

Name: \_\_\_\_\_

NATS 101 Introduction to Weather and Climate, Section 54, Fall 2005  
Quiz #3: Thursday, 10 November 2005.

Air Pressure and Winds [30]

\_\_\_\_\_ 1. On an *upper-level* map **cold** air aloft (above the friction layer) is associated with \_\_\_\_\_ pressure and \_\_\_\_\_. [5]

- a. low, divergence
- b. low, convergence**
- c. high, divergence
- d. high, convergence

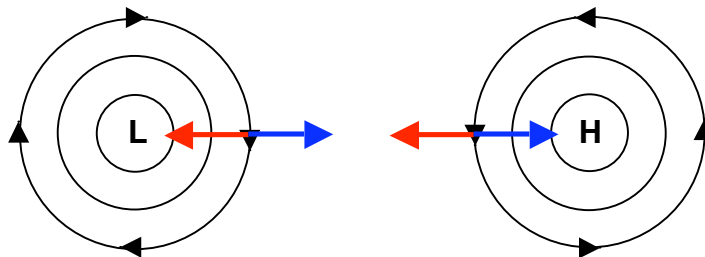
\_\_\_\_\_ 2. On a *surface* map **cold** air at the surface is associated with \_\_\_\_\_ pressure and \_\_\_\_\_. [5]

- a. low, divergence
- b. low, convergence
- c. high, divergence**
- d. high, convergence

\_\_\_\_\_ 3. If the clouds overhead are moving from north to south, the upper-level center of **high** pressure would be \_\_\_\_\_ of you if you were in the northern hemisphere. [5]

- a. east
- b. west**
- c. north
- d. south

4. Describe how wind blows around high *and* low pressure centers in the **southern** hemisphere at upper levels. Use a diagram to show all forces and the wind direction for both cases. Do not include vertical motions. [5]



**Winds blow clockwise around a low, and counter-clockwise around a high. Opposite of the sense in the Northern Hemisphere.**

**-Black arrows designate wind direction**

**-Blue arrows designate the Coriolis Force (CF)**

**-Red arrows designate the Pressure Gradient Force (PGF)**

**There is no Frictional Force (FF) because this is at upper levels**

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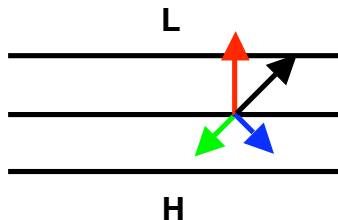
5. What are isobars? How do they generally appear on an upper-level map in regions of strong wind? Weak wind? [5]

**Isobars are lines of constant pressure. In regions of strong winds, the isobars are tightly spaced. In regions of weak winds, the isobars are widely spaced.**



6. Briefly explain why winds converge around a *surface* low pressure and diverge around a *surface* high pressure. Use a diagram to illustrate your point. [5]

**Winds converge around a surface low and diverge around a surface high due to friction. As seen below, friction turns the wind out of/away from a high and into/towards a low.**



**Black Arrow = Wind Direction**

**Green Arrow = Frictional Force (FF)**

**Blue Arrow = Coriolis Force (CF)**

**Red Arrow = Pressure Gradient Force (PGF)**

Vertical Motion [10]

\_\_\_\_\_ 7. Hydrostatic equilibrium describes [5]

- a. **the balance between gravity and a vertical pressure gradient.**
- b. the balance between friction and the Coriolis force.
- c. the balance between gravity and a horizontal pressure gradient.
- d. the balance between a horizontal pressure gradient and the Coriolis force.

\_\_\_\_\_ 8. Vertical air motion over surface high and low pressure regions is the result of [5]

- a. the hydrostatic balance.
- b. **conservation of mass.**
- c. the horizontal pressure gradient.
- d. none of the above.

Measurement of Pressure and Winds [10]

\_\_\_\_\_ 9. In a mercury barometer the force exerted by the outside air pressure is balanced by [5]

- a. the pressure gradient in the mercury column.
- b. the air pressure at the top of the mercury column.
- c. **the weight of the mercury column.**
- d. all of the above.

