

Physics 105 Class 8

WORK AND ENERGY

Definition of work in physics:

Work done by the force **F** = **component** of force **along** the _____ direction times the magnitude of the displacement.

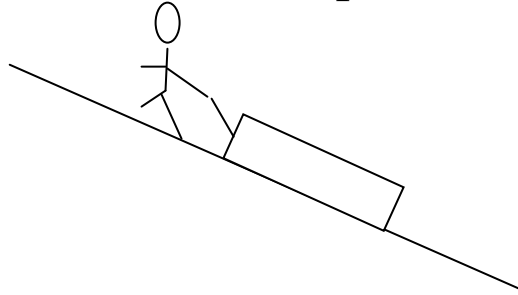
SI Units: 1 N * 1 meter =

Positive or negative work?

- If acting by itself the force would **speed up** the object along its current path, the work by that force is _____
- If acting by itself the force would **slow down** the object, the work by that force is _____

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A girl pulls a sled up a hill at constant speed.



Is any work done by the following forces, and is the work positive or negative?

1. positive
2. negative
3. zero

- The girl's force on the sled
- Friction
- The force of gravity on the sled
- The sled's force on the girl
- The normal force on the sled
- The net force on the sled

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Energy is easier!

Some problems that are hard using Newton's 2nd law can be worked easily with energy concepts

Kinetic energy:

W-KE theorem from the kinematic equations:

An object at initial speed v_o is pushed with acceleration a for a distance Δx . Find the **final speed**.

Find the **change of the kinetic energy** in terms of the work done

If the object sped up, the **net** work done was _____.

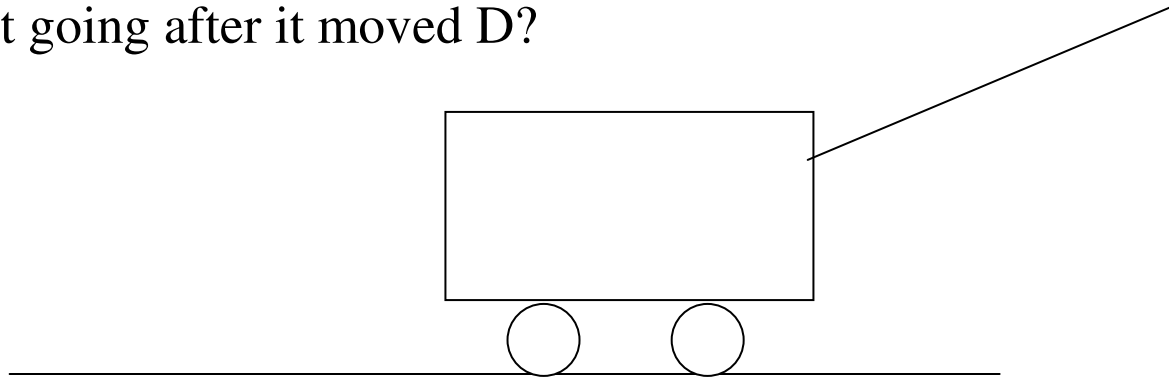
If it slowed down, the **net** work done was _____.

If it moved at constant speed, the **net** work done was ____.

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A boy pulls his toy **mass m** with a **force P** , at an **angle θ** above the horizontal. He moves the toy a **distance D** along the ground without friction.

If the initial velocity of the toy was v_0 , how **fast** was it going after it moved D ?



Two ways to work this:

Work-kinetic energy theorem

Newton's laws and kinematic eqns.:

(have to use if we want to know _____)

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You pull on a 60 kg wagon with a force of 80 N at an angle 30 degrees above horizontal. It starts from rest, and after traveling 12 meters, it's going 3 m/s. There is also some work done by friction.

