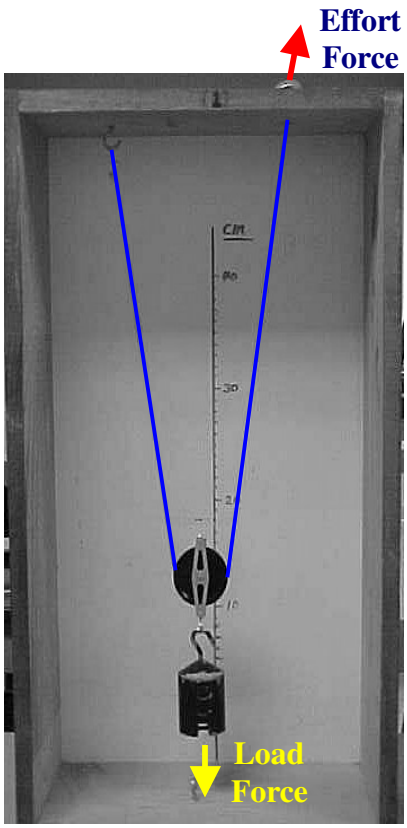
   In order to lift the weight up 10 cm, we have to pull the string down _____ cm.

6. Does this pulley system offer a real **force advantage**? _____

7. Does this pulley system offer a real **speed advantage**? _____

8. Does this pulley system offer a **direction advantage**? _____

Pulley System # 2—A Single Movable Pulley



1. The mass hanging on the string is _____grams.

   This is _____ kg.

   The **Force of Gravity** on the mass is _____N

   The **Load Force** of this Simple Machine is _____N

2. Hook a spring scale to the washer at the top of the box and pull up gently to determine the Effort Force. Record it here:

   The **Effort Force** of this pulley system is _____N

3. Calculate the **Mechanical Advantage** of this pulley system.

   $$\textbf{MA} = \frac{\text{Load Force (N)}}{\text{Effort Force (N)}} = \frac{\_\_\_\_\_\text{N}}{\text{N}} = \_\_\_\_\_$$

4. How many strings are **directly** holding up the black weight? _____string(s)

5. Take the spring scale off the washer and, with a ruler, measure how far you have to pull the washer up in order to raise the weight a distance of 10 cm.

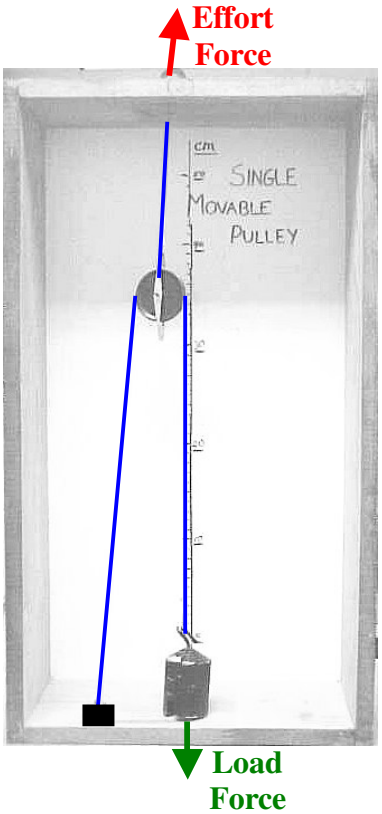
   In order to lift the weight up 10 cm, we have to pull the washer up _____ cm.

6. Does this pulley system offer a real **force advantage**? _____

7. Does this pulley system offer a real **speed advantage**? _____

8. Does this pulley system offer a **direction advantage**? _____

Pulley System # 3—A Different Single Movable Pulley



1. The mass hanging on the string is _____grams.

   This is _____ kg.

