Help students learn physics

Professor Gordon Thomas

NJIT New Jersey Institute of Technology

Center for Pre-College Programs

Inspiring young minds for college access and success in Science, Technology, Engineering, and Mathematics (STEM)

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

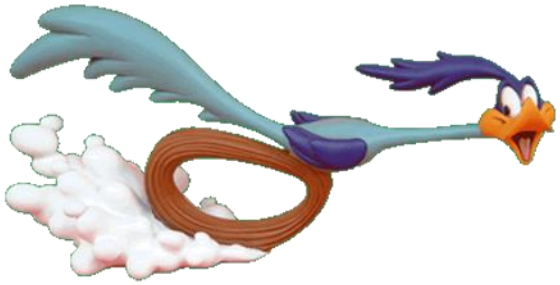
- Be able to use a teaching method that launches pre-college students into college, based on the effectiveness of this method in Prof. Thomas' college physics course.
- Integrate into this method the quantitative analysis that is central to the NJSLS.
- Be able to use remedies for potential stumbling blocks in the transition from pre-college science to success in college physics – remedies that link with the NJSLS.

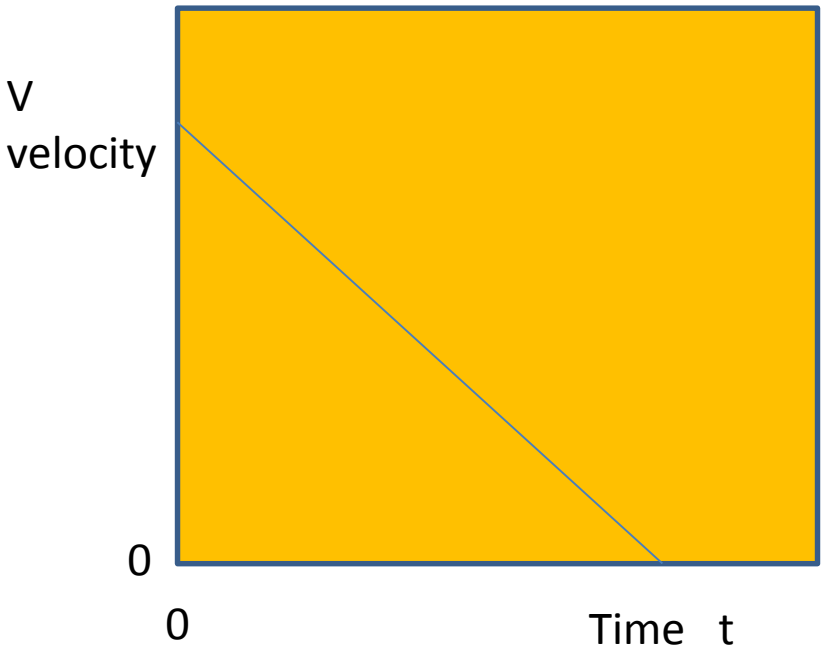
Extra introductory info:

