AP Physics B (Ms. Grant)

One-Dimensional Linear Motion Exam Review

Objectives: **SWBAT describe and analyze linear motion**

Problem-Solving Strategies:

- Draw a picture (motion diagram, pictorial/graphical representation)
- G.U.E.S.S. (Given, Unknown, Equation, Substitute, Solve) Method
- Ask yourself if youy answer is complete (sig-figs, units) and makes sense.

Important Concepts:

- Position (displacement)
- Velocity
- Acceleration
- Position v. Time, Velocity v. Time, and Acceleration v. Time Graphs

Applications:

- Uniform motion
- Motion with constant acceleration
- Free fall

Distance

- The total length of the path traveled by an object.
- Does not depend upon direction (scalar).

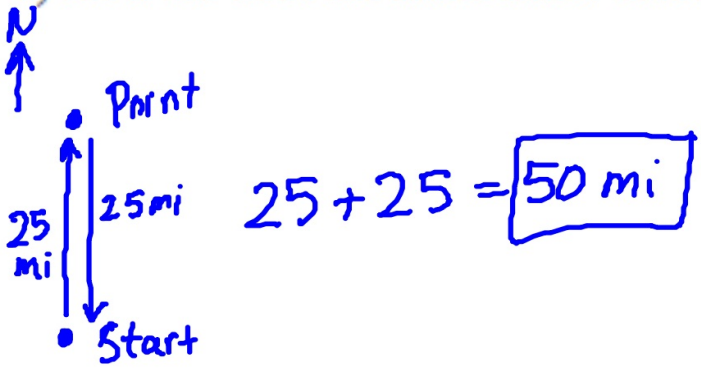
Displacement

- The change in position of an object.
- Depends only on the initial and final positions, not on path.
- Includes direction (vector).
- Represented by Δx.

Problem: Distance versus Displacement

1. A hiker hikes 25 miles due north and then all the way back to the starting point.

a) How far does the hiker hike? **Show your work.**



$25 + 25 = \boxed{50\ mi}$

Problem: Distance versus Displacement

1. A hiker hikes 25 miles due north and then all the way back to the starting point.

b) What is the hiker's displacement? **Show your work.**

$x_i = x_f \quad \therefore \Delta x = \boxed{0\ m}$

$\downarrow$

therefore

Average speed

- $s_{ave} = d / t$

scalar d = distance
t = elapsed time

Average Velocity

- $v_{ave} = \Delta x / t$

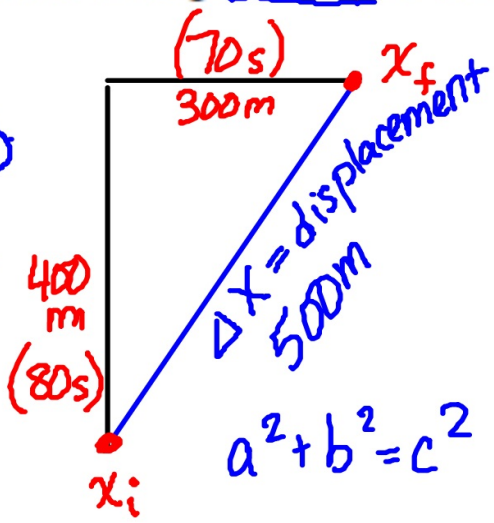
vector Δx = displacement $(x - x_o)$
t = elapsed time

$$\bar{V} = \frac{\Delta X}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

Problem: Average Velocity (1988)

62. A truck traveled 400 meters north in 80 seconds, and then it traveled 300 meters east in 70 seconds. The magnitude of the average velocity of the truck was most nearly

(A) 1.2 m/s
(B) 3.3 m/s
(C) 4.6 m/s
(D) 6.6 m/s
(E) 9.3 m/s



$$\bar{V} = \frac{\text{displacement}}{\text{time}}$$

$$= \frac{500\text{m}}{150\text{s}}$$

$$a^2 + b^2 = c^2 \qquad =$$

Acceleration

- A change in velocity.
- Acceleration can be speeding up, slowing down, or turning.
- The SI unit for acceleration is m/s^2.
- If the sign of the velocity and the sign of the acceleration is the same, the object speeds up.
- If the sign of the velocity and the sign of the acceleration are different, the object slows down.

