1. Let $f(z) = (\text{Re } z)^2 + (\text{Im } z)^2 - 2i \text{Re } z \text{Im } z$. At which $z$ is $f(z)$ complex differentiable? Analytic? Explain.

2. Integrate $\text{Im } z \, dz$ along the straight line segment from the origin to $3i - 4$.

3. Integrate $\frac{e^z}{2z^2 + z} \, dz$ counterclockwise around the unit circle.

4. Expand $\frac{1}{z}$ in a Taylor series at $z = 3i - 4$. What is the disc of convergence?

5. Expand $(z^2 - 3iz - 2)^{-1}$ in a Laurent series centered at the origin and valid in the annulus $\{z : 1 < |z| < 2\}$.

6. Integrate $\sin(\csc z)$ around the unit circle.

7. Use Rouche’s theorem to determine the number of zeros, counted with multiplicity, of $z^3 - 8z^2 + 11z - 1$ in the annulus $\{z : 1 < |z| < 2\}$.

8. Find a fractional linear transformation that maps the unit disc to the exterior of the circle of radius 2 centered at $i$. 