Dynamics study guide for chapter five in HH

1) Define

      Wave dispersion

      Phase speed

      Group velocity

      Retrograde motion (see http://glossary.ametsoc.org/wiki/Retrograde_wave)

2) Write equations for:

      Harmonic series, trigonometric version

      Harmonic series, trigonometric version with a phase shift

      Exponential version of a Fourier series with a phase shift

      Imaginary number

      Beta plane approximation

3) Why is the intrinsic phase speed of a Rossby wave to the west? A drawing may be helpful.

4) Draw a line that matches the restoring force

Wave on a density discontinuity   Adiabatic expansion and compression

Rossby wave   Requires a boundary

Kelvin wave   Coriolis parameter f

Inertia waves $\dfrac{\partial f}{\partial y}$

Sound wave   Gravity

5) Circle the waves which are non-dispersive (multiple answers):

sound waves   ;   deep-water waves   ;   Rossby waves   ;   shallow-water waves   ;

intermediate ocean eaves

6) List three characteristics of normal mode motion

7) Linearize $u \dfrac{\partial T}{\partial x}$. Assume $u = \bar{\bar{u}} + u'$ and $T = \bar{\bar{T}} + T'$

8) Assuming a solution of $\psi = \hat{\psi} e^{i(kx - vt)}$, solve for $\dfrac{\partial^2 \psi}{\partial x^2}$

9) Assuming a solution of $\psi = \hat{\psi} e^{i(kx - vt)}$, solve for $\dfrac{\partial}{\partial t}\left(\dfrac{\partial^2 \psi}{\partial x^2}\right)$

10) The solution for v for ocean waves is $v^2 = gk \tanh(kh)$.

   Solve for the phase speed c for shallow water waves

   Is a shallow-water wave dispersive?

   How does the phase speed change with water depth?

   Solve for the phase speed c for deep-water waves.

   Is a deep-water wave dispersive?

   Rewrite the phase speed using $k = \dfrac{2\pi}{L}$

   How does deep-water phase speed vary with wavelength?

11) Solve for v from the following Rossby wave derivation:

$$ivk^2\hat{\psi}e^{i(kx-vt)} - \bar{u}ik^3\hat{\psi}e^{i(kx-vt)} + ik\beta\hat{\psi}e^{i(kx-vt)} = 0$$

Solve for the phase speed c.

Is a Rossby wave dispersive?

Rewrite the phase speed using $k = \frac{2\pi}{L}$

Is the intrinsic westward phase speed faster for long wave or short waves

Why do most synoptic waves move east anyway?

Solve for the group velocity

Which direction is the group velocity?