Dynamics Test 3 study guide

1) Define

Barotropic atmosphere

Baroclinic atmosphere

Equivalent barotropic

Absolute vorticity

Potential vorticity

Laminar flow

Reynolds numbers

Hodograph

Roughness length

Friction velocity

The two components which contribute to relative vorticity in natural coordinates (Drawings and non-mathematical description okay)

2) Write the following expressions or values.

Basic definition of the thermal wind

Approximate relationship of ω to w

Vertical component of relative vorticity ζ in (x,y) coordinates

Typical synoptic value of relative vorticity

Barotropic PV equation

3D vorticity

Typical range for drag coefficient

Order of magnitude of the Reynold's number where turbulence occurs

Logarithm wind profile

Power law for wind profile

3) Write the general solution of $\frac{|\vec{V}|^2}{R} + f|\vec{V}| + \frac{\partial \Phi}{\partial n} = 0$ for gradient wind balance using the quadratic formula $x = -\frac{b}{2a} \pm \sqrt{\left(\frac{b}{2a}\right)^2 - \frac{c}{a}}$. Multiply the gradient wind balance by R first.

What is the solution for a regular low?

An anomalous low could be represented by what phenomenon?

What is the solution for a regular high?

Write the dynamic constraint for curvature in ridges.

From this relationship, what wind constraint occurs in high pressure systems?

4) Draw the balance of forces in a ridge.

Is the wind subgeostrophic or supergeostrophic in a trough?

Why?

5) Draw the balance of forces in a trough

Is the wind subgeostrophic or supergeostrophic in a trough?

Why?

6) Draw the four balances of forces within the boundary layer.

7) Draw the thermal wind when the wind is from the northwest at 850mb and is from the west at 500mb. Assume the wind magnitude is the same at both levels.

8) The wind is from the south at the surface. If the wind is veering with height to 700 mb, give a typical example of wind direction at 850 mb and at 700 mb? Is this associated with cold air advection or warm air advection in this layer?

9) The wind is from the south at the surface. If the wind is backing with height to 700 mb, give a typical example of wind direction at 850 mb and at 700 mb? Is this associated with cold air advection or warm air advection in this layer?

10) List three mechanisms which contribute to turbulence.

11) Draw a typical vertical profile of temperature, potential temperature, and wind during the day. Label the four layers.

12) Draw a typical vertical profile of temperature, potential temperature, and wind during the night. Label the four layers.

13) A disc of air with height h is displaced northwards. Which of the following will help conserve barotropic PV? (ζ decreases, h increases, divergence)

14) If the wind backs in the lower troposphere , and is veering aloft, the atmosphere locally is becoming (more stable, less stable, can't tell)

15) The thermal wind "blows" with warmer air (on its left, on its right, behind it)

16) Winds in a ridge are (subgeostrophic, supergeostrophic, geostrophic)

17) To derive the prognostic vorticity equation, one step is to take $\frac{\partial}{\partial x}$ of the (meridional eq. of motion, zonal eq. of motion, continuity eq.)

18) Downstream of a 500-mb trough is associated with: (500-mb convergence, descent, $\omega < 0$)

19) Downstream of a 500-mb ridge is associated with: (500-mb divergence, w<0, ascent)

20) What is NOT true? Bulk formulas represent surface fluxes of a scalar variable with a proportionality to: (a drag or transfer coefficient; $w'(scalar\ variable)'$; mean wind of surface layer; a vertical scalar difference between levels z and z_o ;)

21) An unstable surface layer is characterized by: $\frac{\partial T}{\partial z} < -1.5$°/(100 meters); $\frac{\partial T}{\partial z} > -0.5$°/(100 meters); -1.5°/(100 meters)> $\frac{\partial T}{\partial z} > -0.5$°/(100 meters)

22) A stable surface layer is characterized by: $\frac{\partial T}{\partial z} < -1.5$°/(100 meters); $\frac{\partial T}{\partial z} > -0.5$°/(100 meters); -1.5°/(100 meters)> $\frac{\partial T}{\partial z} > -0.5$°/(100 meters)

23) An neutral surface layer is characterized by: $\frac{\partial T}{\partial z} < -1.5$°/(100 meters); $\frac{\partial T}{\partial z} > -0.5$°/(100 meters); -1.5°/(100 meters)> $\frac{\partial T}{\partial z} > -0.5$°/(100 meters)

24) Surface winds in an unstable surface layer will be (greater, less) than surface winds in a neutral atmosphere

25) Surface winds in a stable surface layer will be (greater, less) than surface winds in a neutral atmosphere

26) List 4 factors which contribute to ascending motion

27) Be able to compute vorticity from a weather map. See the example at: http://weatherclasses.com/uploads/4/2/8/6/4286089/vorticity_calculation_example.pdf

28) Qualitatively list the four components which contribute to $\frac{\partial \zeta_a}{\partial t}$ in the prognostic vorticity equation in z coordinates.

Which term is important for contributing to the rotating updraft in supercell thunderstorms?

Which term disappears in p vertical coordinates?