

Work Encyclopedia Article

Work

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Work

Who is doing more work, a weight lifter holding up, but not moving, a 200 lb (91 kg) barbell, or an office worker lifting a pen? The weight lifter is certainly exerting more effort, and many people would say doing more work. To a physicist, however, the office worker is doing more work as long as the weight lifter does not actually move the barbell. The weight lifter does a considerable amount of work lifting the barbell in the first place, but not in holding it up.

The term work has a very specific meaning in physics that is different from the everyday use of the term. In physics, the amount of work is the **distance** an object is moved times the amount of **force** applied in the direction of the **motion**. If the force is not parallel to the direction of motion, the force must be multiplied by the **cosine** of the **angle** between the force and the direction of motion to get the component of the force parallel to the motion.

If the force applied in the direction of motion is **zero**, then the work done is zero regardless of the amount of motion. Likewise, if the distance moved is zero, then the work done is zero regardless of the force applied. Any number multiplied by zero is still zero. In the above example, the weight lifter is exerting a large force, but as long as he doesn't actually move the weight he is doing zero work, just exerting a lot of effort. The office worker does not need to exert much force to lift the pen, but the force is not zero. So lifting and moving the pen is more work than supporting but not moving the weight. Now think about the weight lifter actually lifting the weight. There is a large force required to lift the weight, and it moves several feet. The weight lifter is now doing quite a bit of work. To do work you must actually move something. Just exerting a force, no matter how large, is not enough.