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





$$v_{ave}=x/t \; ; \quad v_{ave}=(v+v_0)/2$$

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

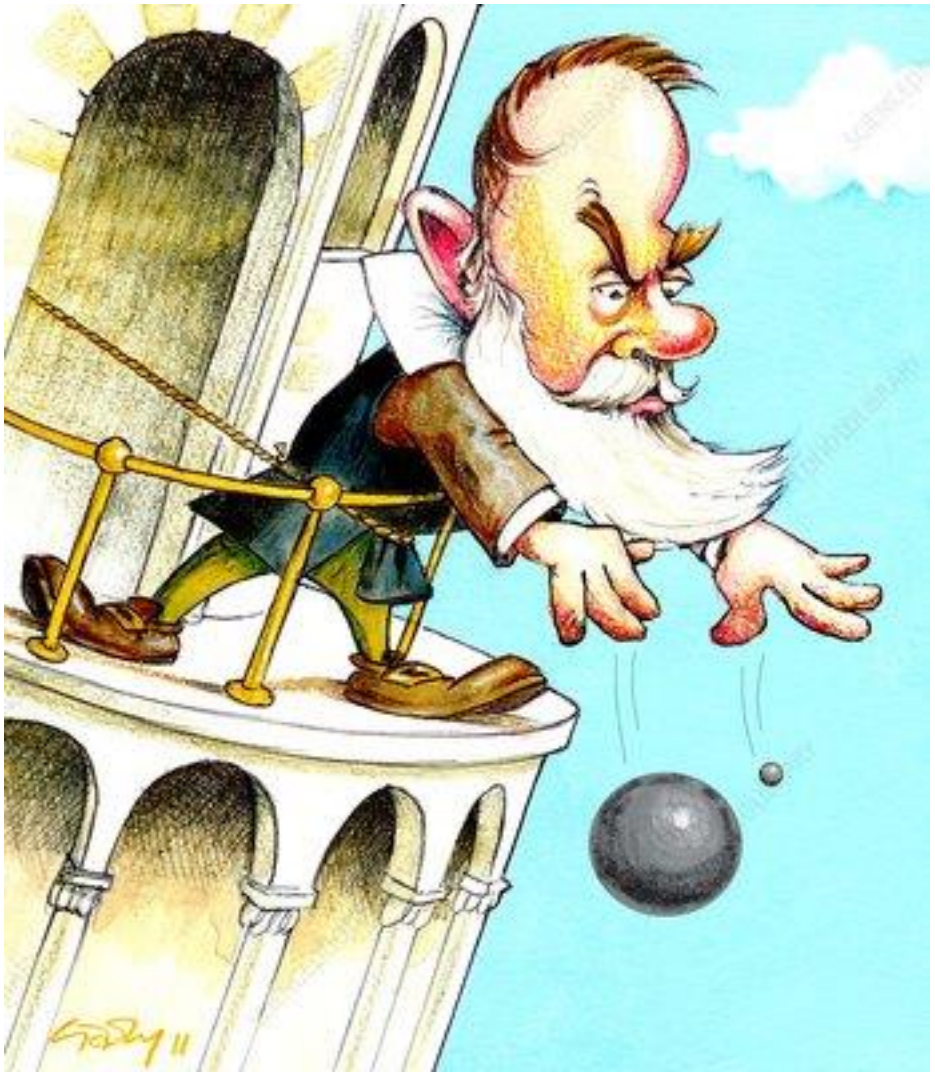
Walk on the roof

Drop a ball.

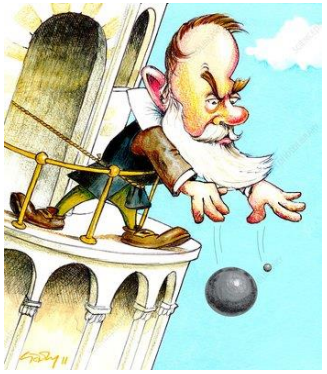
Measure the height and the time of the fall.

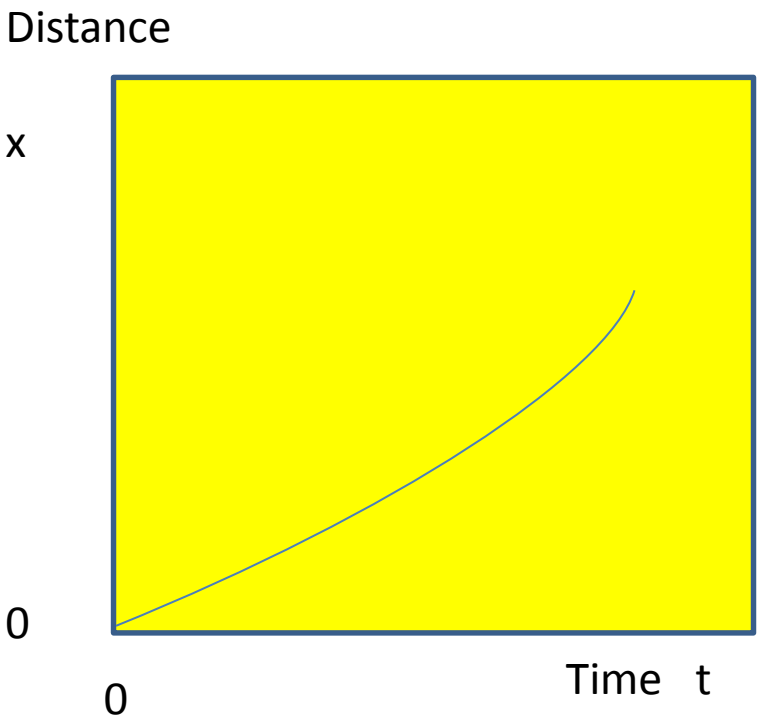
Guard the landing spot.

