Dynamics Test 2 Study Guide

Write the following expressions

Vertical motion symbol in (x,y,p) coordinates

Coriolis parameter *f*

Zonal equation of motion, scaled for synoptic systems (x,y,z)

Zonal equation of motion, scaled for synoptic systems (x,y,p)

Meridional equation of motion, scaled for synoptic systems (x,y,z)

Meridional equation of motion, scaled for synoptic systems (x,y,p)

Vertical equation of motion, scaled for synoptic systems (x,y,z)

Hydrostatic equation in (x,y,z)

Hydrostatic equation in (x,y,p)

3D vector equation of motion

2D vector equation of motion

The two component equations of motion in natural coordinates

Zonal geostrophic wind u_g in (x,y,z)

Meridional geostrophic wind v_g in (x,y,z)

Zonal geostrophic wind u_g in (x,y,p)

Meridional geostrophic wind v_g in (x,y,p)

Vector version of the geostrophic wind $\overrightarrow{V_g}$ in (x,y,z)

Vector version of the geostrophic wind $\overrightarrow{V_g}$ in (x,y,p)

Geostrophic wind $\left|\overrightarrow{V_g}\right|$ in natural coordinates

Expand $\frac{DT}{Dt} = 0$ into its advective and local time derivative components in (x,y,p) components

Expand $\frac{DT}{Dt} = 0$ into its advective and local time derivative components in (x,y,z) components

2D trajectory equation in x and y components

Mass divergence form of continuity equation

Velocity divergence form of continuity equation

Continuity equation in (x,y,p)

$\nabla \cdot \vec{V}$ in (x,y)

$\nabla \cdot \vec{V}$ in (x,y,z)

$\nabla \cdot \vec{V}$ in natural coordinates

Give typical numerical values for the following. Include units where applicable. Assume mid-latitudes (45°)

a. Scaled vertical wind component (W) for synoptic systems

b. Scaled vertical wind component (U) for synoptic systems

c. Depth scale for troposphere (H)

d. Length scale for synoptic systems (L)

e. Coriolis parameter (f) for mid-latitudes

f. Scale analysis for $\frac{Du}{Dt}$ for synoptic systems

g. Scale analysis for fu for synoptic systems

h. Scale analysis for $2w\Omega\cos\phi$ for synoptic systems

i. Scale analysis for uw/a for synoptic systems where a is the earth's radius (scaled at 1,000,000 m)

j. Scale analysis for $-\frac{1}{\rho}\frac{\partial p}{\partial x}$ for synoptic systems

k. $\nabla \cdot \vec{V}$ for synoptic scale

l. Typical Rossby number (Ro) for synoptic systems

m. Typical Rossby number (Ro) for tornadoes

n. Typical Rossby number (Ro) for inner-core of hurricanes

o. One half-pendulum day at 30 deg latitude

List 5 qualities of a good streamline analysis

Streamlines which depict confluence or diffluence are called: _____

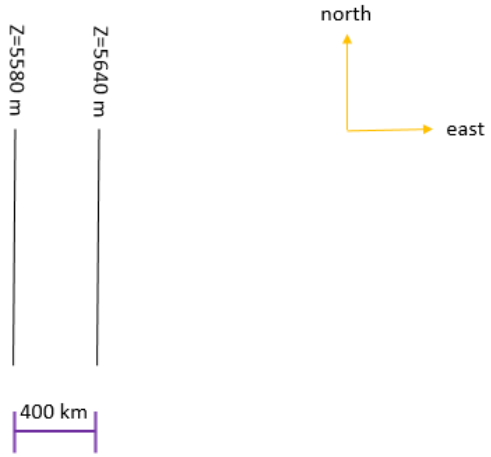
A transition area between two singular points is called a _____

Describe and draw the two components of $\nabla \cdot \vec{V}$ in the natural coordinate system

List three factors that impact $\frac{\partial T}{\partial t}$ where T is temperature

List three factors that impact $\frac{\partial q}{\partial t}$ where q is mixing ratio

What is the wind speed at 45°N latitude if the geopotential height (Z) decreases toward the west at 60 m per 400 km (assume straight flow and no friction).



What direction is the wind blowing from in the above question?

For the following wind vector, draw $\hat{n}$ in the middle of the vector

Is R positive, negative, 0, or in the above question?

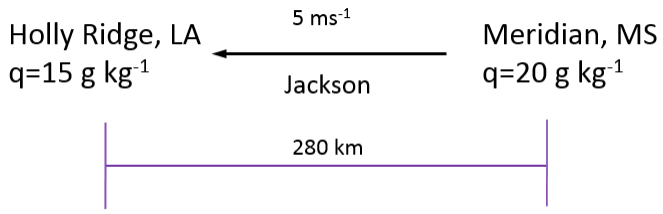
How is K related to R?

From the following chain rule:

$$\delta q = \left(\frac{\partial q}{\partial t}\right)\delta t + \left(\frac{\partial q}{\partial x}\right)\delta x + \left(\frac{\partial q}{\partial y}\right)\delta y$$

derive an expression for the total derivative $\frac{Dq}{Dt}$ in (x,y) coordinates where q is mixing ratio. Show all steps.

Is moist air advection or dry air advection occurring below in Jackson?



Write an expression which approximates $-\vec{V} \cdot \nabla q$ in Jackson for the above values

Assuming q=17.5 g kg^{-1} in Jackson, predict the mixing ratio in Jackson 2 hours into the future based on moisture advection.

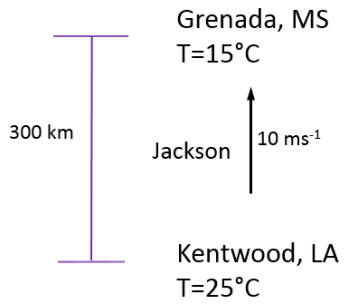
What other process could cause moisture changes in Jackson?

From the following chain rule:

$$\delta T = \left(\frac{\partial T}{\partial t}\right)\delta t + \left(\frac{\partial T}{\partial x}\right)\delta x + \left(\frac{\partial T}{\partial y}\right)\delta y$$

derive an expression for the total derivative $\frac{DT}{Dt}$ in (x,y) coordinates where T is temperature. Show all steps.

Is warm air advection or cold air advection occurring below in Jackson?



Write an expression which approximates $-\vec{V} \cdot \nabla T$ in Jackson for the above values

Assuming T=20°C in Jackson, predict the temperature in Jackson 2 hours into the future based on temperature advection.

What other process will change the temperature in Jackson?

Given the general relationship:

$$\frac{D_a\vec{A}}{Dt} = \frac{D\vec{A}}{Dt} + \vec{\Omega} \times \vec{A}$$

Derive the 3-D vector equation of motion in final form. Show all steps and substitutions.

Define:

Advection

Lagrangian frame of reference

Eulerian frame of reference

Rossby number

Geostrophic wind

Inertial oscillation

Cyclostrophic flow

Trajectory

Streamline