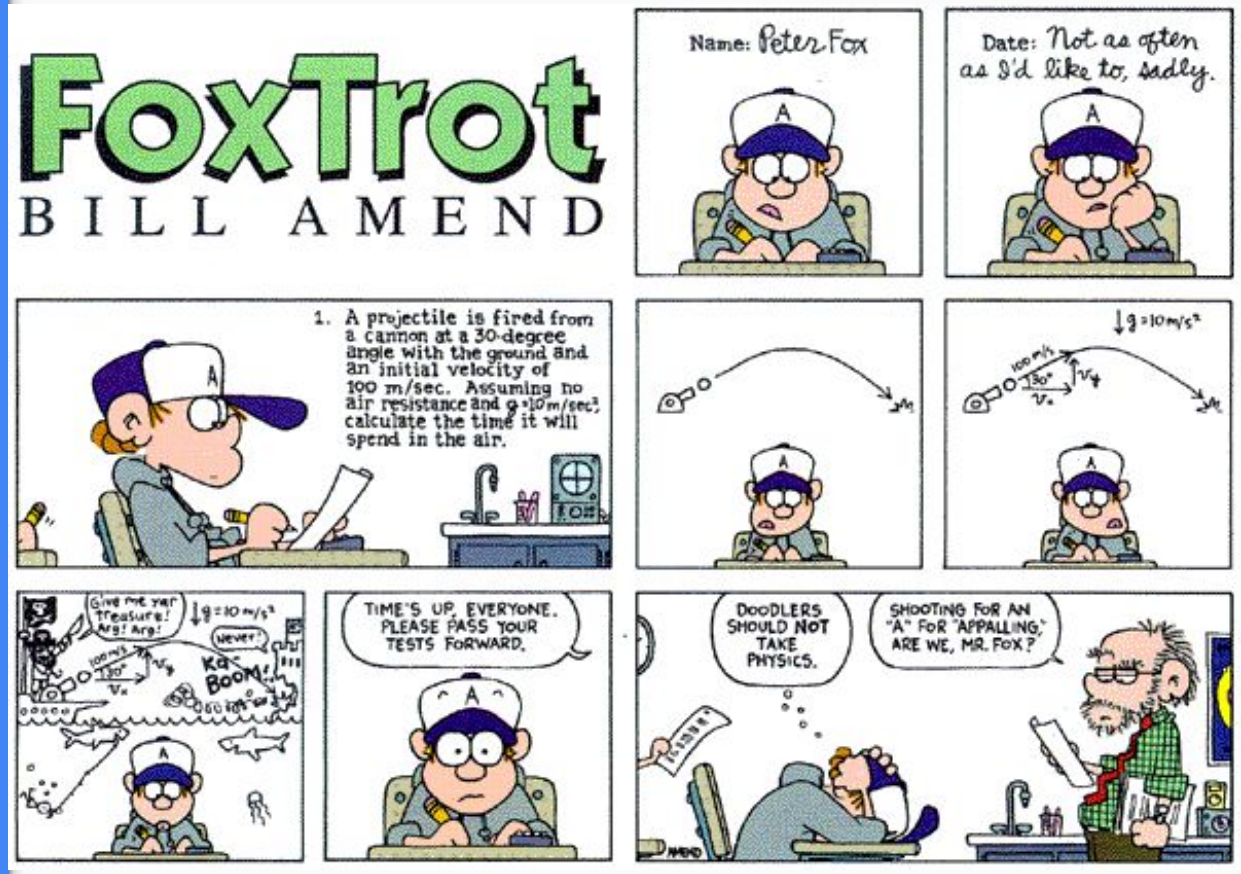
Physics Education Laboratory Lecture 05 - p1

Kinematics Concepts and Pedagogical approach with Multiple Representations

Francesco Longo • 04/10/2023

Real world


FoxTrot
BILL AMEND
Name: Peter Fox
Date: Not as often as I'd like to, sadly.
1. A projectile is fired from a cannon at a 30-degree angle with the ground and an initial velocity of 100 m/sec. Assuming no air resistance and g=10m/sec², calculate the time it will spend in the air.
Give me yer treasure! Arg! Arg!
NEVER!
Ka-BOOM!
TIME'S UP, EVERYONE. PLEASE PASS YOUR TESTS FORWARD.
DOODLERS SHOULD NOT TAKE PHYSICS.
SHOOTING FOR AN "A" FOR "APPALLING," ARE WE, MR. FOX?