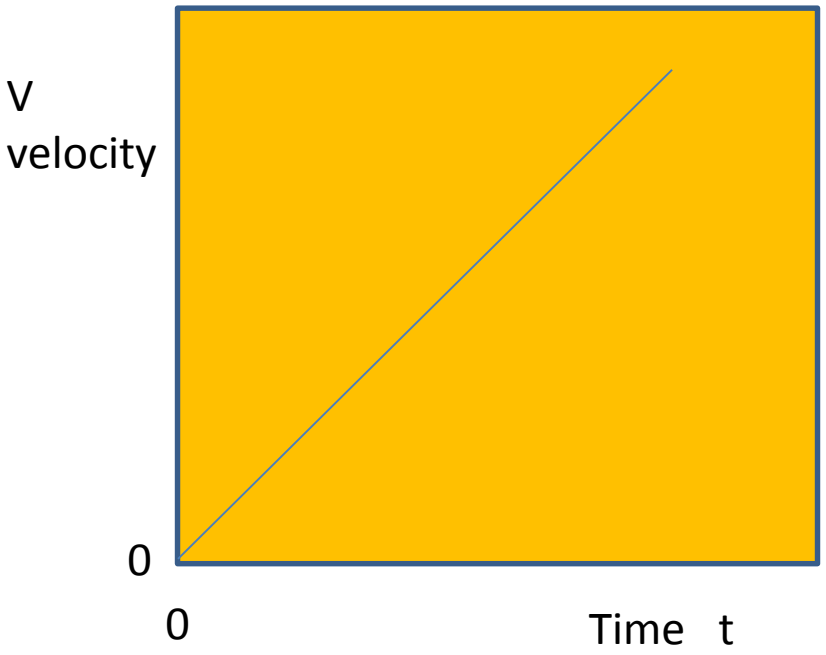
Come back to study acceleration.



