Simulation of a blood clotting protein
Outline

• QUIZ

• Kinematics: Modeling Motion
  – Position vs time
  – Velocity
  – Average Velocity
# Quiz

## Answers

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
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<tbody>
<tr>
<td>D, H</td>
<td>B</td>
<td>D or E</td>
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## Average: 5.5

![Quiz 1](image-url)
Q1

(3 pts) You know that 1 cubic centimeter of biomaterial has a mass of 1 gram. What’s the mass of 1 cubic meter of biomaterial?

A. 10 g
B. $10^2$ g
C. $10^4$ g
D. $10^6$ g
E. 1 kg
F. 10 kg
G. 100 kg
H. 1000 kg
Which equation could represent the surface area of a cylinder?

A. $2\pi R + 2\pi Rh$

B. $2\pi R^2 + 2\pi Rh$

C. $2\pi R^2 + 2\pi h$

D. $\pi R^2 h$
Q3

(2 pts) Estimate the thickness of a page in a typical textbook. (2 pts) Explain your reasoning

A. $10^{-1}$ m
B. $10^{-2}$ m
C. $10^{-3}$ m
D. $10^{-4}$ m
E. $10^{-5}$ m
F. $10^{-6}$ m
G. $10^{-7}$ m
H. $10^{-8}$ m
Outline

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Be more specific in your question:
*Can we go over the uniform motion equations?*

*Will we be required at some point to know the different forms of the equations in uniform motion section?*
The sonic ranger (motion detector)

- The sonic ranger measures distance to the nearest object by echolocation.
  - A speaker clicks 30 times a second. A microphone detects the sound bouncing back from the nearest object in front of it.
  - The computer calculates the time delay between and using the speed of sound (about 343 m/s at room temperature) it can calculate the distance to the object.
Using Position Graphs to Describe Motion

• If I place the sonic ranger at the left side of the room and you walk slowly towards it at almost a constant velocity what will the position graph look like?

Generate the graph on your whiteboard.
Which is the correct graph?
Describe in your own words the motion captured in this position vs time graph.
Velocity: Change in position

- Average velocity
  \[ \langle v \rangle = \frac{\Delta x}{\Delta t} \]

- Instantaneous velocity = same (but for short \( \Delta t \))
  \[ v = \frac{dx}{dt} \]
Position to velocity

\[ v(t) = \frac{dx}{dt} \]

Difference of two positions at two (close) times

\[ v(t) = \frac{x(t + \Delta t/2) - x(t - \Delta t/2)}{\Delta t} \]

Ratio of change in position that takes place to the (small) time interval
Using Velocity graphs to describe motion

• If I place the sonic ranger at the left side of the room and you walk slowly towards it at almost a constant velocity what will the *velocity* graph look like?

Generate the graph on your whiteboard.
How many times does the man’s speed go to zero?
1. Never
2. Once
3. Twice
4. Three times
5. Four times
Predicting Position from Velocity

\[ dx = v(t) \, dt \]

\[ x = \int dx = \int v(t) \, dt \]

change in position that takes place in a small time interval

sum ("\( \Sigma \)" in the changes in position over many small time intervals)
Predicting the Future with differential equations

Suppose we know the value of something as a function of time at a given time, \( f(t) \), and we know its derivative, \( df/dt \) at that time. We can use that to predict the future!

\[
\frac{df}{dt} = \frac{\Delta f}{\Delta t} = \frac{f_{\text{end}} - f_{\text{beginning}}}{\Delta t}
\]

\[
f_{\text{end}} - f_{\text{beginning}} = \left( \frac{df(t)}{dt} \right) \Delta t
\]

\[
f(t + \Delta t) - f(t) = \left( \frac{df(t)}{dt} \right) \Delta t
\]

\[
f(t + \Delta t) = f(t) + \left( \frac{df(t)}{dt} \right) \Delta t
\]
Example of a Diff Eq.

- Epidemiology: Number of people infected by a disease is proportional by the number of people in the population
- A simple model for the spread of infection

\[ \frac{dI(t)}{dt} = AI(t) - BI(t) \]

\( A = \) rate at which population gets infected
\( B = \) rate at which infected people are cured (or die)

\[ \frac{dI}{dt} = (A - B)I \]
Example

• How do you have to walk to make the sonic ranger produce the following velocity graph?

• Draw the position graph.