Physics 131-Physics for Biologists I

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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, 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).

\[ \vec{a}_A = \vec{g} = \frac{\vec{W}_{E \rightarrow A}}{m_A} \quad \text{(independent of A!)} \]

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

\[ \vec{W}_{E \rightarrow A} = m_A \vec{g} \]

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

\[ g = 9.8 \text{ N/kg} \]

9/19/12
The prof throws two balls at the same time. The first one of 1 kg is thrown with \( \vec{v} = \frac{m}{s} \hat{j} \) and the other of 5 kg is thrown with \( \vec{v} = \frac{m}{s} \hat{j} \).

Which object hits the ground first?

1. 1 kg ball
2. 5 kg ball
3. Hit at the same time
Which ball will land on the ground first

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

(Whiteboard, TA & LA)
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