Roof: Falling from rest



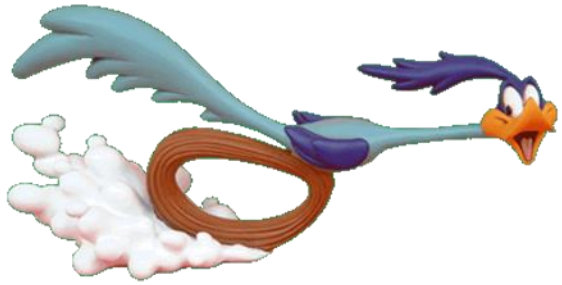


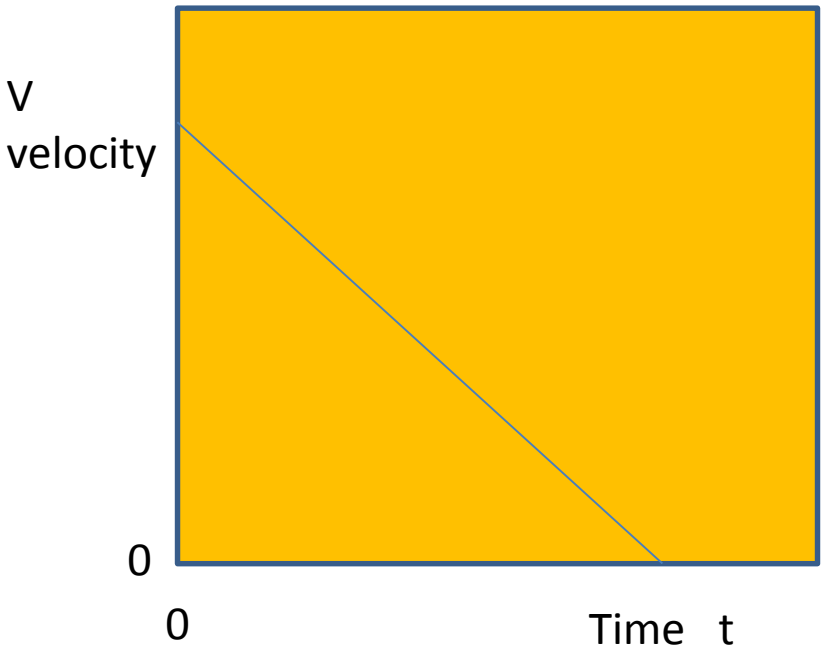


$$v_{ave}=x/t \; ; \quad v_{ave}=(v+v_0)/2$$

$$v_0=0 \; ; \quad v=2x/t \; ; \quad a=v/t$$

Review: Slowing to a stop

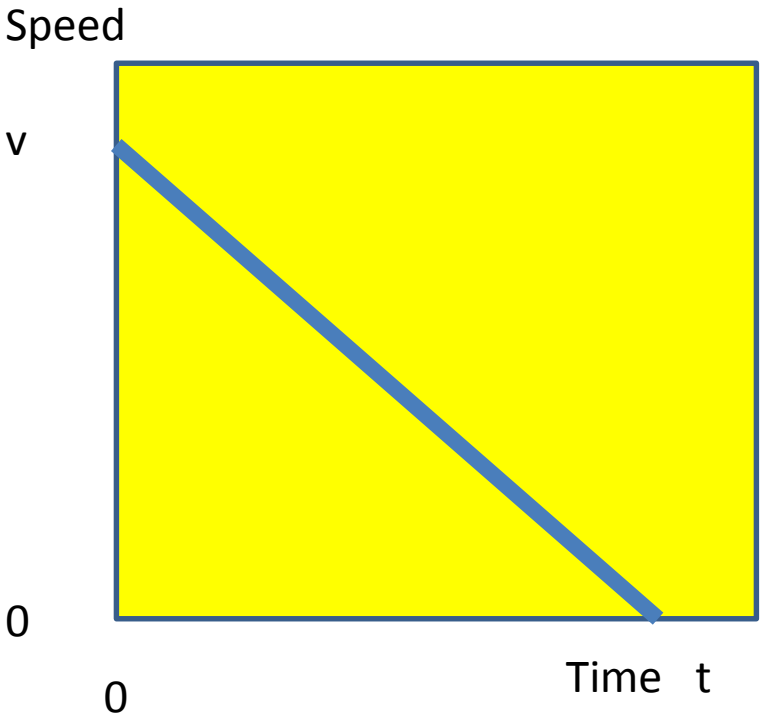


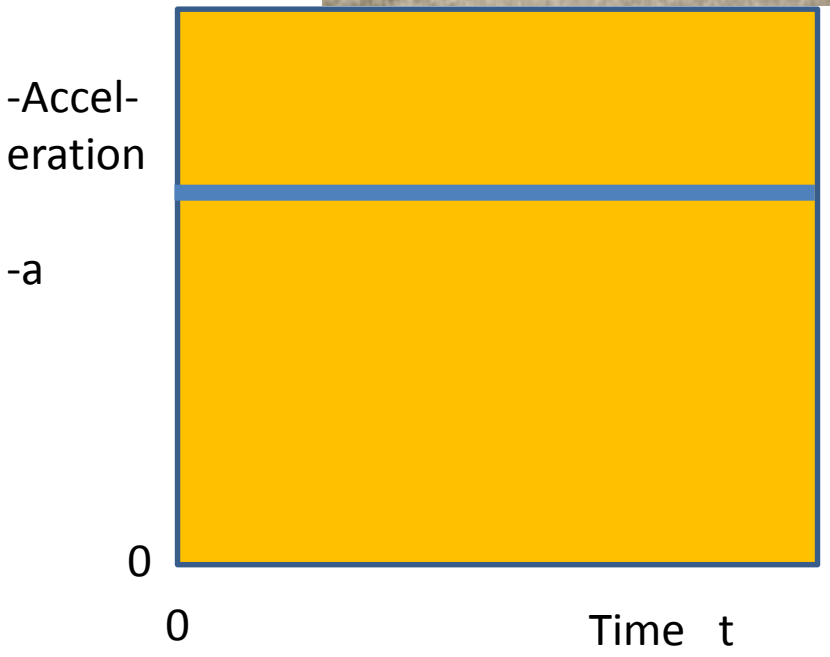


$v_{ave}=x/t$; $v_{ave}=(v+v_0)/2$

$v=0$

-Acceleration (slowing down)





$$a = (v - v_0)/t = -v_0/t$$

Experiment

