P1200 Sample Hand-in Homework Annotated Key Due Date: N/A

See the HiHW grading rubric posted on Carmen under modules/course documents

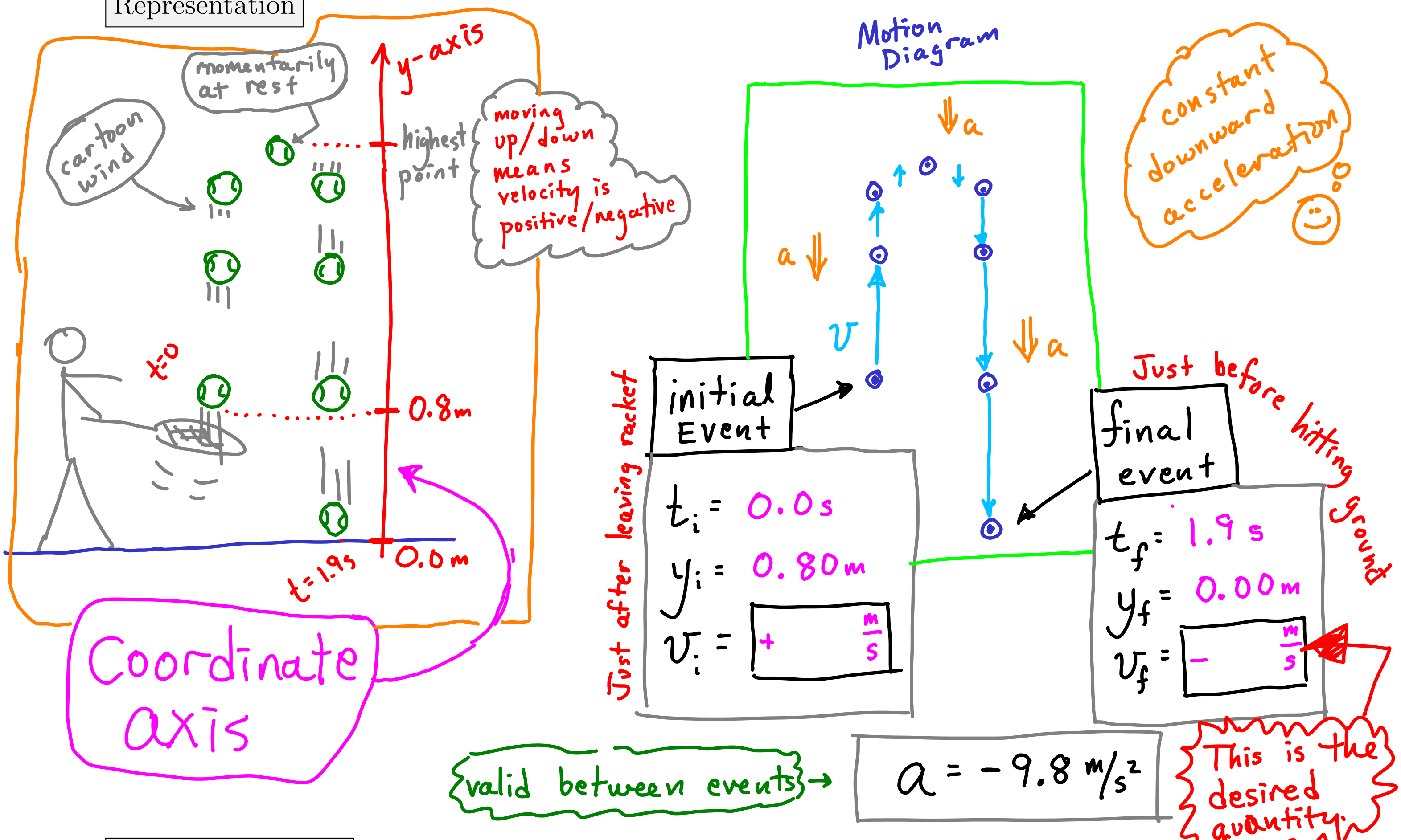
Name: [your name here] Recitation Instructor: Bob Jones

While warming up before the match, Serena Williams is gently bouncing a tennis ball up and down on her racket. She then gives it a powerful upward hit from an initial height of 0.80 m and sends it traveling perfectly vertically. After rising to its maximum height, the ball falls back down to the court. Given that the ball was in the air for a total of 1.9 s, determine its velocity upon hitting the court.

