Please show all work and explain your answers.

1. Integrate \( \frac{\cos z \, dz}{z(z^2 + 4)} \) around the circle of radius 2 centered at \(-i\).

2. Integrate \( \frac{e^{z^2} \, dz}{z^3} \) around the same circle as above.

3. Integrate \( \Re \) along the straight line segment from 1 to \(i\).

4. Suppose \( f : \mathbb{C} \to \mathbb{C} \) is entire and the real part \( \Re[f(z)] > 0 \) for all \( z \in \mathbb{C} \). What can you conclude about \( f \)? Prove your assertion. Cite any theorems you use in your proof.