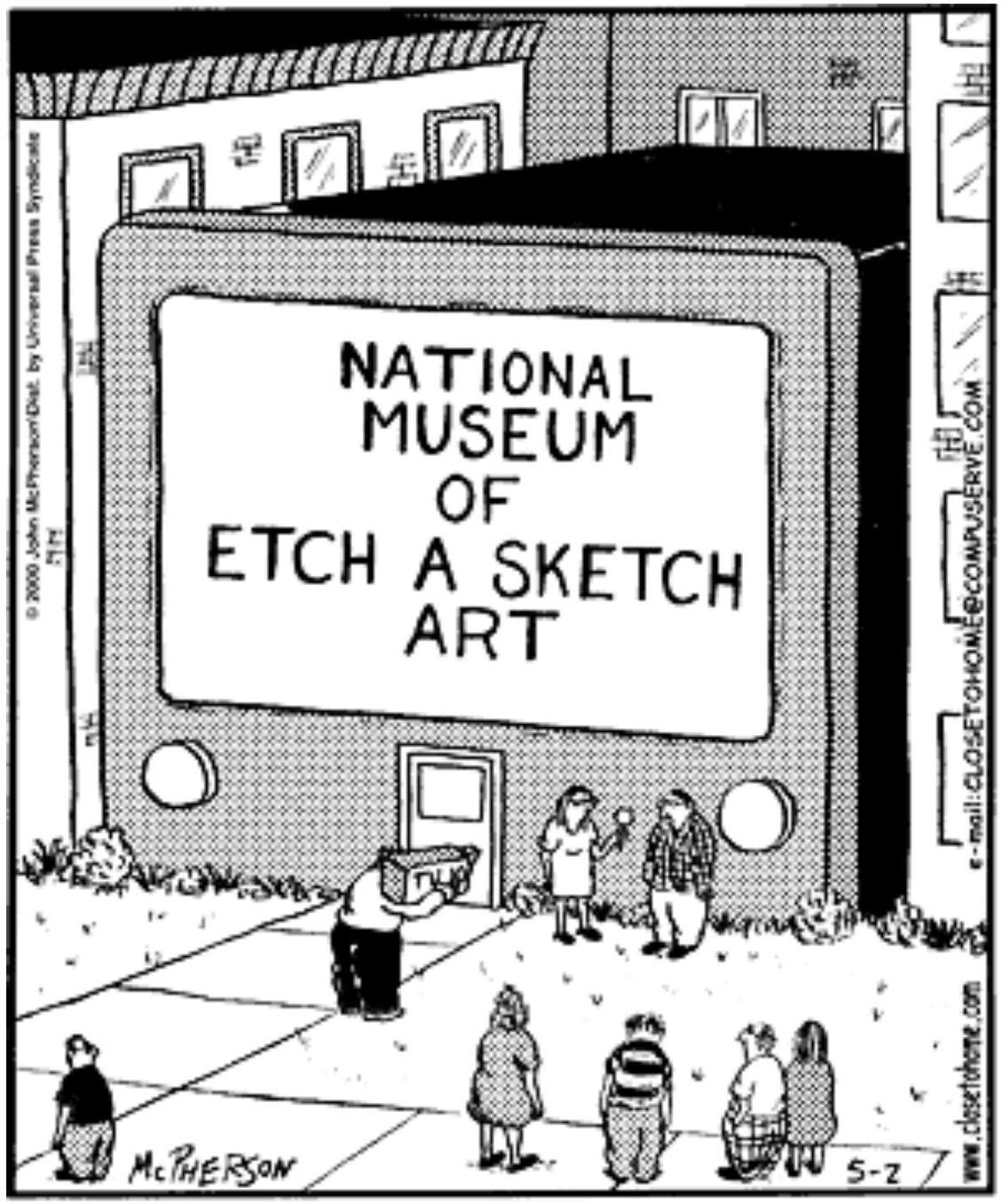
Physics 123

Please find the card with your picture in the front of the room and write the following on it:

1. Preferred name
2. Your hometown
3. Interests, hobbies, major
4. Title of the last book you read (or a favorite)
5. Some interesting/funny fact about yourself to help me remember you

Hand your card in before you leave.



"Structurally, the building is fine. But sadly, the earthquake destroyed all of our art pieces."

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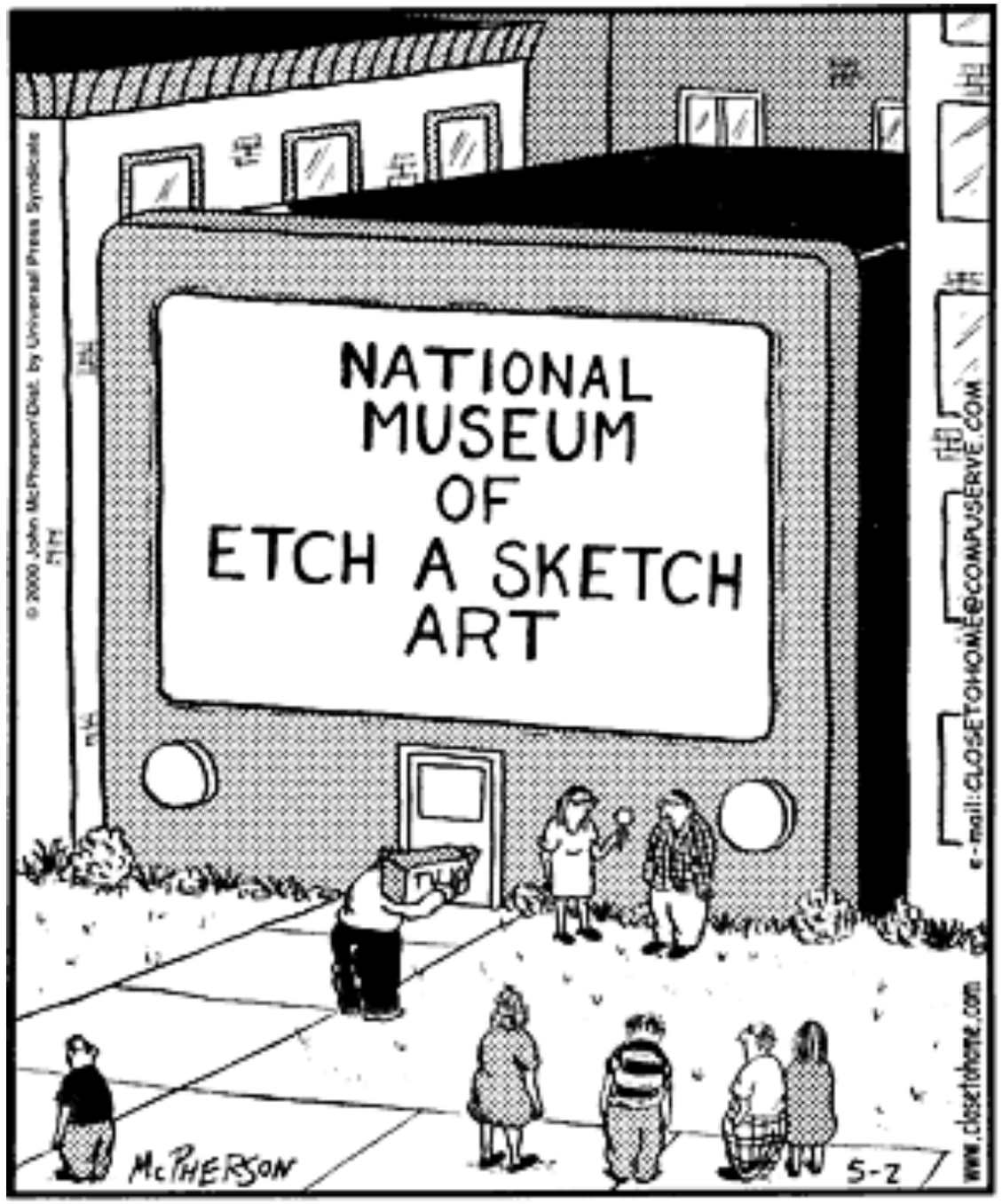

"Structurally, the building is fine. But sadly, the earthquake destroyed all of our art pieces."

Physics 121: Principles of Physics

Who am I?

Lance Nelson

Rigby, Idaho

Computational Physics
Material Physics

"Why things break" by Mark Eberhart

I like to play handball
but I'm not very good.

What's handball?

Main topics for this course

1. Oscillations
2. Fluid mechanics (PHSCS 121 for fluid matter)
3. Thermodynamics (heat, entropy, energy)
4. Waves, sound
5. Optics (light waves)

Physics majors

Surprising statistic

The “what to do” of this course...

Syllabus

The “what to do” of this course...

Syllabus

- Schedule

The “what to do” of this course...

Syllabus

- Schedule
  - focus on concepts one day, problem solving the next

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The “what to do” of this course...

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- HW

The "what to do" of this course...

Syllabus

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  - Numerical problems: Install Mathematica https://user.wolfram.com

The "what to do" of this course...

Syllabus

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- Quizzes

The "what to do" of this course...

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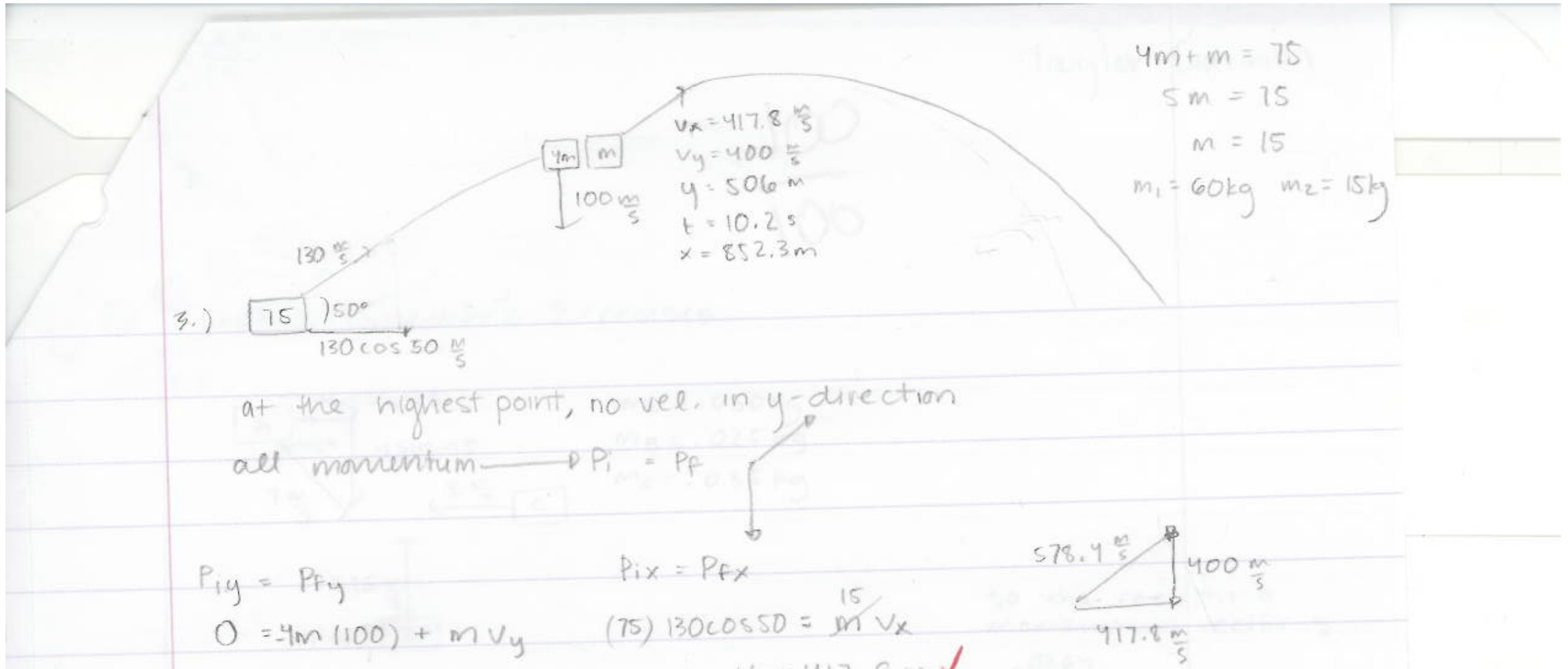
- Honor Code

The "what to do" of this course...

Syllabus

- Schedule
  - focus on concepts one day, problem solving the next
- Reading summaries
- HW
  - Numerical problems: Install Mathematica https://user.wolfram.com
- Quizzes
- Honor Code
- Getting help

3D-BE-SNUB



3.)

at the highest point, no vel. in y-direction

all momentum ⟶ $P_i = P_f$

$P_{iy} = P_{fy}$

$0 = -4m(100) + mv_y$

$(60)(100) = 15v_y$

$v_y = 400 \frac{m}{s}$ ✓

$P_{ix} = P_{fx}$

$(75)\,130\cos 50 = mv_x$ (15)

$v_x = 417.8 \frac{m}{s}$ ✓

for first interval before explosion:

$v_{fy}^2 = v_{iy}^2 + 2a\Delta y$

$\Delta y = \frac{0 - (130\sin 50)^2}{2(-9.8)} = 506$ ✓

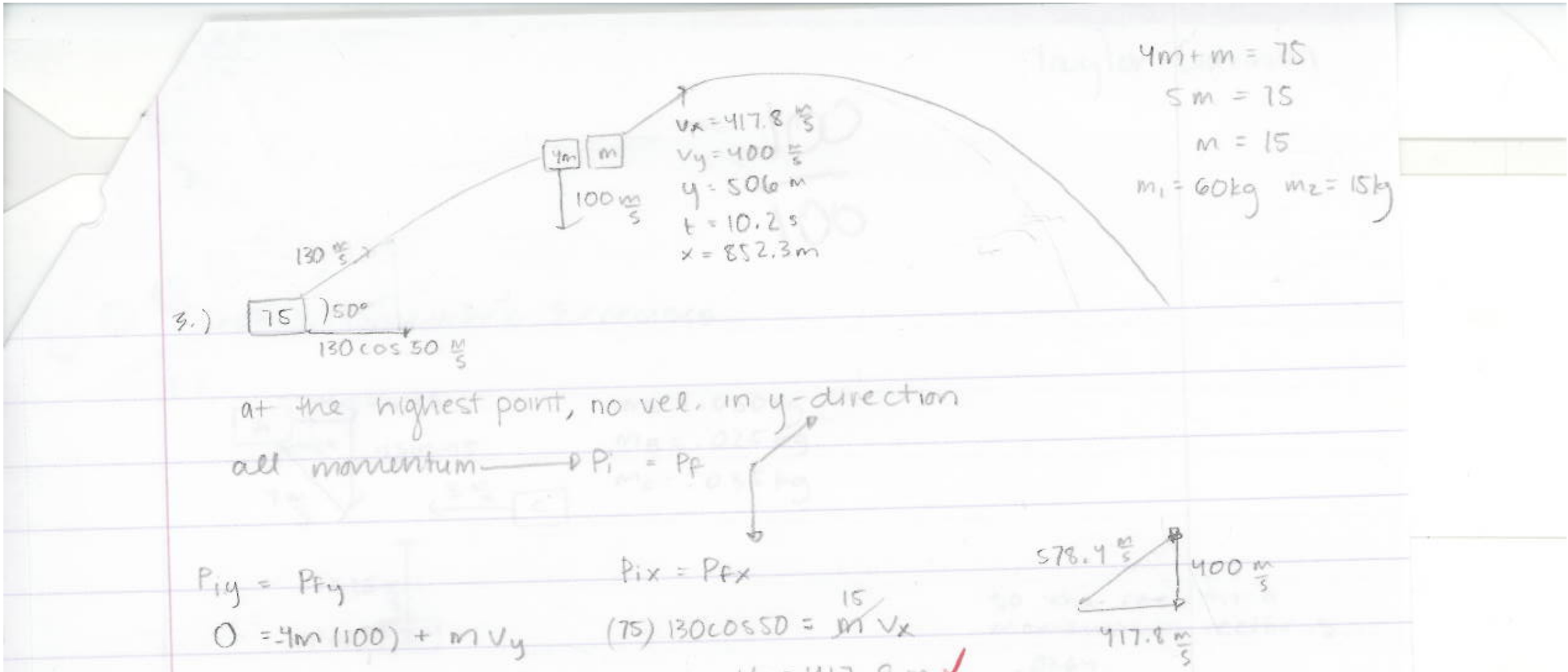
$x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2$

$852.3\,m = 0 + 130\cos 50\,(10.2)$ ✓

$v_{fy} = v_{iy} + a\Delta t$

$\Delta t = \frac{0 - 130\sin 50}{-9.8} = 10.2$

3D-BE-SNUB



- Neat, legible (please try hard, your future boss will thank you)

