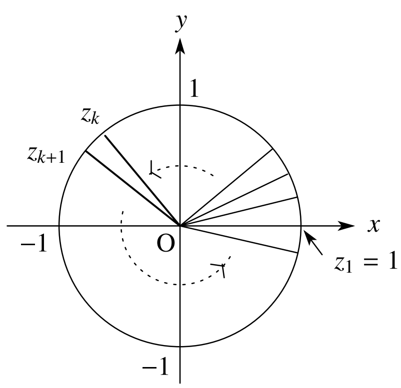
$$z_k = \cos\frac{2\pi}{n}(k-1) + i\sin\frac{2\pi}{n}(k-1)$$

Therefore,

$$\begin{aligned}
\sum_{k=1}^{n}\frac{z_{k+1}-z_k}{z_k} &= \sum_{k=1}^{n}\left(\frac{z_{k+1}}{z_k}-1\right)\\
&= \left(\frac{\cos\frac{2\pi}{n}k + i\sin\frac{2\pi}{n}k}{\cos\frac{2\pi}{n}(k-1)+i\sin\frac{2\pi}{n}(k-1)}-1\right)\\
&= \sum_{k=1}^{n}\left(\cos\frac{2\pi}{n}+i\sin\frac{2\pi}{n}-1\right)\\
&= n\left(\cos\frac{2\pi}{n}+i\sin\frac{2\pi}{n}-1\right) \qquad \cdots ①
\end{aligned}$$

Set $\frac{2\pi}{n} = \theta$,then if $n \to \infty$ then $\theta \to 0$ so,

$$\begin{aligned}
I &= \lim_{n\to\infty} n\left(\cos\frac{2\pi}{n}+i\sin\frac{2\pi}{n}-1\right) \qquad \leftarrow ①\\
&= 2\pi\left(\lim_{\theta\to 0}\frac{\cos\theta-1}{\theta} + i\lim_{\theta\to 0}\frac{\sin\theta}{\theta}\right)\\
&= 2\pi i \qquad \cdots ans.
\end{aligned}$$



Next,

$$\sum_{k=1}^{n}\frac{z_{k+1}-z_k}{{z_k}^2} = \sum_{k=1}^{n}\frac{1}{z_k}\left(\frac{z_{k+1}}{z_k}-1\right) = \left(\cos\frac{2\pi}{n}+i\sin\frac{2\pi}{n}-1\right)\sum_{k=1}^{n}\frac{1}{z_k} \qquad \cdots ②$$

Here,

$$\sum_{k=1}^{n}\frac{1}{z_k} = \sum_{k=1}^{n}\left\{\cos\frac{2\pi}{n}(k-1) - i\sin\frac{2\pi}{n}(k-1)\right\} = \sum_{k=1}^{n}\left(\cos\frac{2\pi}{n}-i\sin\frac{2\pi}{n}\right)^{k-1}$$

The right side is a sum of the first n th terms of the sequence ,such that the first term is 1, and the common ratio is $\cos\frac{2\pi}{n} - i\sin\frac{2\pi}{n}$, If we set $r = \cos\frac{2\pi}{n} - i\sin\frac{2\pi}{n}$, then.

$$r^n = \left(\cos\frac{2\pi}{n} - i\sin\frac{2\pi}{n}\right)^n = \cos 2\pi - i\sin 2\pi = 1$$

Thus, if $n \geq 2$

$$\sum_{k=1}^{n} \frac{1}{z_k} = \frac{1 - r^n}{1 - r} = 0$$

Therefore,because of ②

$$J = 0 \qquad \cdots ans.$$