ATM OCN *(Meteorology)* **100**   **NAME:** _____

SUMMER 2004   *[Please Print!]*

E.J. Hopkins   **DATE DUE:** _____

HOMEWORK #3

1. ATMOSPHERIC HUMIDITY

PART A. SLING PSYCHROMETER

Use Tables 6.5 and 6.6 of your textbook (*The Psychrometric Tables*), to determine the dewpoint and relative humidity when the air (or dry-bulb) temperature is 15°C and the wet-bulb temperature is 12°C. *[Please include appropriate units!]*

Wet-bulb depression   = _____

Relative humidity   = _____

Dewpoint temperature   = _____

PART B. OTHER HUMIDITY MEASURES

Use the table for saturation vapor pressure (see below) to calculate the following:

a. If the air temperature were 76°F and the dewpoint were 56°F, what is the *relative humidity*?

Relative humidity = _____ .

b. If air temperature were 62°F and the relative humidity were 80%, what is the *dewpoint*?

Dewpoint temperature = _____ .

c. Which condition **a.** or **b.** would have more water vapor? ***Please explain!***

SATURATION VAPOR PRESSURE OVER LIQUID WATER
as a function of TEMPERATURE
[Source: *Smithsonian Meteorological Tables,* 1971]

TEMPERATURE [F°]	SAT. VAPOR PRESSURE [mb]	TEMPERATURE [F°]	SAT. VAPOR PRESSURE [mb]
20	3.71	62	18.96
22	4.04	64	20.34
24	4.40	66	21.81
26	4.78	68	23.37
28	5.18	70	25.03
30	5.63	72	26.79
32	6.11	74	28.66
34	6.62	76	30.64
36	7.17	78	32.73
38	7.76	80	34.96
40	8.39	82	37.31
42	9.06	84	39.80
44	9.79	86	42.43
46	10.56	88	45.21
48	11.39	90	48.15
50	12.27	92	51.26
52	13.22	94	54.53
54	14.22	96	57.99
56	15.30	98	61.63
58	16.44	100	65.47
60	17.66		

2. ADIABATIC PROCESSES - THE MOUNTAIN BARRIER

PART A. The initial ascent *(Clearly show your work for partial credit!)*

An air parcel is part of a Pacific maritime air mass moving toward the West Coast. The parcel, located just above the ocean surface, has an initial air temperature of 10°C and a dewpoint temperature of 5°C. This air parcel is forced to ascend the Coastal Range, with a 2000 m elevation.

A.1. How far up the west (windward) slope of the mountain range would the air have to be lifted in order for it to become saturated? (Assume no change in moisture content of the air, no physical phase changes and that the dewpoint remained constant).

_____ [Please include units!]

A.2. What is the air temperature at this level?

Air temperature = _____

A.3. What is the dewpoint temperature at this level?

Dewpoint temperature = _____

PART B. To the top

The air parcel continues up the 2000 meter mountain, condensing out moisture as clouds as it rises and all condensate falls to the ground as precipitation.

B.1. What is the air parcel temperature at the crest of the mountain (2000 m above sea level)? [Assume the average moist adiabatic lapse rate of 7°C per 1 km]

Air temperature = _____

B.2. What is the dewpoint of the parcel at the crest of the mountain?

Dewpoint temperature = _____

PART C: The descent.

The air parcel now moves down the east slope of the mountain, to a valley that has an elevation essentially at sea level.

C.1. What is the air parcel temperature in this valley? [Assume no physical phase changes in any residual moisture or clouds]

Air temperature = _____

C.2. What is the dewpoint temperature of the parcel in this valley?

Dewpoint temperature = _____

PART D: Comparison.

D.1. How has the parcel temperature changed from the start to the end?

Difference in air temperature = _____

D.2. How has the parcel dewpoint changed from the start to the end?

Difference in dewpoint = _____

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3. APPARENT TEMPERATURE

Using the tables of *Apparent Temperature Index* and *Heat Stress Hazards* in your text book (pages 132–133), determine the apparent temperatures for the following set of air temperatures and relative humidities. Indicate what human hazards are possible for these cases.

Air temperature [°F]	R.H. [%]	Apparent temperature [°F]	Hazard to humans
85°	20		
85°	70		
100°	50		
75°	10		

a. Under what condition(s) would the apparent temperature be less than the observed air temperature?

b. Does this situation appear reasonable? Why? Explain with personal examples.

c. How is heat lost most effectively from the human body on a hot summer day?

4. PRECIPITATION FORMATION THEORIES

a. Name two (2) *different* requirements for the ***collision-coalescence*** theory:

    1. _____.

    2. _____.

b. Name two (2) *different* requirements for the ***ice crystal*** (***Bergeron***) theory:

    1. _____.

    2. _____.

c. Why is the simple ***diffusion-condensation process*** not considered a plausible precipitation formation process?

d. By how many times does the volume of a typical cloud droplet (with a diameter of 20 micrometers) have to increase to form a typical raindrop (diameter of 2 millimeter)? *(**Please show your work for partial credit!**) (**Hint: 1 millimeter = 1000 micrometers**)*

5. PRECIPITATION TYPES

<u>**PART A**</u> Distinguish between *freezing rain* and *ice pellets***:**

    Freezing rain:

    Ice pellets:

<u>**PART B**</u> During the winter of 1995–96, Madison received four major snowstorms with total snowfall amounts for each storm totaling 4 inches or more. On 27 Nov. 1995, 7.6 inches of snow fell, with a liquid water equivalent of 1.33 inch. On 26 to 27 Jan 1996, 13.4 inches of snow fell, with a liquid water equivalent of 1.00 inch. Calculate the snow to liquid ratio (the number of inches of snow to every inch of liquid water equivalent, such as 10 to 1) for each storm.

    27 Nov. 1995   _____ .

    26 to 27 Jan. 1996   _____ .

    Which storm had the "fluffy stuff" (as compared with the heavy, wet snow with a high liquid content)?

    How do these ratios for the two storms compare with the typical 10 to 1 ratio often used as an estimate?

6. PRECIPITATION EXTREMES   *[Please include units where appropriate.]*

    Where is the greatest annual total precipitation in the United States?

    _____ .

    How much precipitation was observed at this locale?

    _____ .

    What was the greatest amount of rain that has been recorded in one day in the United States?

    _____ .

    Where was this daily record rainfall recorded?

    _____ .

    Approximately how long is the world record dry spell?

    _____ .

    What was the record amount of snow that has fallen in one day in the United States?

    _____ .

    Where was this daily record snowfall recorded?

    _____ .

    Where is the greatest annual total snow fall in the United States?

    _____ .

    How much snow fell at this station?

    _____ .