Measure the average acceleration of a ball that rolls to a stop.

Question 3

- 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 0.2m/s and so the initial speed is 0.8m/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

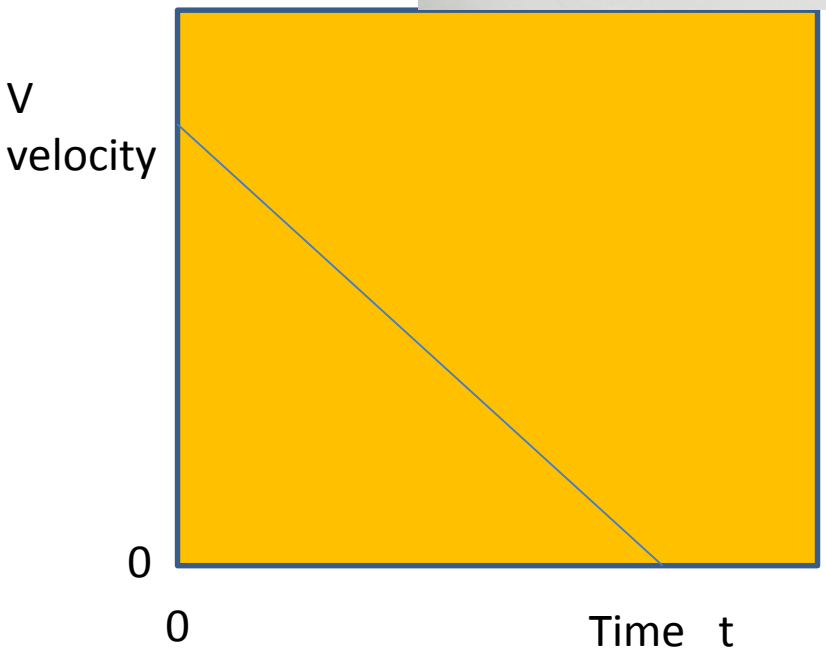
(same problem backwards): a car skids to a stop in 5 seconds. The tires on that road surface produce an acceleration of $-0.5\ m/s^2$. What was the speed, in m/s, when the driver put on the brakes?

