

You may use any books, notes, tables, or calculators you wish. Be sure and write your answers so that someone other than yourself can understand your exposition. Give exact answers—do not give decimal or other approximations. *Fortuna vobiscum.*

1. Compute

$$\oint_C \frac{z+i}{z^3+2z^2} dz ,$$

where C is

- (a) one time around the circle $|z|=1$ in the counterclockwise direction.
- (b) one time around the circle $|z+2-i|=2$ in the counterclockwise direction.
- (c) one time around the circle $|z-2i|=1$ in the counterclockwise direction.

2. Let $f(z) = z^2 - 2z + 3$.

(a) Find the Taylor series expansion of f about the point $z_0 = 1$. (That is, expand f in powers of $z-1$.) For what values of z is this expansion valid? Explain.

(b) Find the Laurent series of $\frac{z^2 - 2z + 3}{z-1}$ about $z_0 = 1$.

(c) Find the integral $\oint_C \frac{z^2 - 2z + 3}{z-1} dz$, where C is one time around the square with sides $x = \pm 1$ and $y = \pm 1$, in the counterclockwise direction.

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