Hello!

- Grab a whiteboard.
- Write the formula for work on it.

This Week

- M: Into to Work, Power and Energy.
- T: Continue Work, Power and Energy.
- W: Review for quiz.
- R: Quiz.
- F: Lab.

Work

- When something is displaced by a force.
- Work is only measured by the **component** of force in the direction of the displacement.
- Formula: work = force x displacement x Cosθ.

Cosθ

- Θ: the angle **between** the direction of the force and the direction of the displacement.
- If the force and direction are in the same direction, θ=0.

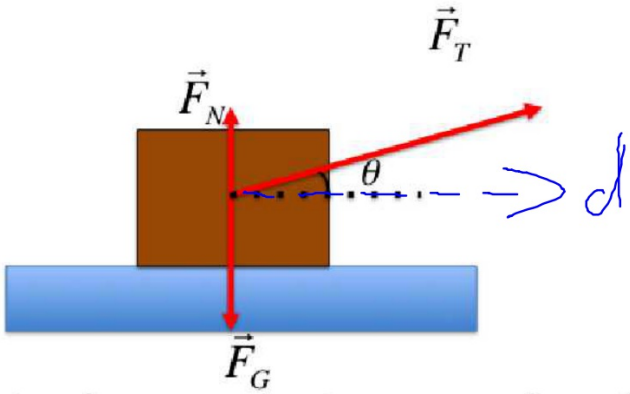
Find θ and calculate Cosθ

A man pushes a car to the right

Find θ and calculate Cosθ

Gravity accelerates a skydiver.

Find θ and calculate Cosθ

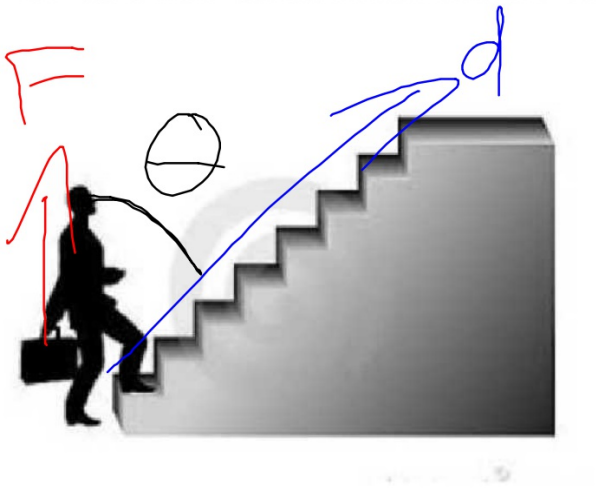


A box is dragged at an angle of 30°

Find θ and calculate Cosθ

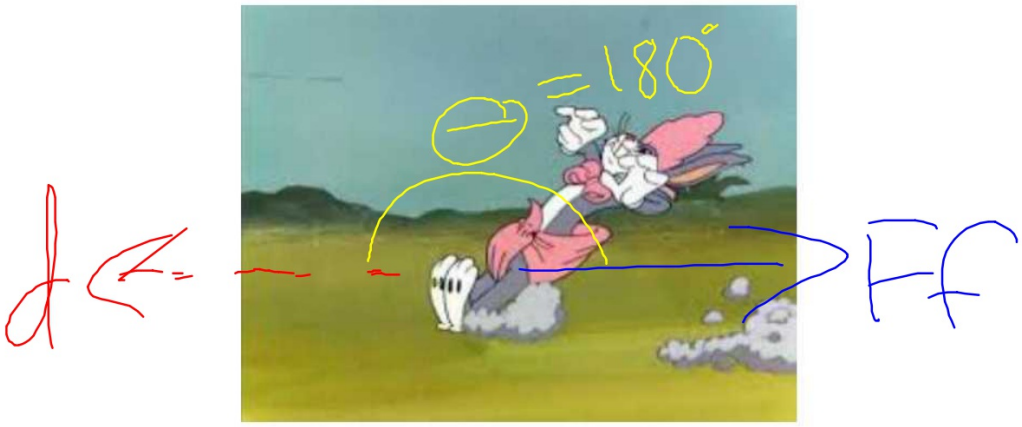
A server carries a tray across a restaurant

Find θ and calculate Cosθ



A man carries a briefcase up stairs

Find θ and calculate Cosθ



A rabbit skids to a stop

Circular Motion Quizzes

The average was a 91.8%!

Way to go!

Check that the grade on the quiz is the same as the grade on IC.

Work = FDCosθ

- W: work done on a system [Nm or joules]
- F: the force applied [N]
- D: the displacement [m]
- Cos θ: ratio comparing the angle of force and displacement. [none]

Joules [J]

- Metric unit of energy.
- Defined in many ways:
  - Newton Meters: Nm
  - F=ma, so energy is also (kgm/s^2)xm
  - This becomes kgm^2/s^2
  - Others to follow in later weeks.

$W = F \cdot d \cdot \cos\theta$

Calculate the energy put into the system.

K: $F = 200N$

$d = 5m$

$\theta = 0^\circ$

$W = 200N \cdot 5m \cdot \cos 0^\circ$

$= 1000J$

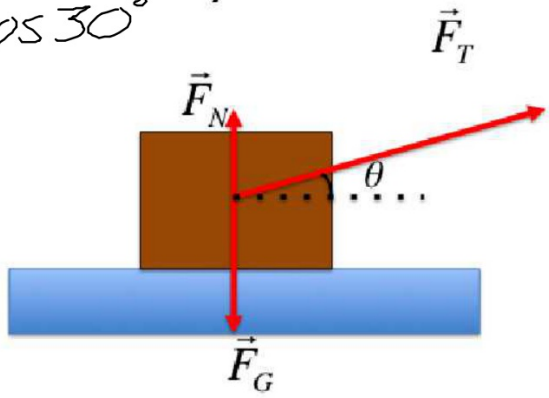
A man pushes a car with a force of 200N for 5m.