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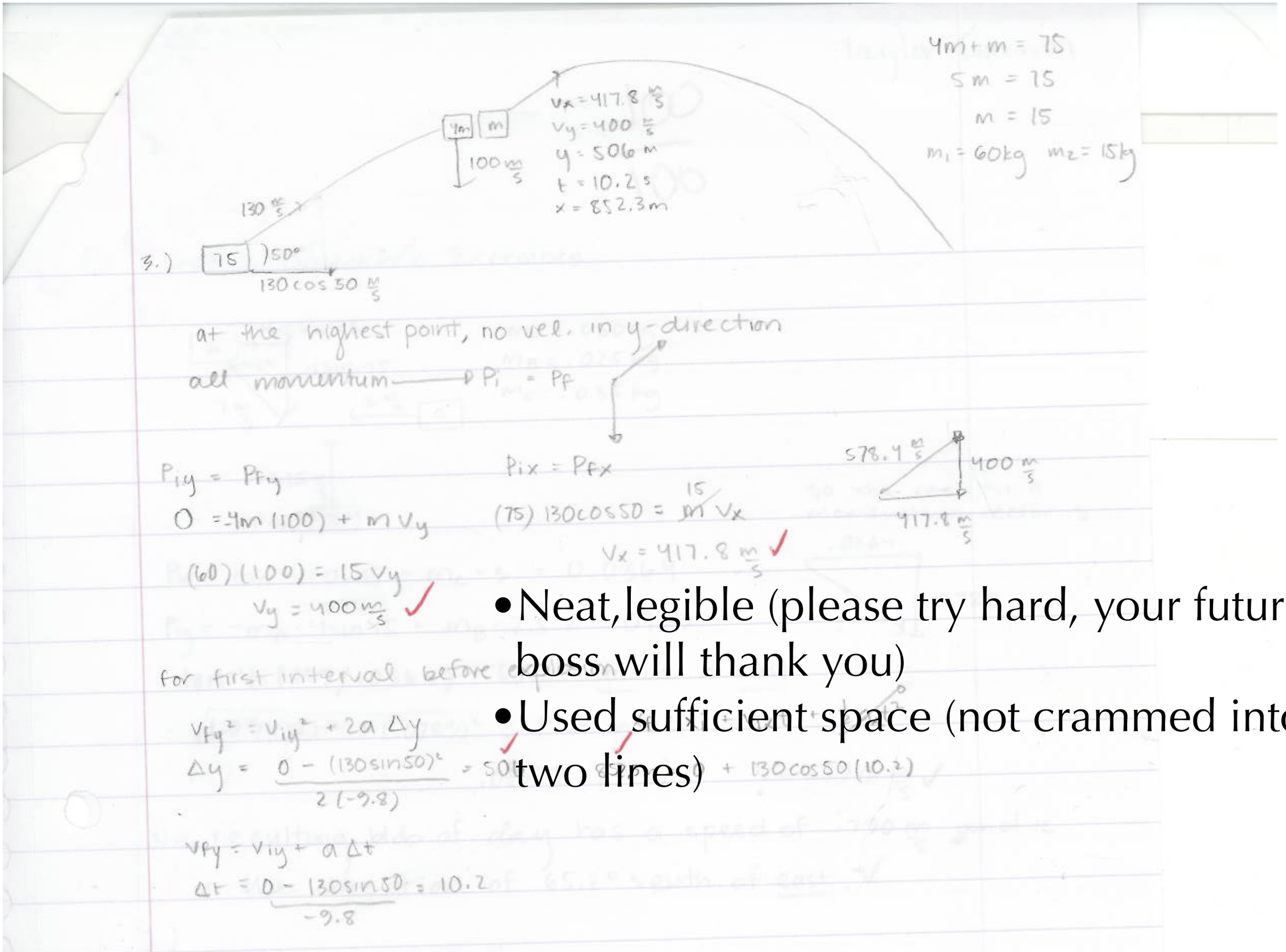

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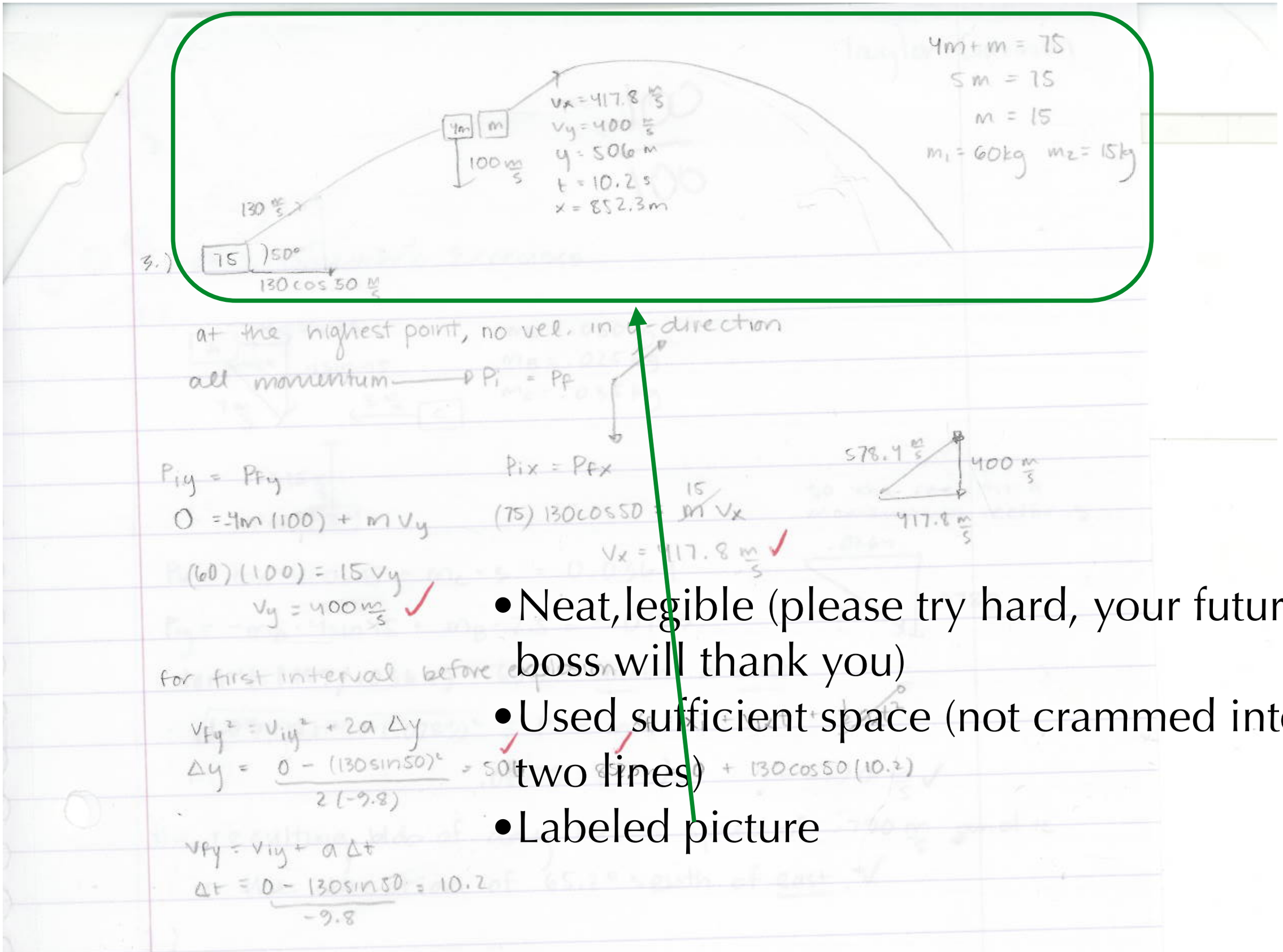
- Used sufficient space (not crammed into two lines)

3D-BE-SNUB



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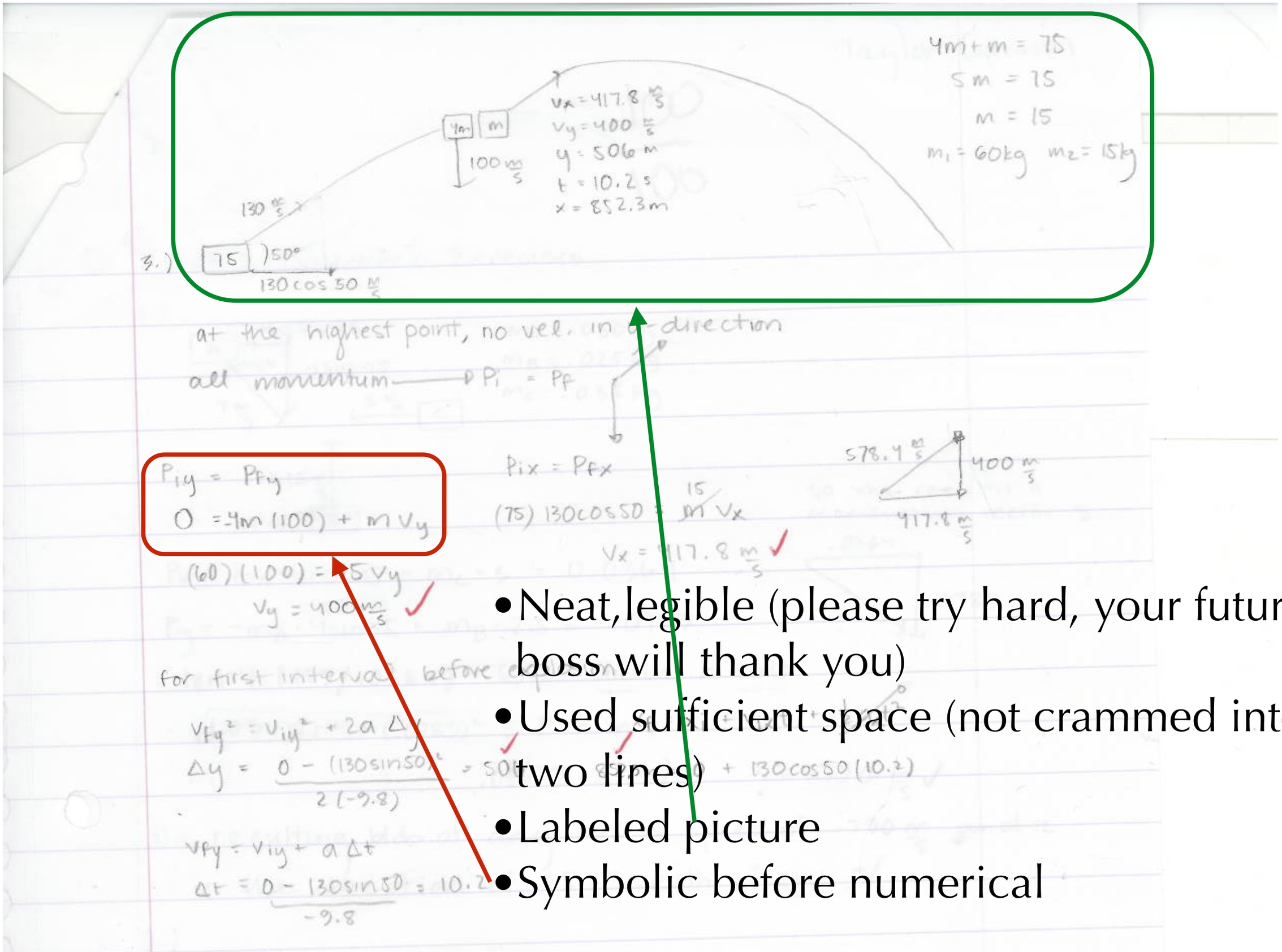
- Labeled picture

3D-BE-SNUB



- Neat, legible (please try hard, your future boss will thank you)
- Used sufficient space (not crammed into two lines)
- Labeled picture
- Symbolic before numerical

Why did the Savior teach using parables?

Why did the Savior teach using parables?

Matt 13:10-11

Alma 12:9-10

Facts about learning

—Learning is deeper and more durable when it is **effortful**.

- Rereading text and massed practice is the least productive learning strategy (and most deceptive).[1]
- Retrieval practice is a more effective learning practice. Quizzing yourself on key concepts after lecture is more effective than reviewing the lecture notes or text.
- Your intellectual abilities are not hard-wired at birth.
- Easy and fast learning is not as deep and lasting as hard and slow learning(sorry).

Learning (teaching philosophy)

Think of something you do really well (or know a lot about).

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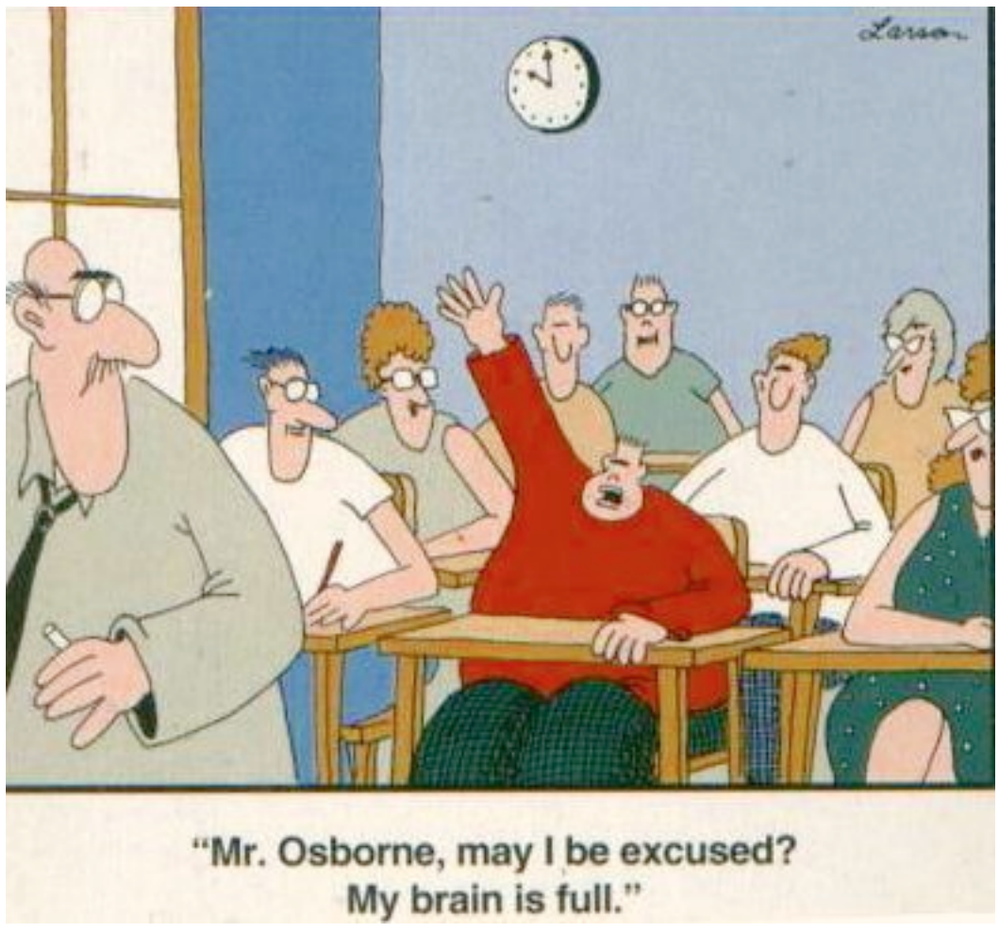

