ES106 Lab Week 6 Moisture in Atmosphere

Read the following directions before starting into the lab activities in this packet. This addendum summarizes changes that are necessary for you to complete the lab at home.

You can work on the lab packet on your own time during Sunday through Thursday of each week.

When you have completed the packet for this lab, you can take the weekly lab quiz that is available on Moodle. The online quiz is due by **6:00 PM on Thursday** and will no longer be available to students after that time. **Be sure to give yourself 30 minutes to complete the quiz!**

There will also be a **Hand-In Page** that is due by **6:00 PM on Thursday** (See directions below).

Directions:

Complete the Pre-Lab (Page 1.2) questions first.

The Table on page 1.3 is one of the most important pages in the whole lab. You will refer to it again and again. If you ever find yourself saying, "how can I know this information?" it probably means you need to be looking at Table 1. This table shows you the water vapor capacity for a particular temperature. Another way of interpreting this is that the grams/kg equal the amount of water vapor needed to saturate the air at that temperature. You can also reverse this to say, when I have x g/kg of water vapor, the temperature at which that is enough to saturate it is the dew point temperature. These are all related principles and they all come from reading Table 1!

Activity 1: Complete this section using data from Table 1. Plot out the graph to see how water vapor capacity changes with temperature. For question 3, you are just finding the differences in water vapor capacity for different temperatures using the data from Table 1.

Activity 2: Complete this section using data from Table 1 on page 1.3 along with the relative humidity formula given on this page (page 1.5). Table 2 gives you the temperature and the water vapor content. You will need to look up the water vapor capacity from Table 1. Plugging those values into the relative humidity formula will give you the relative humidity. Be sure to answer the questions in between the tables to make sure you understand the concepts being covered. Please note that Table 4 is in Fahrenheit instead of Celsius when determining your water vapor capacity.

Activity 3: To complete this section you will need to refer to the Sling Psychrometer video link on Moodle. Alternatively, you can view it from this link: https://youtu.be/Yx8nzhmJu_A . The video gives you the data you need to complete the first three lines of Table 5. Then you will need to use Tables 6 and 7 in order to determine the relative humidity and dew-point temperature. The last page of this addendum leads you through an example of how to read the relative humidity table.

Activity 4: To complete this section, you will need to refer to the Dew Point by Condensation Pdf on Moodle. This will show you an alternative way of determine dew point than we used in Activity 3. It

will also give you the necessary value to complete the dew-point temperature line on page 1.10. Questions 20 – 22 once again refer back to Table 1 on page 1.3 to get the values. It should be simple math to determine question 22 after getting the data for the two previous questions from Table 1.

Part B: Adiabatic Processes – **Though there aren't any blanks to complete on page 1.11, it is absolutely critical that you get your dry adiabatic lapse rate and wet adiabatic lapse rate values from this page. Do not use values from anywhere else!** In addition, Figure 2 is not just a pretty diagram of what we are going to do on the next exercise. It gives you the starting temperature, starting relative humidity, and starting elevation for the next exercise. If you do not get your values from the diagram on this page, you will probably get nearly everything wrong on the turn-in page.

Page 1.12 is your turn-in page this week. It must be the version of this page that you can download from Moodle this week or you will receive no points for this exercise. An extremely important part of this page is that it must be done in order. If you feel confused about how to get the answer for one question, do not skip to the next question. That will lead to disastrous results. Each question gives you data needed to answer the following questions. **There is a helper PDF called "Orographic Lifting Presentation" on Moodle that will help guide you through the principles needed to complete this page.**

We will skip the Post-Lab Assessment (Page 1.13)

Reading the relative humidity chart

If you look at the relative humidity chart and don't know where to start, this example should help you out.

Using a sling psychrometer in our back yard, we get the following readings (note these are not the ones to use for this lab, they are just an example):

Dry bulb temperature: 12°C

Wet bulb temperature after spinning psychometer for several minutes: 8°C

Difference between the wet bulb and the dry bulb (subtraction): 4°C

Using that information we look up the dry bulb temperature on the Y-axis and the difference between the two thermometers on the X-axis, as highlighted below.

TABLE C.1 Relative humidity (percent).

Dry bulb (°C)	Depression of Wet-Bulb Temperature (Dry-Bulb Temperature Minus Wet Bulb Temperature = Depression of the Wet Bulb)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
−20	28																					
−18	40																					
−16	48	0																				
−14	55	11																				
−12	61	23																				
−10	66	33	0																			
−8	71	41	13																			
−6	73	48	20	0																		
−4	77	54	32	11																		
−2	79	58	37	20	1																	
0	81	63	45	28	11																	
2	83	67	51	36	20	6																
4	85	70	56	42	27	14																
6	86	72	59	46	35	22	10	0														
8	87	74	62	51	39	28	17	6														
10	88	76	65	54	43	38	24	13	4													
12	88	78	67	57	48	38	28	19	10	2												
14	89	79	69	60	50	41	33	25	16	8	1											
16	90	80	77	62	54	45	37	29	21	14	7	1										
18	91	81	72	64	56	48	40	33	26	19	12	6	0									
20	91	82	74	66	58	51	44	36	30	23	17	11	5									
22	92	83	75	68	60	53	46	40	33	27	21	15	10	4	0							
24	92	84	76	69	62	55	49	42	36	30	25	20	14	9	4	0						
26	92	85	77	70	64	57	51	45	39	34	28	23	18	13	9	5						
28	93	86	78	71	65	59	53	45	42	36	31	26	21	17	12	8	4					
30	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16	12	8	4				
32	93	86	80	73	68	62	56	51	46	41	36	32	27	22	19	14	11	8	4			
34	93	86	81	74	69	63	58	52	48	43	38	34	30	26	22	18	14	11	8	5		
36	94	87	81	75	69	64	59	54	50	44	40	36	32	28	24	21	17	13	10	7	4	
38	94	87	82	76	70	66	60	55	51	46	42	38	34	30	26	23	20	16	13	10	7	5
40	94	89	82	76	71	67	61	57	52	48	44	40	36	33	29	25	22	19	16	13	10	7

Dry-Bulb (Air) Temperature

Relative Humidity Values

* To determine the relative humidity, find the air (dry-bulb) temperature on the vertical axis (far left) and the depression of the wet bulb on the horizontal axis (top). Where the two meet, the relative humidity is found. For example, when the dry-bulb temperature is 20°C and a wet-bulb temperature is 14°C, then the depression of the wet bulb is 6°C (20°C − 14°C). From Table C-1, the relative humidity is 51 percent and from Table C-2, the dew point is 10°C.

We find where those two values intersect and that value, 57, is the relative humidity of 57%.

Since the y-axis goes up by twos, if you get an odd number temperature reading (e.g. 13), you will need to approximate your reading based on the values that bracket it. (So if we had dry bulb of 13°C and difference of 4, we would approximate the relative humidity as about 58%).

Note that the dew point table at the bottom of your lab page is read in a similar fashion.