

5th year
1st problem set
deadline
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FX [f:ks]

www.fks.sk/fx
fx@fks.sk

powered by FKS
KTFDF FMFI UK
Mlynská Dolina
842 48 Bratislava

This is the first problem set of the fifth year of the correspondence seminar FX (pronounced as f:ks).

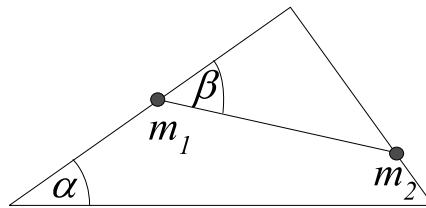
FX is a bonus category of FKS: if the A or B categories are not enough for you (for qualitative or quantitative reasons), go for FX! You will be rewarded by interesting and not completely trivial problems, which will (as we hope) broaden the horizons of your world of physics.

FX works similarly as FKS does - send your solutions by mail or e-mail to the addresses given above before the deadline also given above. (The deadlines for FX will be usually a week after the deadlines for FKS.) We will send you back your graded solutions and a new problem set. You can also find all the materials on-line - including an archive of problems and model solutions of the previous years of FX.

Before jumping straight into the problems, we would like to remind you that FX is here for you. Hence, if you have any comments, questions or doubts (concerning the seminar or physics or in fact anything vaguely related), do not hesitate and drop us a line. Good luck!

FX1 Triangle

Marika had nothing to do at her math class, so she made herself a triangle from some wire. She also put two marbles of masses m_1 and m_2 on her triangle, connected with a thread. Everything is shown in the picture.

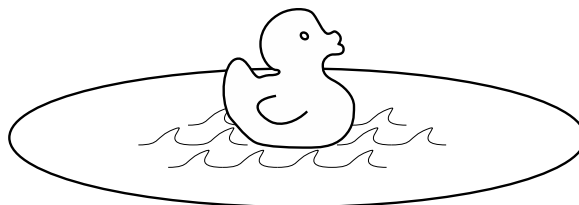


What is the angle β for the equilibrium position? Is this equilibrium stable? What is the tension in the thread?

FX2 Duck

Since Halucinka did not win a black FKS T-shirt, she decided to get hold of an orange duck in a rather different way. One was swimming in a round pond and so she decided to hunt it down. The duck wants to fly away and save itself, however it needs to get to the land to fly up. Halucinka is running around the pond with a speed v , the duck is swimming in the pond with a speed u . For what ratio $v : u$ can the duck still fly away? How does it need to move in that case?

Obviously, Halucinka does all she can to get her duck.



FX3 The Sea of Water

Ppershing found a very interesting article¹. There, the Google describes how to map the sea-floor. The trick is simple. By radars, you measure the height of the water, which is influenced by underwater mountains.

Your task is a little easier. Assume, that the ocean has a constant depth H , only at one spot there is a cone-shaped mountain with the base radius r and the height $h < H$. The density of the water is ρ_0 , the density of the mountain is ρ . What is the increase of the water level right above the cone due to the cone's gravity?

Solve the problem numerically, for the following values $r = 50$ km, $h = 5$ km, $H = 6$ km, $\rho_0 = 10^3$ kg.m⁻³, $\rho = 5 \cdot 10^3$ kg.m⁻³, $G = 6,67 \cdot 10^{-11}$ N.kg⁻².m² and $g = 9,81$ m.s⁻².

¹<http://googleblog.blogspot.com/2009/02/atlantis-no-it-atlant-isnt.html>