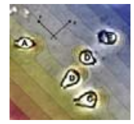
Physics 131- Fundamentals of Physics for Biologists I



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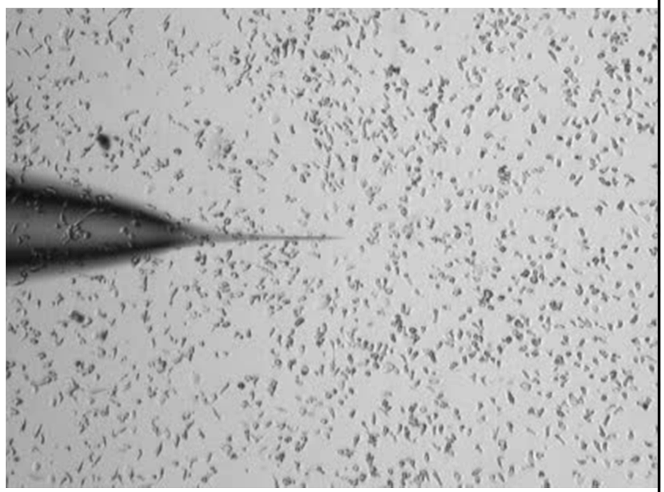
9/24/2012

-How can we describe motion (Kinematics)

- What is responsible for motion (Dynamics)

Movie of the Day
Chemically guided motion



Outline

- Quiz 3
- NEW office hours
  - 5pm-6.30pm Thursday
- Newtons Laws
- Forces
  - Gravitational Force
  - Spring force
  - Normal force

Newton's Laws

- Newton 0:
  - An object responds to the forces it feels when it feels them.
- Newton 1:
  - An object that feels a net force of 0 keeps moving with the same velocity (which may = 0).
- Newton 2:
  - An object that is acted upon by other objects changes its velocity according to the rule $\vec{a}_A = \vec{F}_A^{net} / m_A$
- Newton 3:
  - When two objects interact the forces they exert on each other are equal and opposite. $\vec{F}_{A\to B}^{type} = -\vec{F}_{B\to A}^{type}$

Kinds of Forces

- Touch
  - Normal Force N
  - Tension Force T
  - Friction Forces f, F^D, F^V

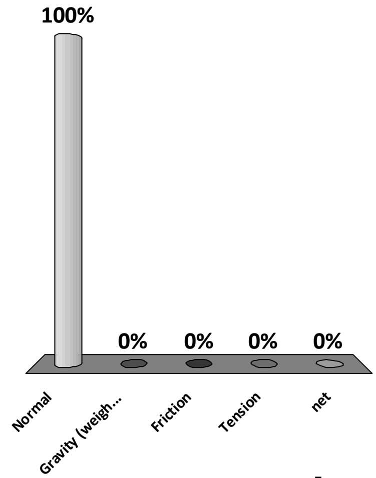
Don't touch
  - Weight Force W
  - Electric Force F^E
  - Magnetic Force F^M

- Notation convention.

$$\vec{F}^{\text{type of force}}_{\text{(object causing force)}\to\text{(object feeling force)}}$$

What is the type of the second force in this example of Newton 3rd ?

1. Normal
2. Gravity (weight)
3. Friction
4. Tension
5. net



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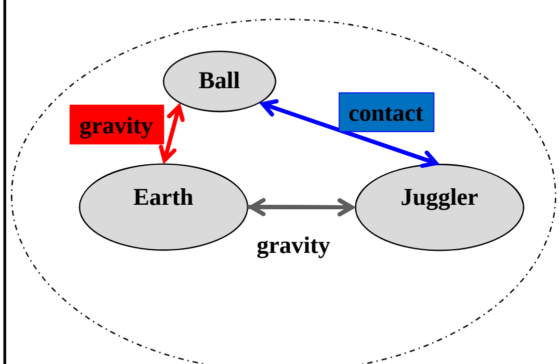
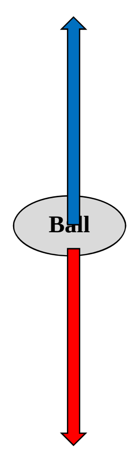
System Schema and Force Diagram





