Thursday, December 10, 2015
9:16 AM

PVA Day 1 2015
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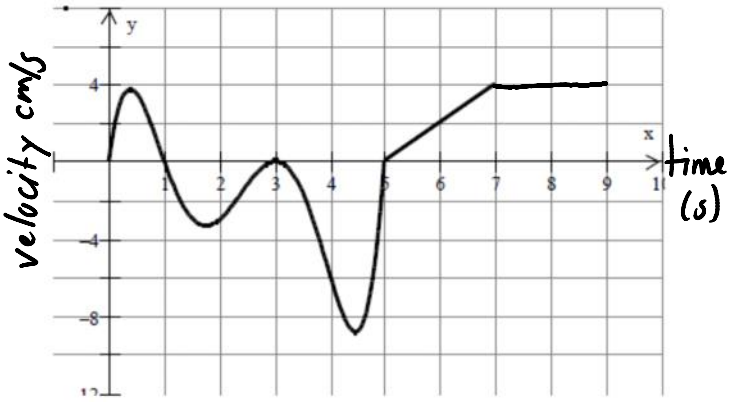
Unit 5 Day 4: Motion: Position, Velocity, and Acceleration (3.4)

Warm-Up: Work with your group to answer the following questions given the graph and info below.

A hungry mouse is in the middle of a long tube at time $t = 0$. Nobody is sure how he got there, but when $t = 0$, he is in the middle of the tube. He runs back and forth as some smelly food is placed then removed from each end of the tube.

This is not hurting the mouse in any way. Think of it as mouse exercise.

This is the graph of the mouse's velocity in cm/sec as a function of time. Assume movement to the right is positive velocity.



a) Which way did the mouse run first? Was the mouse thrown into the tube or placed?

right → v+ place → v(0) = 0

b) When was the mouse moving the fastest? What direction was he going?

4.5s left → v-

c) When did the mouse turn around?

t = 1, 5s → velocity changes sign

d) On what intervals was the mouse speeding up? Slowing down?

Up: (0, .5) (1, 1.75) (3, 4.5) (5, 7) Down: (.5, 1) (1.75, 3) (4.5, 5)

e) On what intervals was the mouse moving to the right?

(0, 1) (5, 9) v+

f) Describe what was happening near $t = 3$.

He stopped and then resumed moving to the left.

g) What is happening on the interval (7, 9)?

a = 0 / constant velocity

h) Relative to the center of the tube, where is the mouse at $t = 5$ (left or right)?

left

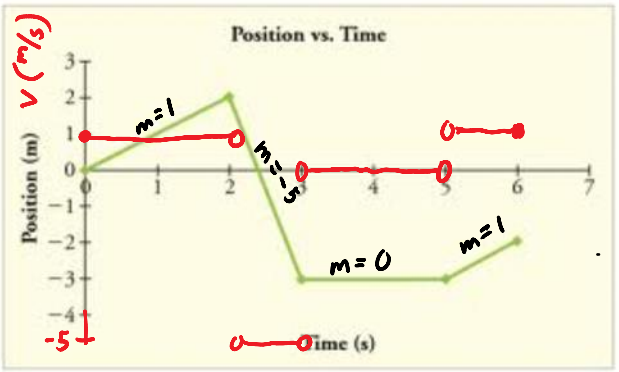
Functions: $s(t)$ or $x(t)$ = position

$v(t) = s'(t) = x'(t)$ = velocity → $\frac{\Delta s}{\Delta t}$

$a(t) = v'(t) = s''(t) = x''(t)$ = acceleration → $\frac{\Delta v}{\Delta t}$

Position → slope → Velocity

Example 1: A particle P moves on back and forth on a telephone line. The graph shows the position of P as a function of time t.



(a) When is P moving to the left? (2, 3) $s' = v -$

to the right? (0, 2) (5, 6) $s' = v +$

standing still? (3, 5) $s' = v = 0$

(b) What is the displacement of P from $t = 0$ to $t = 6$?

displacement = $s(6) - s(0)$ ($s(0)$ ↓, $s(6)$ ↓)

$\Delta s = -2 - 0$

$= -2$ m

(c) What is the total distance P traveled from $t = 0$ to $t = 6$?

Total Distance = 2m + 5m + 0m + 1m = 8 m

(d) Graph the particle's velocity on the same graph above.

