Energy, Work, and Power

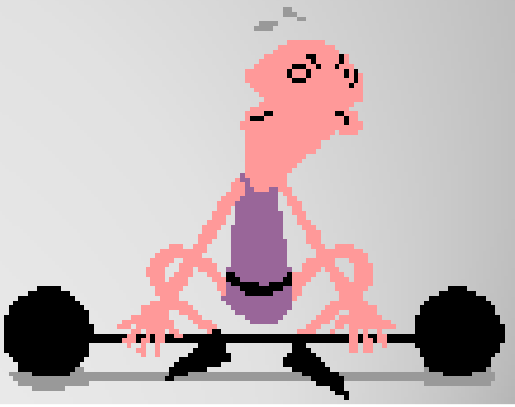
1. What would happen to the force of gravity if you doubled the mass of one object and tripled the distance it is away from the other.

2. What would happen to the tension in a rope (equal to F_c) it your doubled the radius of the rope you were swinging around?

Intro

Work

- Work is done when a force acts on an object and moves it a certain distance.
- Work = net force x distance
- **W=Fd**
- The unit for work is the **<u>Joule</u>** which is a N·m



d = 2.5 m

500 N of force applied

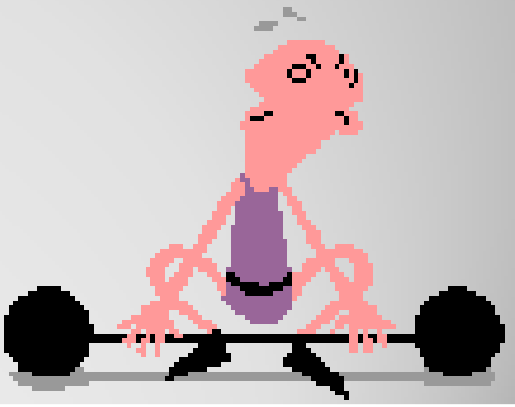
Ex A. How much work is being done by a weightlifter below that applies 500 Newtons of force lifting a mass 2.5 meters?

F= 500 N

d = 2.5 m

W=Fd

W= (500)(2.5) = 1250 J



d = 2.5 m

500 N of force applied

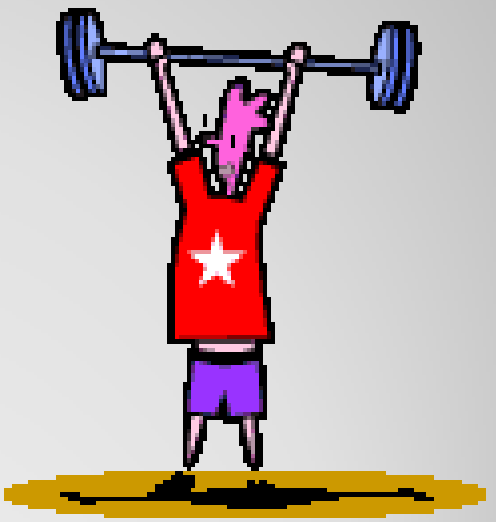
Ex B. How much work is being done by a weightlifter below that applies 1000 Newtons of force but does not move the mass?