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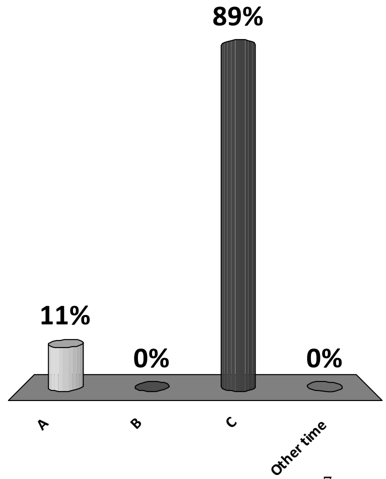
Where on the acceleration vs time diagram does the juggler let go of the ball?

1. A
2. B
3. C
4. Other time



Review of forces

Weight Force W

- Experiment: See how it behaves when gravity is the <u>only</u> force acting on it. We expect it to speed up (accelerate). How does that acceleration depend on the object?

$$\vec{a}_A = \frac{\vec{W}_{E \to A}}{m_A}$$

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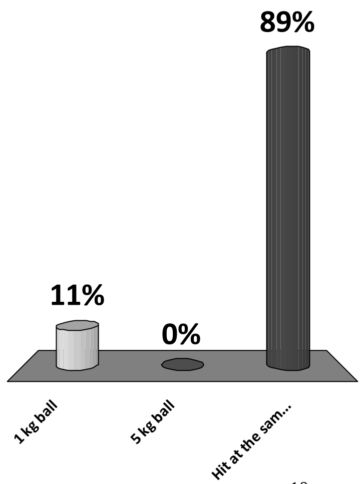
The prof drops two metal spheres, one of 1 kg, the other of 5 kg. Which object hits the ground first

1. 1 kg ball
2. 5 kg ball
3. Hit at the same time



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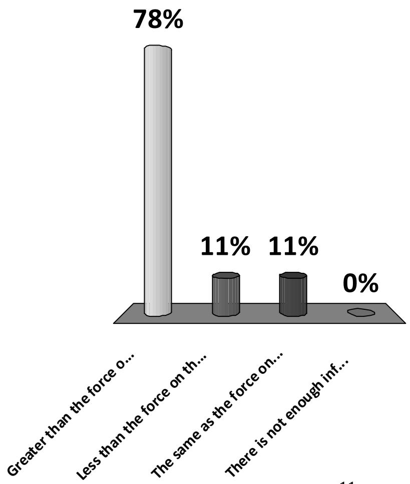
The prof drops two metal spheres, one of 1 kg, the other of 5 kg. They hit the ground at (almost) exactly the same time. The weight force on the 5 kg weight is:

1. Greater than the force on the 1 kg weight
2. Less than the force on the 1 kg weight
3. The same as the force on the 1 kg weight.
4. There is not enough information to tell.



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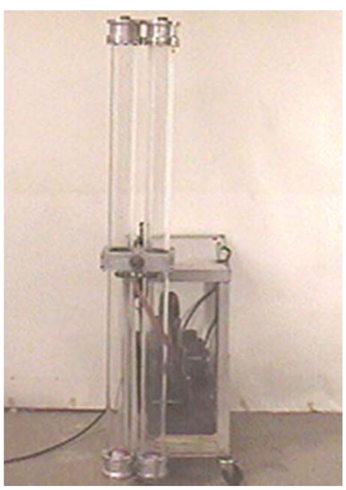
Is it really true for ALL objects? Even a feather?



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The Gravitational Field Strength

- We find that, when we can ignore the effects of air as another object that exerts force, that all objects accelerate the same in free fall (only *W* acting).

$$\vec{a}_A = \vec{g} = \frac{\vec{W}_{E \to A}}{m_A} \qquad \text{(independent of A!)}$$

- Experimentally, this is a constant independent of the object. Therefore:

$$\vec{W}_{E \to A} = m_A \vec{g}$$

- Define the constant g as the *gravitational field strength.* (Units of N/kg)

$$g \approx 9.8 \text{ N/kg}$$

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