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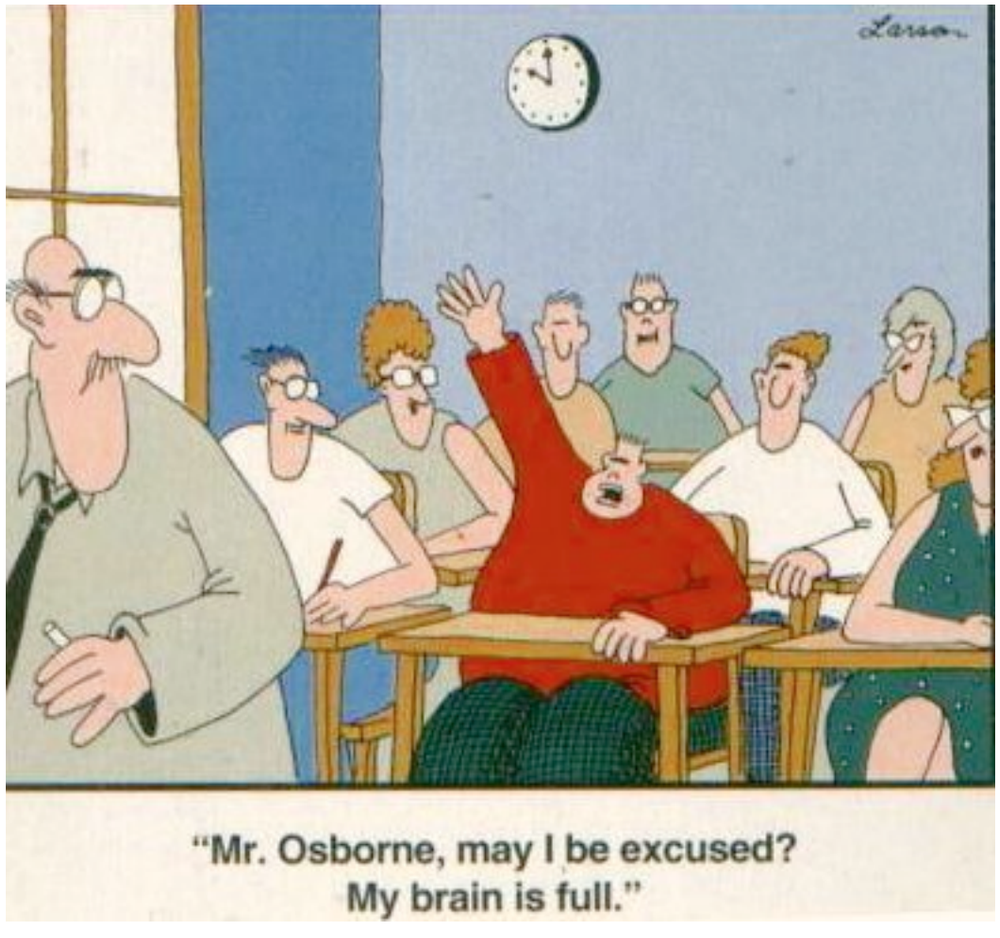
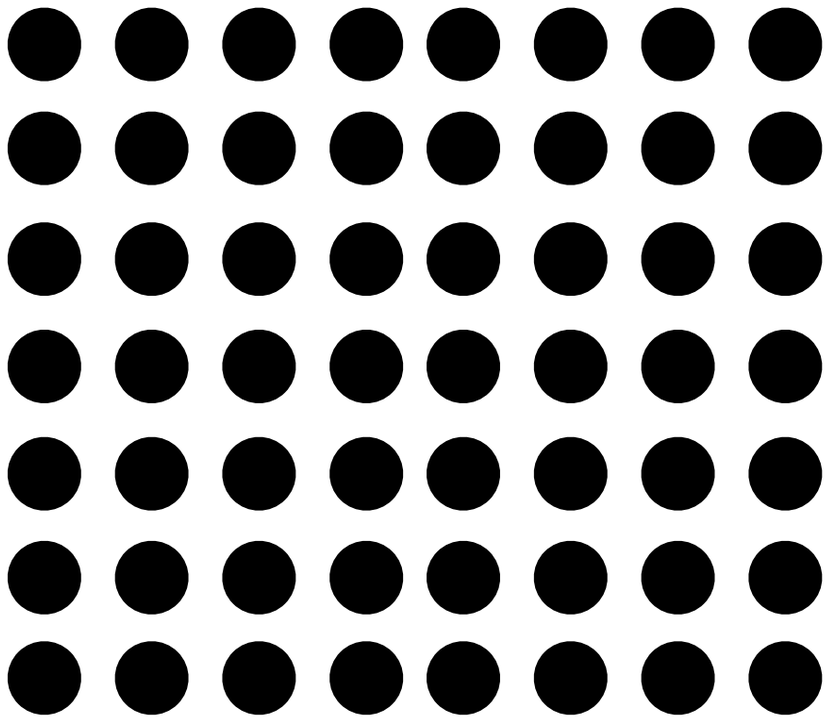
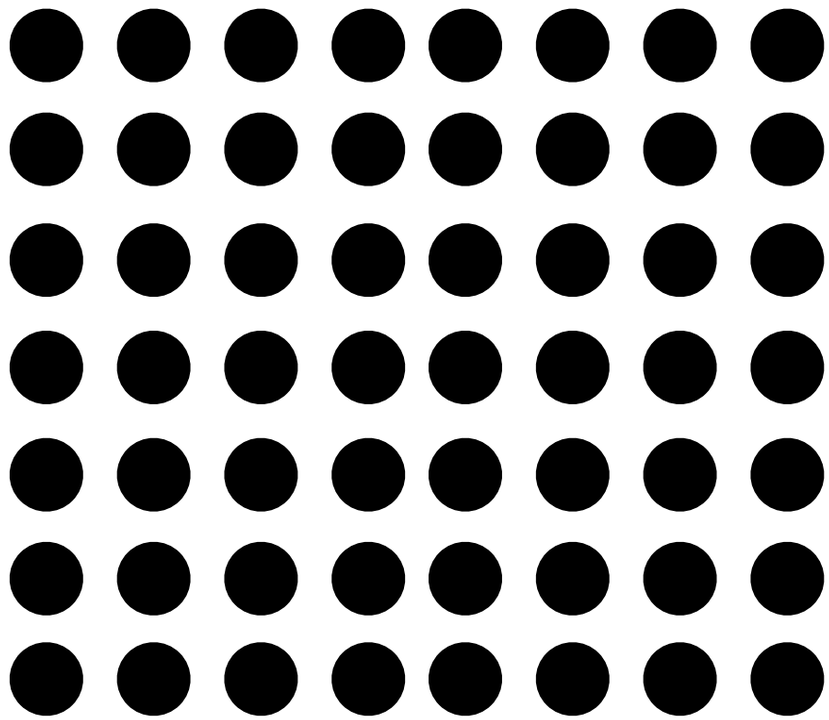
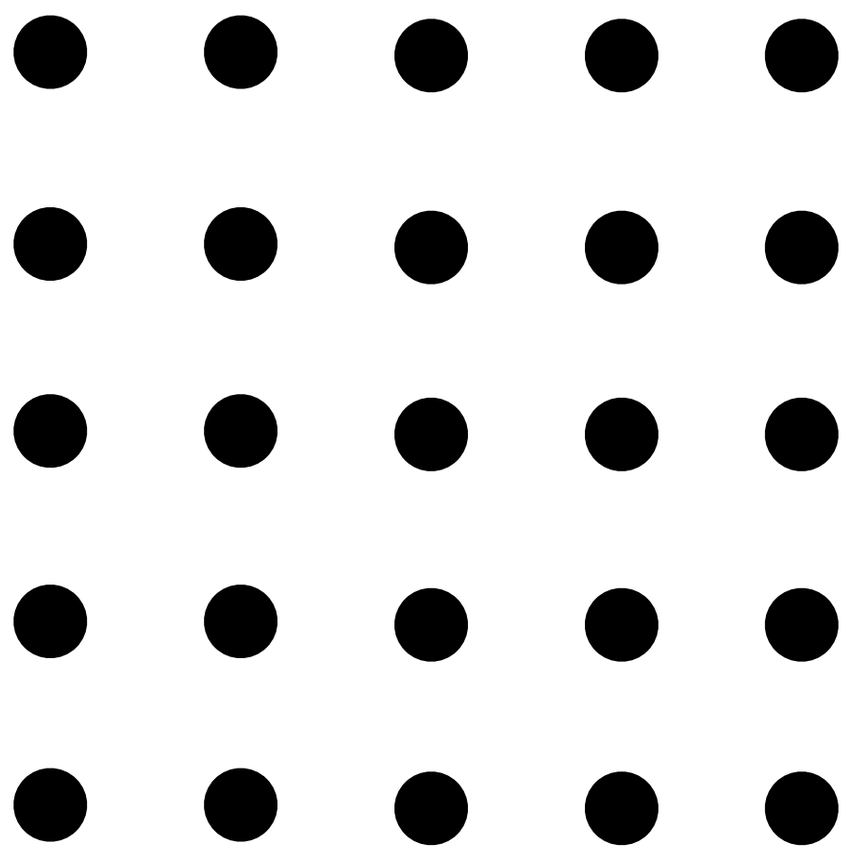




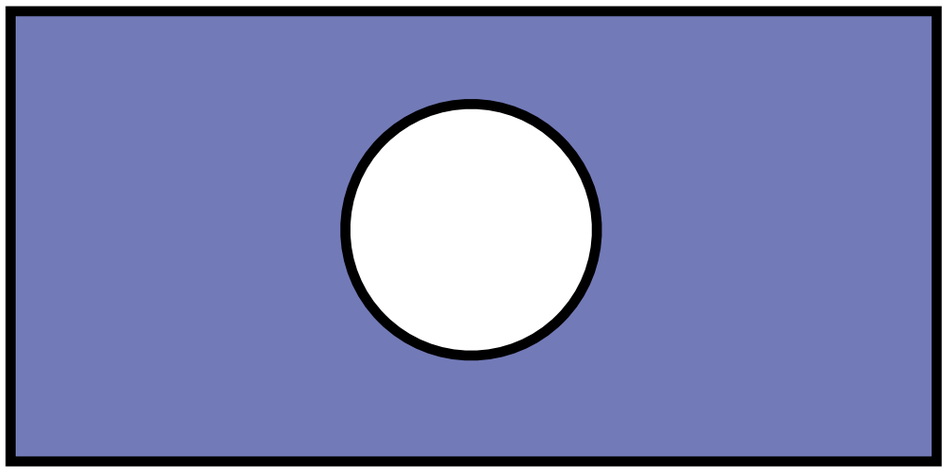
Cold



Hot



Will the hole get bigger or smaller?



Oscillatory Motion

What does that mean?

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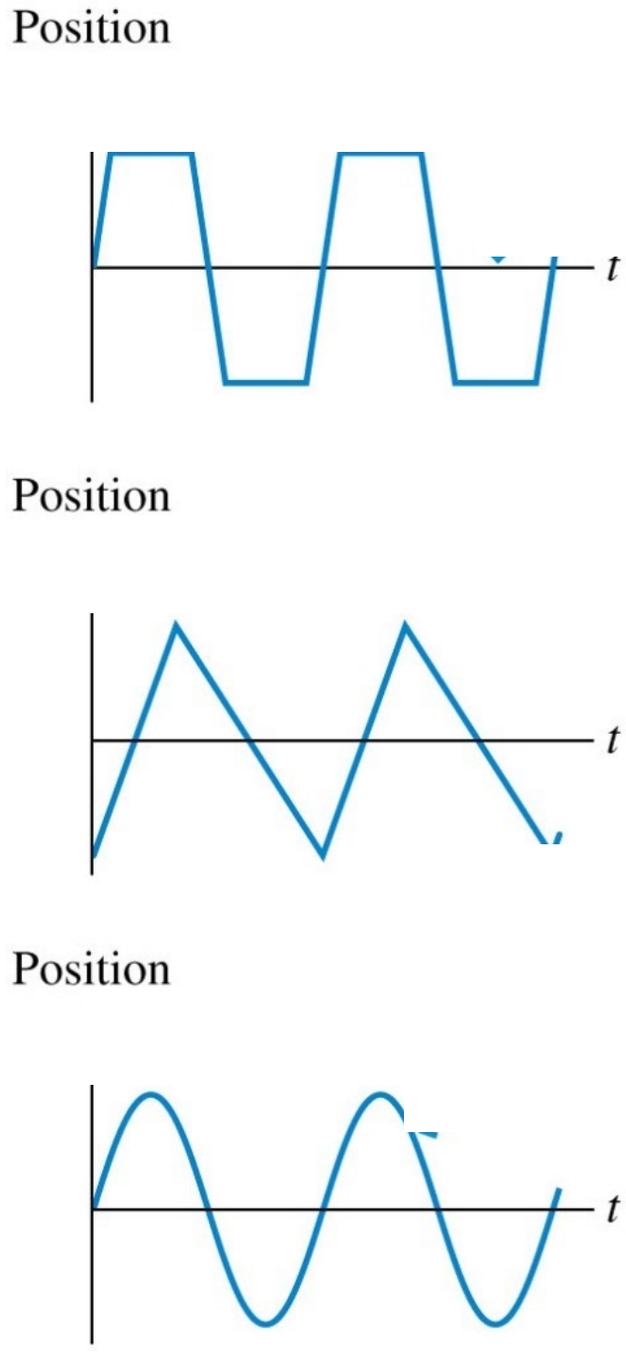
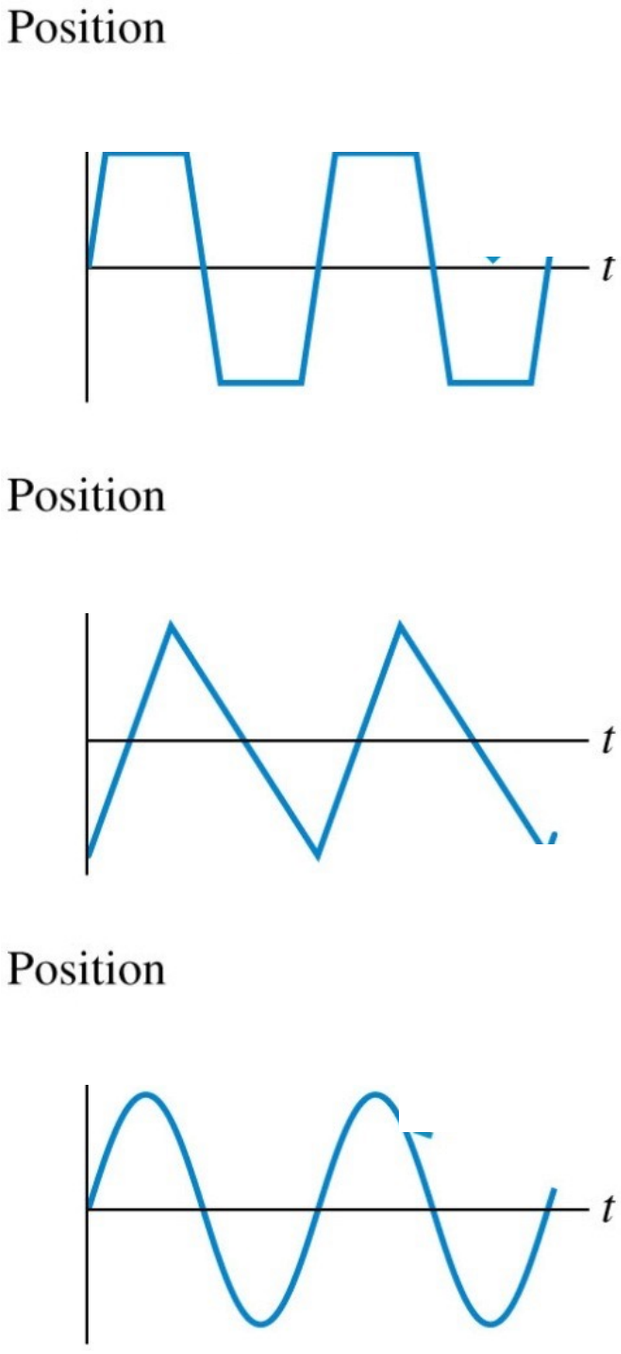


Oscillatory Motion

What does that mean?

Period?

Frequency?



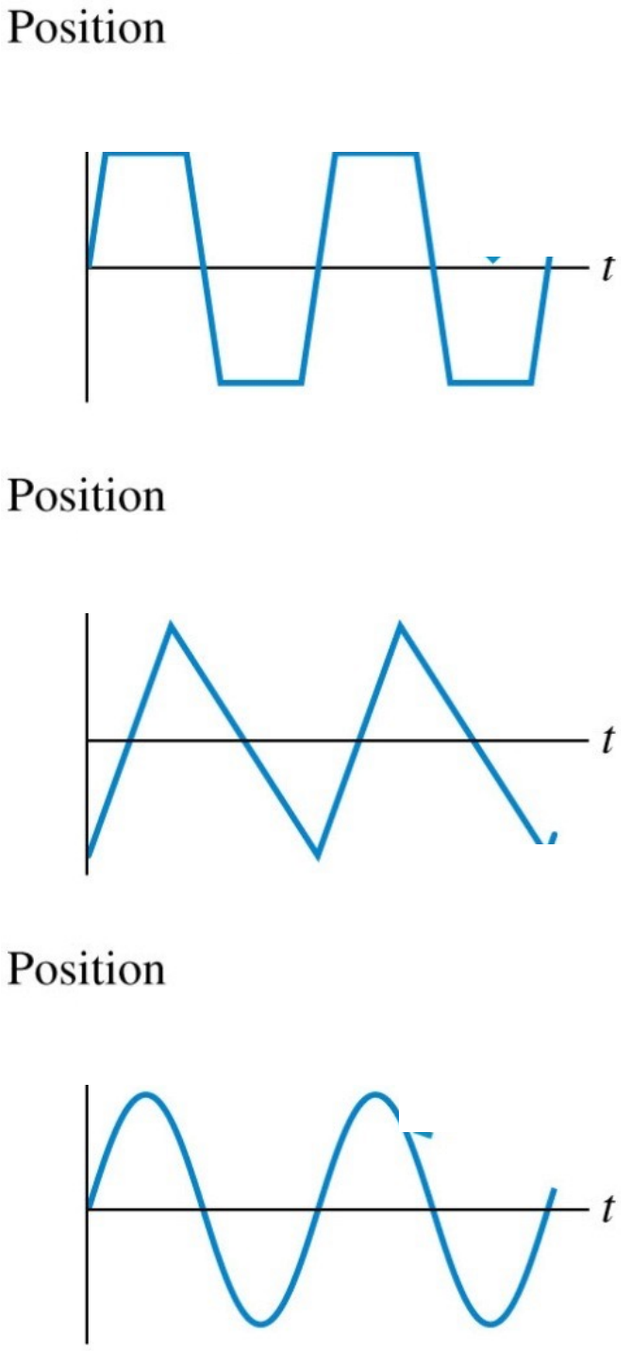
Oscillatory Motion

What does that mean?

