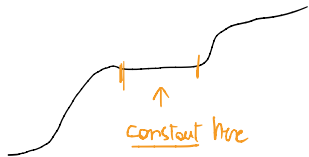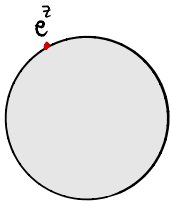①

constant here

This is a counterexample for F **not** locally invertible.

② $\cdot^z \mapsto$

e^z

This is a counterexample for F **not** proper