Relative Humidity, Evaporation, and Latent Heat

Name: ______________________

#1. Determining Relative Humidity: Using room temperature water, cotton, string, and a thermometer, you will measure the relative humidity inside the classroom and then again outside in front of the building. Notice that you need to record degrees C and degrees F as you go along. Please do this in pairs.

Inside:

Dry bulb temperature (°C): ___________ Dry bulb temperature (°F): ___________

Wet Bulb Temperature (°C): ___________ Wet Bulb Temperature (°F): __________

Relative Humidity: _____
(from chart – use °C)

Outside:

Dry bulb temperature (°C): ___________ Dry bulb temperature (°F): ___________

Wet Bulb Temperature (°C): ___________ Wet Bulb Temperature (°F): __________

Relative Humidity: ______
(from chart – use °C)

#2. Determining Latent Heat: Using a similar setup as you did for the Relative Humidity experiments, experiment with rubbing alcohol and acetone (fingernail polish remover) to determine which substance is best at removing latent heat. Do this **outside**. As before, keep waving the soaked cotton around until the temperature bottoms out. Pour some of the acetone/rubbing alcohol into the glass beaker, and then soak your cotton from the beaker – otherwise your cotton will end up in the bottom of the bottle.

Rubbing Alcohol: Initial temp: ________ Final Temp: ________ ΔTemp = ____________
[For initial temp, use your thermometer to determine the temp of the liquid inside the bottle]

Acetone: Initial temp: ________ Final Temp: _______ ΔTemp = ____________
[For initial temp, use your thermometer to determine the temp of the liquid inside the bottle]

Water: Initial temp (°F): ________ Final Temp (°F): ________ ΔTemp = ____________
*[**you did this experiment already** – just measure the initial temperature of the water by putting your thermometer in it. The final temp is the outdoor wet bulb temp from question #1 above.]*

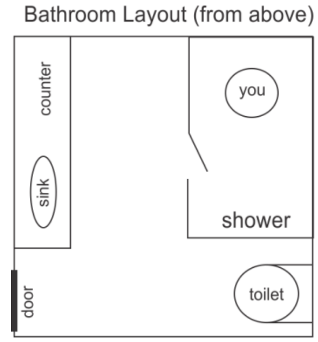
Which substance removed the **most latent heat** in today's atmospheric conditions? ___Acetone____

#3. Would your outdoor dog be more comfortable in Albuquerque with a temperature of 90°F and RH of 20% or in Houston with a temperature of 90°F and a RH of 50%? Albuquerque Houston Not Enough Info

#4. You are scheduled to run a marathon on your choice of three days. You'd like to pick the day that will be the most comfortable – this means that **your sweat will be the most effective** in cooling you. (calculations are required to answer this – please show your work)

Monday: Temp = 85°F; Dew Point = 50°F
Wednesday: Temp = 90°F; Dew Point = 40°F
Friday: Temp = 95°F; Dew Point = 35°F

#5. The layout for your bathroom is shown to the right. You have the bathroom door closed and are taking a shower. While you are taking a shower, the shower door is also closed. The temperature of the air inside your shower is 84°F. A thermometer on the counter is also showing 84°F. However, when you open the shower door, you suddenly feel colder. Why is this happening? Relate your answer to the relative humidity.



The relative humidity in the shower is probably 100% or very close to it. There is very little or no evaporation occurring while you are in the shower. The relative humidity in the rest of the bathroom is lower than 100%. When you step out of the shower into an environment of RH less than 100%, the evaporation rate is suddenly higher and thus noticeable. A higher evaporation rate means more thermal energy being removed from your body in the form of latent heat from evaporating water molecules. You feel this cooling effect when you step out of the shower.

#6. In Albuquerque many homes have "Swamp Coolers" [more officially called 'evaporative coolers']. They make cool air by blowing air through a moist pad (usually on the roof). Why do you suppose that one does not find any swamp coolers in the southeastern US? Be as specific as you can.

A swamp cooler is shaped like a cube that sits on the roof. The middle of the cube has a fan that sucks air in from outside, through the cube, and then into the house. The sides of the cube are covered with 'pads' which look like sponges. A water pump inside keeps these pads wet. So as the air moves through the wet pads, evaporation takes place and latent heat is removed. As air moves through this zone of evaporation, the air becomes cooler. The exact amount of cooling will depend on the evaporation rate, which in turn depends on the relative humidity. The relative humidity in Albuquerque and most of the western states is usually low in the summer, so we have a high evaporation rate. However, once you start moving to the east, the relative humidity increases substantially. Swamp coolers in the eastern states would do almost nothing because the relative humidity is too high. The high relative humidity would result in a low evaporation rate, which leads to a low rate of latent heat removal. Consequently, the swamp coolers would provide very little cooling in these regions with high relative humidity.

#7. Your body temperature is 98.6°F. If you were digging ditches on a day that was also 98.6°F, would your sweat cool you? Explain why or why not. Assume that the relative humidity is 50%.

The fact that the RH is 50% means that some evaporation is occurring. Evaporation removes latent heat from the ditch digger, so that person would feel some benefit from the evaporating sweat.

#8. June is a very hot month in Albuquerque, and the air is also very dry during this time. If you are a swimmer, you notice that outdoor pools are much colder than covered pools, even though the covered pool is not heated. The outdoor pools remain cold even though they are in the hot sun all day. Why does this happen? Why are the covered pools warmer even though they are not in the sun?

The relative humidity in New Mexico is very low in June. Pools in the open air will evaporate freely as the evaporation rate is very high. This evaporation removes latent heat from the water, resulting in cooler water. A cover on the pool prevents most evaporation, so this water will not be cooled from the removal of latent heat. Molecules that leave the covered cool cannot leave and eventually return to the pool, releasing the thermal energy back into the water.