Representation:	0	1	2
Physics Concept(s):	0	1	2
Initial Equation(s):	0	0.5	1
Symbolic Answer:	0		1
Units Check:	0	0.5	1
Neatness:	-2	-1	0
Total:			
Correct Answer:	Y	N	

Translate the word problem into pictures and diagrams

Representation



Physics Concept(s) (Refer to the list of concepts on Carmen under modules/course documents.)

(1) One-dimensional kinematics (with constant acceleration)

↓ Show your equation work on next page ↓

Initial Equation(s)

always true: "Δ" = final − initial

$$\text{Eq. ①: } (\Delta y) = v_i\cdot(\Delta t) + \tfrac{1}{2}a\cdot(\Delta t)^2$$

$$\text{Eq. ②: } v_f = v_i + a\cdot(\Delta t)$$

Algebra Work (Symbols only. Don't plug in any numbers yet.)

Reminder of the given values

$y_i = 0.80\,m$

$y_f = 0.00\,m$

$t_i = 0.0\,s$

$t_f = 1.9\,s$

$a = -9.8\,\frac{m}{s^2}$

you can make notes indicating what you do at each step.

$$\text{Eq. ①: } (\Delta y) = v_i\cdot(\Delta t) + \tfrac{1}{2}a\cdot(\Delta t)^2$$

v_i: not known, solve for it

subtract $\frac{1}{2}a(\Delta t)^2$

$$(\Delta y) - \tfrac{1}{2}a\cdot(\Delta t)^2 = v_i\cdot(\Delta t)$$

Divide by (Δt)

$$v_i = \left\{\frac{(\Delta y)}{(\Delta t)} - \frac{1}{2}a\cdot(\Delta t)\right\}$$

Substitute that into Eq 2:

$$\text{Eq. ②: } v_f = v_i + a\cdot(\Delta t)$$

$$= \left\{\frac{(\Delta y)}{(\Delta t)} - \frac{1}{2}a\cdot(\Delta t)\right\} + a\cdot(\Delta t)$$

use: $-\frac{1}{2} + 1 = +\frac{1}{2}$

$$= \frac{(\Delta y)}{(\Delta t)} + \frac{1}{2}a\cdot(\Delta t)$$

Symbolic Answer:

$$\boxed{v_f = \frac{(\Delta y)}{(\Delta t)} + \frac{1}{2}a\cdot(\Delta t)} = \frac{(\Delta y) + \frac{1}{2}a\cdot(\Delta t)^2}{(\Delta t)}$$

same

Units Check

$[x]$ = units of x

Example: $[(\Delta t)]$ = second

$$[v_f] = \frac{m}{s} \stackrel{?}{=} \left[\frac{(\Delta y)}{(\Delta t)}\right] = \frac{m}{s} \stackrel{?}{=} [a\cdot(\Delta t)] = \frac{m}{s^2}\cdot s = \frac{m}{s}$$ ✔

Note that all three terms have the same units.

Numerical Answer (Obtain this by plugging numbers into your symbolic answer.)

$(\Delta t) = t_f - t_i = (1.9) - (0) = 1.9\,s$

$(\Delta y) = y_f - y_i = (0) - (0.8) = -0.80\,m$

$(\Delta v) = v_f - v_i = \boxed{-\quad \frac{m}{s}}$ unknown.

$$v_f = \frac{(-0.8)}{(1.9)} + \frac{1}{2}(-9.8)(1.9)$$

Note use of parenthese

$$\boxed{v_f = -9.7\,\frac{m}{s}}$$

Pay attention to the signs