**EAS 1600 - INTRODUCTION TO ENVIRONMENTAL SCIENCES**

**Fall, 2015**

**Exam 2 – 10/5/15**

<      **Answer all  Questions**
<      **Show <u>all your work</u> and be sure and report units where appropriate**
<      **Place your name on each page**
<      **This is a closed-book exam; all are expected to comply with Georgia Tech Honor Code**

I am aware and in compliance with the Georgia Tech Honor Code and I agree to abide by the grading policies of this class.


Signature: _____


Print Name: _____


Lab Section: _____


**B**

**Answer the following multiple choice questions (1 – 10) by circling the appropriate answer.**

**1.** Circle all of the following which are greenhouse gases in the Earth system,

(5 points)

a) nitrogen ($N_2$)
b) oxygen ($O_2$)
**c) CFC-11**
**d) water vapor ($H_2O$)**

**2.** The Azores are islands located in the Atlantic Ocean at latitudes about $37^o$ N. Mark all of the answers below that describe the climate of the Azores.

(5 points)

a) Rising air
**b) Sinking air**
**c) Clear Skies**
d) Cloudy Skies

**3**. What is the pressure at 10 m below the surface of the ocean?

(5 points)

a) 5000 mb
b) $5 \times 10^9$ Pa
c) 128 atm
**d) $2 \times 10^5$ Pa**

**4.** The prevailing wind direction at $15^o$ N is _____ and $15^o$ S is _____.

(5 points)

**a) East, East**
b) North, South
c) West, East
d) East, West

**5**. The atmospheric pressure at 11 km altitude is approximately _____.

(5 points)

a) 1000 mb
**b) 250  mb**
c) 500 mb
d) 2000 mb

**6**. A cylinder of compressed air has a pressure of 160 Pa and a temperature close to room temperature. What is the density of the air?

(5 points)

a) 1.2 kg m$^{-3}$
**b) 1.90 g m$^{-3}$**
c) 2.0 kg m$^{-3}$
d) 0.2 g cm$^{-3}$

**7**. What is the difference in air pressure between the top of Stone Mountain which is at an elevation of 1700 ft. and Decatur, GA which is at an elevation of 1000 ft.?

(5 points)

a) 0.94 atm
**b) 0.025 atm**
c) 0.084 atm
d) 15 Pa

**8**. An air parcel _____ in the atmosphere and a cloud forms which _____ the air parcel.

(5 points)

**a) rises, warms**
b) rises, cools
c) descends, cools
d) descends, warms

**9**. Circle the cities that you expect to be hot and humid in the in the summer time.

(5 points)

**a) Washington, DC**
**b) Charleston, SC**
c) San Diego, CA
d) San Francisco, CA

**10**. The atmospheric pressure at the top of Mt. Everest is about 0.33 atm. What is the altitude of the top of Mt. Everest?

(5 points)

**e) 29,000 ft**
f)  1.6 km
g)  5.5 km
h)  300 m

**11**. True or False. Mark each statement below as True or False (2 pts each)

    a.  Air flowing along a stream is cooled by evaporation of water from the stream. _____T_____

    b.  Air is usually descending near the equator. _____F_____

    c.  When 100 g of water freezes 33.3 kJ of energy are released and heat the surrounding environment _____T_____

    d.  The Pacific High brings cool, dry air to the California Coast.__T____

    e.  Water vapor is the greenhouse gas that absorbs the most radiation.___T____

    f.  Increasing the amount of greenhouse gases in the atmosphere will increase the effective temperature of the Earth. _____F_____

    g.  As the temperature of the atmosphere increases atmospheric pressure at sea level is unchanged. _____T_____

    h.  Carbon Dioxide ($CO_2$) is a greenhouse gas that is increasing in concentration in the atmosphere _____T_____

    i.  Nitrous Oxide ($N_2O$) is a greenhouse gas that is increasing in concentration in the atmosphere. _____T_____

    j.  The surface temperature of the Earth would cool if the albedo of the Earth is decreased. _____F_____

    k.  The surface temperature of the Earth is greater than the effective temperature due to the Greenhouse Effect._____T_____

    l.  The primary energy source for a hurricane is the latent heat associated with the evaporation and condensation of water. _____T_____

**12.** Draw a diagram of a Hadley Cell in the tropics. Be sure to indicate horizontal and vertical motions of air in the cell. Label areas of high and low pressure as well as approximate latitudes. Indicate where there would be significant precipitation.

(10 pts)



