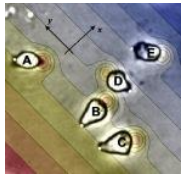
Physics 131-Physics for Biologists I



Professor: Wolfgang Losert

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Final exam:

Wednesday December 18th 6.30pm-8.30pm

1) Take makeup exam at 2pm
2) Take makeup exam at 3pm

Weight Force W

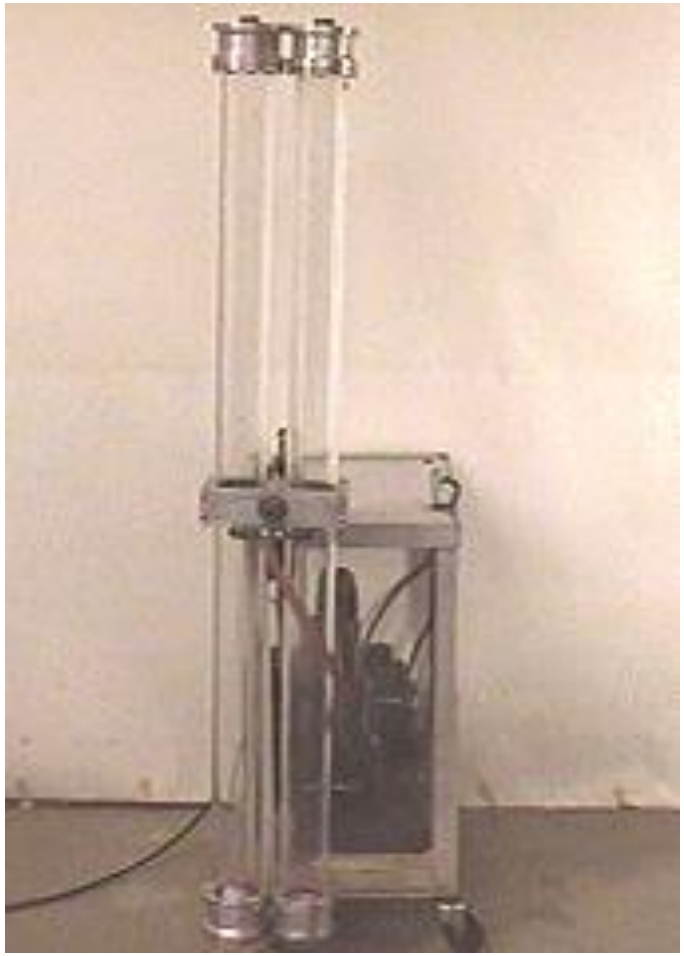
- Experiment: See how it behaves when gravity is the only force acting on it. We expect it to speed up (accelerate). How does that acceleration depend on the object?

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

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**

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



The Gravitational Field Strength

- We find that, <u>when we can ignore the effects of air as another object that exerts force</u>, 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)

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

The prof throws two balls at the same time.

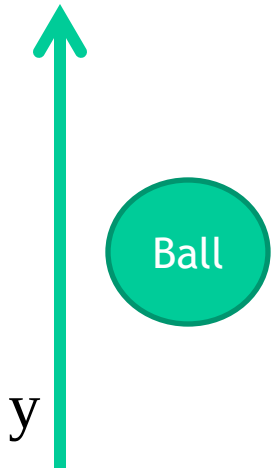
The first one of 1 kg is thrown with $\vec{v} = 1\frac{m}{s}\hat{j}$

the other of 5 kg is thrown with $\vec{v} = 2\frac{m}{s}\hat{j}$

Which object hits the ground first?

(Whiteboard, TA & LA)

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

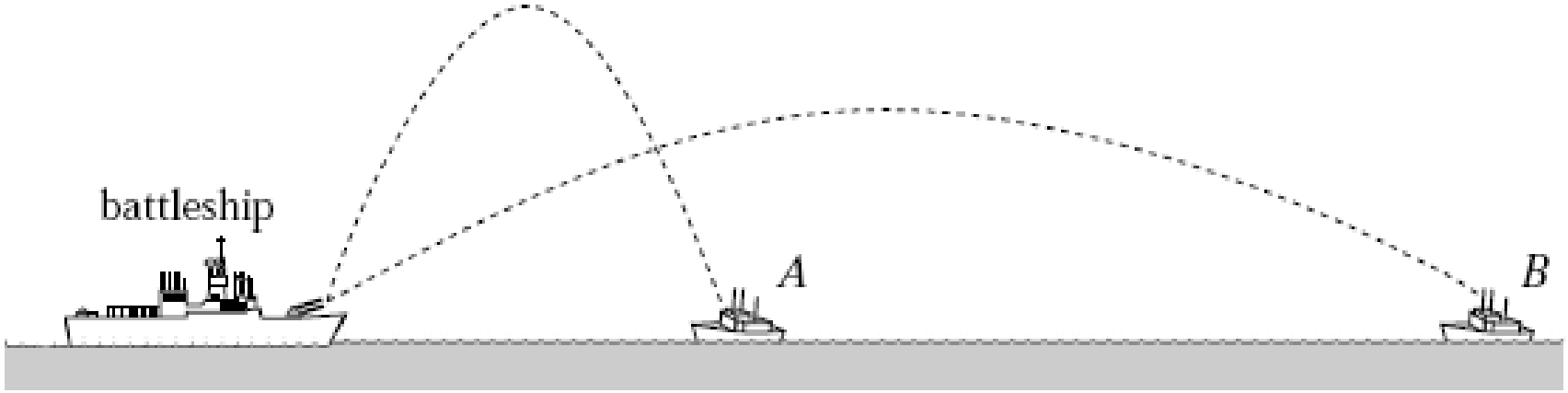


Which ball will land on the ground first

(Whiteboard, TA & LA)

1. Dropped ball
2. Shot ball
3. **Both at the same time**
4. Depends on speed of shot
5. Don’t know

A battleship simultaneously fires two shells at enemy ships. If the shells follow the parabolic trajectories shown, which ship gets hit first? (from E. Mazur)



1. *A*
2. both at the same time
3. ***B***
4. need more information

The ball on the funnel cart will land

1. **In the funnel**
2. Ahead of the funnel
3. Behind the funnel
4. Depends on speed of cart
5. Don’t know

Foothold idea: Force Fields

A *force field* is an idea we use for non-touching forces. It puts a vector at each point in space. The vector direction and length indicate the direction and magnitude of the force **exerted by the surrounding system on our object of interest**.

The force field near the surface of the earth for a 1kg object and a 5kg object:

Gravitational Fields

- A *force field* is an idea we use for non-touching forces.
  It puts a vector at each point in space. The vector direction and length indicate the direction and magnitude of the force **exerted by the surrounding system on our object of interest**.
- For non-touching interactions (e.g. gravity) the force on the object of interest depends on mass. A *gravitational field* is a force field with this "coupling strength" divided out so the field does not depend on what test object is used.

$$\vec{g} = \frac{\vec{F}_{\text{acting on } m}}{m}$$

Compare the gravitational field near the surface of the earth for a 1kg object and a 5kg object. Vectors will have

1) The same direction
2) Same magnitude only
3) Same direction and magnitude
4) different direction and magnitude