

Newton Has the Joules

Purpose: To calculate work in a variety of tasks

Formulas/conversions:

Work = Force x Distance ($W = F \times d$)

1 lb = 2.21 kg

1 kg = 9.8 newtons

1 newton-meter = 1 joule

Materials

scales or balance
objects to lift
meter sticks
calculators
science journal

Background

Work is done by a force acting through a distance. For work to be done, a force must move an object. If there is not movement, there is no work. Work is the product of the force applied to an object and the distance through which the force is applied. The formula used to express this concept is work (W) = force (F) x distance (d). As you can see from the formula, two conditions must be met for work to be done. One, a force must be applied, and two, the force must make the object move.

To calculate how much work is being done, follow these steps:

1. Find the mass of the object in grams and convert to kilograms.
2. Convert the mass of the object to weight by multiplying the mass by 9.8. Force is measured in newtons, so this number is the amount of force or the number of newtons that it will take to lift the object.
3. Measure (in meters) the distance that the object is lifted. Remember that the force must be applied in the same direction. If you lift an object 2 meters and walk 5 meters with it, you only did work when you lifted the object.
4. Multiply the number of newtons and the distance the object was lifted to get the unit of work, which is called a newton-meter (N-m).
5. One newton-meter is equal to one joule (unit of measure for energy or work).

Procedure

1. Your group will be competing with the other groups in your class. The object of the game is to do more work than any other group.
2. You have 10 minutes to carefully read the explanation above and discuss within your group how work is done. Reach a consensus about how to do more work than the other groups.
3. Choose one person in your group to be the worker.
4. Choose three objects in the classroom for the worker to lift and record them in your science journal.
5. Using the balance, find the mass of the first object and convert to newtons.
6. Have the worker lift the object. Measure and record the distance the object was lifted.
7. Multiply the newtons and the distance to find Newton-meter (unit of work).
8. Convert newton-meters to joules and record in your science journal.
9. Repeat steps 3-8 with the other two objects.
10. Find the sum of the three joules of work completed by your group.
11. Share with the class the amount of work your group did to determine which group did the most work. They are the "hardest workers."

Conclusion

1. What is force?
2. What is work?
3. Since Jacob weighs 90 lb and they need to lift him over 3.5 m, how much work will they need to do to lift him to the tree house?
4. What other factors do the tree house detectives have to consider to calculate the amount of work needed to get Jacob into the tree house?

