Assignment #5
The Ultimate Sandbox?
Due on Thursday, 19 March.

One of Archimedes' (*c.* 287-212 B.C.) more whimsical works is *The Sand Reckoner* in which he computes an upper bound for the number of sand grains that would be required to fill the known universe, as it was then understood. This exercise required Archimedes to extend the number system then used in the Hellenistic world to handle the large numbers involved, and it may be that showing how one could so extend was the real point.

1. Read through *The Sand Reckoner** and summarize the knowledge of the solar system as given by Archimedes. *[5]*

It's interesting to note that Archimedes refers at one point to attempts to prove that the circumference of the Earth was less than 300,000 stadia. His contemporary Eratosthenes famously calculated (probably about 240 B.C.) the circumference of the Earth to be about 252,000 stadia, a figure that is about 10% too large if he was using the Olympic stade (about 176.4 *m*) and about 15% too large if he was using the Italian stade (about 184.8 *m*). (There were other stades in use at various times in various places, just to complicate the issue.) It's not clear whether Archimedes wrote *The Sand Reckoner* before Eratosthenes did his computation of the Earth's circumference.

2. Compute the number of sand grains required to fill the solar system, as we understand it. This will require you to make reasonable choices as to the size of the sand grains and what the boundary of the solar system ought to be. *[5]*

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* Ilan Vardi's translation, with commentary, of *The Sand Reckoner* (PostScript) can be found at: `http://www.lix.polytechnique.fr/Labo/Ilan.Vardi/sand_reckoner.ps`
Pdf copies will be on Blackboard and on the course web page at: `euclid.trentu.ca/math/sb/3810H`