Period? Frequency?

$$f = \frac{1}{T} \qquad \text{or} \qquad T = \frac{1}{f}$$

1 Hz = 1 cycle per second = 1 s^{-1}

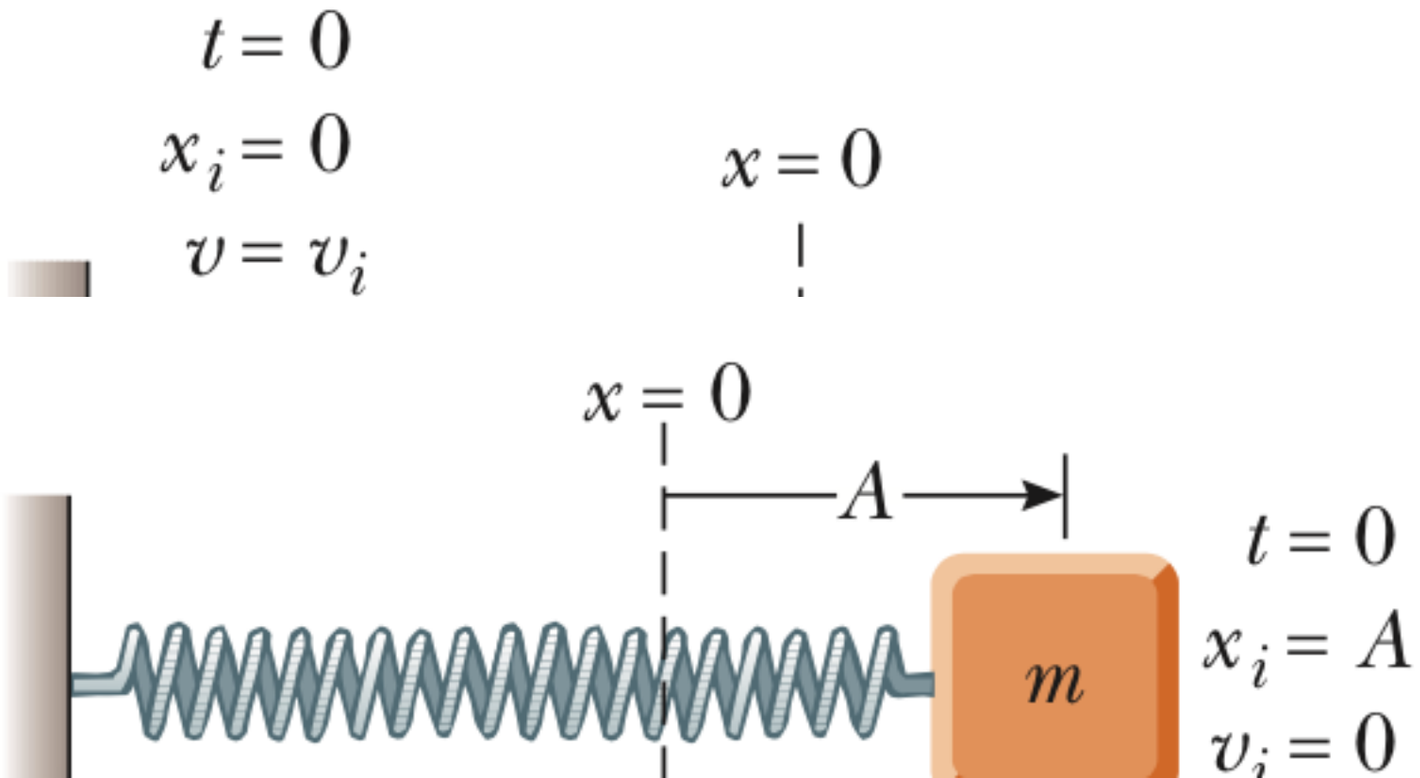


Example : A speaker cone

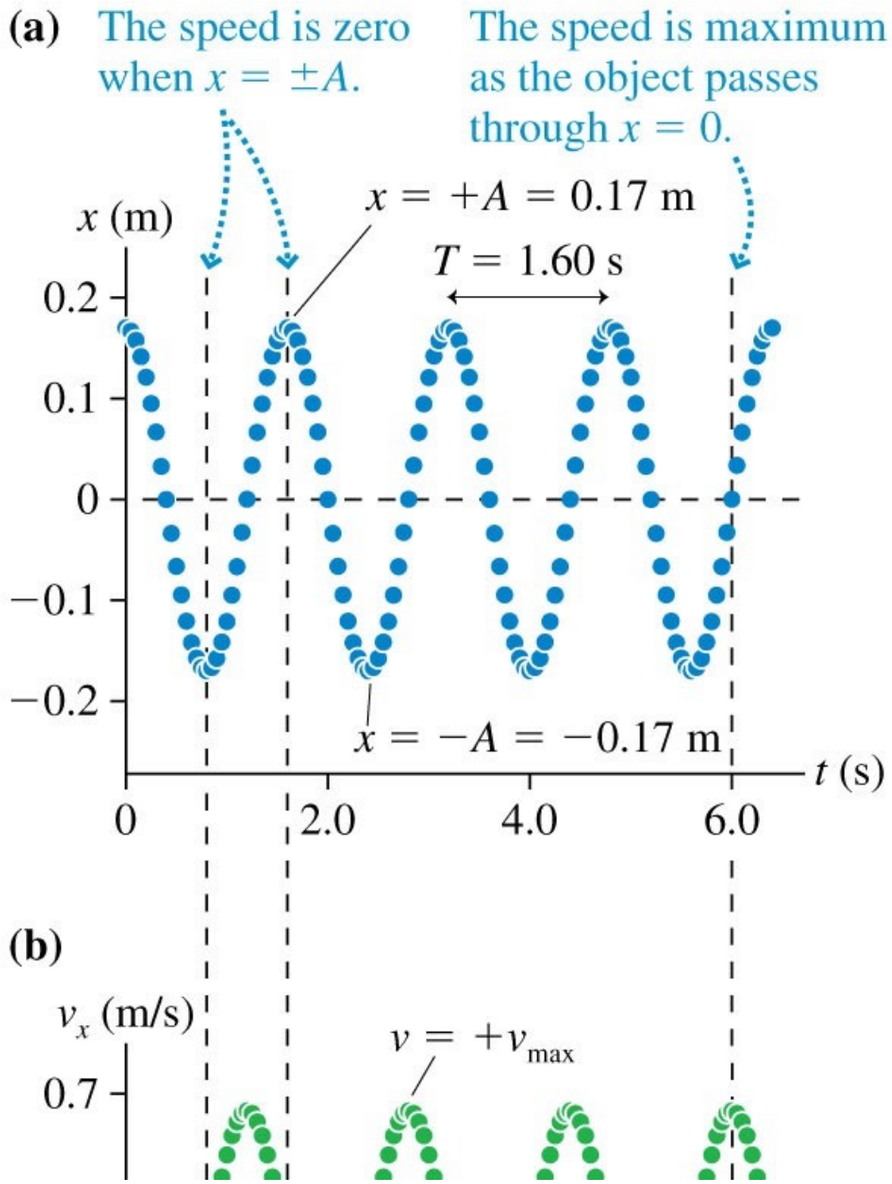
This speaker cone vibrates back and forth 5000 times every second. What is the period(T) and frequency(f) of the speaker?

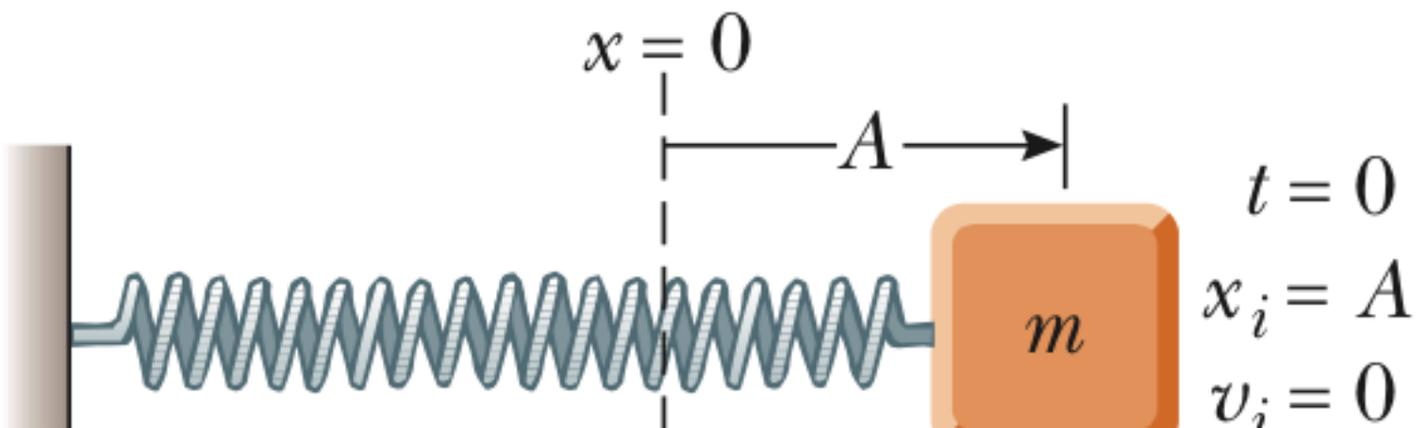
Simple Harmonic Motion

What does the position vs. time graph look like?

