Challenging assignment 1

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do not bother answering it after 25th August 2014

- This is **not** a mandatory assignment.
- Assignment problems are slightly tougher than exam and classroom problems. These problems are expected to provoke critical and *out of the box* thinking.
- Try and solve as many problems as you can. You are not expected to solve all problems.
- You are not evaluated based on this. So, do not copy.

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1. Suppose $y^{(n)}$ stands for the n th derivative of $y(x)$. If n is even, then $y^{(n)} = y$. Can you guess $y(x)$? What happens to $y^{(n)}$ when n is odd ?
2. Find
$$\underbrace{D^n(D^n(\dots D^n}_{n \text{ times}}(x^{n^n}\underbrace{)\dots))}_{n \text{ times}}$$
3. Give a geometric (intuitive!) proof of
$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{r}{\frac{\mathrm{d}r}{\mathrm{d}\theta}}$$
4. Suppose any vertical cross section of a soap bubble floating on the surface of water looks identical. The base of the bubble(on the surface of water) is circular with radius r. The curvature of any point on the cross section is proportional to height from the surface of water. The bubble bursts if curvature at any point exceeds c_{max}. Whats is maximum possible height of a bubble?