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10. How does a wind vane work? What does it measure? [5]

**Wind vanes measure wind direction only. Wind vanes consist of a long arrow with a tail, which is allowed to move freely about a vertical post. The arrow points into the wind, thus giving the direction that the wind is coming from.**

#### Scales of Motion [10]

11. Give three examples of microscale scale motion in the atmosphere. [5]

**Small turbulent eddies, smoke rising from a chimney, paper/trash blowing in the air, branches/leaves swirling in the air**

12. Explain why El Niño/La Niña is a global scale phenomenon. What far reaching effects does it have? [5]

**El Niño/La Niña is a global scale phenomenon because it affects areas outside of its vicinity. That is, El Niño/La Niña occurs in the Tropics yet has extratropical effects. Some of its far reaching effects include warm/wet conditions in the US Southwest during El Niño and cool/dry conditions in the US Southwest during La Niña**

#### Eddies [10]

\_\_\_\_\_ 13. Clear Air Turbulence can result from which of the following processes? [5]

- a. Flow over a mountain
- b. Jet Stream
- c. Thermals
- d. All of the above.**

\_\_\_\_\_ 14. Mountain waves are formed in \_\_\_\_\_ conditions with strong \_\_\_\_\_.

[5]

- a. unstable, wind shear.
- b. stable, wind shear.**
- c. unstable, vertical pressure gradients
- d. stable, vertical pressure gradients

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Thermal Circulations [30+6]

\_\_\_\_\_ 15. Katabatic winds are \_\_\_\_\_ winds that flow \_\_\_\_\_. [5]

- a. **cold, down a mountain side**
- b. warm, down a mountain side
- c. cold, up from a valley
- d. warm, up from a valley

\_\_\_\_\_ 16. In a Sea Breeze air over the *land* \_\_\_\_\_, causing air to flow \_\_\_\_\_. [5]

- a. cools, onshore
- b. **warms, onshore**
- c. cools, offshore
- d. warms, offshore

\_\_\_\_\_ 17. The onset of the North American Monsoon is characterized by a \_\_\_\_\_ shift in the Bermuda high, resulting in \_\_\_\_\_ winds over the southwest US. [5]

- a. southward, southeasterly
- b. southward, westerly
- c. **northward, southeasterly**
- d. northward, westerly

E.C. If *only* the poles were to warm, how would the polar jet stream be affected? [3]  
**If only the poles were to warm, the North-South temperature gradient would weaken resulting in a weakened polar jet stream**

18. Use the diagram to describe the winds above the North Atlantic ocean gyre. How do they influence the ocean currents? Include upwelling region(s) on your figure and state what causes such conditions. Show the currents, but you don't have to name them. Clearly indicate the surface current direction with respect to the surface winds on your diagram. [10]



- Black circle represents N. Atlantic gyre
- Blue arrows represent easterlies
- Red arrows represent westerlies
- Shaded area represents upwelling

- The easterlies and westerlies drive the N. Atlantic gyre
- Northerly flow off the coast of Africa drives ocean current; transport to the right of the flow results in upwelling

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E.C. Describe Ekman Transport. What forces are involved? [3]

**Ekman transport is caused by wind blowing over the surface of the ocean. A balance between Coriolis and Frictional forces is set up, and a transport of water results. At the surface, the transport is at an angle to the current. As you go deeper into the water, the transport spirals. The net transport is to the right of the current in the N. Hemisphere.**

19. Describe how the Conveyor Belt Circulation might be shut down. What are the expected consequences for global climate? [5]

**If the earth were to warm, the polar ice caps would melt. This melting would release large amounts of fresh water. Since fresh water is lighter than salt water, the water at the poles would be unable to sink. The Conveyor Belt would be broken.**

**The consequences for global climate would be the shutdown of Equator-to-pole heat transport. The Conveyor Belt brings heat from the Tropics to the poles. If this heat were not transported, the poles would grow even colder causing an ice age.**