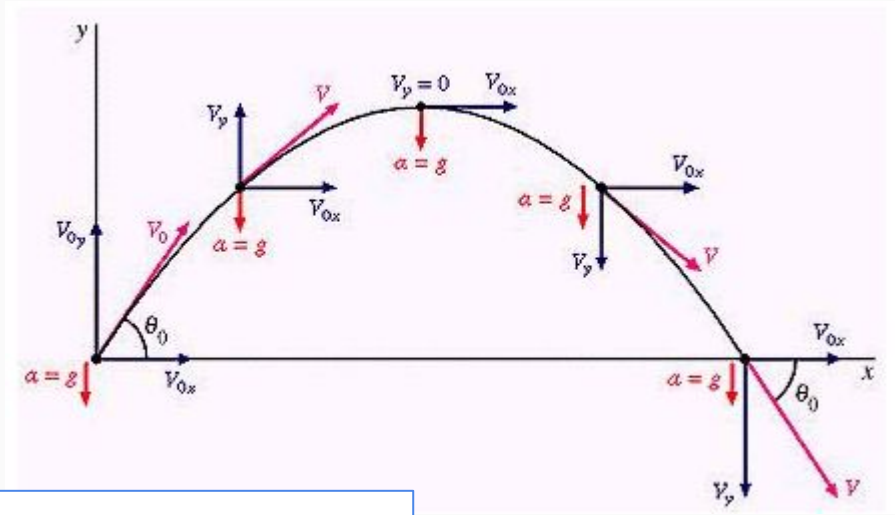
Key-concepts in kinematics

Defining quantities/variables for describing motion (position, displacement, speed, velocity, acceleration)

Frame of reference and observers

From one dimensional to bi-dimensional motion (from scalars to vectors)

