Student Name: ­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Unit 3: Systems**

**Lesson 1: Core Technologies**

File 3.1.4: Mechanical Advantage Worksheet

Simple machines (lever, pulley, wedge, screw, inclined plane, wheel, and axle) are often combined to create complex mechanical machines. Simple machines apply mechanical advantage to typically move an output force (load) with an input force (effort), less than that of the output force. The general equation for mechanical advantage is shown below:

Mechanical Advantage = Load/Effort

Each simple machine possesses its own equation for mechanical advantage. The formula for mechanical advantage for each simple machine is represented below:

|  |  |
| --- | --- |
| Lever | Inclined Plane |
| Mechanical Advantage of a Lever =  Length to Effort/Length to Load | Mechanical Advantage of an Inclined Plane = Length of Plane/Height of Plane |
| Wheel and Axle | Pulley |
| Mechanical Advantage of a Wheel and Axle = Radius of Effort/Radius of Load | Mechanical Advantage of a Pulley =  number of ropes that support the pulley |
| Wedge | Screw |
| Mechanical Advantage of a Wedge =  Length of slope/thickness of wedge | Mechanical Advantage of a Screw =  circumference / pitch |

**Practice**

Using the equations above, calculate mechanical advantage for the following examples. Be sure to show your work.

1. What is the mechanical advantage of the system pictured on the right?

2. If the load is 100 pounds, how much effort is required to pick up the load?

3. What is the mechanical advantage of the system pictured on the left if the diameter of the wheel is 15 feet and the diameter of the axle is 3 feet?

4. If Mrs. Jones can only pull with 25 lbs. of force, how much weight can she lift using the wheel and axle system from question 3?

5. If we build a ramp in Tech Ed class that is 2 feet high, and the length of the ramp is 30 feet, what is the mechanical advantage?

6. How much effort force would someone need to push a 50-pound box up the ramp from question 5?

7. Jose and Suzette construct an arm where the effort is located 10 inches from the fulcrum and the load is 25 inches from the fulcrum, what is the mechanical advantage of the arm?

**Application**

One student group has decided to design a device where a toy car (10 grams) must apply a force to lift a 50-gram weight 2 inches in the air. What simple machine could the group use, and what mechanical advantage would they need to achieve their goal? Place your answer, including a sketch of the device, in the space below.

**Reflection on the Design Problem**

How could simple machines and mechanical advantage help me in designing my device for the Rube Goldberg activity?

Write your response in the space below using complete sentences.

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