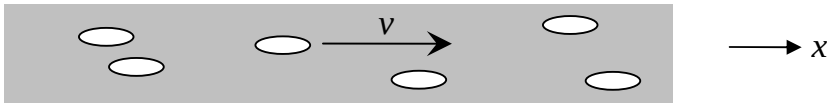
PHYC10007: Physics for Biomedicine

Tutorial Sheet 1 — *Kinematics*

Discussion/Conceptual questions

Last updated: 31/07/2014

1. Consider a blood cell moving along an artery, with some positive velocity v in direction x. The diameter of the artery is increasing or decreasing from left to right.

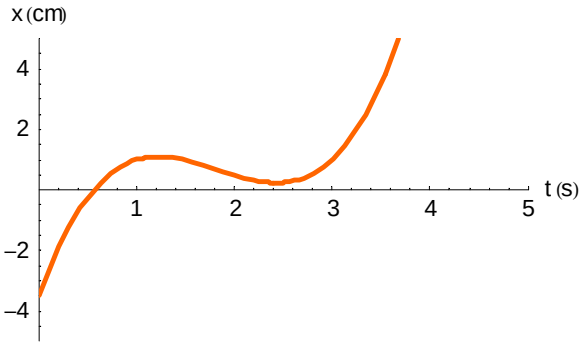


   (a) Can the blood cell experience a negative acceleration, while still moving in the same direction?

   (b) What is the direction of a negative acceleration vector?

   (c) Might the negative acceleration be caused by the diameter of the artery increasing or decreasing?

2. Consider the following position-time graph for a blood cell in a blood vessel.



   (a) Plot the velocity and acceleration graphs for the blood cell.

   (b) When is the velocity zero?

   (c) When is the acceleration zero?

   (d) Do you think the position-time curve shows the blood at the beginning or end of a heartbeat?

Problem-solving questions

3. Two crazy biomed students, Victor and Dani, go parachuting. Victor jumps out, but Dani waits a moment such that they are separated by at least 10m for safety reasons. Ignore air resistance in the following.

   (a) Calculate how long Dani should wait.

   (b) They jump from a height of 2.0km. What would their velocity be when they reached the ground, if their parachutes failed?

   (c) What would be the distance between Victor and Dani when he hits the ground?

4. Consider a particle with position given by $x(t) = 4 - 12t + 3t^2$ (where t is in seconds and x is in meters).

   (a) What is its velocity at t = 1 s?

   (b) Is it moving in the positive or negative x-direction at that time?

   (c) What is its speed at that time?

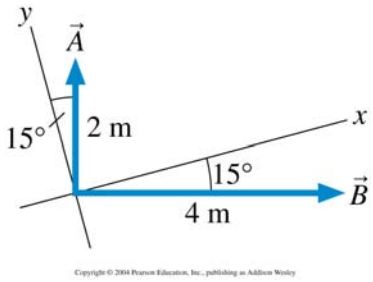
   (d) Is the speed increasing or decreasing at that time?

   (e) Is there every an instant when the velocity is zero? If so, give the time t.

(f) Is there a time after t = 3s when the particle is moving in the negative direction of x? If so, give the time t.

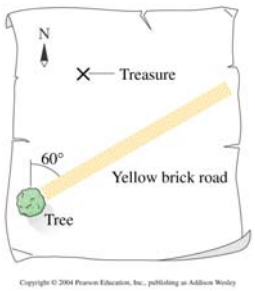
5. At the 2008 Olympics, Russian athlete Yelena Isinbayeva broke her own world record in the women's pole vault with a leap of 5.04 meters. Estimate how fast she was running, if all her horizontal speed was translated into vertical speed, assuming that she is a point particle starting at half her height (let's say she is 1.6m tall) above the ground.

6. The figure shows vectors $\vec{A}$ and $\vec{B}$. Find $\vec{D} = 2\vec{A} + \vec{B}$. Write your answer in component form.



7. The treasure map in the figure gives the following directions to the buried treasure:

> 'Start at the old oak tree, walk due north for 500 paces, then due east for 100 paces. Dig.'



But when you arrive, you find an angry dragon just north of the tree. To avoid the dragon, you set off along the yellow brick road at an angle 60° east of north. After walking 300 paces you see an opening through the woods. Which direction should you go, and how far, to reach the treasure?

From: Physics for Scientists and Engineers - A Strategic Approach

8. When you sneeze, the speed of particulate matter leaving your nose is typically 150 km/hr.

(a) What is the speed in m/s?

(b) Your nose is about 1.50m from the ground. If the material leaves your nose perfectly horizontally, and ignoring air resistance, calculate how far it will travel before it reaches the ground.