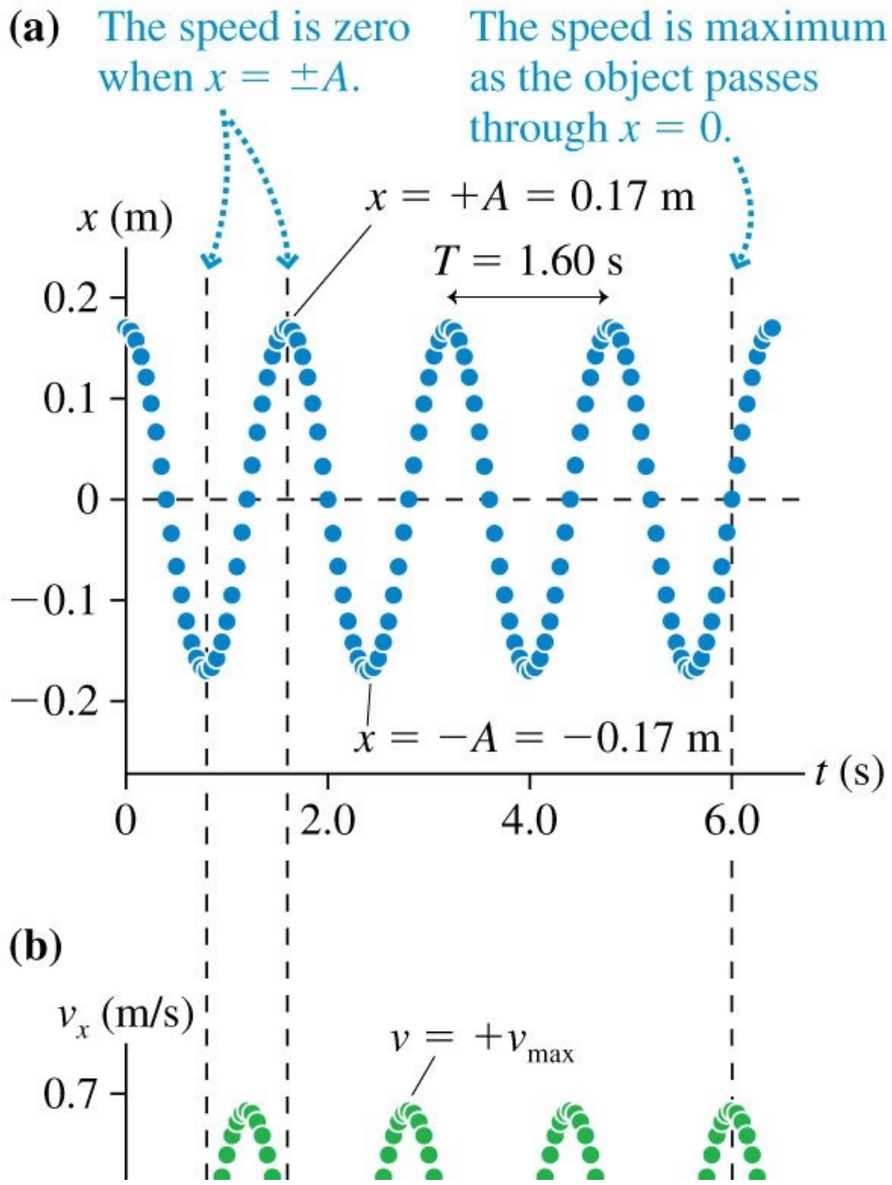


Simple Harmonic Motion

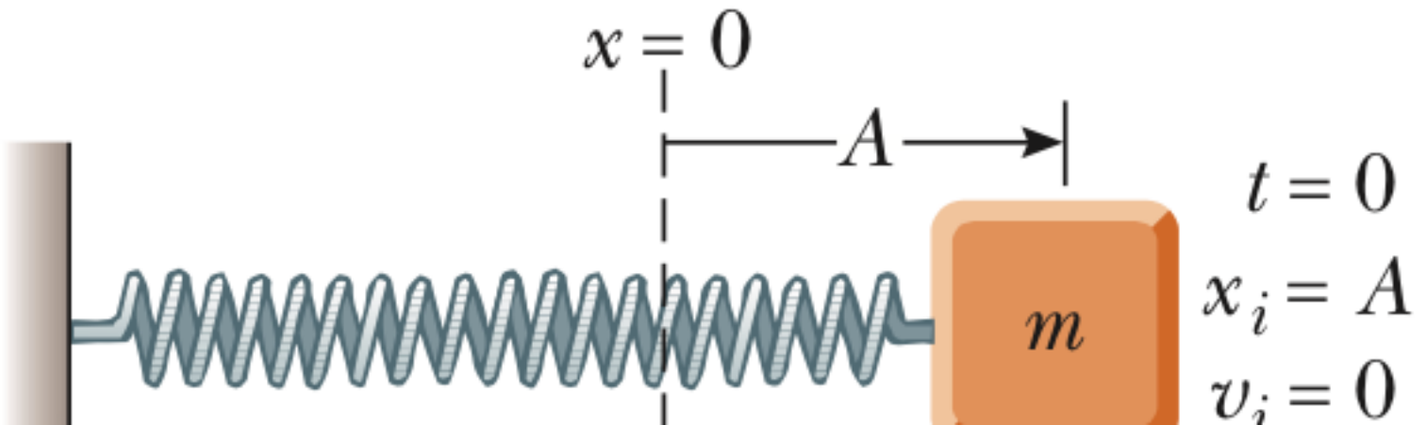




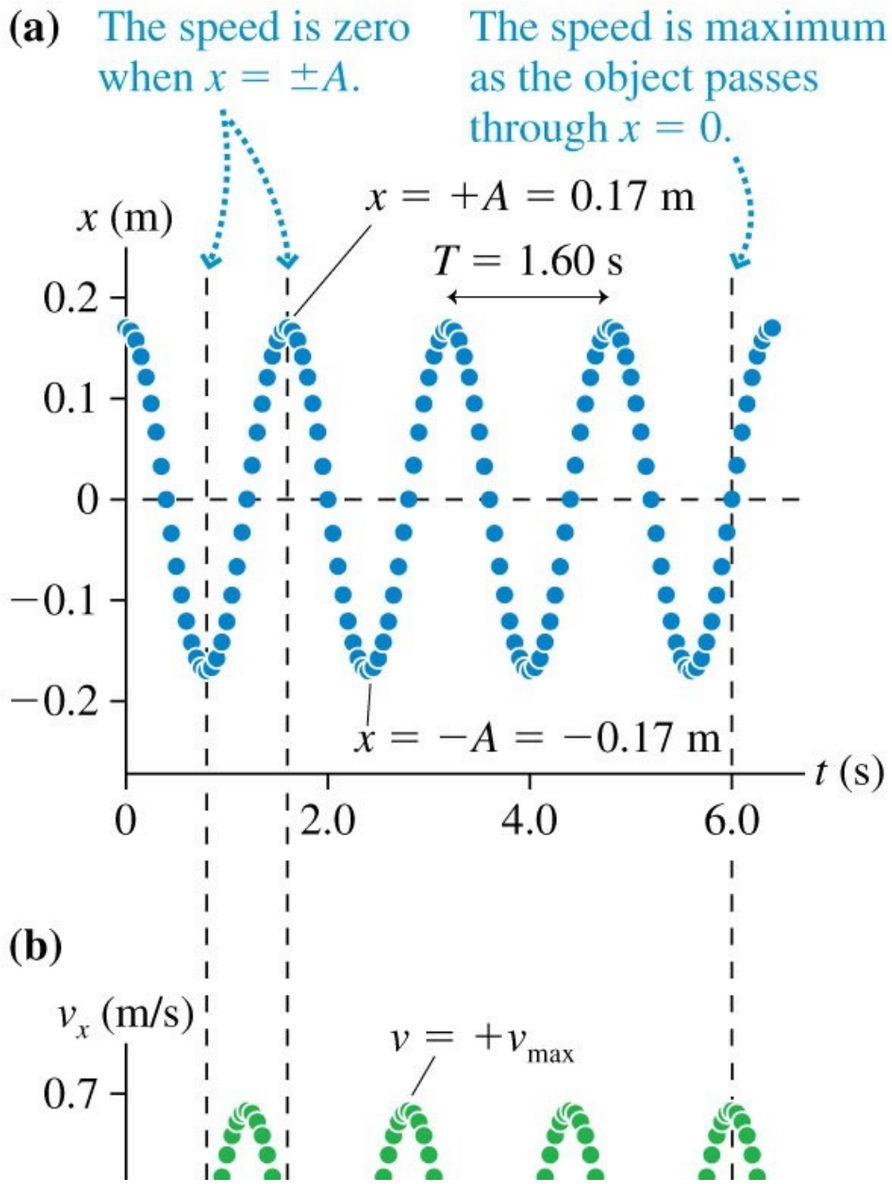
Simple Harmonic Motion

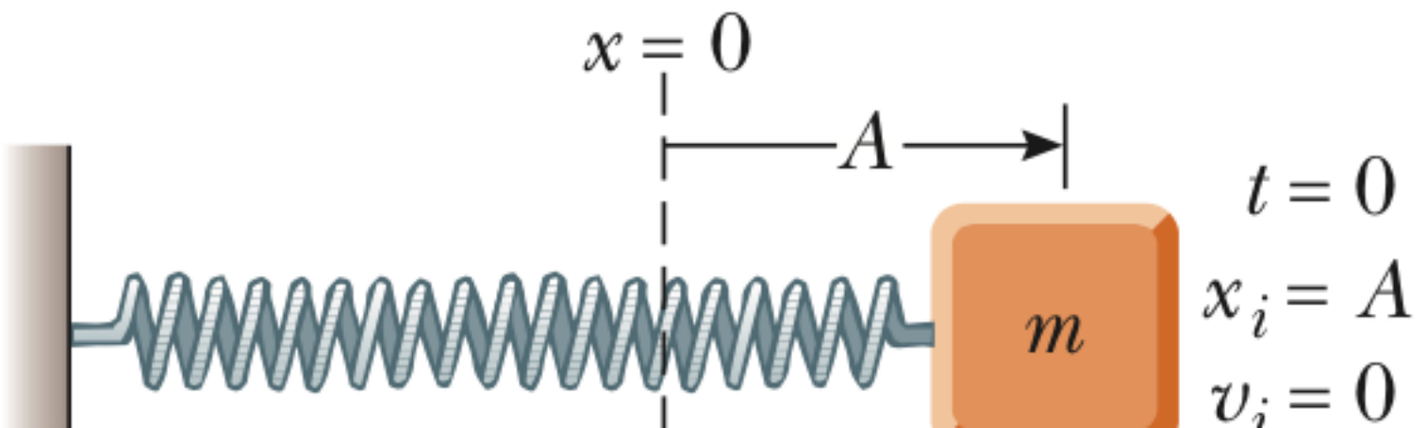


What does x_i vs t graph look like?



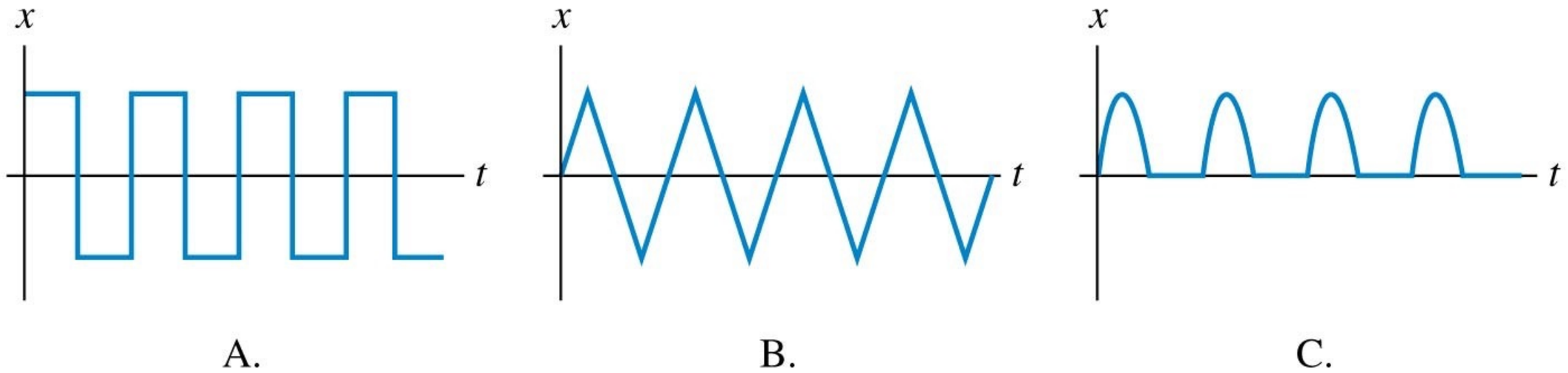
Simple Harmonic Motion





Quiz

Which oscillation (or oscillations) is SHM?



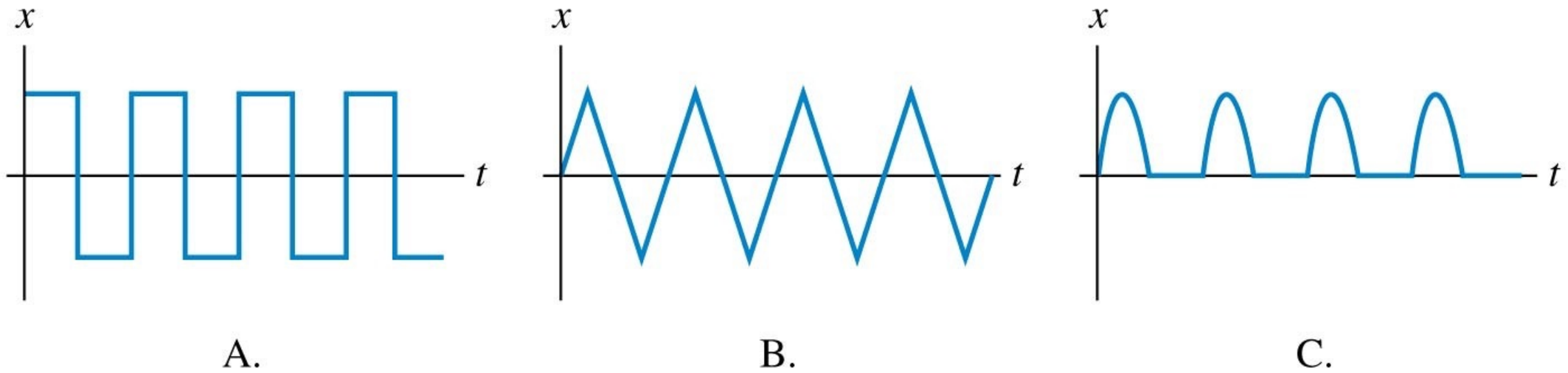
A. B. C.

D. A and B but not C.

E. None are.

Quiz

Which oscillation (or oscillations) is SHM?



A. B. C.

D. A and B but not C.

E. None are.

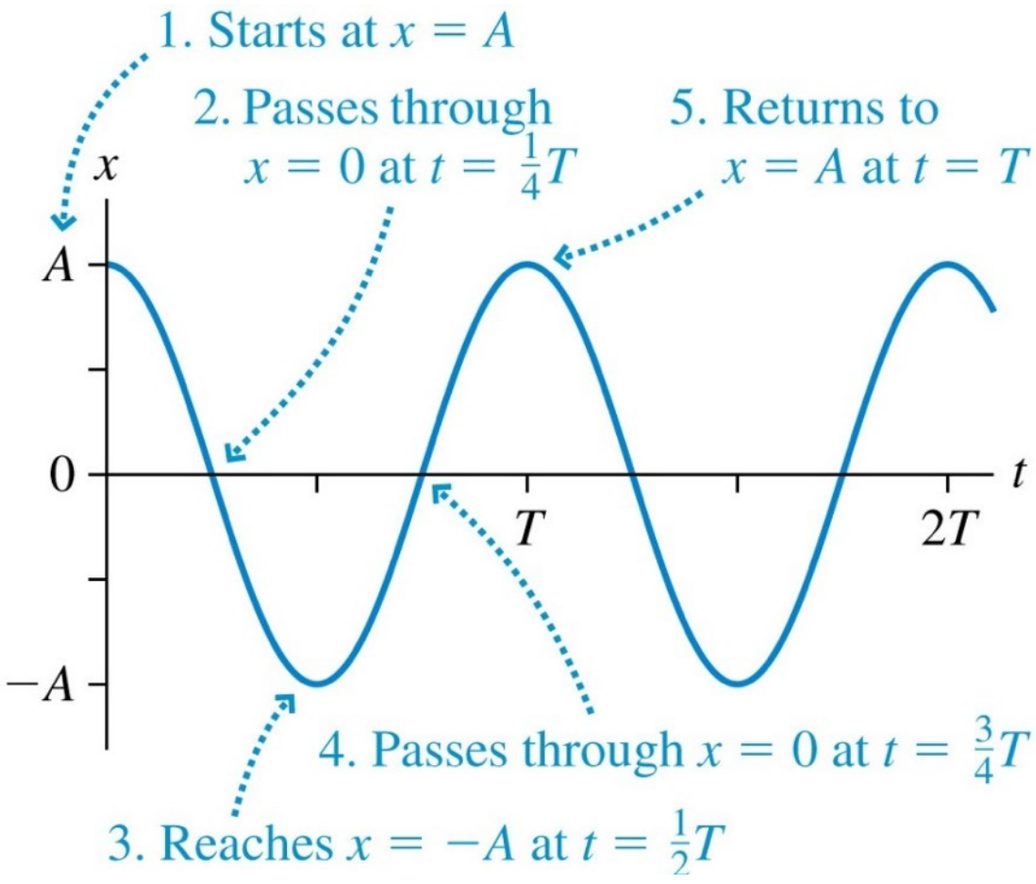
Simple Harmonic Motion (the position function)

$$x(t) = A\cos(\frac{2\pi}{T}t)$$

$$\omega = \frac{2\pi}{T} \qquad f = \frac{1}{T}$$

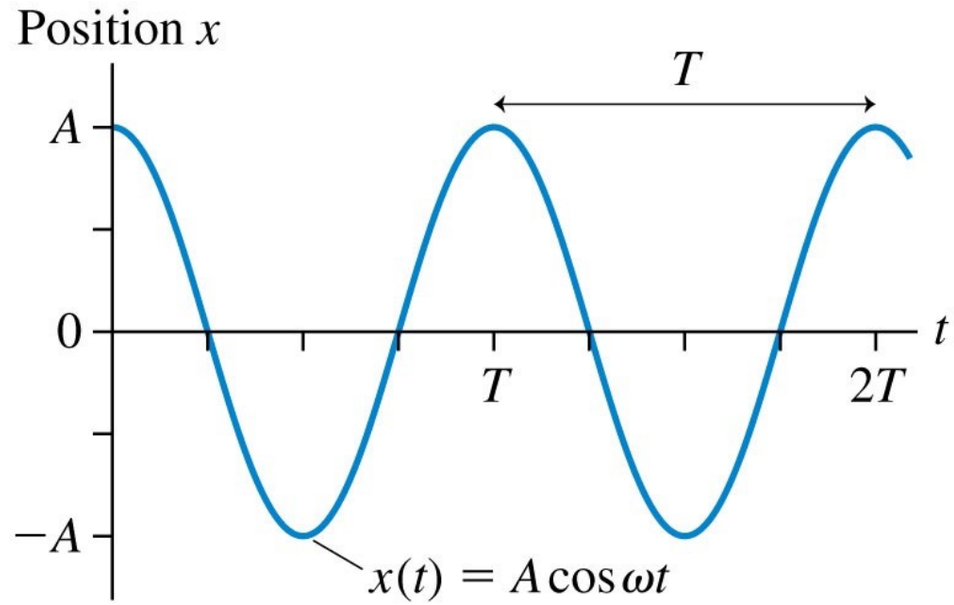
$$x(t) = A\cos(\omega t)$$

$$x(t) = A\cos(2\pi f t)$$



Simple Harmonic Motion (the velocity function)

$$x = A\cos(\omega t)$$

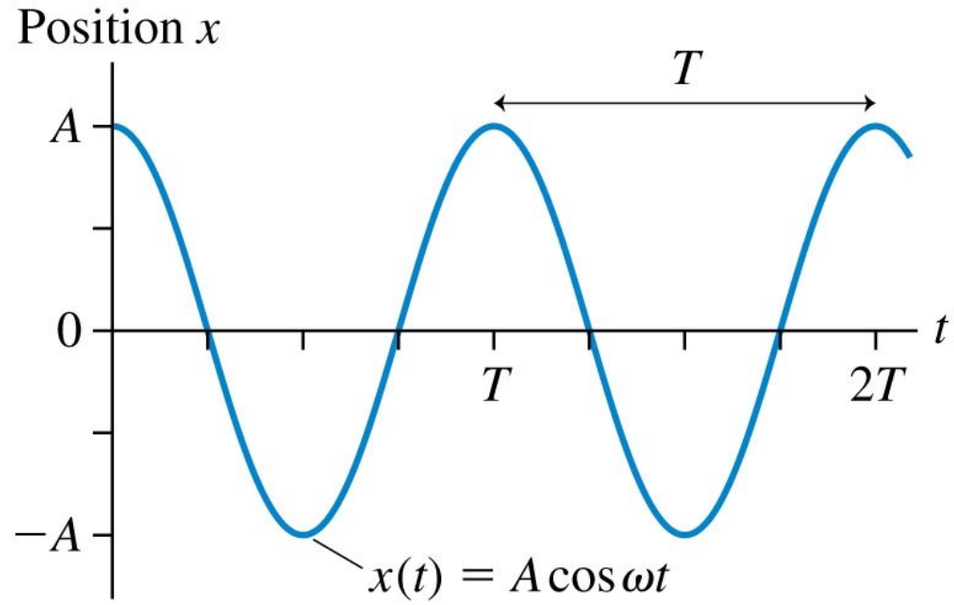


What is the velocity function?