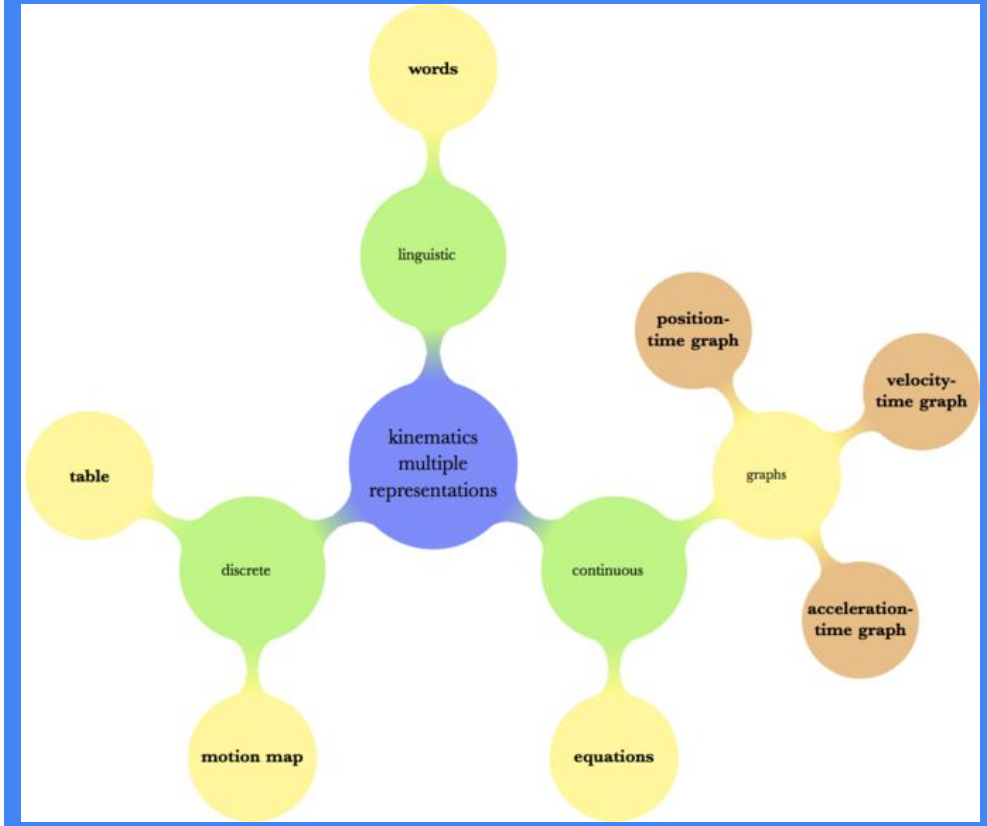
Relative motion



Knowledge of curricula

Key-concepts in Kinematics with Multiple Representations

Orientation toward science teaching



https://fockphysics.wordpress.com/2013/06/15/sbg-and-multiple-representations-in-kinematics/

Misconceptions

Knowledge of students' prior understandings

- Zero velocity implies zero acceleration, even for an instant.
- Velocity decreasing means something slows down. (Failure to account for vector character of velocity.)
- Constant circular speed implies zero acceleration. (#VectorFail)
- Distance and displacement are often confused.
- Position and displacement are often confused when making graphs.
- Position, velocity, and acceleration are "undifferentiated".
- Same velocity means same position.
- The meaning of the slope (in s-t graphs, in v-t graphs, in y-x graphs).

(McDermott et al, 1987)

Math difficulties

- Discriminating the slope and height of a graph and interpreting changes in height and changes in slope
- Identifying slope with the angle between straight line and the x axis
- Evaluate the sign of the slope according to the quadrant in which the line is drawn
- Interval/point confusion

Knowledge of instructional strategies

(Planinic M. et al, 2012)

Phys difficulties

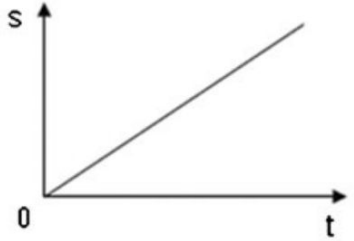
- Interpretation of the meaning of line graph slope in a physics context
- The slope of the line constantly increase (or decrease) in s-t graphs, that means a change in velocity
- Students who have not yet reached the formal operational stage of cognitive development are likely to view graphs as something concrete rather than indicators of abstract trends
- Spatial imagery vs visual imagery

Phys difficulties

Math difficulties

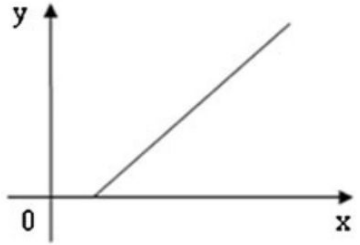
Knowledge of instructional strategies

P1. Distance – time graph of an object's motion is shown below. Which statement best describes this motion?



A. The object is not moving.
B. The object is moving at a constant velocity.
C. The object is moving with a uniformly decreasing velocity.
D. The object is moving with a uniformly increasing velocity.

M1. Consider the following line (ray) in the coordinate system. Which statement is correct?



A. The slope of the line is constant and different from zero.
B. The slope of the line is constant and equal to zero.
C. The slope of the line is constantly increasing.
D. The slope of the line is constantly decreasing.

(Planinic M. et al, 2012)

Questionnaire on Kinematics

https://nhrhs.instructure.com/files/6518/download?download_frd=1

Questionnaire on Kinematics - Let’s try it

https://forms.gle/eX4cFVu9QkHzEyzA7