Exam 1 Review

Emphasis will be on motion (1 and 2-D) with constant acceleration, but you should also be familiar with unit conversion, vectors, and the calculus aspects of motion since these are all necessary problem solving tools.

* 5-8 questions similar to in-class examples and HW

* 2 hours 45 minutes

* B.Y.O. formula sheet with anything (8.5 x 11" both sides)

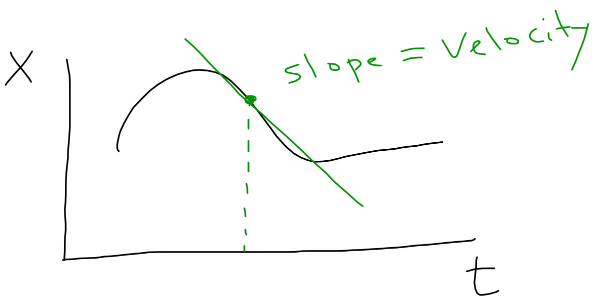
* graphing or scientific calculator, Optional: ruler, protractor, compass

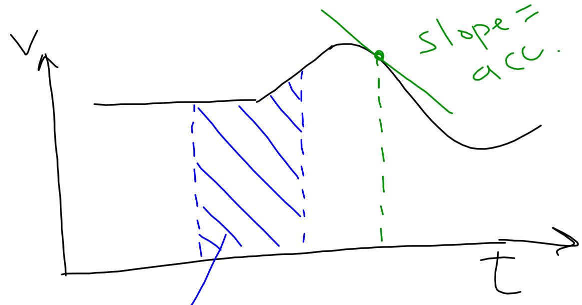
1-D motion

Position (x) changes with time (t)

- If $\frac{dx}{dt} \neq 0$ then the object is moving

$$v \equiv \frac{dx}{dt}, \quad v_{ave} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$





$$\text{Area} = \int v\,dt = \Delta x$$

$$a \equiv \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

$$a_{ave} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

For const. a:

$$V_f = V_i + at$$

$$X_f = X_i + \frac{1}{2}(V_i + V_f)t$$

$$X_f = X_i + V_i t + \frac{1}{2}at^2$$

$$V_f^2 = V_i^2 + 2a(X_f - X_i)$$

2D motion

x-direction

$$V_{fx} = V_{ix} + a_x t$$

$$X_f = X_i + \frac{1}{2}(V_{ix} + V_{fx})t$$

$$X_f = X_i + V_{ix} t + \frac{1}{2}a_x t^2$$

$$V_{xf}^2 = V_{ix}^2 + 2a_x(X_f - X_i)$$

y-direction

$$V_{fy} = V_{iy} + a_y t$$

$$y_f = y_i + \frac{1}{2}(V_{iy} + V_{fy})t$$

⋮

same t,
otherwise independent

$\left(a_g = 9.81\,\frac{m}{s^2} \text{ down}\right)$

Example

Given $x = 21 + 22t - 6t^2$ $\quad [x] = \text{meters}$ $\quad [t] = \text{seconds}$

(a) What are x_i, V_i, and a?

$\boxed{x_i = 21\text{ m}}$ $\quad \boxed{a = -12\text{ m/s}^2}$

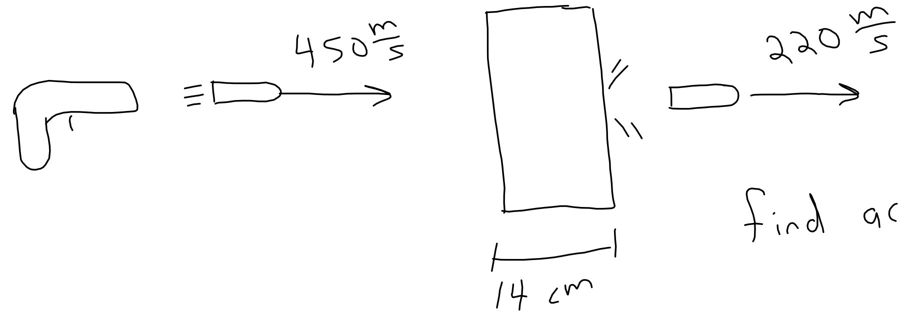
$\boxed{V_i = 22\ \frac{m}{s}}$

b) find V_{ave} for $0 < t < 3\text{ s}$.

$$V_{ave} = \frac{x_f - x_i}{t_f - t_i} = \frac{33\text{m} - 21\text{m}}{3\text{s} - 0\text{s}} = \boxed{4\ \frac{m}{s}}$$

$$x_f = 21 + 22(3) - 6(3)^2 = 33$$

Example



find acceleration.

