

Due Wednesday, April 18, 2007

Questions for grading:

1. On a warm, humid, day the temperature of the air is 25 C, the pressure is 1.013×10^5 Pa, and the relative humidity is 75%.

(a) What proportion of the molecules in this air are water molecules?

(b) How much, roughly, would the temperature have to drop for the water to form droplets in the air? The temperature at which this happens is known as the dew point.

2. (Taken from Giancoli, Chapter 18, Question 19). You have a sample of water, and are able to control the pressure and temperature.

(a) Describe the phase changes you would see at 100 C if you reduced the pressure from 220 atm, and slowly lowered the pressure to 0.004 atm, keeping the temperature constant.

(b) Describe what happens with the same pressure range at a temperature of 0.00 C.

Most of the needed information can be read off Knight's fig. 16.4, Giancoli's fig. 18-6, or from my fig. 2-3, but remember that the triple point of water is at 0.01 C.

3. (a) A biological sample is packed in a thermos flask with some liquid nitrogen. The stopper of the flask fits loosely, so that the nitrogen can boil off until the gas remaining in the flask is pure nitrogen at atmospheric pressure. What is the temperature of the sample when this equilibrium situation is reached?

(b) If the same flask is packed loosely with dry ice (solid carbon dioxide) round the sample, again with a loosely fitting stopper, what is the temperature of the sample when all the air in the flask has been replaced by CO₂ solid and vapor at atmospheric pressure?

Explain your answers carefully.

4. Calculate the specific heat of a metal from the following data. A container made of the metal weighs 3.63 kg and contains 13.6 kg of water. A 1.81 kg piece of the same metal initially at a temperature of 177 C is dropped into the water. The container and water initially have a temperature of 15.6 C, and the final temperature of the entire system is 18.3 C.

Other questions:

5. The boiling point of water in Aspen, Colorado is 91 C. What is the atmospheric pressure?

What altitude would this correspond to in an isothermal atmosphere?

6. An energetic athlete dissipates all the energy in a diet of 4000 kcal per day. If he were to release this energy at a steady rate, how would this output compare with the energy output of a 100W bulb?

What do you think is your own **peak** output of work?

7. An iron ball drops onto a concrete floor from a height of 10 m. On the first rebound it rises to a height of 0.50 m. Assume that all of the macroscopic kinetic energy lost in the collision with the floor goes into the ball. The specific heat of iron is .50 J/gC°. During the collision (a) has heat been added to the ball? (b) Has work been done on it? (c) Has its internal energy changed? (d) How much has the temperature of the ball risen after the first collision?