Humidity Problems II

** All numbers should have units **
** Round to two decimal places **

1a. On a typical day in late June in Albuquerque, the temperature **outside** the house is 100°F. The mixing ratio is 3.0 g/kg. What is the relative humidity **outside**?

5.73%

1b. On the same day in June, the temperature **inside** the house is 70°F. The air inside is the same as the air outside – so the mixing ratio is the same as the previous problem. What is the relative humidity **inside**?

15.69%

1c. In the above problems, **why** are the relative humidities inside and outside different if the air inside and outside is exactly the same air?

The temperatures are different. Therefore, the maximum possible mixing ratios are different in each case.

2a. On the afternoon of July 1st, the temperature is 80°F and the Dew Point is 50°F. What is the relative humidity?

34.21%

2b. Later that same evening (July 1st), the night cools off to 55°F. What is the relative humidity at that point?

82.94%

2c. How cold would it need to get on July 1st to reach a relative humidity of 100%?

50°F

2d. If it did get down to the temperature you answered in 2c, what other process would you notice happening?

a. Dew b. Frost c. Rain d. Nothing

3. You breathe in a lung full of air. On which day would you be breathing in more water vapor?

a. Air with a reported dew point of 50°F
b. Air with a reported dew point of 40°F.
c. Not enough information to answer.

4. The dew point is reported as 25°F and the high temperature is 55°F. What, if anything, will be observed outside if the temperature dips to 20°F tonight?

a. Dew b. Frost c. Rain d. Nothing

5. The relative humidity is 33%. The temperature is 75°F.

a. What is the mixing ratio? [hint – write out the formula for relative humidity, solve for what you don't know]

7.51 g/kg

b. Approximate the dew point: __ between 40°F and 45°F – but closer to 45°F _____

6. Some air with a dewpoint of 20°F is sealed in an airtight container. The container is then warmed to a higher temperature. We don't know the starting and ending temperatures – only that the boxed was warmed.

a. How has the dew point of the air inside the container changed? Increase Decrease Stay the Same

b. How has the mixing ratio of the air inside the container changed? Increase Decrease Stay the Same

c. How has the relative humidity of the air inside the container changed? Increase Decrease Stay the Same

7. A parcel of air that is near the surface has a temperature of 80°F and has a dew point of 40°F. This parcel of air starts to move upward. As it moves upward, it expands and cools. Assume that this air does not mix with other air around it.

(circle answers)

a. Before the air begins to move, is the relative humidity above 100%, equal to 100%, or less than 100%?

b. As the air rises and cools, does the relative humidity increase, decrease, or stay the same?

c. As the air rises and cools, does the dew point increase, decrease, or stay the same? (we have to assume that the air has not cooled to the dew point yet)

d. What will the temperature of the air parcel be when the relative humidity reaches 100%? __40°F _____

8. You have a box of air that has a dew point of 40°F and a temperature of 70°F. You squirt a little bit of water into the box with a squirt gun, put the lid back on, and let it sit for an hour. Assume that the temperature remains a constant.

A. Will the dew point inside the box go up? Yes No NEI
B. Will the relative humidity inside the box go up? Yes No NEI
C. Will the mixing ratio inside the box go up? Yes No NEI

9. You hear two different accounts of the weather report from two different people who live in the same area. One says that she just heard on the local radio that the relative humidity today is 13%. The other says he heard this morning – on the same station - that the relative humidity was 45%. How could this be? Hint: they are both probably right. Why?

The weather reports were probably from different times of the day when the temperatures were different. The 45% was probably reported in the morning when it was colder, and the 13% was probably reported later in the day when it was warmer.

10. On Monday, the dew point is reported to be 50°F. On Tuesday, the dew point is reported to be 40°F. No other information is available. On which day would there be more water molecules in the air?

Monday Tuesday NEI

11. On Wednesday, the relative humidity is reported to be 50%. On Thursday, the relative humidity is reported to be 40%. No other information is available. On which day would there be more water molecules in the air?

Wednesday Thursday NEI

12. The air outside is stagnant and there is no wind. The ground is very dry and there is no standing water. So, it is very unlikely that there is any water being evaporated to the atmosphere outside. The temperature reaches a high of 70°F in the afternoon, and low of 45°F in the early morning. Dew or rain does not form during this 24-hr period.

a. Would you expect the mixing ratio of the air outside to change in a 24-hr period? Yes No NEI
b. Would you expect the dew point of the air outside to change in a 24-hr period? Yes No NEI
c. Would you expect the relative humidity of the air outside to change in a 24-hr period? Yes No NEI

Stamp of approval: _____

13. Throughout the day you keep checking the **dew point temperature**. You notice that the dew point keeps decreasing – in the morning it was 59°F, then by noon it was 52°F. By sunset it was down to 48°F. Which of the following statements must be true? (select all that apply)

a. The abundance of water molecules in the air has been increasing throughout the day.
b. The abundance of water molecules in the air has been decreasing throughout the day.
c. The air temperature has been increasing throughout the day.
d. The air temperature has been decreasing throughout the day.

14. Throughout the day you keep checking the **relative humidity**. You notice that the relative humidity keeps decreasing – in the morning it was 73%, then by noon it was 42%. By sunset it was down to 29%. Which **two** possibilities provide an explanation for these observations:

a. The abundance of water molecules in the air has been increasing throughout the day.
b. The abundance of water molecules in the air has been decreasing throughout the day.
c. The air temperature has been increasing throughout the day.
d. The air temperature has been decreasing throughout the day.

15. If the dew point of a parcel of air changes, the mixing ratio must also change. True or False?

16. If the mixing ratio of a parcel of air changes, the dew point must also change. True or False?

17. If the relative humidity of a parcel of air changes, the mixing ratio must also change. True or False?

18. If the relative humidity of a parcel of air changes, the dew point must also change. True or False?

19. Can you think of a situation where we would we have a very high relative humidity and yet very dry air? Explain how that might occur:

We would need a COLD day where dew point is close to the temperature. For example, if the outside temperature was 10F, then we know the air must be dry. If the dew point was 5F, then the Relative Humidity would be high though the air is dry.

20. When someone says to you that "the humidity is very high today" – why is that an ambiguous statement? There are at least two reasons I am looking for.

#1. We have several ways to describe humidity now: Mixing Ratio, Dew Point, and Relative Humidity. Which one is the person talking about? A high relative humidity doesn't necessarily mean a high dew point.

#2. A high Relative Humidity could be due to either high water in the atmosphere, low temperature, or some combination of both. Without more information, we don't know which is the case. A case of high Relative Humidity is ambiguous without more information.