Calculate the energy put into the system.

Ka F, d, θ

$W = 50N \cdot 4m \cdot \cos 30^\circ$

173 j



A box is dragged 4m. A force of 50N pulls at an angle of 30°.

Calculate the energy put into the system.

K: d, F, θ

$W = F \cdot d \cdot \cos\theta$

$-280\,j$

A rabbit skids to a stop over 7m.
The frictional force is 40N

Find some Work

- You and your partner find an example of work that can be done around the room.
- Describe the work done and calculate it.
- Present your findings to another lab group.
- Allow them to calculate the work also.

Potential Energy

- Energy stored in a system.
- When released, there is a force that will do work.
- This means that some kind of negative work has to be done.

Nature is Lazy

- The system will want to be at the lowest energy level possible.
- By “storing” energy in a system, we have the possibility of work being done later.
- The system wants to be brought to is lowest energy level possible, releasing energy.

Potential Energy

- An archer draws a bow. By displacing the string, he stores energy in the system.
- Energy in = energy out.

Gravitational Potential Energy

- By displacing an object vertically, you allow gravity to do work on an object.
- GPE is mgh. Mass x gravity x height of displacement.

A busser carries a 10kg load of dishes up stairs. The dishes have a 3.5m vertical displacement and a 4m horizontal displacement. What is the potential energy put into the dishes?

K: $m = 10\,kg$

$g = 9.8\,m/s^2$

$h = 3.5\,m$

$GPE = mgh = 10kg \cdot 9.8\frac{m}{s^2} \cdot 3.5m$

$= 343\,N$

A 3kg mass is dragged at a constant speed 6.5m across a floor. If μ=0.4, how much work does the pull on the object do?

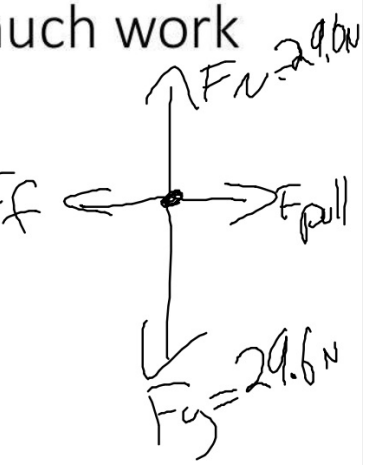
$F_{pull} = 11.76\,N$

$d = 6.5\,m$

$\theta = 0°$

$11.76\,N = F_N \mu = F_f$

$W = F \times d = 76.44\,J$



Springs

- The more that you compress a spring, that harder it becomes to compress.
- The more compressed, the more force will be applied to an object that the spring applies to an object.

Hook's Law: $F_{spring}=-kx$

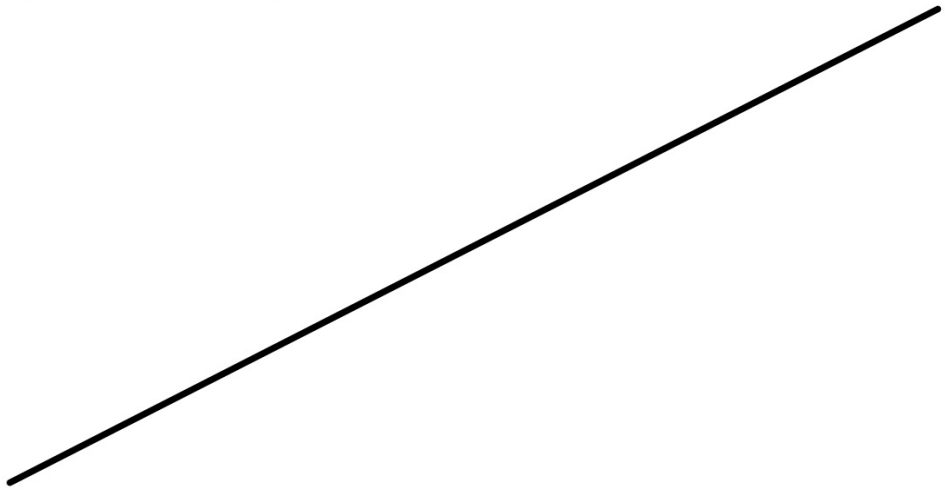
- F: the force that a spring will apply when released.
- X: the displacement (compression) of the spring.
- k: the spring constant.

The spring constant: k

- The more compression on a spring, the more force the spring will apply.
- k: N/m
- If displacement doubles, force of the spring also doubles.
- Linear relationship.

A force of 30N compresses a spring 2.5m. What is the spring constant?

The spring constant on a spring is 12N/m.
Graph the displacement vs force over 5m.



Potential Energy on a Spring

- Go to learningscience.org
- Under physical science, select motion and forces.
- # 5 is springs and things.

Activity 1

Show energy of number 1.

- Click ¼ time.
- Hang the 50g mass on the first spring.
- Observe the relationship between potential, kinetic energy and thermal.

Activity 2

- Turn gravity and friction to zero.
- Put time in real time.
- Put the 250g mass on the spring.
- Observe the relationship between kinetic and potential energy.