e. Sublimation: solid to gas or gas to solid = system must gain 680 cal of energy or lose 680 cal of energy respectively for transformation to occur
(1) e.g. dry ice sublimates to gaseous carbon dioxide with no intervening liquid phase

G. Basic Laws of Classical Physics

1. Conservation of Mass - mass is neither created nor destroyed
2. Conservation of Energy - energy is neither created nor destroyed
3. Newton's Second Law of Motion: F = ma (force is equal to mass x acceleration)

Example Conservation Equation in Hydrology

Total Water In = Total Water Out (for example in an aquifer or a watershed)

thus,

$$I - Q = \Delta S$$

where I = water into a system, Q = water flow out of a system, ΔS = change in storage of system

Example Problem: A reservoir is full to the brim and holds 10 km^3 of water. During the course of a given year, the reservoir receives 0.58 km^3 of water via rainfall. Meanwhile, a local city uses 2.3 km^3 of water, what is the net change in reservoir storage for the year?

Show all of your math work. $\Delta S = I - Q = 0.58 km^3 - 2.3 km^3 = -1.72 km^3$

NET LOSS OF $1.72\ km^3$

What is the absolute volume of water in storage at the reservoir after the year in question?

$10\ km^3 - 1.72\ km^3 = 8.28\ km^3$

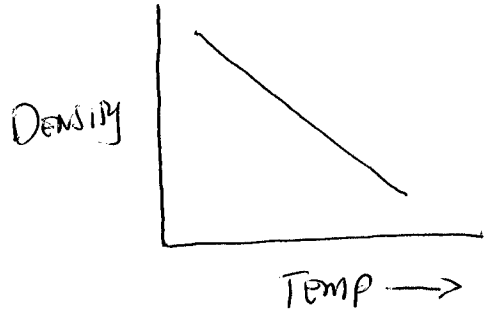
III. Physical Properties of Water

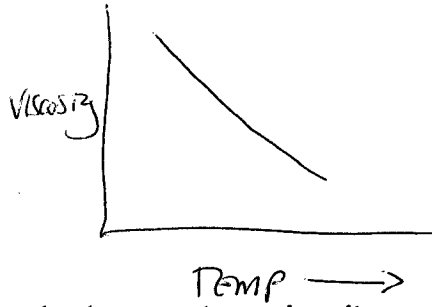
A. Can exist in all three physical states: liquid, solid (ice), and gas (water vapor)
B. Transformation Processes related to energy input and entropy of water: heating of water, > atomic activity of the water molecules, i.e. > vibrational energy of water atoms.

1. ICE ----------HEAT----- WATER-------HEAT -------WATER VAPOR
(<32 degrees) (32-212) (>212 degrees F)

In-Class Exercise - Examining the Physical Properties of Water

Draw two generalized graphs depicting the relationship between water temperature (x axis) vs. density (y-axis) and viscosity (y-axis).





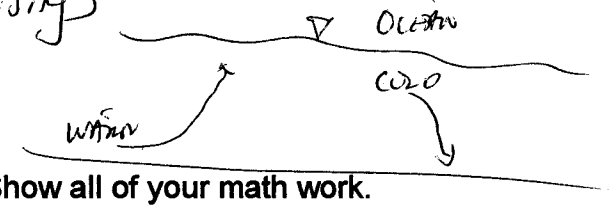
Describe the general relationships between water temperature, density, and viscosity.

AS TEMP >, DENSITY AND VISCOSITY <

DENSITY DECREASES AS VOLUME >

What effect will the temperature-density relationship have on ocean circulation? Discuss and draw a cross-sectional diagram to support your discussion.

- WARM WATER RISES (< DENSITY)
- COLD WATER SINKS (> DENSITY)



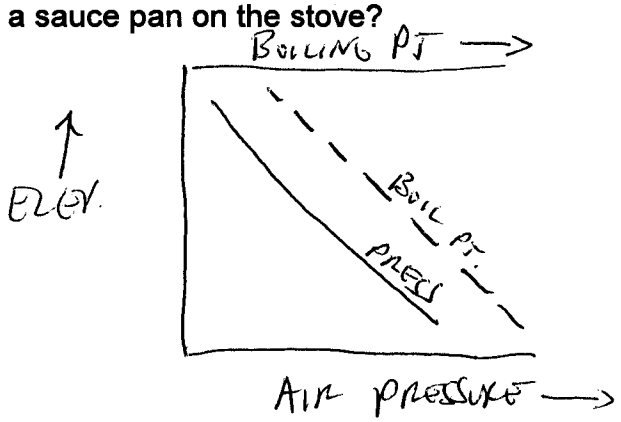
How many pounds will 500 gallons of water weigh? Show all of your math work.

$$(500\ \text{GAL})\left(\frac{1\ \text{FT}^3}{7.48\ \text{GAL}}\right)\left(\frac{62.4\ \text{lb}}{\text{FT}^3}\right) = 4171\ \text{lb}$$

If someone were to give you 3000 pounds of water, how many gallons would you have? How many cubic feet? Show all of your math work.

$$3000\ \text{lb}\left(\frac{1\ \text{FT}^3}{62.4\ \text{lb}}\right)\left(\frac{7.48\ \text{GAL}}{\text{FT}^3}\right) = 359.6\ \text{GAL} = 48.1\ \text{FT}^3$$

Draw a generalized graph of elevation (y-axis) vs. air pressure (x-axis). On the same graph, but in a different color (or line style), graph the boiling points of water (x-axis). What is the general relationship between elevation, air pressure, and the boiling point of water? Given these relations, what is the temperature of boiling water inside a pressure cooker, compared to that in a sauce pan on the stove?



AS ELEV <, AIR PRESS >,
BOILING PT >