Sample questions for Exam 1 (mostly material from Chapt 1, HH)

Write the derived name, as well as the units for force, pressure, energy, and power in terms of kg, m, and s.

Write the definitions for u, v, and w in x,y,z coordinates

Which ones are a zonal wind component, a meridional wind component, and vertical motion component?

Which ones are a south/north wind component and an east/west wind component?

Is a south wind component negative or positive?

Is an east wind component negative or positive?

Be able to convert a) wind for ms^{-1} to knots or and mph, and vice versa; b) pressure from mb to PA, and Pa to mb; c) Celsius to Kelvins; d) meters to km, miles, feet, and inches, and vice versa. I'll give the conversion values, you will need to show the calculation.

Write the following:

a) Definition of a Taylor Series Expansion f(x) about a reference value x_o

b) Vector notation in three dimensions for $\vec{A}$

c) Expression for ∇T in three dimensions

d) Expression for $\nabla \cdot \vec{V}$ in three dimensions

e) The x component of the pressure gradient force per unit mass on a constant height surface

f) Hydrostatic equation

g) Thickness equation

h) x-component of eddy viscosity force

i) Equation of state for dry air (also called the ideal gas law)

j) Definition of earth rotation rate Ω

k) Value of earth rotation rate Ω (s^{-1})

l) Definition of geopotential

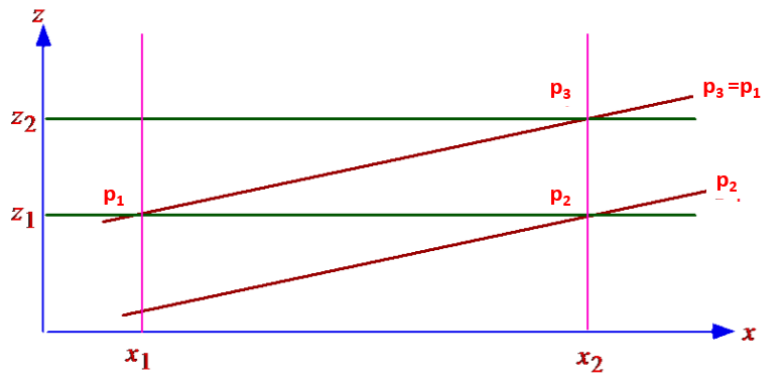
m) Equation for geopotential ϕ

n) Equation for geopotential height Z

o) Sigma coordinate system

p) Scales of horizontal motion in km for:
   i. dust devils
   ii. tornadoes
   iii. cumulonimbus clouds
   iv. fronts
   v. tropical cyclones
   vi. baroclinic cyclones
   vii. planetary waves

For the following figure:



Complete the following expression:

$$\frac{p_3 - p_1}{x_2 - x_1} =$$

Apply the chain rule, and derive an expression which relates the x-component of the pressure gradient force on a constant geopotential height surface to the pressure gradient force on a constant pressure surface.

What is the major advantage of using pressure as a vertical coordinate compared to height?

From the hydrostatic equation, derive the thickness equation

Show that pressure is the weight per unit area

The horizontal Coriolis force is proportional to what factors?

A missile is fired eastward at 45°N and travels 700 km at a horizontal speed of u_o =800 ms^{-1}. By how much is the missile deflected by the Coriolis force? (Hint: integrate $\frac{dv}{dt} = -2\Omega u \sin\phi$ twice and assume the deflection is sufficiently small so that $u_o \approx u$). Also see page 17 in HH.

Compute ΔZ from 700 to 600 mb if the mean virtual temperature is -10°C

Circle the correct answer

1) For a north wind in the Northern Hemisphere, the horizontal Coriolis force produces which acceleration?

A) $\frac{dv}{dt} < 0$

B) $\frac{dv}{dt} > 0$

C) $\frac{du}{dt} < 0$

D) $\frac{du}{dt} > 0$

2) In the Southern Hemisphere, the Coriolis force deflects all horizontal motion:

a) To the left
b) To the right

3) The 3-D Coriolis force in the Northern Hemisphere deflects a 20 ms^{-1} west wind at 45°N and 90°W:

a) South of 45°N
b) West of 90°W
c) East of 90°W
d) North of 45°N

And

a) Downward
b) Upward
c) Neither

If the latitude was 60°N, the horizontal deflection would

a) Increase
b) Decrease
c) Not change

If the west wind increases to 30 ms^{-1}, the horizontal deflection would

a) Increase
b) Decrease
c) Not change

3) The 3-D Coriolis force deflects a descending ball at the equator

a) To the east
b) To the west
c) Neither

4) "Effective" gravity contains which force?

a) Coriolis force
b) Pressure gradient force
c) Centrifugal force
d) Friction

5) A rotating frame of reference relative to the earth is NOT referred to as

a) Absolute
b) Relative
c) Accelerated
d) Noninertial

6) A sidereal day is the time it takes for the earth to make one complete rotation relative to the

a) Sun
b) Stars
c) Moon

7) The altimeter reading on an airplane flying along an isobaric surface toward colder air will be

a) Too high
b) Too low
c) Unaffected by the change in temperature

8) Cold-core lows _____with height

a) Intensify
b) Weaken

Justify your answer by drawing some pressure surfaces with height and paying attention to the spacing between the isobars

How is it possible for a cold-core low to have a low surface pressure?

9) Warm-core lows _____with height

a) Intensify
b) Weaken

Justify your answer by drawing some pressure surfaces with height and paying attention to the spacing between the isobars

What is special about the warm-core of a hurricane that contributes to such a low surface pressure?

10) Which of the following is *not true* about the mean sea-level pressure (MSLP) reduction equation?

a) Except at z=0, MSLP will be > than the station pressure
b) The conversion factor is proportional to $\overline{T_v}/z_{stn}$
c) There are different methodologies for obtaining $\overline{T_v}$
d) The differences between MSLP and a station pressure are larger for a cold surface temperatures, assuming the same lapse rate