Exercise on effective wavenumbers

1. Show that $\boldsymbol{\nabla} \times \boldsymbol{A} = k\boldsymbol{A}$ for $\boldsymbol{A} = (0, \sin kx, \cos kx)$, and explain why this allows you to calculate an effective wavenumber.

2. Use the Pencil Code from `http://pencil-code.googlecode.com` to calculate effective first and second wavenumbers. The trick is to use just the induction equation to produce an initial Beltrami field, i.e.

   ```
   HYDRO     = nohydro
   DENSITY   = nodensity
   MAGNETIC  =   magnetic
   VISCOSITY = noviscosity
   EOS       = noeos
   ```

   So we don't use any hydro or density, etc. The Beltrami field is then initialized in start.in using:

   ```
   &magnetic_init_pars
     initaa='Beltrami-x', amplaa=1., kx_aa=16.
   /
   ```

   Finally, you need to output the relevant material in the 'print.in' file, i.e.

   ```
   abm(f20.14)
   ajm(f20.14)
   arms(f10.6)
   /
   ```

   Compile the code in one dimension and run the code for one time step.

3. Determine $\langle \boldsymbol{A} \cdot \boldsymbol{B} \rangle / \langle \boldsymbol{A}^2 \rangle$ and $\langle \boldsymbol{A} \cdot \boldsymbol{J} \rangle / \langle \boldsymbol{A}^2 \rangle$ for different wavenumbers of the Beltrami field.

4. Repeat the same with a larger number of mesh points (say 1024 or more) by modifying src/cparam.local and recompiling.