$v = s'$ → slopes

avg rate of change
slope b/t 2 pts

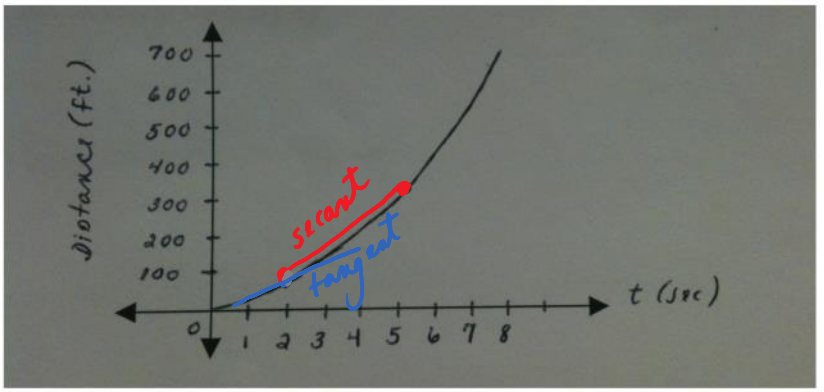
Example 2: Below is a distance graph of a race car. The slope of the secant line from $t = 2$ to $t = 5$ is 100 ft/s or 68 mph. The slope of the tangent line at $t = 2$ is 57 ft/s or 39 mph.

(a) Given the information above, what is the average velocity of the car from $t = 2$ to $t = 5$?

100 ft/s

(b) What is the instantaneous velocity at $t = 2$?

57 ft/s



(c) How would you find instantaneous velocity of a car?

speedometer. ↓ add ; direction

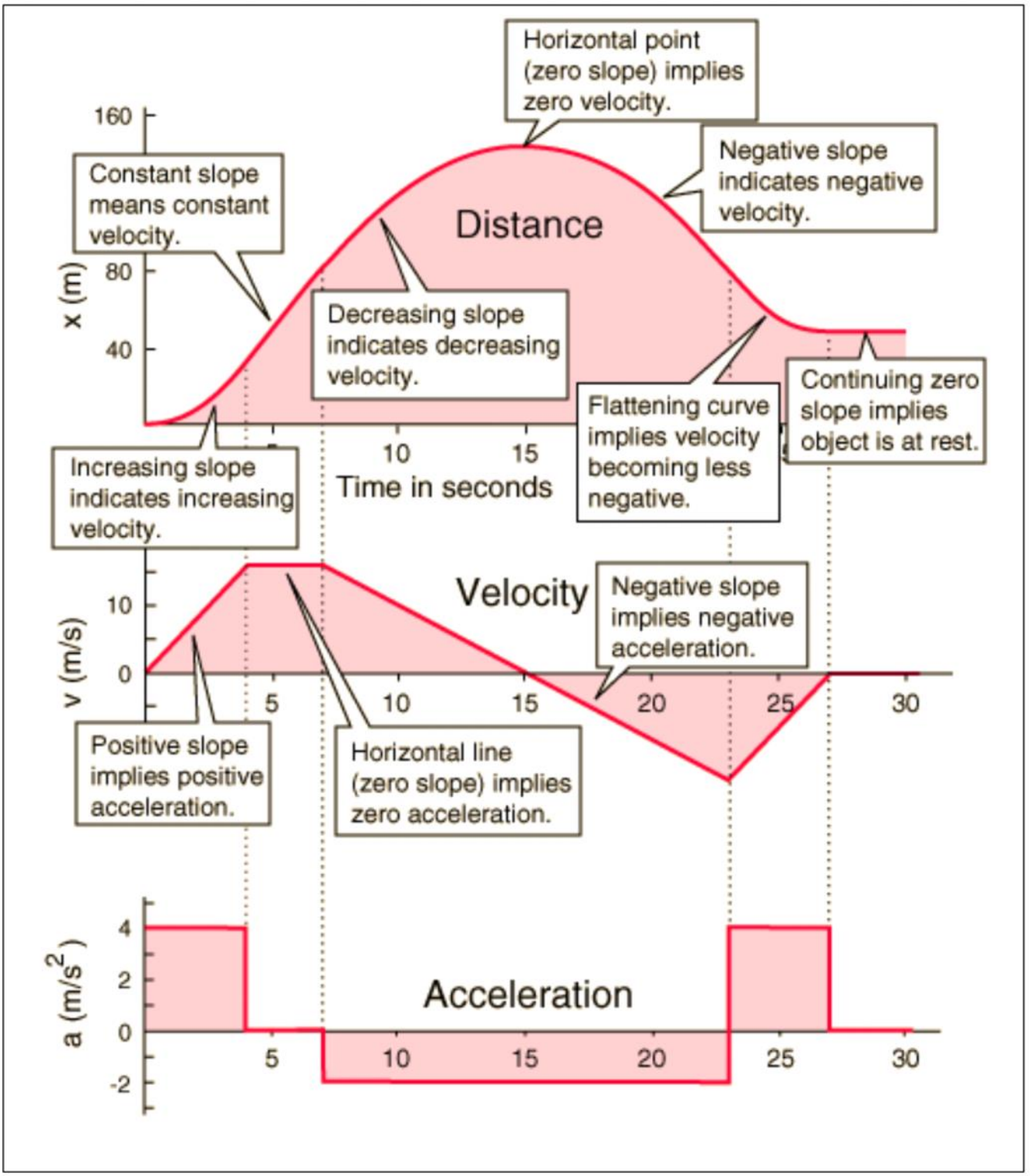
(d) Could you find the exact instantaneous velocity of the car at $t = 4$?