Simple Harmonic Motion (the velocity function)

$$x = A\cos(\omega t)$$

$$v_x = \frac{dx}{dt} = A\frac{d}{dt}[\cos(\omega t)]$$



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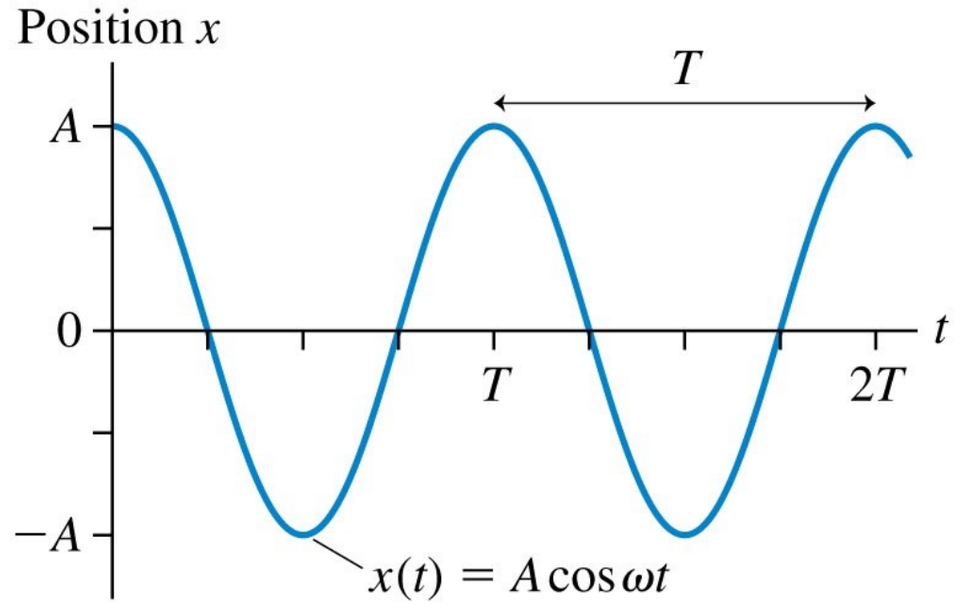
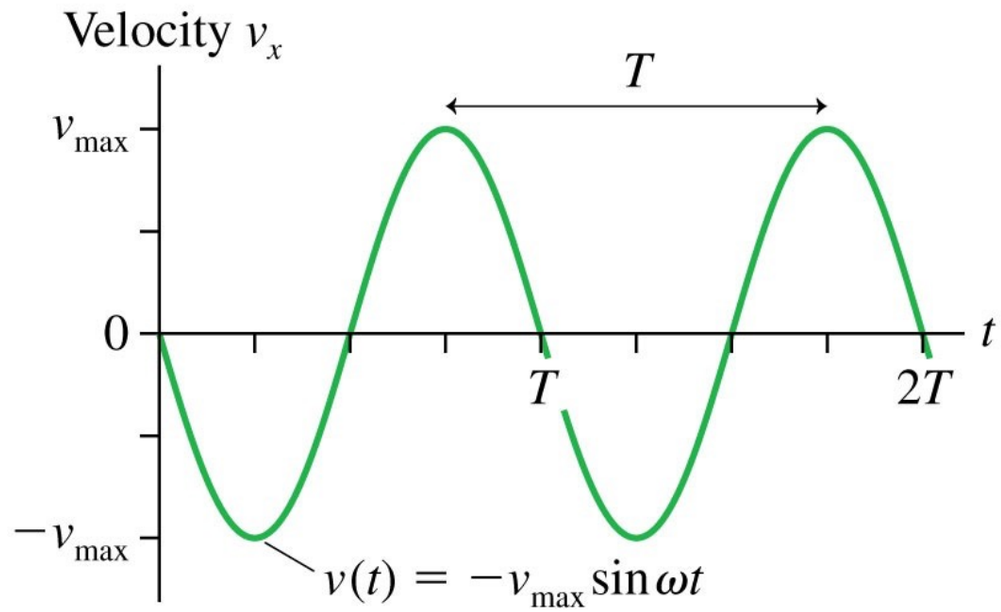
$$x = A\cos(\omega t)$$

$$v_x = \frac{dx}{dt} = A\frac{d}{dt}[\cos(\omega t)]$$

$$v_x = -A\omega\sin(\omega t)$$



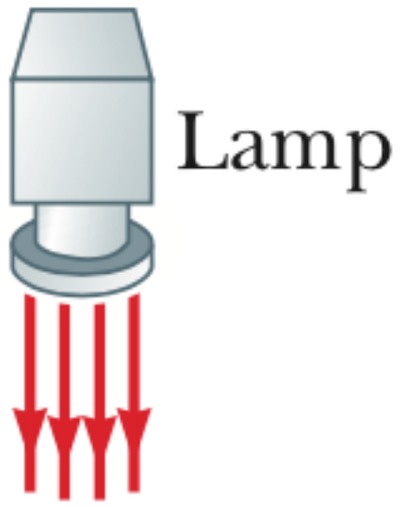


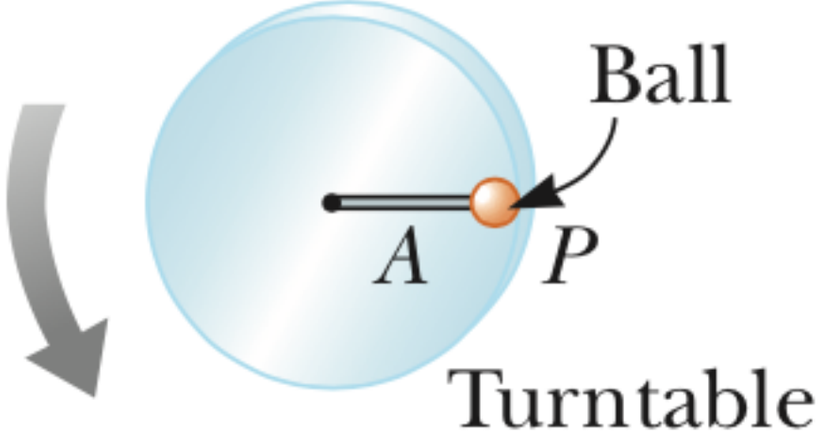
Example

An air-track glider is attached to a spring, pulled 20.0 cm to the right, and released at t = 0 s. It makes 15 oscillations in 10.0 s.

a. What is the period of oscillation?
b. What is the object's maximum speed?
c. What are the position and velocity at t = 0.800 s?

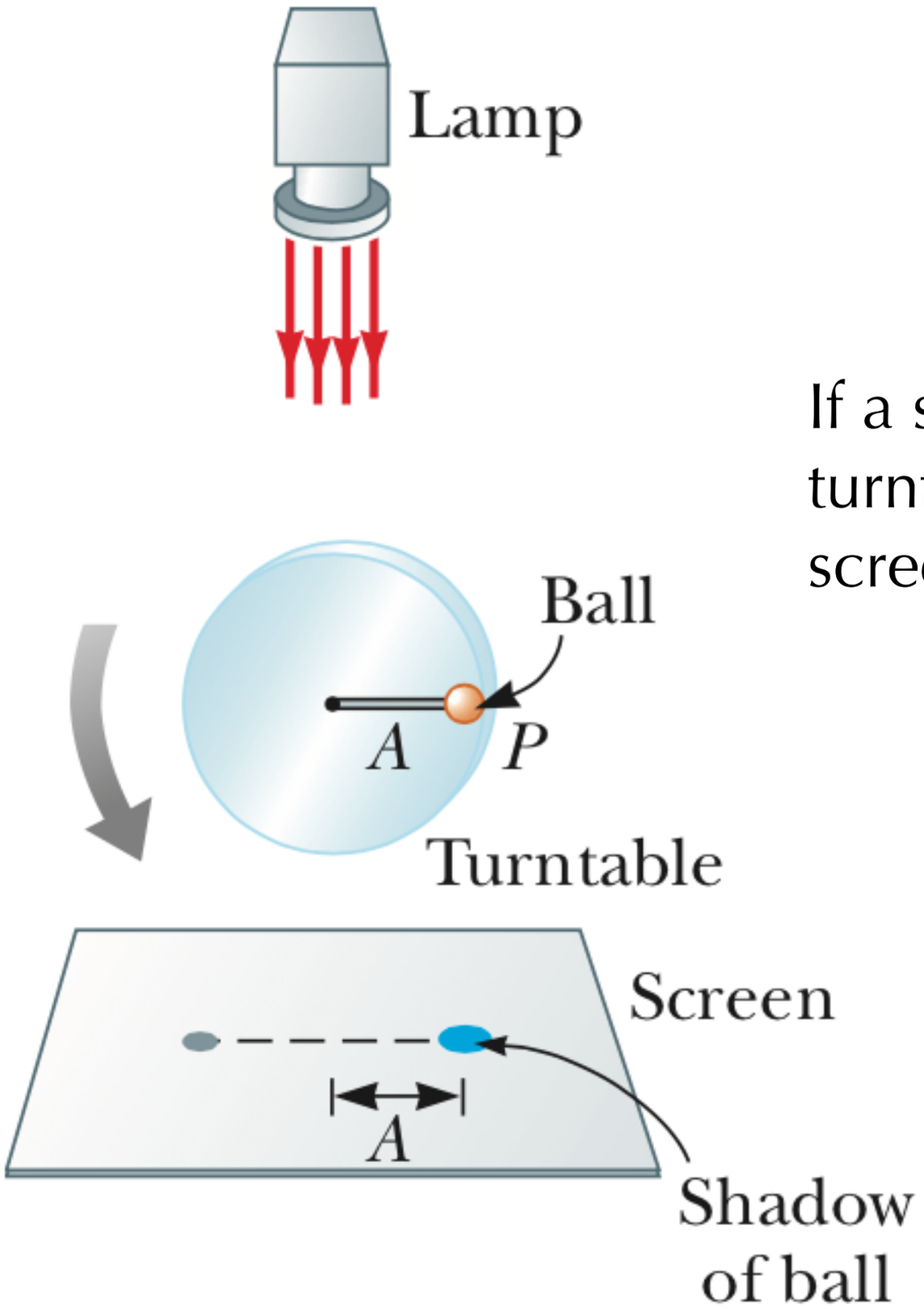
Simple harmonic motion and circular motion





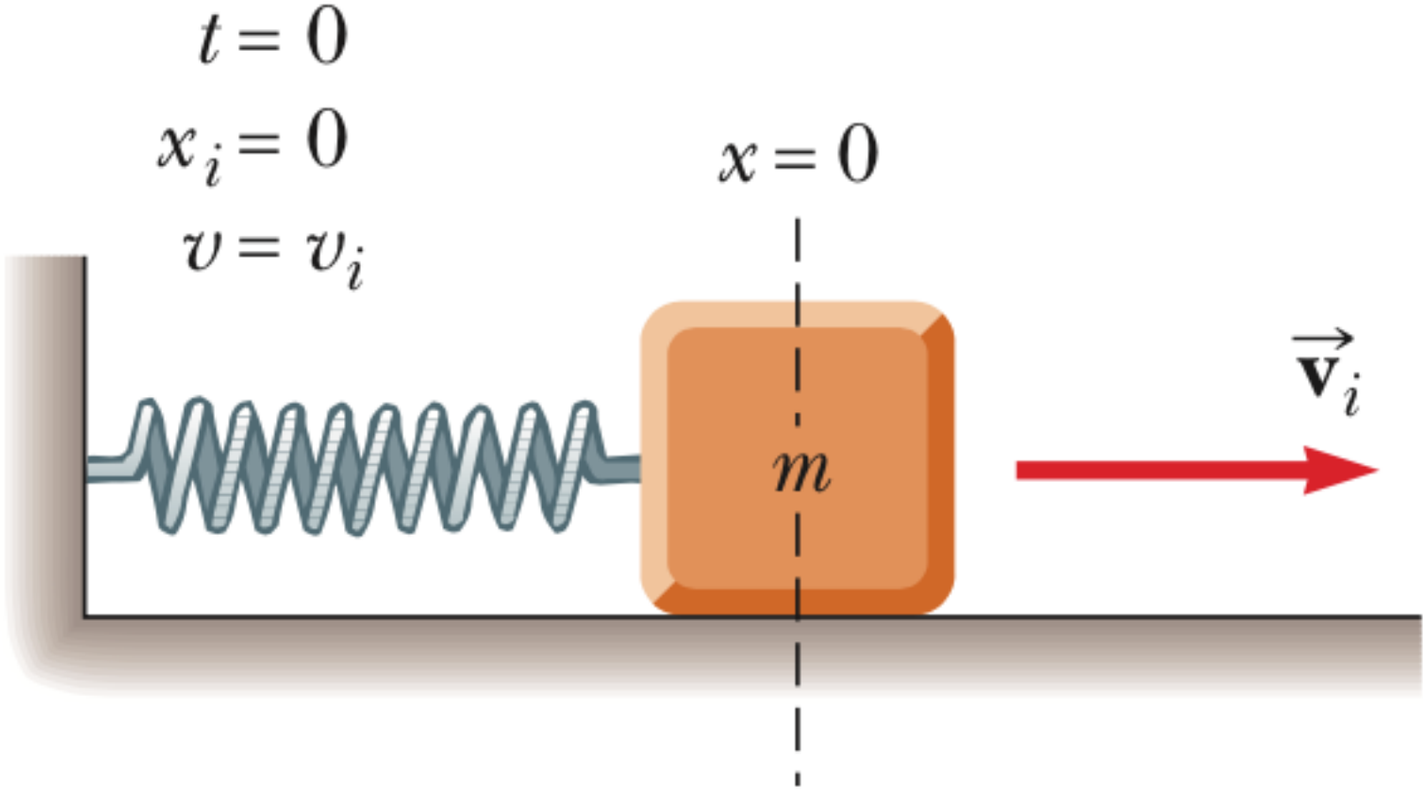
If a screen is placed below the turntable, what would you see on the screen?

Simple harmonic motion and circular motion



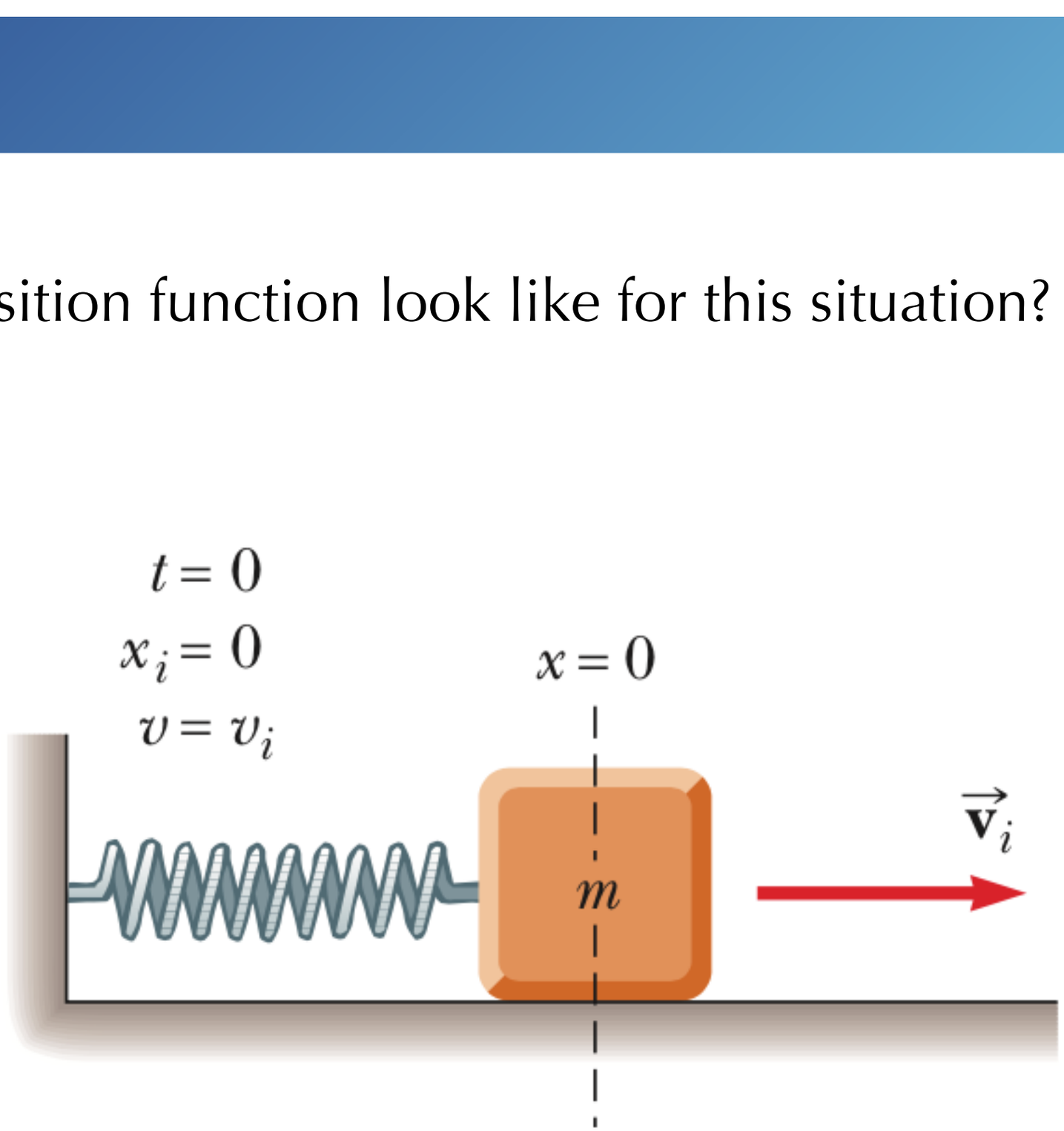
If a screen is placed below the turntable, what would you see on the screen?

