

# Course Name: Hardcore Mechanics Problems #

Ky-Anh Tran

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## **Problem 1** *points aimed at each other*

Here are some sample problems we will consider in this class, feel free to tinker your mind with them.

3 points are located at the vertices of an equilateral triangle whose side equals  $a$ . They all start moving simultaneously with velocity  $v$  constant in magnitude, with the first point heading continually for the second, the second for the third, and the third for the first. How soon will the points converge.

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## **Problem 2** *continued, points aimed at each other*

This is an extension of the idea from the last problem and requires some calculus concepts.

Point A moves uniformly with velocity  $v$  so that the vector  $\vec{v}$  is continually aimed at point B, which itself is moving rectilinearly and uniformly with velocity  $u < v$ . At the initial moment of time  $\vec{v} \perp \vec{u}$  and the points are separated by a distance  $l$ . How soon will the points converge.

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## **Problem 3** *blocks connected by spring*

2 blocks, of mass  $m_1$  and  $m_2$  are connected by a spring of rest length  $l_0$  and elastic constant  $k$ . They are at rest on a frictionless horizontal plane. A constant force  $\vec{F}$  pulls horizontally one of the masses. What is the maximum and minimum separation of the blocks as time passes?

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**Problem 4** *Jumping ring*

A small mass  $A$  is fixed to the inside of a thin, rigid ring of radius  $R$  and mass equal to that of mass  $A$ . The hoop rolls without slipping over the horizontal plane; at the moments when the body  $A$  gets into the lower position, the center of the hoop moves with velocity  $v_0$ . At what values of  $v_0$  will the hoop move without bouncing?

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