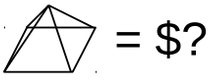
Mathematics 3810H – Ancient and Classical Mathematics
Trent University, Winter 2020

Assignment #1
The Great (Lego?) Pyramid



Due on Thursday, 16 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 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 minimum estimate of how much it cost to build the Pyramid of Khufu, in terms of the amount of grain needed to feed the workers building it, but not counting the cost of quarrying and moving the stone to the site. *[7]*

2. Give a minimum estimate of how much it would cost to build the Pyramid of Khufu out of 2×2 Lego blocks, in terms of the amount of grain needed to feed the workers building it, but not counting the cost of buying and delivering the Lego blocks to the site. *[3]*

Note. You will need to look up some facts, or find them out for yourself, to answer either question. As an (in)sanity check, we will assume, because this is a math – not an engineering! – course, that the Lego blocks used in the second question are infinitely strong. 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 $V = \frac{1}{3}s^2h$.