What would the position function look like for this situation?



What would the position function look like for this situation?

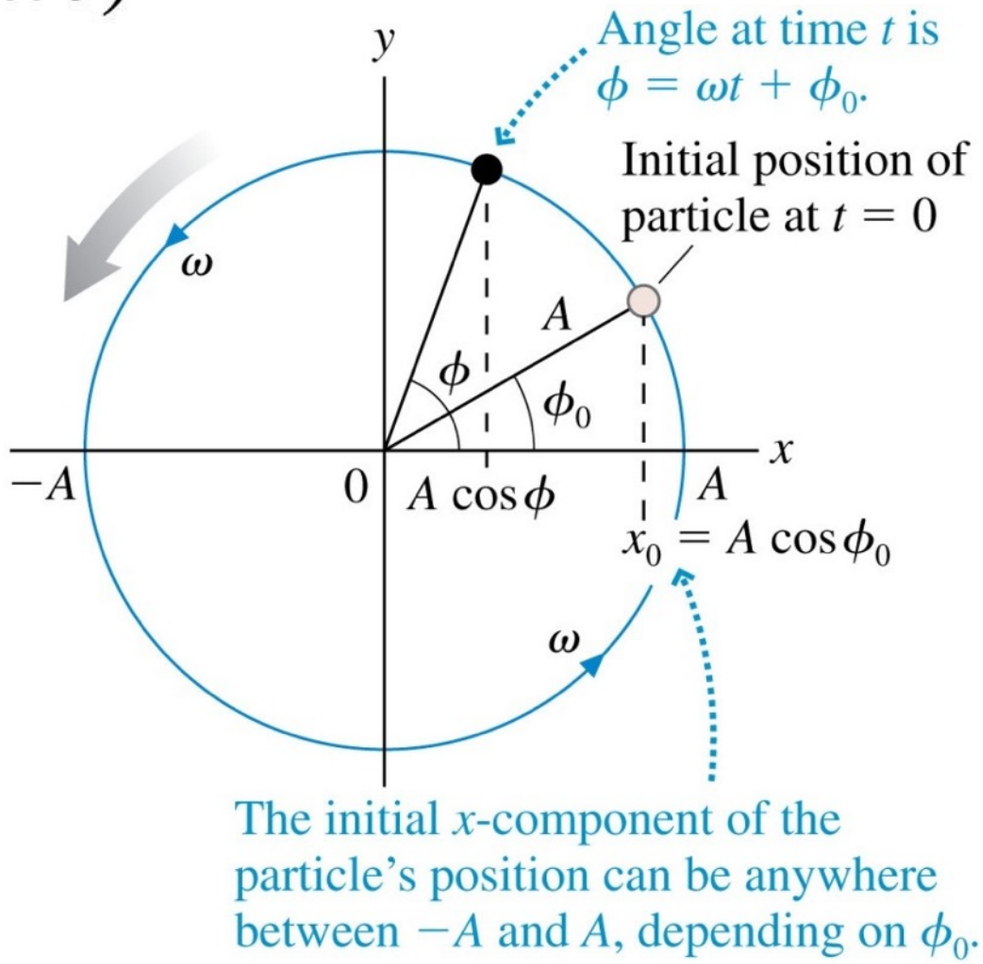
$$x(t) = A\cos(\omega t + \phi_0)$$



The phase constant

What is the value of this function when t=0?

$$x = A\cos(\omega t)$$



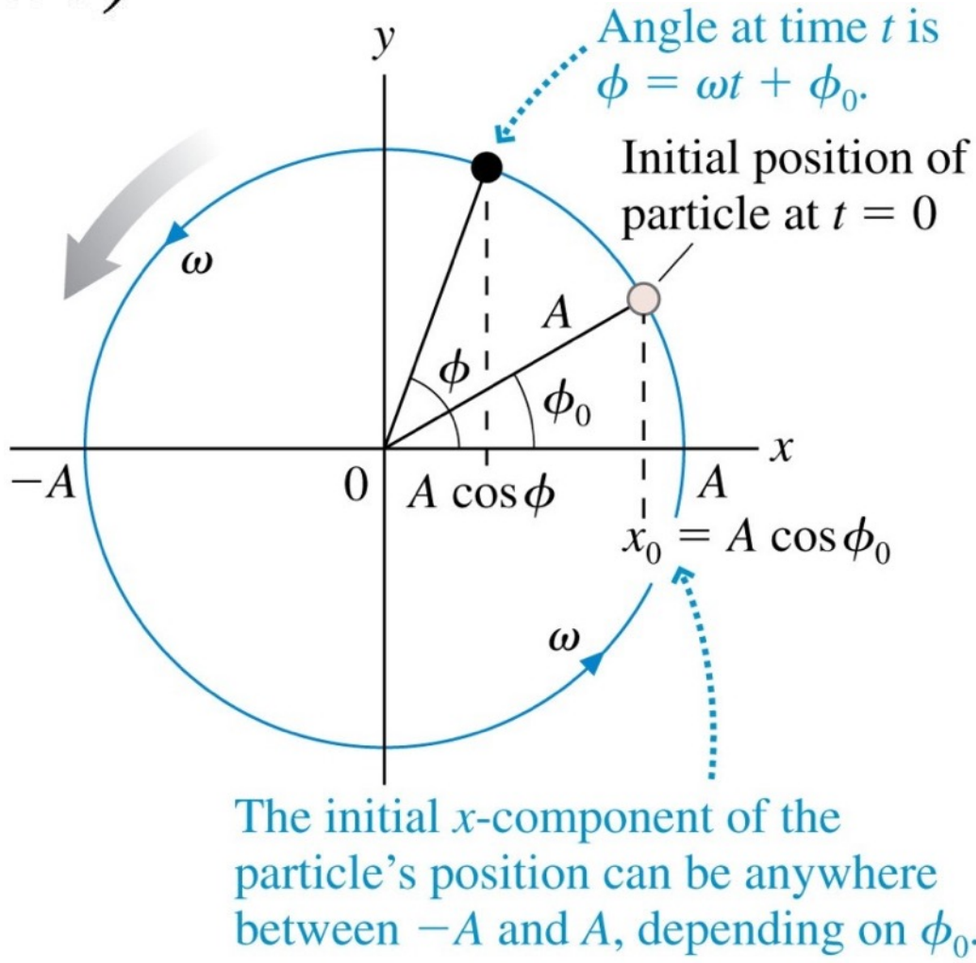
reminder: Mathematica Notebook

The phase constant

What is the value of this function when t=0?

$$x = A\cos(\omega t)$$

What if $x \neq A$ when $t = 0$?



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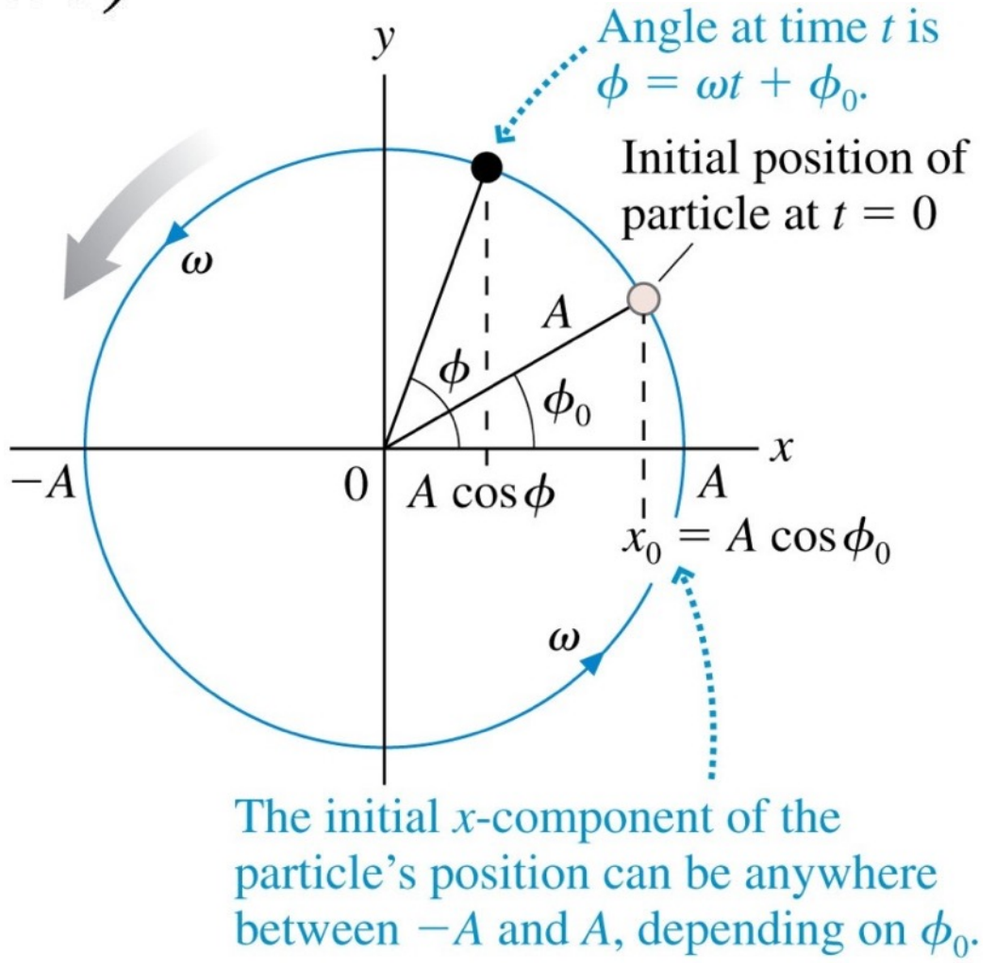


$$x(t) = A\cos(\omega t + \phi_0)$$

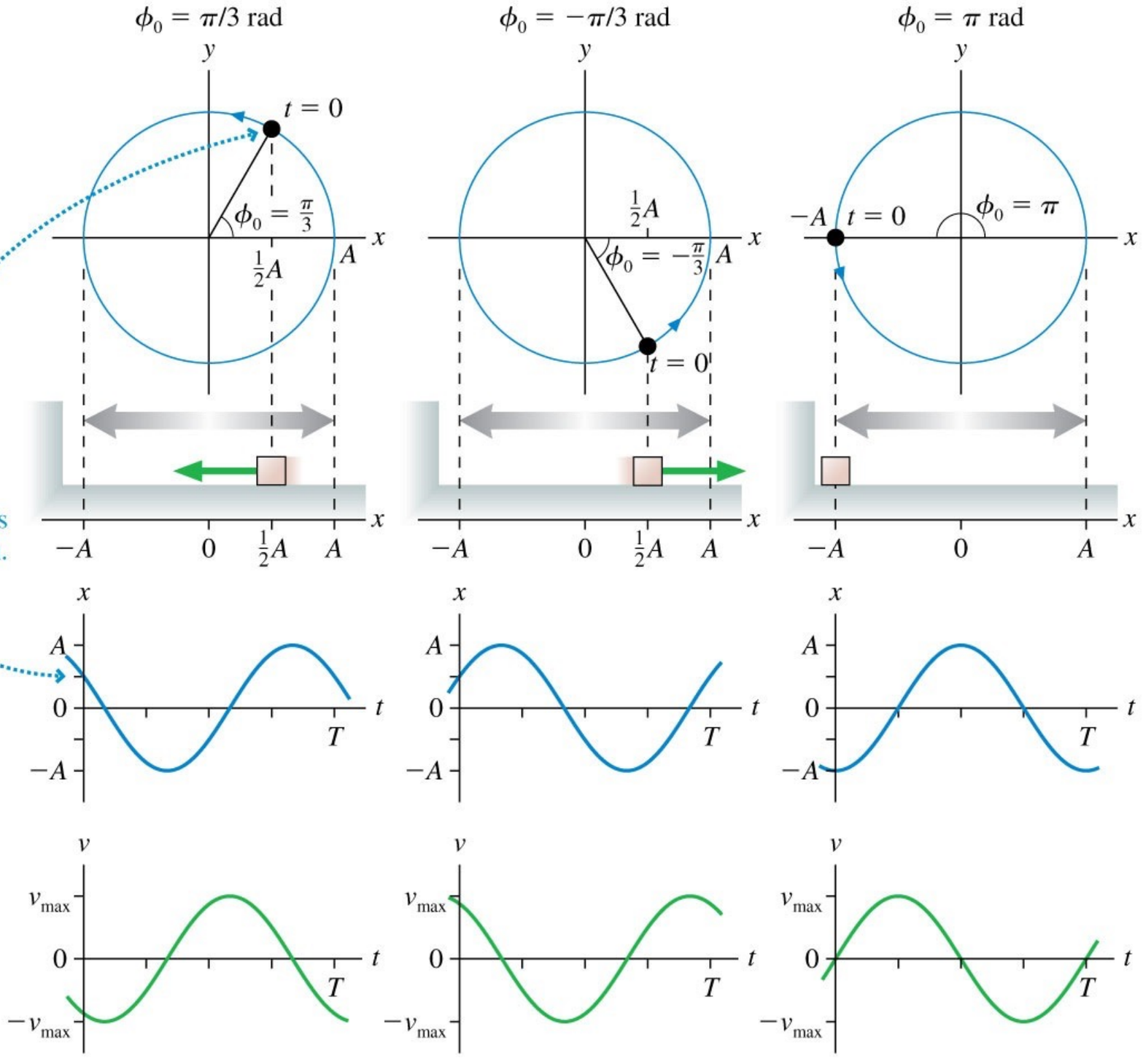
$$v(t) = -\omega A\sin(\omega t + \phi_0) = v_{\max}\sin(\omega t + \phi_0)$$

reminder: Mathematica Notebook

The phase constant

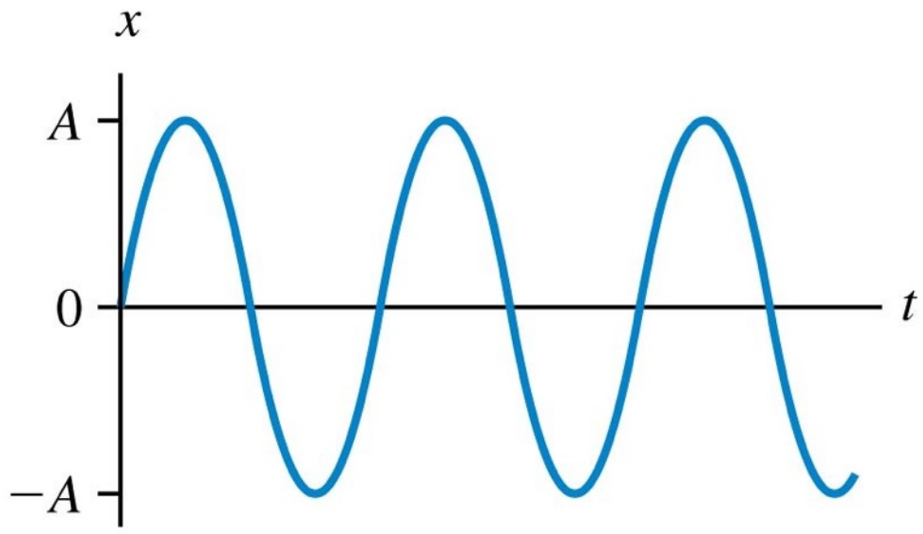
The starting point of the oscillation is shown on the circle and on the graph.

The graphs each have the same amplitude and period. They are *shifted* relative to the $\phi_0 = 0$ rad graphs of Figure 14.5 because they have different initial conditions.



