Presentations07
The Beginning of Infinitesimal Calculus

	Topic/Exercise	Presenter	
1	Find the Maclaurin expansion for e^x, $\sin x$ and $\cos x$. Then substitute $x \leftarrow ix$ to obtain the identity $e^{ix} = \cos x + i \sin x$; then repeat with $x \leftarrow -ix$ to get another identity; finally solve two equations in two unknowns to get $\sin x$ and $\cos x$ in terms of e^{ix} and e^{-ix}. (See my notes on the class website: http://webhome.auburn.edu/~smith01/math3010Sp25/EulerFormulas.pdf)		
2	Consider the equation $(x + iy)^2 = 0 + 1i$. Set up two equations in x and y and find real numbers that satisfy the equations. This will calculate $\sqrt{i}$.		
3	Prove de Moivre's theorem: $$(\cos x + \mathrm{i} \sin x)^n = \cos nx + i \sin nx$$ Where $i = \sqrt{-1}$. Hint: use induction.		
4	Look up the hyperbolic trig functions, sinh and cosh; prove the identity: $$\cosh^2(x) - \sinh^2(x) = 1$$		
5	Prove that the sum of all the elements in a row of Pascal's triangle is an integral power of 2. Hint: try induction. (See my notes on the class website: http://webhome.auburn.edu/~smith01/math3010Sp25/PascalTriangleIdentities.pdf .)		
6	Use the fact that $$\binom{n}{k} = \frac{n!}{k!\,(n-k)!}$$ to obtain the identity $$\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$$		
7	In your textbook select some problems to do from the section on the history of the development of the infinitesimal calculus.		
8	Use the method of exhaustion to calculate the area of a parabolic sector. (See my notes on the class website: http://webhome.auburn.edu/~smith01/math3010Sp25/MethodOfExhaustion.pdf .)		
9	Select one of the "notes" from the notes region of the class website to present on the early calculus or related to the current class discussions.		