No, b/c no function

(e) If I tell you that the acceleration for the car is nearly a constant 28.5 ft/s^2, what does this mean?

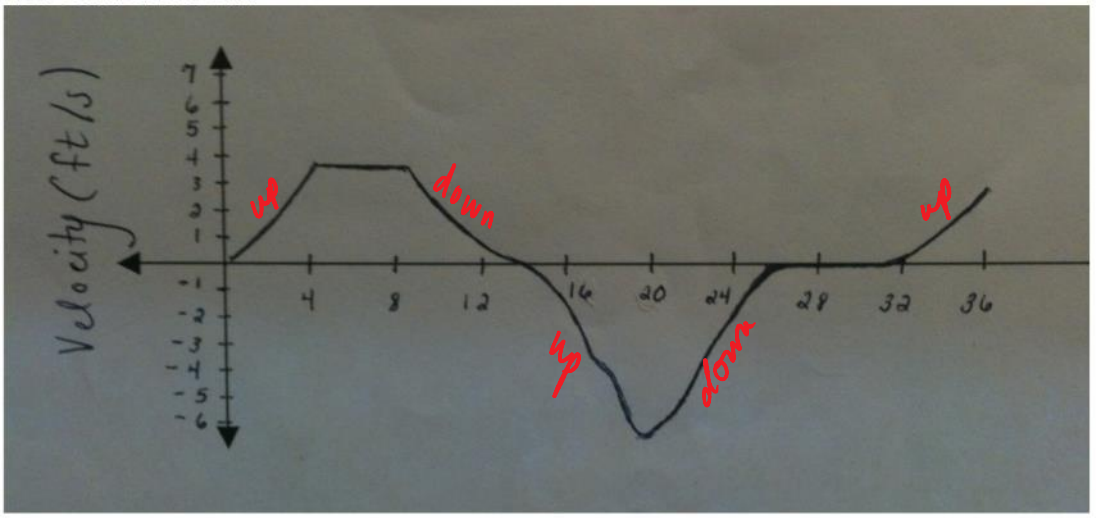
Velocity is increasing 28.5 ft/s every second

Visual Position (Distance), Velocity, Acceleration



Position ← above/below → Velocity

Example 3: A student walks in front of a motion detector that records her velocity. The graph shown below uses feet and seconds.



(a) When is the girl moving forward?

(0,14) ∪ (31, 36) v + (above x-axis)

(b) When is the girl moving backwards?

(14, 26) v − (below x-axis)

(c) When is her velocity the greatest?

(4, 8) greatest y

(d) When is her speed the greatest?

t = 20 seconds → s = |v| greatest y value

(e) When is velocity 0?

t = 0, 14, (26,31) seconds (x-axis)

(f) When is she speeding up?

(0,4) (14, 20) (31, 36) → v is moving away from 0 (x-axis)

(g) When is she slowing down?

(8,14) (20, 26) → v is moving towards 0 (x-axis)

(h) When is acceleration positive? (0,4) (21,24) (31,34) v' +

v'

negative? (8,20) v' −

zero? (4,8), (24,31) v' = 0

t=20