2

$$= I + \frac{\varepsilon I^2}{8} + \frac{\varepsilon I}{4}\sin(2\theta - \Omega t)$$
$$+ \frac{\varepsilon I}{2}\sin\Omega t - \frac{\varepsilon I^2}{8}\cos 4\theta - \frac{\varepsilon I}{4}\sin(2\theta + \Omega t)$$

$$= I + \frac{\varepsilon I^2}{8} + \frac{\varepsilon I}{4}\sin(2\theta - \Omega t)$$
$$+ \frac{\varepsilon I}{8}(4\sin\Omega t - I\cos 4\theta - 2\sin(2\theta + \Omega t))$$

If $\Omega \simeq 2$ the terms in the last bracket vary rapidly compared to $\sin(2\theta - \Omega t)$ so make a transformation $2\theta - \Omega t \to \cancel{2\phi}$ i.e. $\theta - \frac{\Omega t}{2} \to \phi$.

5/5

$I \to J$.

Then $K(\phi, I, t) = H(\theta(\phi, J), I(\phi, J)) + \frac{\partial F}{\partial t}$

Choose an $F_2(J, \theta)$ generating fn.

Then $\phi = \frac{\partial F_2}{\partial J} = \theta - \frac{\Omega t}{2} \Rightarrow F_2(J,\theta) = J\left(\theta - \frac{\Omega t}{2}\right) + g(\theta)$

$I = \frac{\partial F_2}{\partial \theta} = \frac{\partial}{\partial \theta}\left(J\left(\theta - \frac{\Omega t}{2}\right) + g(\theta)\right) = J + g'(\theta)$

$I = J \Rightarrow g'(\theta) = 0$. set $g(\theta) = 0$

(1) $$K = J + \frac{\varepsilon J^2}{8} + \frac{\varepsilon J}{4}\sin 2\phi - \frac{\Omega J}{2}$$
$$+ \frac{\varepsilon J}{8}(4\sin\Omega t - J\cos(4\phi + 2\Omega t) - 2\sin(2\phi + 2\Omega t))$$
$$= J + \frac{\varepsilon J}{4}\sin 2\phi - \frac{\Omega J}{2} + \frac{\varepsilon J^2}{8}(1 - \cos(4\phi + 2\Omega t))$$
$$+ \frac{\varepsilon J}{2}\sin\Omega t - \frac{\varepsilon J}{4}\sin 2(\phi + \Omega t)$$

Should have left in this form.

$$= J + \frac{\varepsilon J}{4}\sin 2\phi - \frac{\Omega J}{2} + \frac{\varepsilon J^2}{4}\sin^2(2\phi + \Omega t)$$
$$+ \frac{\varepsilon J}{2}\sin\Omega t - \frac{\varepsilon J}{4}\sin 2(\phi + \Omega t)$$

The last three terms vary quickly by comparison with the 1st three so we will ignore them to give the conservative approximation

$$K = J + \frac{\varepsilon J}{4}\sin 2\phi - \frac{\Omega J}{2}$$

Your answer does not appear to follow the sequence in the question