30°N     Northeast Trade Winds

H

L   0°        precipitation

H     30°S      Southeast Trade Winds
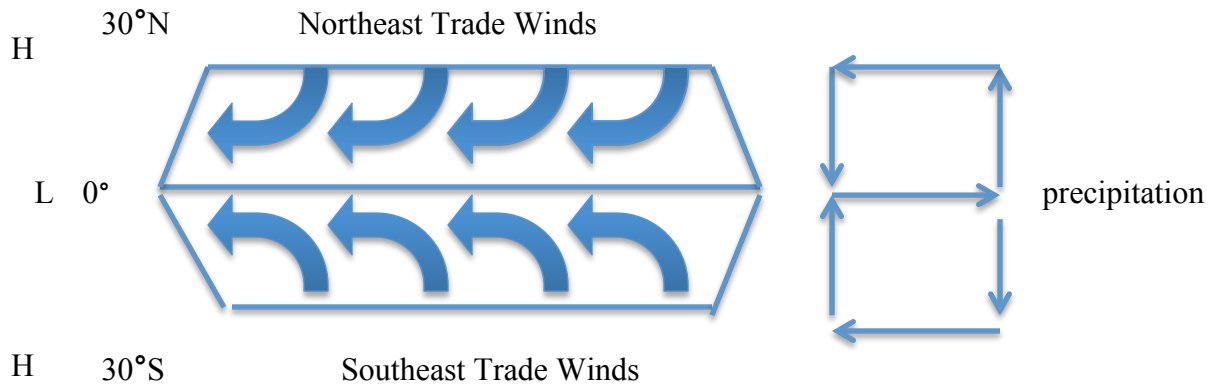
**13.** A balloon floats is at an altitude of 1 km at a temperature of 283 K and has a volume of 10 m³. The mass of the balloon is 2.3 kg. What is the buoyant force on the balloon? Is this balloon rising, falling, or stationary (i.e. floating)? Why?

(12 pts)

Use barometric law to solve pressure at 1 km.

$$p = p^0 \exp\left(-\frac{z}{H}\right) = 1.013\times10^5 \text{Pa}\times \exp(-1km/8\ km) = 8.9\times10^4\ Pa$$

The density of the outside air is

$$\rho_{air} = \frac{P}{TR_d} = \frac{8.9\times10^4}{283\times287}kg/m^3 = 1.10\ kg/m^3$$

Buoyant force $= \rho_{air}Vg = 1.10\times10\times9.8\ N = 107\ N$

Buoyant force > Weight of balloon, so the balloon is rising.

5

**14.** Draw a diagram of a low pressure system in the northern hemisphere. Indicate the horizontal flow pattern about the system with arrows showing the wind directions. Label on the diagram where you might expect to find a cold front. Also indicate the vertical motion of air associated with the system. What type of weather do you expect to be associated with this system? Be sure and pay attention to the compass directions indicated below.

(10 pts)



L

Rising motion; Precipitation and clouds

N

E
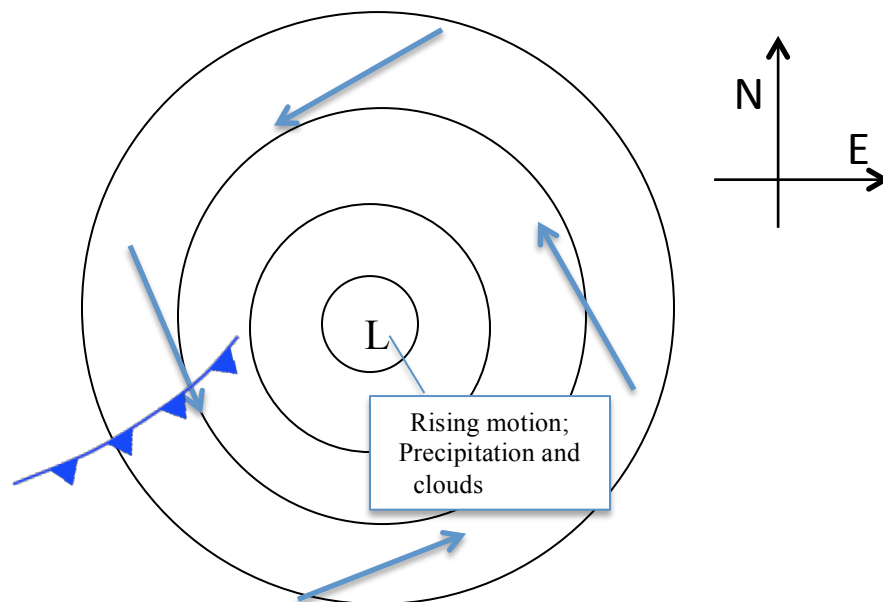
**Extra Credit (10 pts)**

Tropical corals are in danger of "bleaching". What is bleaching and what is the primary cause?

**Formulas, facts, and constants you may find useful:**

1. The latitude of a point is earth is defined as the angle defined by that point, the center of the Earth, and the Equator. For Example, Atlanta is at $34^o$ N, The Equator is $0^o$, and the South Pole is $90^o$ S.

2. Surface area of a sphere with radius r; $A = 4\pi r^2$,
3. Pressure units 1 atm = 1013 mb = $10^5$ Pa, 1 Pa = 1 kg m$^{-1}$ s$^{-2}$

4. Ideal Gas Law $P = \rho R_d T$
    where $R_d$ is the gas constant for air = 287 J K$^{-1}$ kg$^{-1}$
    $\rho$ is the gas density.
    For example the density of air is 1.2 kg m$^{-3}$ at 1 atm. and 20 C.

5. $P = P^0 exp(-z/H)$ is the barometric pressure law, where H=8 km and z is altitude

6. 1.0 ft = 0.3048 meters

7. d=vt (d-distance, v-velocity, t-time)

8. the change in pressure ($\Delta P$) of a fluid in a gravitational field is given by the hydrostatic law
    $$\Delta P = -\rho g \Delta z$$
    Where g = 9.8 m s$^{-2}$, $\rho$ is the density of the fluid, and $\Delta z$ is the change in altitude

9. for water the heat of condensation/evaporation = 2500 J/g, heat of melting/freezing = 333 J/g

10. Density of liquid water = 1 g cm$^{-3}$