Uniformly Accelerated Motion

- $a_{ave} = \Delta v/t$
  Δv = change in velocity ($v-v_o$)
  t = elapsed time

$$a = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - t_i}$$

Kinematic equation for uniform motion:

$$x_f = x_i + v_x \Delta t \quad \text{(constant velocity)}$$

$\Delta x = x_f - x_i$
$\Delta t = t_f - t_i$
FYI

Kinematic equations for motion with constant acceleration:

$$(v_x)_f = (v_x)_i + a_x \Delta t$$

$$x_f = x_i + (v_x)_i \Delta t + \frac{1}{2} a_x (\Delta t)^2$$

$$(v_x)_f^2 = (v_x)_i^2 + 2 a_x \Delta x$$

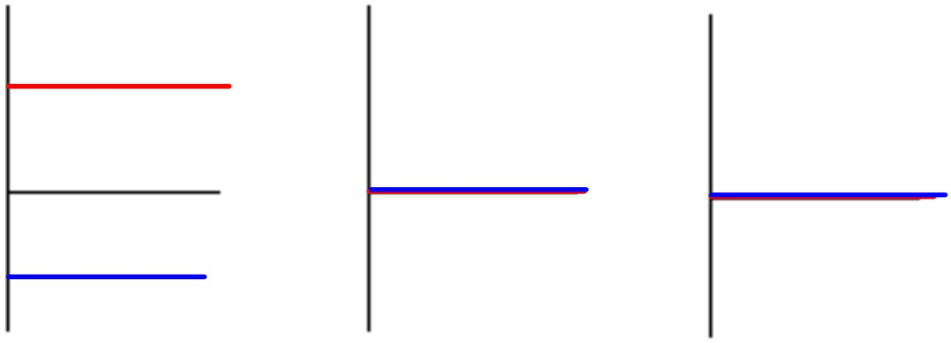
Problem: Kinematic Equations (1984)

65. A body moving in the positive x direction passes the origin at time t = 0. Between t = 0 and t = 1 second, the body has a constant speed of 24 meters per second. At t = 1 second, the body is given a constant acceleration of 6 meters per second squared in the negative x direction. The position x of the body at t = 11 seconds is