$V_i = 450 \frac{m}{s}$

$V_f = 220 \frac{m}{s}$

$X_i = 0\ m$

$X_f = 14\ cm$

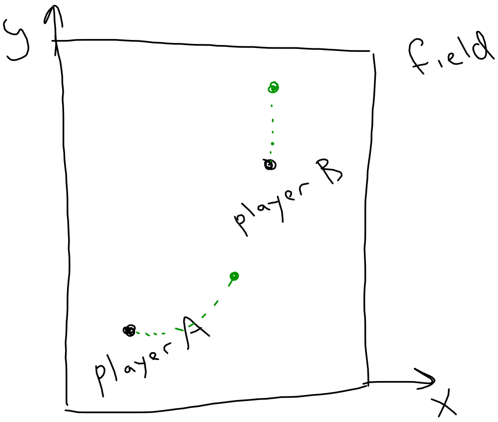
~~$t = ?$~~

$a = ?$

$$V_f^2 = V_i^2 + 2a\Delta X$$

$$a = \frac{V_f^2 - V_i^2}{2\Delta X} = \boxed{-550 \frac{km}{s^2}}$$

Example



A

$\vec{X}_i = (10, 15)\,m$

$\vec{V}_i = (3, 0)\,\frac{m}{s}$

$\vec{a} = (0, 1)\,\frac{m}{s^2}$

B

$\vec{X}_i = (25, 30)\,m$

$\vec{V}_i = (0, 5)\,\frac{m}{s}$

$\vec{a} = (0, 0)\,\frac{m}{s^2}$

How far apart after 3s?

A

$X_f = X_i + V_{xi}t + \frac{1}{2}a_x t^2$

$= 19m$

$y_f = 15 + 0 + \frac{1}{2}(1)3^2$

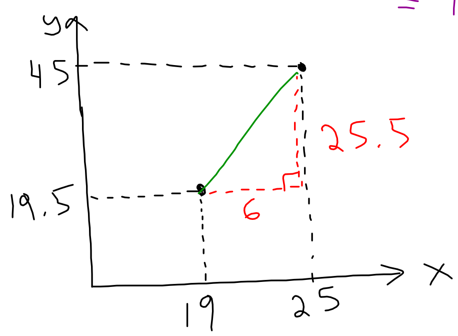
$= 19.5m$

B

$X_f = 25\,m$

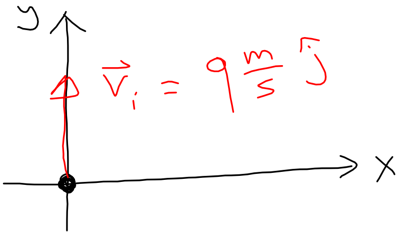
$y_f = 30 + 5(3)$

$= 45m$



$\sqrt{6^2 + 25.5^2} = \boxed{26.20\,m}$

Example



$$\vec{a} = (2\hat{i} - 4\hat{j})\frac{m}{s^2}$$

when $x = 15\,m$, what is the speed?

y-direction

$v_i = 9\frac{m}{s}$

$a = -4\frac{m}{s^2}$

$y_i = 0$

$$v_f = v_i + at$$
$$= 9 - 4(3.88)$$
$$= -6.52\ m/s$$

x-direction

$x_i = 0$

$x_f = 15\,m$

$a = 2\,m/s^2$

$v_i = 0$

$$v_f^2 = v_i^2 + 2a\Delta x$$
$$v_f = \sqrt{60} = 7.75\frac{m}{s}$$

$$v_f = v_i + at$$
$$t = 3.88\,s$$

$$\text{speed} = \sqrt{(-6.52)^2 + (7.75)^2}$$
$$= \boxed{10\frac{m}{s}}$$