1)

Since there are only TWO ways to change the relative humidity, there are only two physical processes that can generate fogs. A fog may form as a result of the air cooling to its dewpoint temperature, or it may form if water vapor is added to the air as liquid water evaporates into unsaturated air. When warm, moist air flows over a snow surface, as described in this problem, the relative humidity is increased as that air cools upon contact with the snow surface. The transport of the warm air northward is known as warm air *advection*. Consequently, *advection fog* is the result of the circumstances described in this problem.

2)

The relative humidity (RH) is defined as either

RH = mixing ratio / saturation mixing ratio
or
RH = vapor pressure / saturation vapor pressure.

In either expression, the ratio describe the actual amount of water vapor *relative* to the total possible amount at the given temperature and pressure. Thus, an RH value of 90% in January means simply that the air on such a day has 90% of the total possible water vapor it could have at the temperature and pressure on that day. The same is true regarding the RH value of 65% for the July day.

Since warm air has a greater capacity for water vapor than cold air, it is very likely that 90% capacity on a cold day means alot less actual water vapor than does 65% capacity on a hot July day. Thus, the actual vapor content, which can be measured by the absolute humidity, defined as

Absolute Humidity = mass of water vapor / volume of air that contains it

is almost certainly greater on the July day.

3)

In your home, upon stepping out of the shower, the dewpoint depression is 10. Upon stepping out of the pool at Bullhead City, AZ, the dewpoint depression is 42! This difference indicates that the air in Bullhead City is much drier (has a much lower relative humidity) than the air in your bathroom. Liquid water is covering your body in both cases but is much more readily evaporated in Bullhead City than in your bathroom because the air in Bullhead City is so much drier. When the liquid water evaporates it

cools your skin and therefore if it evaporates quickly (as in Bullhead City) it will result in a dramatic cooling of your skin. Thus, you would feel alot cooler in the Bullhead City case despite the higher air temperature.

EXTRA CREDIT:

The problem involves determining the VOLUME of water involved in covering the surface of the Earth with a 1" deep layer. We begin by calculating the surface area of the (nearly) spherical Earth. The surface area of a sphere is given by

$$Area = 4\pi R^2 = 4\pi(6{,}370{,}000 \; m)^2$$

We can express the radius of the Earth (a large number) in scientific notation as 6.37×10^6 m. When we do this, the surface area of the Earth becomes

$$Area = 4\pi(6.37 \times 10^6 \, m)^2 = 5.1 \times 10^{14} \; m^2$$

or just over 500 trillion square meters!! If we then multiply this AREA by the depth of the water (1" is equal to .0254 m) the we have the VOLUME of water involved.

$$Volume = Area \, x \, Depth = (5.1 \times 10^{14} \; m^2) \, x \, (.0254 \, m) = 1.29 \times 10^{13} \; m^3$$

or 12.9 trillion cubic meters. Now, since you know the density of liquid water, we just multiply this VOLUME by the density (which is mass/volume) to get the mass of water involved;

$$Mass = Volume \, x \, Density = (1.29 \times 10^{13} \; m^3) \, x \, (1000 \, kg/m^3) = 1.29 \times 10^{16} \; kg$$

Since a 1 kg mass weighs nearly 2.2 lbs, this translates to about 14 trillion tons of water!!