   The **Force of Gravity** on the mass is _____N

   The **Load Force** of this Simple Machine is _____N

2. Hook a spring scale to the washer at the top of the box and pull up gently to determine the Effort Force. Record it here:

   The **Effort Force** of this pulley system is _____N

3. Calculate the **Mechanical Advantage** of this pulley system.

   MA = $\frac{\text{Load Force (N)}}{\text{Effort Force (N)}}$ = $\frac{\text{\_\_\_\_\_N}}{\text{N}}$ = _____

4. How many strings are **directly** holding up the black weight? _____string(s)

5. Take the spring scale off the washer and, with a ruler, measure how far you have to pull the washer up in order to raise the weight a distance of 10 cm.

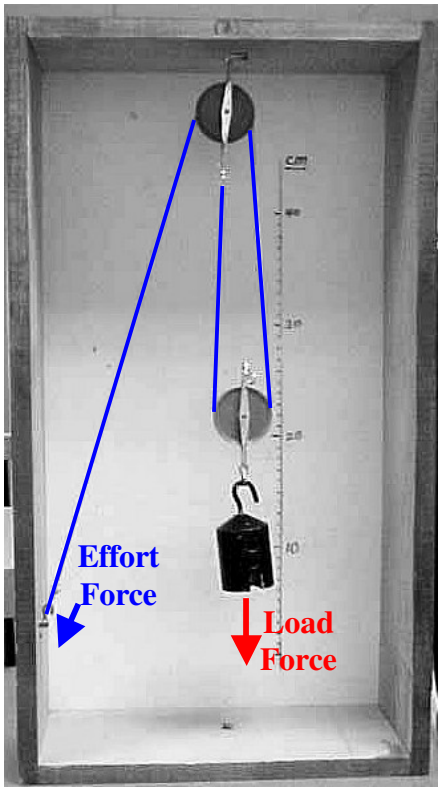
   In order to lift the weight up 10 cm, we have to pull the washer up _____ cm.

6. Does this pulley system offer a real **force advantage**? _____

7. Does this pulley system offer a real **speed advantage**? _____

8. Does this pulley system offer a **direction advantage**? _____

Pulley System # 4—A Double Pulley System with one Fixed and one Moveable Pulley



1. The mass hanging on the string is _____grams.

   This is _____ kg.

   The **Force of Gravity** on the mass is _____N

   The **Load Force** of this Simple Machine is _____N

2. Unhook the string at the bottom left of the box and BE CAREFUL TO KEEP TENSION ON THE STRING! Hook up a spring scale and with the spring scale, pull down gently to determine the Effort Force. Record it here:

   The **Effort Force** of this pulley system is _____N

3. Calculate the **Mechanical Advantage** of this pulley system.

   MA = $\frac{\text{Load Force (N)}}{\text{Effort Force (N)}}$ = _____N / N = _____

4. How many strings are **directly** holding up the black

   weight? _____string(s)

5. Take the spring scale off the string, with a ruler, measure **how far** you have to pull the string on the left down, in order to raise the weight a distance of 10 cm.

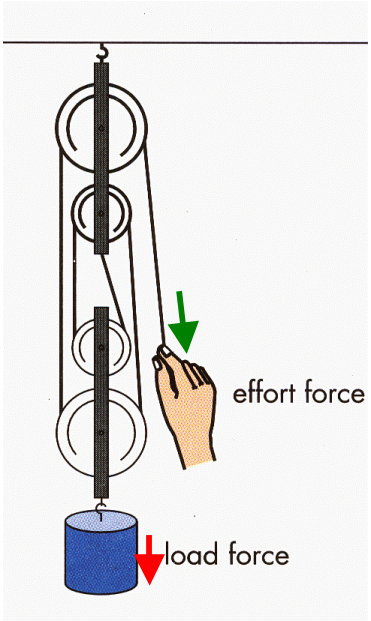
   In order to lift the weight up 10 cm, we have to pull the string down _____ cm.

