

October 3, 2011

Physics 131

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■ **Theme Music: Free Fallin'**
Tom Petty

■ **Cartoon: Johnny Hart**



Outline

- Quiz 4
- Recap of air drag experiment
- Gravity

10/3/11

Physics 131

2

When a coffee filter falls,
which resistive force
dominates?



If it's viscosity:

$$F^{net} = -mg + Bv$$

At terminal velocity:

$$Bv_T = mg$$

$$v_T = m \left(\frac{g}{B} \right)$$

If it's drag:

$$F^{net} = -mg + Cv^2$$

At terminal velocity:

$$Cv_T^2 = mg$$

$$v_T = \sqrt{m} \left(\sqrt{\frac{g}{C}} \right)$$

10/3/11

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3

The Properties of Gravity

- 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?

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

10/3/11

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4

The Gravitational Field Strength

- We find that, when we can ignore the effects of other objects (the air), that all objects accelerate the same in free fall (only W acting).

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

- 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)

10/3/11

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5

Foothold Ideas: Gravity



- Every object (near the surface of the earth) feels a downward pull proportional to its mass:

$$\vec{W}_{E \rightarrow m} = m \vec{g}$$

What object causes W ?

where $\vec{g}$ is referred to as *the gravitational field*.

- This is a pForce even though nothing touching the object is responsible for it.
- The gravitational field has the same magnitude for all objects irrespective of their motion and at all points.
- The gravitational field always points down.
- It is measured to be $g \approx 9.8 \text{ N/kg}$

Why N/kg instead of m/s^2 ?

10/3/11

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Response to Gravity: Free Fall

- After an object has been released,
 - if it is dense enough so the forces from the air can be ignored
 - if nothing else is touching itthe only force acting on it is gravity.

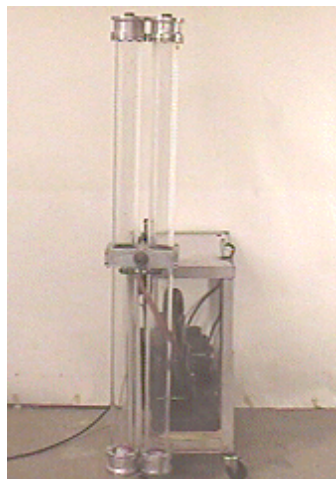
$$\vec{a} = \vec{F}^{net} / m = \vec{W}_{E \rightarrow m} / m = m\vec{g} / m = \vec{g}$$

10/3/11

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7

Is it really true that air is what makes a difference for light objects?



10/3/11

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8