CHAPTER 27

# LAB ACTIVITY

## Dew Point and Relative Humidity

**27.19** Capacity of Air at 1000mb Pressure

| Temp °C | Capacity g/kg | Temp °C | Capacity g/kg |
|---|---|---|---|
| -10 | 1.8 | 13 | 9.5 |
| -9 | 1.9 | 14 | 10.1 |
| -8 | 2.1 | 15 | 10.8 |
| -7 | 2.3 | 16 | 11.6 |
| -6 | 2.5 | 17 | 12.3 |
| -5 | 2.6 | 18 | 13.2 |
| -4 | 2.9 | 19 | 14.0 |
| -3 | 3.1 | 20 | 15.0 |
| -2 | 3.3 | 21 | 15.9 |
| -1 | 3.6 | 22 | 17.0 |
| 0 | 3.8 | 23 | 18.1 |
| 1 | 4.1 | 24 | 19.2 |
| 2 | 4.4 | 25 | 20.4 |
| 3 | 4.8 | 26 | 21.7 |
| 4 | 5.1 | 27 | 23.1 |
| 5 | 5.5 | 28 | 24.6 |
| 6 | 5.9 | 29 | 26.1 |
| 7 | 6.3 | 30 | 27.7 |
| 8 | 6.8 | 31 | 29.4 |
| 9 | 7.3 | 32 | 31.2 |
| 10 | 7.8 | 33 | 33.1 |
| 11 | 8.3 | 34 | 35.1 |
| 12 | 8.9 | | |

Even above the hottest desert areas on Earth, there is water vapor in the air. Water vapor is the source of moisture for clouds and rain. Meteorologists measure both dew point and relative humidity to determine how much water vapor is in the air and to predict chances of precipitation.

Dew point is the temperature at which air is filled or saturated with water vapor. Relative humidity is the extent to which air is saturated with water vapor. When air cools below the dew point, water vapor in the air condenses.

In this lab, you will determine both dew point and relative humidity by using a capacity chart. You will then make and use a psychrometer to find relative humidity.

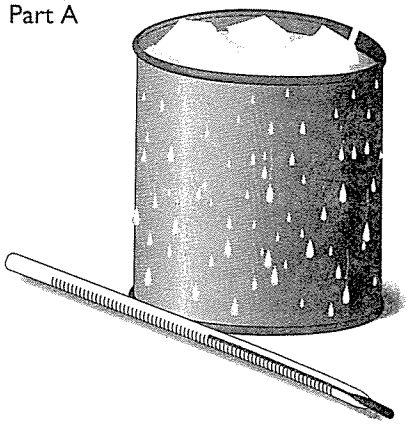
### Lab Skills and Objectives

- To **observe** dew formation, and **compute** relative humidity, using dew point method
- To **compute** relative humidity using psychrometer method
- To **compare** the methods for finding relative humidity

### Materials

- shiny metal cans
- stirring rod or coffee stirrer
- ice cubes or crushed ice
- celsius thermometer
- cloth strip, 2.5 cm x 10 cm
- small rubber bands or string
- spoon
- piece of paper
- water at room temperature

**27.18** Equipment set up for Part A



### Procedure

#### Part A—Dew Point Method

1. **Put on safety goggles.**
2. Use a thermometer to measure the classroom air temperature in celsius. Record the temperature in Data Table A.
3. Look at Figure 27.19. Find the capacity of air to hold water vapor for the temperature in your classroom. Record the capacity.
4. Fill the metal can halfway with water. Place a thermometer in the water. Add a small amount of ice.
5. Use a stirring rod to stir the water slowly.
   **CAUTION: Do not stir with the thermometer; it is fragile and may break.**
6. Watch for the first appearance of dew on the outside of the container. At the instant you see dew, record the dew point temperature in Data Table A.

7. To confirm the accuracy of your first dew point reading, repeat steps 3 through 5.
8. Average your two dew point values. Record the average in Data Table A.
9. Use the capacity chart in Figure 27.19 to determine the air capacity to hold water vapor for your average dew point temperature. Your value for capacity at the dew point equals the specific humidity of the air. Record this value in Data Table A.
10. Use your values and the formula in Data Table A to compute the relative humidity of air at room temperature. Record this value in Data Table A.

**Part B—Psychrometer Method**

11. Read the air temperature in the classroom again. In Data Table B, record this value as your dry-bulb temperature.
12. Construct a paper fan by folding accordian pleats into a piece of paper.
13. Wrap a strip of cloth around the bulb of the thermometer and fasten the cloth with a rubber band or string.
14. Dip the cloth-covered end of the thermometer into room-temperature water. This is now a wet-bulb thermometer.
15. Fan the wet-bulb thermometer briskly with the paper fan. The temperature will drop, then remain constant. Once the temperature becomes constant, read and record the wet-bulb temperature in Data Table B.
16. Subtract the wet-bulb temperature from the dry-bulb temperature and record this value in Data Table B.
17. Turn to the relative humidity table on page 501. Locate the dry-bulb temperature and the difference between the wet-bulb and dry-bulb readings. Determine the relative humidity. Record this value in Data Table B.
18. Answer the questions in *Analysis and Conclusions*.

## Analysis and Conclusions

1. Compare the two relative humidity values for the classroom air from Data Tables A and B. Are the two values the same or different? If the values differ, which value do you think will be more accurate? Explain your answer.
2. Suppose you are looking at clouds that have just formed on a summer afternoon. What do you know about the relative humidity of the air at the bottom of the cloud?
3. Imagine that, early one cool morning, you use a psychrometer outdoors and discover that the wet-bulb and dry-bulb values are the same.

   **a.** What conclusion can you draw about evaporation from the wet-bulb thermometer in this case?

   **b.** What conclusion can you draw about the relative humidity in this case?

   **c.** From your knowledge of relative humidity, would this be a good or bad day for hanging the laundry outdoors to dry? Explain your answer.

**Data Table A—Dew Point Method**

| | |
|---|---|
| 1. Temperature of classroom air (°C) | _____ |
| 2. Capacity of air at classroom air temperature (g/kg) | _____ |
| 3. Dew point from trial 1 (°C) | _____ |
| 4. Dew point from trial 2 (°C) | _____ |
| 5. Average dew point (°C) | _____ |
| 6. Specific humidity (capacity at dew point) (g/kg) | _____ |
| 7. Relative humidity = $\frac{\text{Specific humidity}}{\text{capacity}}$ (%) | _____ |

**Data Table B Psychrometer Method**

| | |
|---|---|
| 1. Temperature of classroom air (dry-bulb temperature) (°C) | _____ |
| 2. Wet-bulb temperature (°C) | _____ |
| 3. Difference between dry- and wet-bulb temperatures (°C) | _____ |
| 4. Relative humidity (%) | _____ |