6. Does this pulley system offer a real **force advantage**? _____

7. Does this pulley system offer a real **speed advantage**? _____

8. Does this pulley system offer a **direction advantage**? _____

Pulley System # 5—A Four Pulley System



1. The **Force of Gravity** on the mass is _____N

   The **Load Force** of this Simple Machine is _____N

2. Gently unhook the spring scale from it's anchor at the bottom right and BE CAREFUL TO KEEP TENSION ON THE STRING! Using the spring scale, pull down gently to determine the Effort Force. Record it here and then hook it back up again:
   The **Effort Force** of this pulley system is _____N

3. Calculate the **Mechanical Advantage** of this pulley system.

   $$\textbf{MA} = \frac{\text{Load Force (N)}}{\text{Effort Force (N)}} = \frac{\_\_\_\_\_\text{N}}{\text{N}} = \_\_\_\_\_$$

4. How many strings are **directly** holding up the black

   weight? _____string(s)

5. Take the spring scale off the string, with a ruler, measure **how far** you have to pull the string on the left down, in order to raise the weight a distance of 10 cm. KEEP THE TENSION ON THE STRING SO THE SYSTEM DOESN'T FALL APART!!!

   In order to lift the weight up 10 cm, we have to pull the string down _____ cm.

6. Does this pulley system offer a real **force advantage**? _____

7. Does this pulley system offer a real **speed advantage**? _____

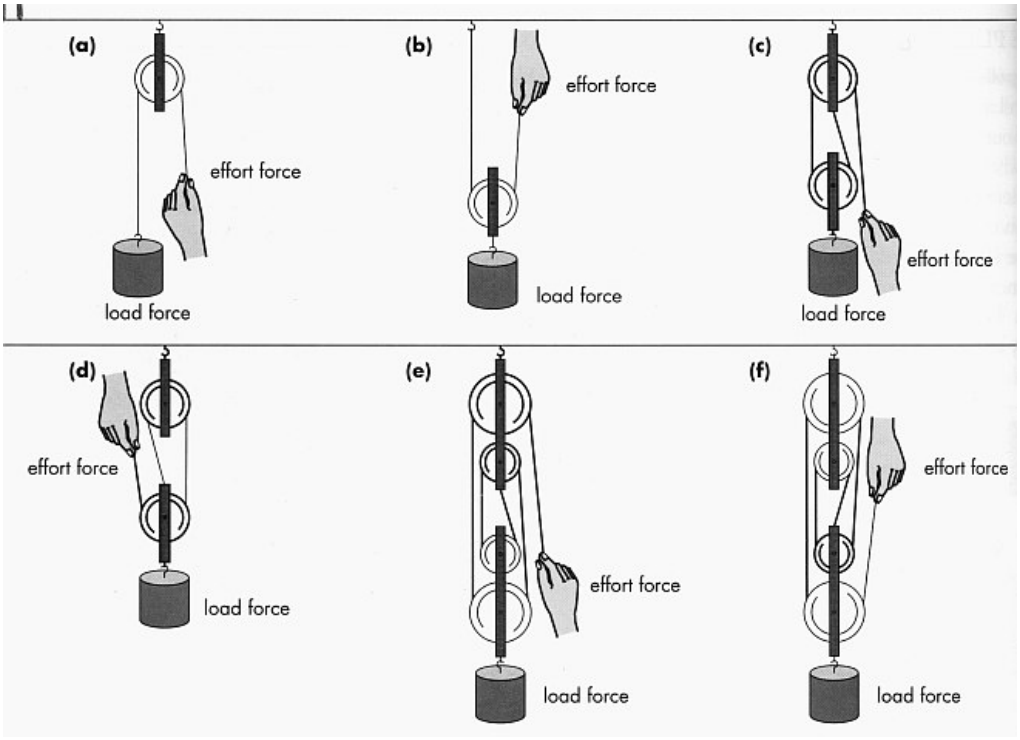
8. Does this pulley system offer a **direction advantage**? _____

Questions:

1. What happens to the Mechanical Advantage when the number of strings directly supporting

   the load **increases**? _____

2. For each of the pulley systems in the following diagram, count the number of strings directly supporting the weight (support strings) and predict the value for the Mechanical Advantage of each system:



Pulley System	Number of Support Strings	Predicted Mechanical Advantage
a		
b		
c		
d		
e		
f		

3. Suggest some practical uses for pulley systems in the real world. (Consider hunters, meat packers, auto-mechanics etc. etc.)