Mechanical Advantage Worksheet B

NAME: _____

DATE: _____

REMINDER:
Mechanical Advantage = Output Force/ Input Force = Input length/ Output Length

Lever: Mechanical Advantage = length of input arm/ length of output arm

Pulley: Count the number of rope segments that exert an upward force on the object being moved.

Wheel and Axle: MA = radius of wheel/radius of axle

Inclined Plane: MA = length of slope/ height of slope

Wedge: MA = length of slope/ width of wedge at widest part

Screw: MA = circumference of the screwdriver/ pitch of the screw

Solve the following problems, showing your work, and turn it in upon completion.

Questions:

1. What is the mechanical advantage of a lever with an input arm of 3 m and an output arm of 12 m?

2. You use a lever to lift a filing cabinet to get a lost key. The input arm is 2 ft and the output arm is 1 ft. What is the MA of the lever?

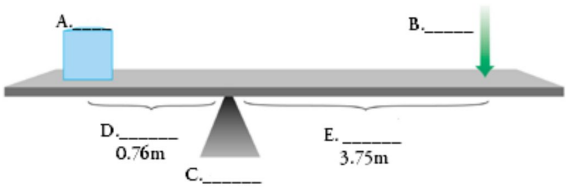
3. You apply a force on a crowbar to open a stuck door. The input length of the crowbar is 26 cm long and the ouput length is 4 cm. Find the MA of the crowbar.

4. A worker uses a board that is 4 m long to pry up a boulder. A small rock is used for a fulcrum and is placed 0.5 m from the output end of a lever. Calculate the MA of the board.

5. Three of your friends are all sitting on one end of a seesaw. The combined weight is 275 N. The length from the fulcrum to your friends is 2.5 m. The rest of the seesaw (from the fulcrum to you) is 4.5 m. What is the MA? What effort force is needed to lift your friends?

6. If you try opening a door by pushing too close to the side where the hinges are, you may find it difficult to push open. Suppose you are trying to open a door that is 85 cm wide. If you push on the door at a point 15 cm away from the hinges, what is your mechanical (dis)advantage?

7. Examine the diagram below and label the lettered parts. Then calculate the mechanical advantage.



8. Suppose you exert a force of 2,800 N to lift a desk up onto a porch. But if you use a ramp, you need to exert a force of only 1,400 N to push it up the ramp onto the porch. What is the mechanical advantage of the ramp?

9. Suppose you built a ramp to the front door of the post office for people using wheelchairs. The post office door is 3 m above the level of the sidewalk. The ramp you build is 15 m long. What is the mechanical advantage of your ramp?

10. It takes 13 kg to push a 52 kg object up an inclined plane. Calculate the mechanical advantage of the inclined plane.

11. A mover uses a ramp to load a crate of nails onto a truck. The crate, which must be lifted 1.4 m from the street to the bed of the truck, is pushed along the length of the ramp. If the ramp is 4.6 m long and friction between the ramp and crate can be ignored, what is the mechanical advantage of the ramp?

12. A wedge with a mechanical advantage of 0.78 is used to raise a house corner from its foundation. If the output force is 7500 N, what is the input force?

13. A complex arrangement of pulleys forms what is called the block in a block and tackle. The rope used to lift the pulleys and the load is the tackle. A block and tackle is used to lift a truck engine, which has a weight of nearly 7406 N. The force required to lift this weight using the block and tackle is 308.6 N. What is the mechanical advantage of the block and tackle?

14. Marc is asked to raise a flag at the Remembrance Day ceremonies at his school. If the effort force to raise the flag is 50 N and the load force the flag plus the rope is 50 N what is the mechanical advantage of the pulley on the flagpole?

15. A pennyfarthing is a style of bicycle with a very large front wheel and a small rear wheel. The cyclist, who sits high above and behind the front wheel, pedals this wheel directly. The distance the pedals are turned (input distance) in one rotation is about 0.64 m. If the mechanical advantage of the pennyfarthing is 0.16, how far does the large wheel turn in one rotation?

16. Suppose the radius of your bicycle's wheel is 30 cm. The radius of the bicycle's axle is just 5 cm. What is the ideal mechanical advantage of the wheel and axle?

17. The wheel of a small dirt bike has a radius of 30 cm. The axle has a radius of 20 cm. What is the mechanical advantage of the wheel and axle?