MATH 4340 – Combinatorial Analysis Assignment #0
Fall 2013

Suppose you have a certain number (say c) of colours, with which you can colour the faces (or vertices, or edges) of a cube, and you are interested in the total number of different colourings that are possible. When determining the number of possible colourings, note that it is not necessary to use every colour (so, for example, an all-red cube is allowed and should be counted when considering instances of c that exceed 1).

When determining what constitutes different versus equivalent colourings, bear in mind that any natural motion of the cube from one position to another is to be taken into consideration. As an example of what this means, should the cube be coloured with white and black such that five faces are white and one is black, then there is only one such colouring and not six (because the cube is not fixed in place).

The main question to be answered is: How many different colourings of the cube are there when there are $c \in \{1, 2, 3, 4, 5, 6, 7\}$ colours available and it is the (a) faces, (b) vertices, or (c) edges that are being coloured? A tabular format for the answers might be helpful:

	To Be Coloured		
Number of Colours	Faces	Vertices	Edges
1			
2			
3			
4			
5			
6			
7			

Part of the idea behind this exercise is to get the class to engage in group discussion and to (hopefully) arrive at a consensus regarding the number of colourings, along with the underlying enumerative arguments.

It is also hoped that these tasks have enough challenge to them to allow for some appreciation for some of the techniques that we'll see later in the course.