Q3a: On the curve $\overline{\gamma}$, we have that $\overline{f(\overline{z})}$ will be continuous since $\overline{f(\overline{\overline{\gamma}})} = \overline{f}$. Since f is continuous for any (ε, δ) pair satisfying the definition of continuity, we have that the same pair will satisfy for $\overline{f(z)}$ since if $|x-y| < \delta$ then $|\overline{f(x)} - \overline{f(y)}| = |f(x) - f(y)| < \varepsilon$. We now compute that

$$\begin{aligned}
\int_{\overline{\gamma}} \overline{f(\overline{z})} dz &= \int_{[0,1]} \overline{f(\gamma(t))} \cdot \overline{\gamma(t)}' dt \\
&= \int_{[0,1]} \overline{f(\gamma(t))} \cdot \overline{\gamma'(t)} dt && \text{(since } \gamma \text{ is a function of real variable)} \\
&= \int_{[0,1]} Re(f(\gamma(t)) \cdot \gamma'(t)) dt - i \int_{[0,1]} Im(f(\gamma(t)) \cdot \gamma'(t)) dt \\
&= \overline{\int_{\gamma} f(z) dz} && \text{(by definition)}
\end{aligned}$$

Q3b: Since integration is independent of parametrization, we can choose $\gamma : [0, 2\pi] \to \mathbb{C}$ defined by $\gamma(t) = e^{it}$. We also note that $\overline{\gamma(t)} = e^{-it}$. Using $3a$, we compute that

$$\begin{aligned}
\overline{\int_{\gamma} f(z) dz} &= \int_{\overline{\gamma}} \overline{f(\overline{z})} dz \\
&= \int_{[0,2\pi]} \overline{f(\gamma(t))} \cdot \overline{\gamma'(t)} dt \\
&= \int_{[0,2\pi]} \overline{f(e^{it})} \cdot -ie^{-it} dt \\
&= -\int_{[0,2\pi]} \overline{f(e^{it})} e^{-2it} \cdot ie^{it} dt \\
&= -\int_{[0,2\pi]} \overline{f(\gamma(t))} \frac{1}{\gamma^2(t)} \cdot \gamma'(t) dt \\
&= -\int_{\gamma} \frac{\overline{f(z)}}{z^2} dz
\end{aligned}$$