Quiz

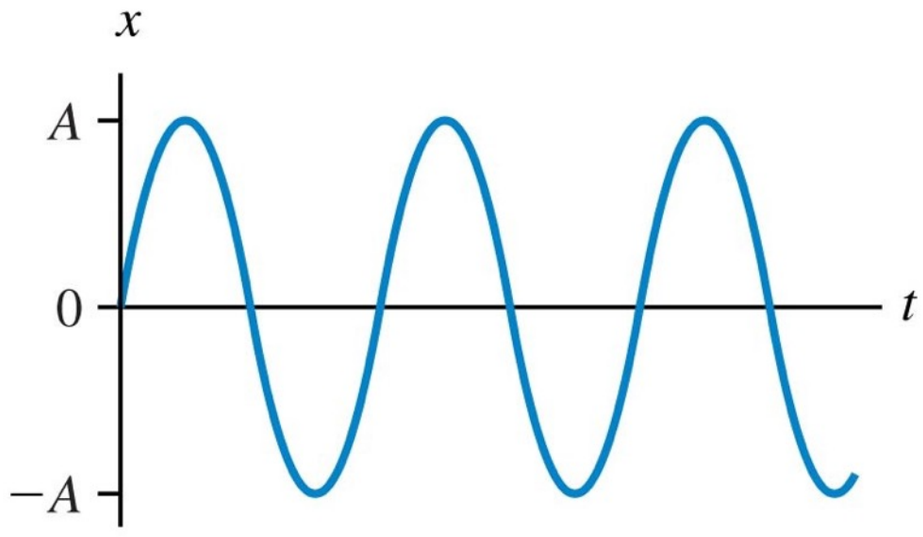
This is the position graph of a mass oscillating on a horizontal spring. What is the phase constant φ_0?



a. $-\pi/2$ rad.
b. 0 rad.
c. $\pi/2$ rad.
d. π rad.
e. None of these.

Quiz

This is the position graph of a mass oscillating on a horizontal spring. What is the phase constant φ_0?



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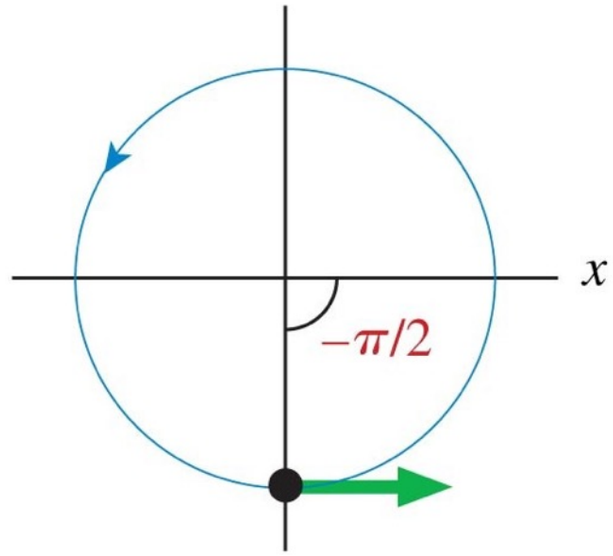
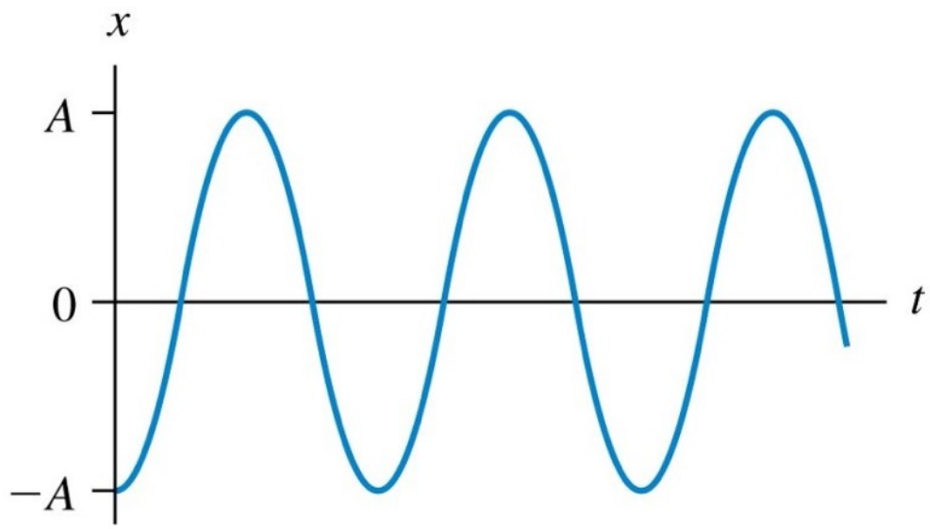


Initial conditions:
$x = 0$
$v_x > 0$

Quiz

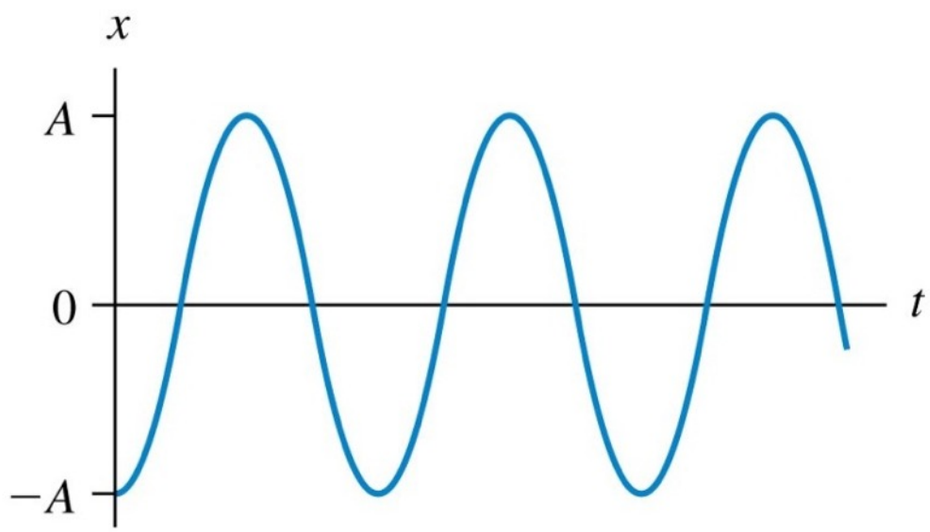
This is the position graph of a mass oscillating on a horizontal spring. What is the phase constant φ_0?



a. $-\pi/2$ rad.
b. 0 rad.
c. $\pi/2$ rad.
d. π rad.
e. None of these.

Quiz

This is the position graph of a mass oscillating on a horizontal spring. What is the phase constant φ_0?



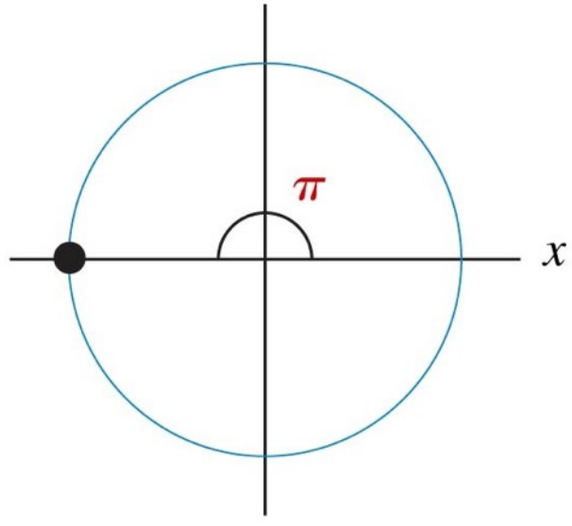
a. $-\pi/2$ rad.

b. 0 rad.

c. $\pi/2$ rad.

d. π rad.

e. None of these.



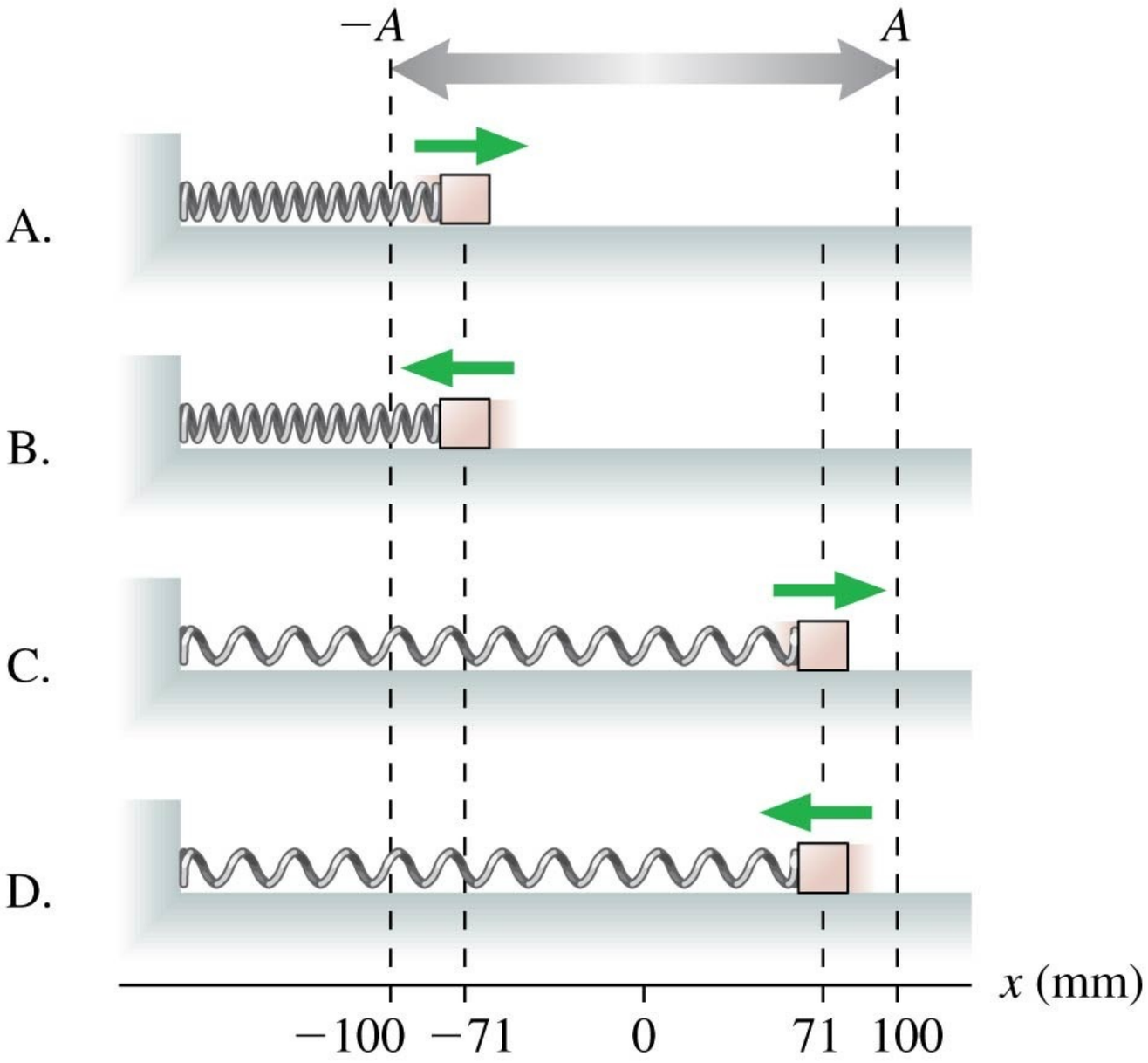
Initial conditions:

$x = -A$

$v_x = 0$

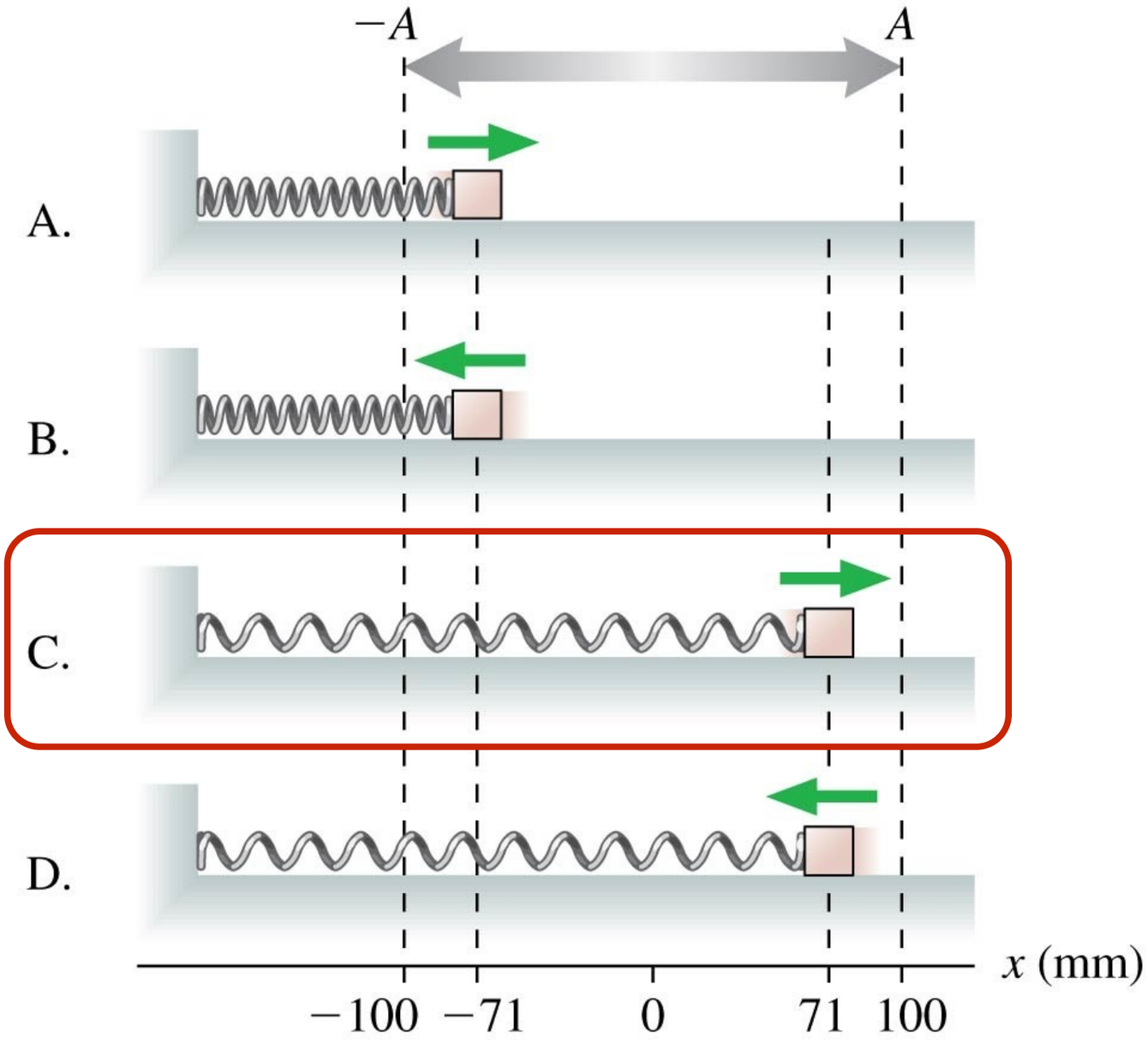
Quiz

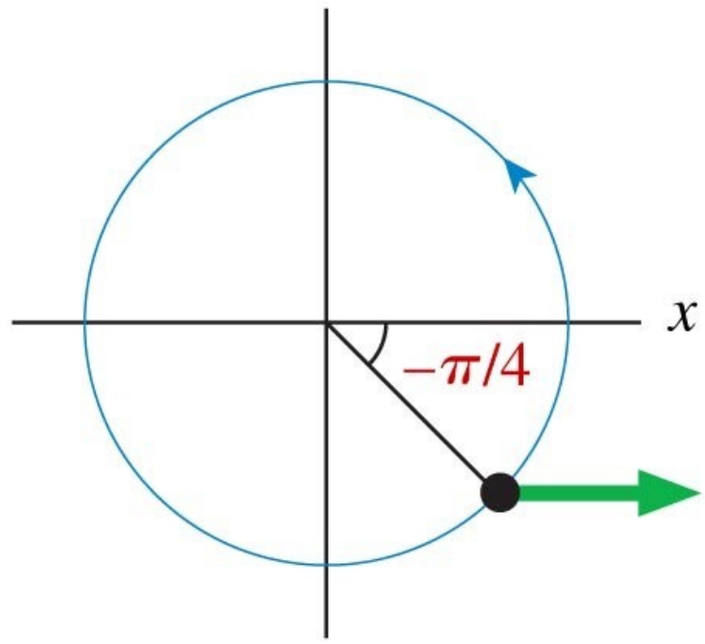
The figure shows four oscillators at $t = 0$. For which is the phase constant $\varphi_0 = -\pi / 4$?



Quiz

The figure shows four oscillators at $t = 0$. For which is the phase constant $\varphi_0 = -\pi / 4$?





Initial conditions:
$x = 0.71A$
$v_x > 0$

Example Problem III

An object on a spring oscillates with a period of 0.80 s and an amplitude of 10 cm. At t = 0 s, it is 5.0 cm to the left of equilibrium and moving to the left. What are the position and direction of motion at t = 2.0 s?