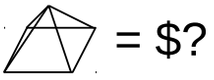
Mathematics 3810H – Ancient and Classical Mathematics
TRENT UNIVERSITY, Winter 2022

Assignment #1
What if the pharaoh had Lego?



Due on Friday, 21 January.

The Pyramid of Khufu (*a.k.a.* the Pyramid of Cheops or the Great Pyramid of Giza) is the largest and most famous of the pyramids built in ancient Egypt. It was built for the pharaoh Khufu of the Fourth Dynasty and is believed to have been completed *c.* 2560 B.C. When finished it was 280 cubits (146.5 metres) tall and had a square base 440 cubits (230.4 metres) on a side. Made mostly of limestone and faced with granite, the pyramid is estimated to have massed about 5.9 million tonnes. Over the millenia, most of the granite facing and some of the limestone blocks have been stripped for other construction projects, so the pyramid is now a little smaller and lighter than it used to be. There is an ongoing debate among archaeologists and other specialists as to just what techniques were used to build it, the size and composition of the work force, how and whether the workers were paid (other than in food and housing), and how long it took to finish.

1. Give a non-trivial minimum estimate of how much it would cost, in terms of the amount of grain needed to feed the workers, to build the Pyramid of Khufu out of 2×2 Lego blocks instead of stone, not counting the cost of buying and delivering the Lego blocks to the site. *[10]*

NOTE. You will need to look up some facts, or find them out for yourself, to answer this question. As an [in]sanity check, we will assume, because this is a math – not an engineering! – course, that the Lego blocks are infinitely strong. Other than this, though, you may assume that physics is applicable. (*Hint, hint!* How much *work* would be need to be done?) One equation that may come in handy is that the volume of a square-based pyramid with sides of length s and height h is $V = \frac{1}{3}s^2h$.