a. 2.5
b. 5
c. 1.25
d. 5.6
e. 0.1

Discussion of Question 4

12 noon

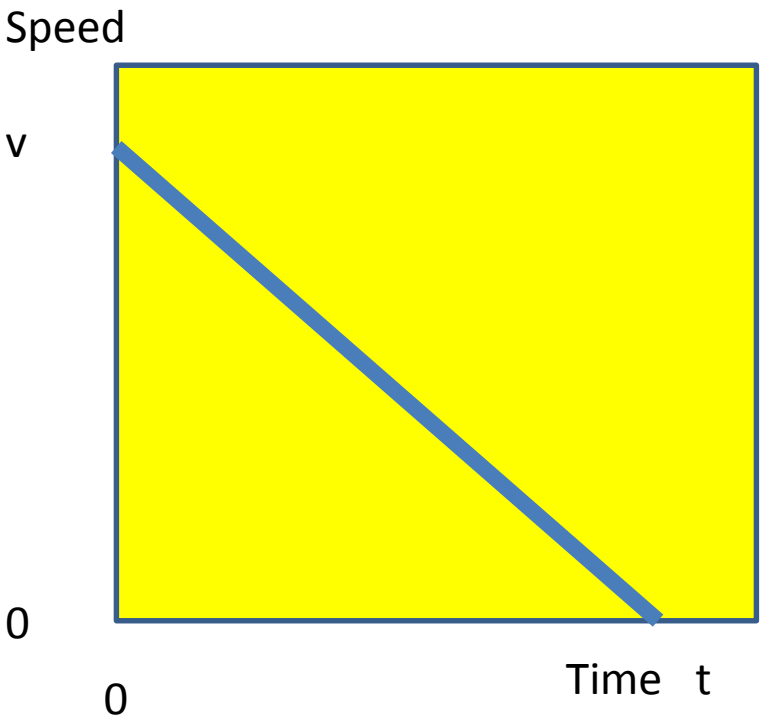
Slowing to a stop

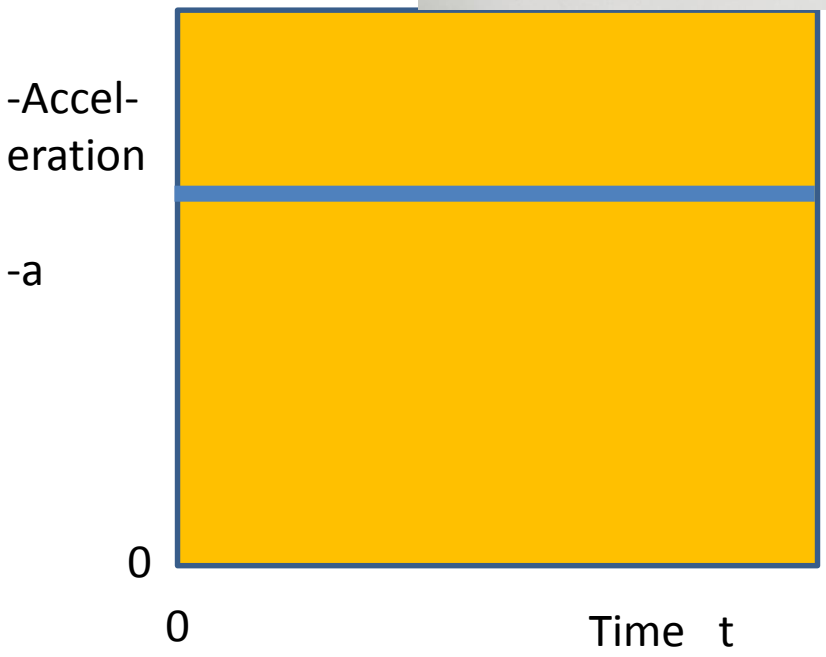


$v_{ave}=x/t$; $v_{ave}=(v+v_0)/2$; $\theta=x/R$

$\omega_{ave}=\theta/t$; $\omega_{ave}=(\omega+\omega_0)/2$

-Acceleration (slowing down)





$$a = (v - v_0)/t$$

$$\alpha_{ave} = (\omega - \omega_0)/t$$

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/s^2 ?

a. -2
b. -0.05
c. -0.5
d. -0.2
e. -0.8

Final discussion

Contact us

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