(A) +99 m (B) +36 m (C) -36 m (D) -75 m (E) -99 m

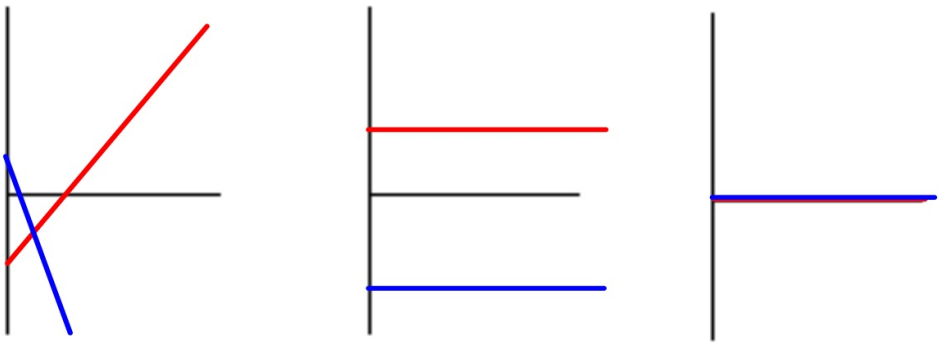
Kinematic Graphs

- Stationary particle



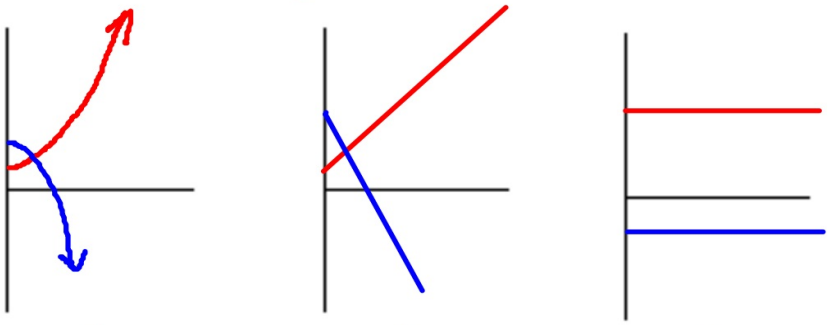
x vs t v vs t a vs t

- Particle moving with constant velocity



x vs t v vs t a vs t

- Particle moving with constant non-zero acceleration



x vs t v vs t a vs t

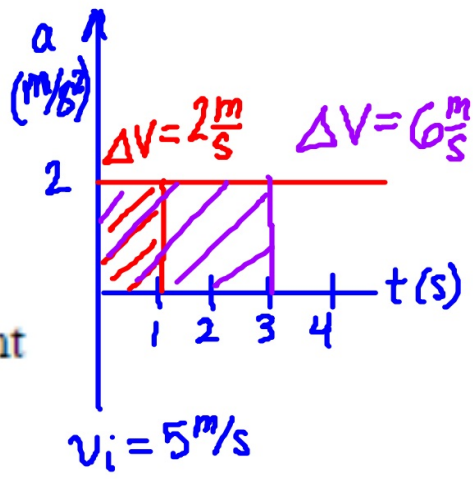
Position-time graph

- Slope = velocity

$v_f = v_i + a\Delta t$

Velocity-time graph

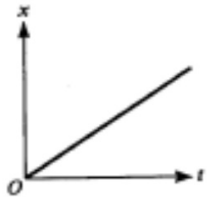
- Slope = acceleration
- Area under = displacement



Acceleration-time graph

- Area under = change in velocity

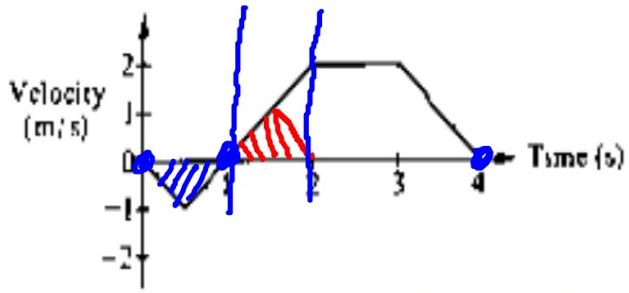
Problem: Kinematic Graphs (1988)



1. The displacement x of an object moving along the x axis is shown above as a function of time t. The acceleration of this object must be

(A) zero
(B) constant but not zero
(C) increasing
(D) decreasing
(E) equal to g

Problem: Kinematic Graphs (1984)



3. The graph shows the velocity versus time for an object moving in a straight line. At what time after time = 0 does the abject again pass through its initial position?

(A) Between O and 1 s
(B) 1 s
(C) Between 1 and 2 s
(D) 2 s
(E) Between 2 and 3 s

Free Fall

- Occurs when an object falls unimpeded.
- Gravity accelerates the object toward the earth.
- $g = 9.8\ m/s^2$ downward.
- $a = -g$ if up is positive.
- acceleration is down when ball is thrown up EVERYWHERE in the balls flight.

Problem: Free Fall (1993)

5. An object is released from rest on a planet that has no atmosphere. The object falls freely for 3.0 meters in the first second. What is the magnitude of the acceleration due to gravity on the planet?

(A) 1 .5 m/s2
(B) 3.0 m/s2
(C) 6.0 m/s2
(D) 10.0 m/s2
(E) 12.0 m/s2

Symmetry in Free Fall

- When something is thrown upward and returns to the thrower, this is very symmetric.
- The object spends half its time traveling up; half traveling down.
- Velocity when it returns to the ground is the opposite of the velocity it was thrown upward with.
- Acceleration is $-9.8\ m/s^2$ everywhere!