Help students learn physics

Professor Gordon Thomas
Ideas to Help Students Learn Physics
A Hands-On Workshop

• Led by: Prof. Gordon Thomas, NJIT Physics

• February 7, 2019  Central King Building 116

• Co-Sponsors: NJAAPT, NJIT Physics, NJIT College of Science and Liberal Arts and NJIT CPCP
Agenda

8:30   Registration and Continental Breakfast
9:00   Welcome and Introductions
       Dr. Jacqueline L. Cusack,
       Executive Director of the NJIT Center for Pre-College Programs
       Dr. Kevin Belfield, Dean, NJIT College of Sciences and Liberal Arts
9:10   Speed: Hands-on Experiments, Formative Questions, Discussion among teachers
10:40  A Walk on the Roof
10:50  Acceleration: Experiments, Questions, Discussion
12:00  Buffet Lunch
1:00   Circular motion: Experiments, Questions, Discussion
2:15   General discussion and evaluation
Workshop Goals

• Be able to use a teaching method that launches pre-college students into college, based on the effectiveness of this method in Prof. Thomas’ college physics course.

• Integrate into this method the quantitative analysis that is central to the NJSLS.

• Be able to use remedies for potential stumbling blocks in the transition from pre-college science to success in college physics – remedies that link with the NJSLS.
Extra introductory info:

Comments on what helps students

• 5 steps of my version of active learning:
  – Mini lecture
  – Hands on demo
  – Question by yourself
  – Discuss with group
  – Summary
Slowing to a stop

\[ \text{Distance} \]

\[ x \]

\[ 0 \]

\[ 0 \]

\[ \text{Time} \ t \]

\[ 0 \]

\[ 0 \]

\[ v_{\text{ave}} = \frac{x}{t} ; \quad v_{\text{ave}} = \frac{(v+v_0)}{2} \]
Experiment

Measure the average speed of a ball that rolls to a stop.
Question 1

A student rolls a ball across a table. It comes to a stop in 0.4 m and a time 2.0 s. What is its average speed in m/s?

a. 2
b. 0.05
c. 0.5
d. 0.2
e. 0.8
Discuss Question 1
Question 2

- A student rolls a ball across a table. It comes to a stop in 0.8 m and a time 2 s. With what speed, in m/s, did the student launch the ball?

a. 1.6
b. 3.2
c. 5.0
d. 0.4
e. 0.8
Discuss Question 2
Walk on the roof

Drop a ball.
Measure the height and the time of the fall.
Guard the landing spot.
Come back to study acceleration.
Roof: Falling from rest

\[ v_{ave} = \frac{x}{t} ; \quad v_{ave} = \frac{v + v_0}{2} \]

\[ v_0 = 0 ; \quad v = \frac{2x}{t} ; \quad a = \frac{v}{t} \]
Review: Slowing to a stop

\[ v_{\text{ave}} = \frac{x}{t}; \quad v_{\text{ave}} = \frac{(v + v_0)}{2} \]

\[ v = 0 \]
-Acceleration (slowing down)

\[ a = \frac{v - v_0}{t} = -\frac{v_0}{t} \]
Measure the average acceleration of a ball that rolls to a stop.
A student rolls a ball across a table. It comes to a stop in 0.4 m and a time 2.0 s, so the average speed is 0.2 m/s and so the initial speed is 0.8 m/s and the final speed is 0. What is the acceleration in m/s\(^2\)?

a. -2
b. -0.05
c. -0.5
d. -0.2
e. -0.8
Discuss Question 3
Question 4

(same problem backwards): a car skids to a stop in 5 seconds. The tires on that road surface produce an acceleration of $-0.5 \text{ m/s}^2$. What was the speed, in m/s, when the driver put on the brakes?

a. 2.5
b. 5
c. 1.25
d. 5.6
e. 0.1
Discussion of Question 4
12 noon
Slowing to a stop

\[ v_{\text{ave}} = \frac{x}{t} \; ; \; v_{\text{ave}} = \frac{(v + v_0)}{2} \; ; \; \theta = \frac{x}{R} \]

\[ \omega_{\text{ave}} = \frac{\theta}{t} \; ; \; \omega_{\text{ave}} = \frac{(\omega + \omega_0)}{2} \]
-Acceleration
(slowing down)

\[ a = \frac{(v - v_0)}{t} \]

\[ \alpha_{\text{ave}} = \frac{(\omega - \omega_0)}{t} \]
Experiment

Measure the average speed of a spinner as it rolls to a stop.
Question 5

• A student spins a spinner. It comes to a stop in 3 Radians and a time 2.0 s, so the average speed is 1.5 Radians/s and so, the initial speed is 3.0 Radians/s and the final speed is 0. What is the angular acceleration, in Radians/s²?

a. -2
b. -0.05
c. -0.5
d. -0.2
e. -0.8
Final discussion
Contact us

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