So the fixed point at $\phi = -\frac{1}{4}\pi$, $J = 1 - \nu$ is a local minimum of the Hamiltonian $\overline{K}(\phi, J)$ and is therefore stable.

(iv) The stable fixed point of $\overline{K}$ is equivalent to a stable periodic orbit in the original representation; when $\phi = -\frac{1}{4}\pi$ and $J = 1 - \nu$ we have

$$\theta = -\tfrac{1}{4}\pi + \left(1 - \tfrac{1}{4}\varepsilon\nu\right) t, \quad I = 1 - \nu$$

or

$$q(t) = \sqrt{2(1-\nu)} \sin\left(\left(1 - \tfrac{1}{4}\varepsilon\nu\right) t - \tfrac{1}{4}\pi\right),$$
$$p(t) = \sqrt{2(1-\nu)} \cos\left(\left(1 - \tfrac{1}{4}\varepsilon\nu\right) t - \tfrac{1}{4}\pi\right), \quad |\nu| < 1.$$