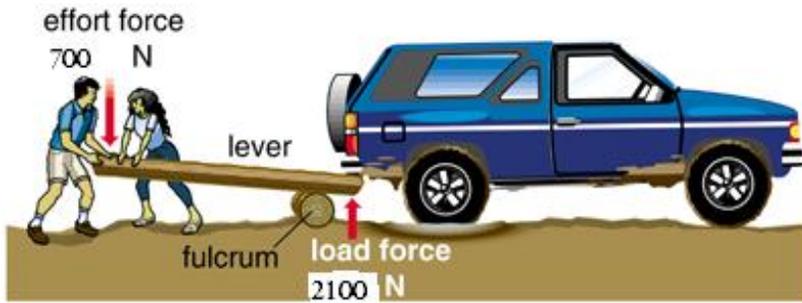


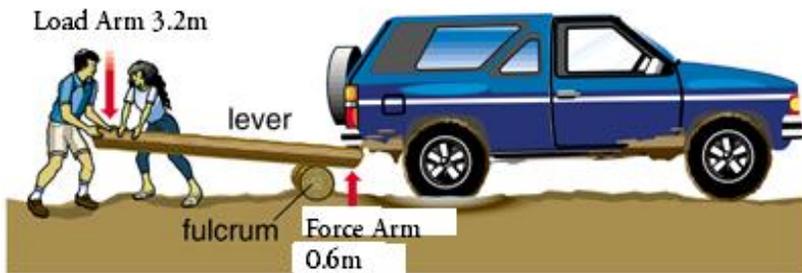
## MECHANICAL ADVANTAGE PRACTICE PROBLEMS

### Lever

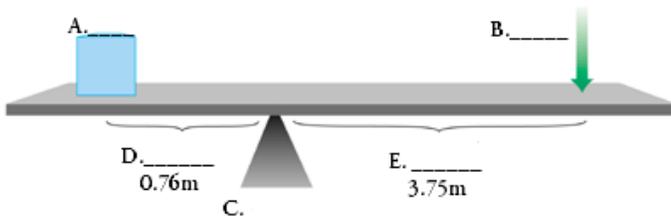
1. What is the ideal mechanical advantage of a lever with a resistance arm of 3 m and an effort arm of 12 m?
2. You use a lever to lift a filing cabinet to get a lost key. The effort arm is 2 ft and the resistance arm is 1 ft. What is the MA of the lever?
3. You apply a force on a crowbar to open a stuck door. The effort length of the crowbar is 26 cm long and the resistance 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 resistance 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. To lift a refrigerator, you can apply a force of 50 N to the 3ft end of a lever. The lever applies a force of 550 N to the fridge. How long must the resistance arm be to accomplish this task?
7. To pull a tree out of a yard, you can apply a force of 50 N to the shovel. The shovel applies a force of 900 N to the tree (load). What is the mechanical advantage of the shovel?
8. To pry a wooden board off of a tree house, you can apply a force of 50 N to a lever. The lever applies a force of 750 N to the board. What is the mechanical advantage of the lever?
9. You apply a force of 18 N on to the end of a lever to open a paint can lid. The resistance of the lid is 9 N. Calculate the MA.
10. What is the mechanical advantage of a hammer if the resistance force is 3500 N and the effort force is 130 N?
11. Suppose you held the handles of a wheelbarrow 2.4 m from where they are attached to the wheel. The heavy stone in the wheelbarrow was 1.2 m from the wheel. What is the ideal mechanical advantage of the wheelbarrow?
12. What is the M.A. of a lever with a resistance arm of 1.5 feet and an effort arm of three feet?
13. A lever has an effort arm of one meter. The resistance arm is .5 meters. What is the mechanical advantage?
14. What is the mechanical advantage of a lever with a resistance arm of 1.2 meters and an effort arm of three meters?
15. You apply a force of 18 N onto the end of a lever to open a paint can lid. The resistance of the lid is 9 N. Calculate the MA.
16. You apply a force on a crowbar to open a stuck door. The effort length of the crowbar is 26 cm long and the resistance length is 4 cm. Find the MA of the crowbar.
17. 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 resistance end of the lever. Calculate the MA of the board.
18. Susan and Jake's truck gets stuck in the mud. They used a tree branch as a lever to lift the truck out of the mud. They applied an effort force of 700N to the branch and the back of the truck weighs 2100N. What is the mechanical advantage of the tree branch lever?



19. Susan and Jake take Susan's car for a drive and get stuck in the mud. The back of Susan's car weighs 900 N. They applied 700 N of force to the tree branch lever. What is the mechanical advantage of the tree branch?
20. If the branch lever mentioned in question 2, the force arm was 3.2m long and the load arm was 0.6m, then what is the mechanical advantage?



21. If Susan and Jake made the force arm 0.2 m instead of 3.2 m then what is the mechanical advantage? Is this easier or harder to lift the load?
22. 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 the mechanical advantage?
23. The input distance of a screw is equal to the circumference of the screw multiplied by the number of times it is turned. If a screw with a circumference of 19 mm is turned 4 times, so that it penetrates into a piece of wood a distance of 8.5 mm, what is the screw's mechanical advantage?
24. A crow bar (lever) is often used to lift a large object. If the crowbar is 100 cm long and the object is 20 cm from the fulcrum, what is the mechanical advantage of the crowbar?
25. Examine the diagram below and label the lettered parts. Then calculate the mechanical advantage.



## Inclined Plane

1. 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?
2. Suppose you built a ramp to the front door of the post office for people using wheel chairs. The post office door is 3 m above the level of the sidewalk. The ramp you build is 15 m long. What is the ideal mechanical advantage of your ramp?
3. It takes 130 N to push a 52 kg object up an inclined plane. Calculate the mechanical advantage of the inclined plane.
4. 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?
5. It has been proposed that the stones of the Pyramids in Egypt were raised by using ramps. Suppose one of these ramps had a mechanical advantage of 3.86. If an input force of 6350 N was provided by laborers, what would the output force on the stone have been?
6. 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?
7. What is the mechanical advantage of the inclined plane illustrated below?



## Pulley

1. 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?
2. 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?

## Wheel and Axle

1. 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?
2. 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?
3. 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?