F= 1000 N

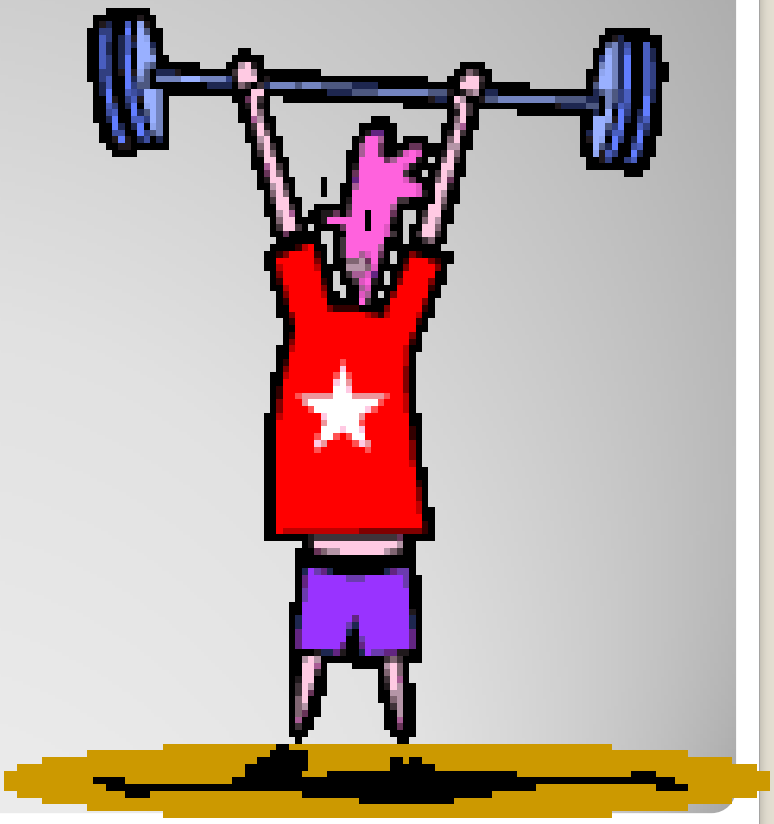
d = 0 m

W=Fd

W= (1000)(0) = 0 J



- **W=Fd**
- No work is done if the object does not travel a distance



Work

- **<u>Power</u>** is the rate at which work is done. Work divided by time

$$P = \frac{W}{t}$$

or

$$P = \frac{Fd}{t}$$

Power

- The unit of power would be joules per second or the **watt**
- **A watt equals one joule of energy in one second**

Unit of Power

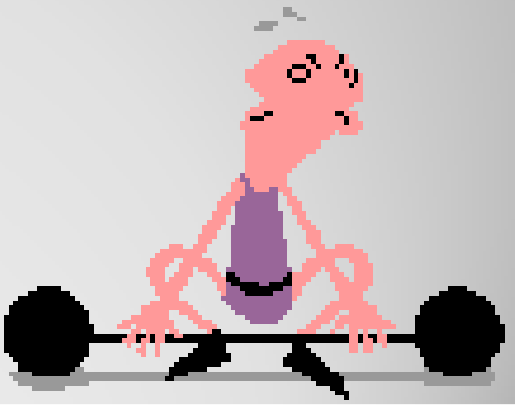
Ex C. A weightlifter who does 1250 Joules of work in 0.5 s applies how much power?

W= 1250J

t= 0.5s

P= W/t

P= 1250/0.5 = 2500 watts



d = 2.5 m

500 N of force applied

Ex D. A weightlifter pulls with 500N of force lifting an object 2.5m in 1.5s. How much power did he apply?

$$P = \frac{W}{t} \quad \text{or} \quad P = \frac{Fd}{t}$$

F= 500 N

d = 2.5 m

t= 1.5 s

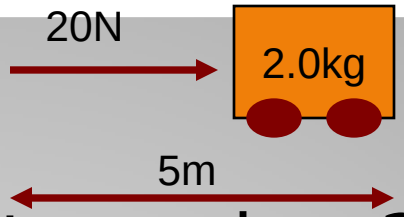
P= (Fd)/t = ((500)(2.5))/1.5 = 833 watts

500 N of force applied

Ex. E: A girl weighing 500 Newtons takes 50 seconds to climb a flight of stairs 18 meters high. What is her power output vertically?

Ex. E: A girl weighing 500 Newtons takes 50 seconds to climb a flight of stairs 18 meters high. What is her power output vertically?

Problem Set #1

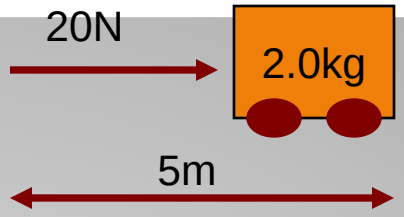


1. A 20 N force is used to push a 2.00 kg cart a distance of 5 meters. What is the work done on the cart?

2. How much power is needed to do push the cart in the example above in 7 seconds?

3. A girl weighing 300 Newtons takes 45 seconds to climb a flight of stairs 24 meters high. What is her power output vertically?

Problem Set #1



1. A 20 N force is used to push a 2.00 kg cart a distance of 5 meters. What is the work done on the cart?

Problem Set #1

2. How much power is needed to do push the cart in the example above in 7 seconds?

Problem Set #1

3. A girl weighing 300 Newtons takes 45 seconds to climb a flight of stairs 24 meters high. What is her power output vertically?

Ex. O: Ned tightens a bolt in his car engine by exerting a 12 N force on his wrench at a distance of 0.40 m from the fulcrum. How much torque must Ned produce to turn the bolt?

Conservation of Ene

- **<u>Law of conservation of energy-</u>** energy cannot be created or destroyed. It can be transformed from one form into another, but the total energy never changes.

FIGURE 9.6 ▲ ©
When released, potential energy will become the kinetic energy of the arrow.