What work did you do on the wagon? _____ J. (From your force)

What was the net work done by all the forces on the wagon? _____ J. (From change in KE)

Then what was the work done by friction on the wagon? _____ J. (From total work)

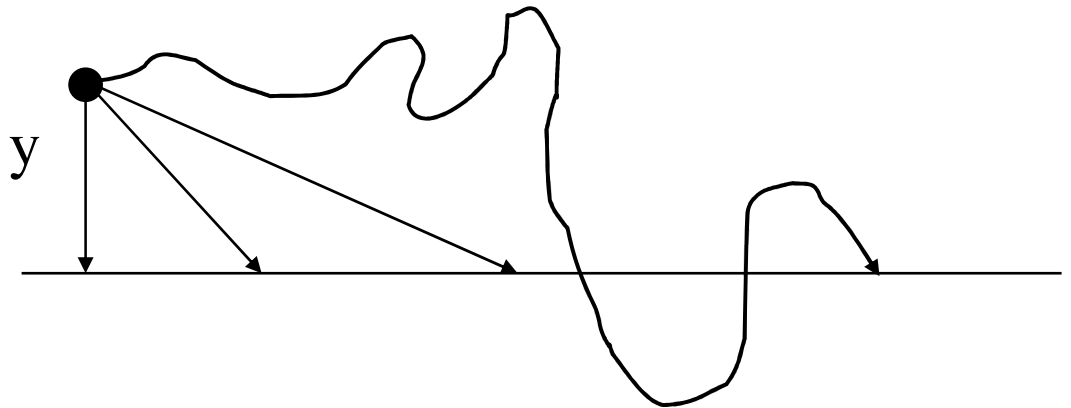
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Gravitational potential energy

PE_{grav} *keeps track* of the _____ done against gravity

Formula:

Change in PE for the different paths?



Conservative vs. nonconservative forces

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Conservation of energy

(with only conservative forces, for now)

Conservation and *symmetry*

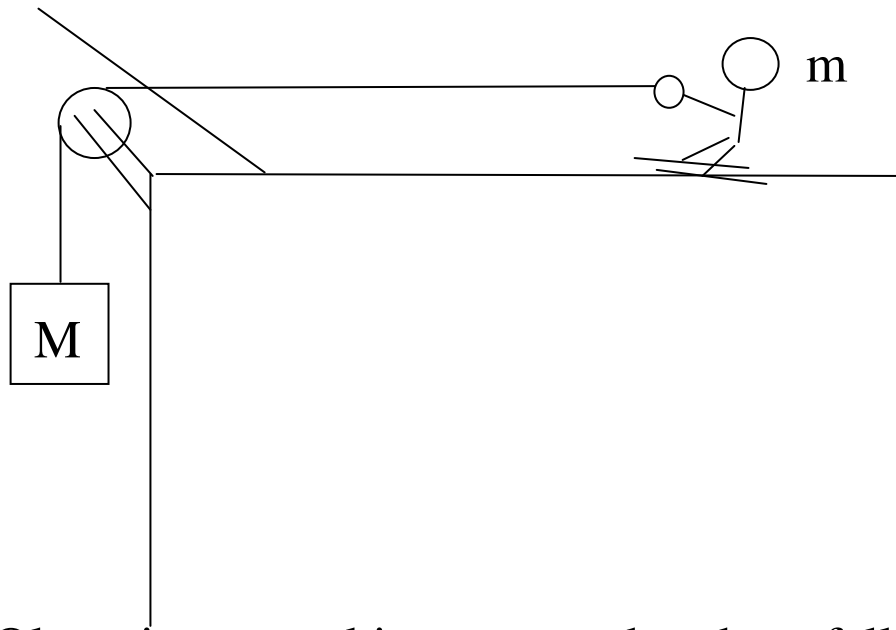
From a cliff of height h you throw balls straight up, straight down and horizontally, all with the *same initial speed*.

Ignore air friction

P9. Which ball has the the highest speed just before it hits the ground?

