

Math 151b
Final Examination
Due Friday, March 13th, 5pm

Instructions: **Remember to type up your solutions.** Please also email me a copy of your final exam.

Allowed materials are Hatcher, your notes, and your old problem sets. You can use any results we covered (however sketchily) this quarter. Please don't discuss the problems with anyone other than me but let me know if you think you've found a mistake or something which doesn't make sense. Have fun!

1. Suppose $S \cong S^2$ is embedded in \mathbf{CP}^2 . What are the possibilities for the relative homotopy groups $\pi_2(\mathbf{CP}^2, S)$ and $\pi_3(\mathbf{CP}^2, S)$?
2. Hatcher, 4.2.5
3. Hatcher, 4.2.15 (Note that the comment here is out of date!)
4. Hatcher, 4.2.16
5. Could there be a pair of maps $f, g : X \rightarrow Y$ with X and Y CW-complexes so that
 - $f_*(x) = g_*(x)$ for all $x \in \pi_n(X)$ and all n , and
 - f and g are *not* homotopic?

If not, say why not. If so, give an example (or prove that examples exist).

6. Hatcher, 4.3.1