

Work and Mechanical Advantage Practice Problems

Use the formula to solve each problem on your own sheet of notebook paper. Make sure you show your work (how the numbers are plugged into the formula) and use the correct units when necessary!

Work: $Work = force \times Distance$

1. How much work is done on a 75 N bowling ball when you carry it horizontally across a 10m wide room?
2. How much work is done when a force of 1N moves a book 2m?
3. You must exert a force of 4.5 N on a book to slide it across a table. If you do 2.7J of work in the process, how far have you moved the book?
4. A child pulls a sled up a snow-covered hill. In the process, the child does 405 J of work on the sled. If she walks a distance of 15 m up the hill, how large a force does she exert on the sled?
5. 55, 000J of work is done to move a rock 25m. How much force was applied?
6. You and 3 friends apply a combined force of 489.5N to push a piano. The amount of work done is 1762.2J. What distance did the piano move?
7. If it took a bulldozer 567.6 joules of work to push a mound of dirt 30.5 meters, how much force did the bulldozer have to apply?
8. A frontend loader needed to apply 137 Newtons of force to lift a rock. A total of 223 joules of work was done. How far was the rock lifted?
9. A young boy applied a force of 2,550 Newtons on his St. Bernard dog who is sitting on the boy's tennis shoes. He was unable to move the dog. How much work did he do trying to push the dog?

Mechanical Advantage: $MA = \frac{Resistance\ force}{Effort\ force}$ or $MA = \frac{Length\ of\ effort\ arm}{Length\ of\ Resistance\ Arm}$

10. A force of 50N is applied to the end of a lever to lift a rock that is 350N. What is the MA of the lever?
11. Using the MA from the previous question, if the input distance is 2 m what is the output distance? (If you draw a picture it will help)
12. A lever used to lift a heavy box has an input arm of 4 meters and an output arm of 0.8 meters. What is the mechanical advantage of the lever?
13. What is the mechanical advantage of a lever that has an input arm of 3 meters and an output arm of 2 meters?
14. A lever with an input arm of 2 meters has a mechanical advantage of 4. What is the output arm's length?
15. A lever with an output arm of 0.8 meter has a mechanical advantage of 6. What is the length of the input arm?

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16. A rake is held so that its input arm is 0.4 meters and its output arm is 1.0 meters. What is the mechanical advantage of the rake?
17. A broom with an input arm length of 0.4 meters has a mechanical advantage of 0.5. What is the length of the output arm?
18. A child's toy rake is held so that its output arm is 0.75 meters. If the mechanical advantage is 0.33, what is the input arm length?
19. If an input force of 202 N is applied to the handles of the wheelbarrow. If the total weight of the wheelbarrow is 444.4 N, what is the mechanical advantage of the wheelbarrow?
20. To calculate the mechanical advantage of a wheelbarrow you need to make two measurements. 1. The distance from the handles to the wheel, the input distance and 2. The distance from the center of the load to the wheel, the outputs distance. If the wheelbarrow's input distance is 0.99 m and the output distance is 0.45 m, what is the mechanical advantage of the wheelbarrow?
21. Amanda uses a wheelbarrow to lift a load of bricks. The bricks weigh 600 N, which is more than Amanda could normally carry. However, with the wheelbarrow, Amanda can lift the bricks with as little as 120 N. What is the mechanical advantage of the wheelbarrow?
22. Marshall wants to remove a tree stump from the ground. To do this, he puts one end of a long beam under the stump and puts all of his weight on the other end. His weight is just enough to lift the stump. The stump weighs 400 N. Marshall weighs 250 N. What is the mechanical advantage of the lever Marshall is using?

Efficiency: $Efficiency = \frac{Work\ output}{Work\ input} \times 100$

23. What is the efficiency of a machine that requires 120J of input energy to do 35 J of useful work?
24. What is the efficiency of a cyclist who expends 900J of work to his bike for it to produce 76 J of useful work?