

1998-1999 Physics Olympiad Preparation Program

— University of Toronto —

Problem Set 2: Mechanics

Erratum

There are minor errors in the version of Question #3 in this problem set, as we rushed to distribute it. We will mark student solutions based on the question we distributed, but you may wish to know that the data, especially, should look more like this!

The change in the hint is interesting, but does not very much alter the answer.

3) Sink, sank, sunk

At some point in the movie “Titanic” it is said that the pressure at its sunken depth is 5500 pounds/inch². Given this, find the depth at which the *Titanic* supposedly came to rest. The ‘real’ answer is 12600 feet, density of water is 10^3 kg m^{-3} (ignore air pressure). Comment on the results, i.e., truth in film-making.

At another point in the movie someone estimates that the *Titanic* will sink in a time of roughly half an hour. Approximating the *Titanic* as a rectangular box of cross-sectional area $A = 882 \times 80 \text{ feet}^2$, mass $M = 40,000$ tons (loaded), total height 80 m, and a horizontal hole at the bottom of a side of the box of area $A' = 100 \times 0.5 \text{ m}^2$, estimate the time it takes sink — that is, when the top of the box is even with the water line. Ignore air.

[HINT: assume the system comes to equilibrium every time a bit of water goes in; you may assume that the flow is steady (i.e. has a constant velocity) – you may then use conservation theorems (e.g., Bernoulli's equation) – but be careful, as this does NOT hold initially, when the water is accelerating!] [Peter]