1. thrown straight up
2. thrown straight down
3. thrown horizontally
4. all the same speed
5. must know details

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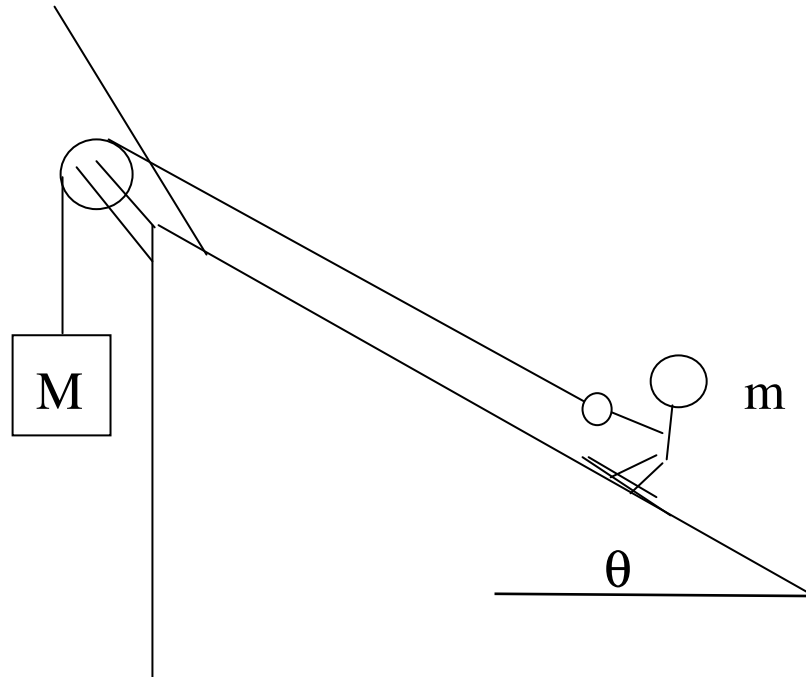


In a new Olympic sport, skiers are sped up by a falling mass, and then are launched off a ramp. When M has fallen a distance D from rest, how fast will the skier be going? Ignore friction.

(Can choose $y=0$ differently for each object)

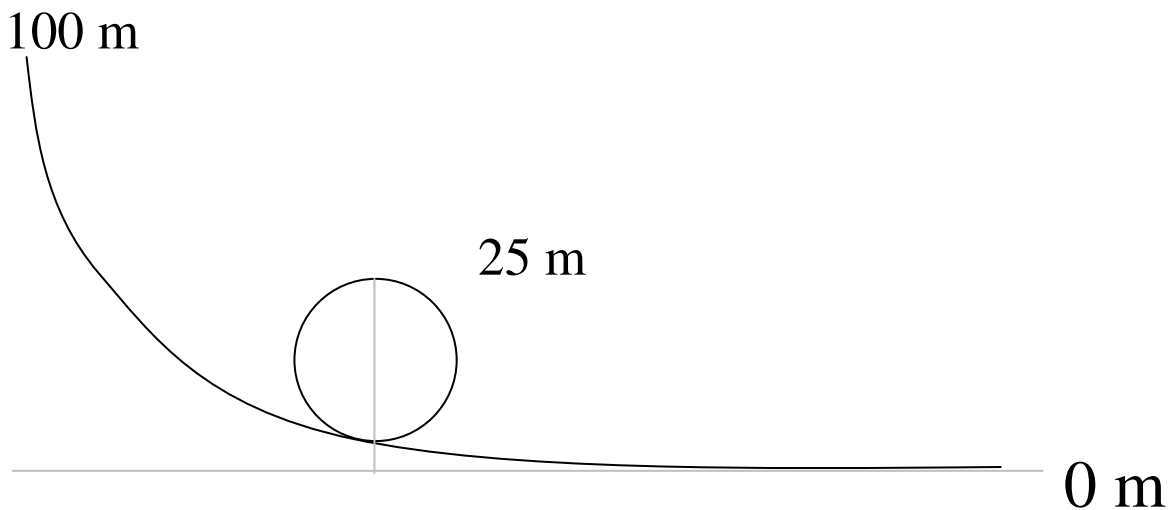
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If the hill is sloped up before the “ramp”, when M has fallen a distance D from rest, how fast will the skier be going? Ignore friction.



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A 500 kg car starts from rest on a track 100 m above the ground. It does a loop-de-loop that is 25 m from the ground at the top. There is no friction. How fast is it going at the *top* of the loop? _____ m/s



Depends on mass?

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HOMEWORK HINTS: