Exam #4: Fluids and Thermodynamics

Name: _____

1) Explain why a ship made of steel with a density of 7850 kg/m^3 can float on water. Find the volume of a ship made of 10000 tons of steel if 20% of the ship is below the water.

2) A fountain is fed from a reservoir of water 2.0 m below the fountain which has a pressure of 140 kPa. A pipe from the reservoir leads up to the center of the fountain and shoots water at an angle of 85° from the horizontal. What is the maximum radius of the fountain so that no water spills out? How would your answer change if a large storm was coming through that caused a decrease in atmospheric pressure?

3) You get into a swimming pool that has rectangular dimensions of 9.700 m x 5.500 m x 1.800 m. If the pool is kept at a comfortable 72.00° F and is full of water and you weigh 82.00 kg, what is the equilibrium temperature? Note the specific heat of the human body is about the same as that of blood which is 3800.0 J/kg/°C. Be sure to carry out to more than four significant figures throughout your calculation but report only four significant figures in the final answer.

4) A star's life is defined as the time it takes to use its fuel. If E is the total energy the star can output and P is the power or the rate that it expels this energy then the lifetime of the star is

$$t = \frac{E}{P} \tag{1}$$

Let's compare two stars, one red star at 2000 K and the other a blue star at 10000 K. The radius of the blue star is 100 times that of a red star. Also the available energy for a blue star is 100 times larger than a red star. Which star will live longer? Calculate how much longer the longer star will live.

5)1.2 moles of O_2 is at a temperature of 23°C and is contained within a volume of 3.1 L.

a. What is the RMS speed of the particles.

b. What is the internal energy of the particles.

c. What is the average speed of the particles? How does this compare with part a)?

6) A large amount of ice (1.0 kg) at -1.0°C is placed 1.0 kg of water that is just about boiling at 99°C. Find the equilibrium temperature of the water and how much of the ice has melted.

7) Fig. 1 shows a typical phase diagram of a given material. Answer the following questions

a. What is the name for points B? What is its physical significance? (2 points)

b. What phase occurs to the right and below point B? How can you tell from the phase diagram? (2 points)

c. If I were at a temperature below point B at what pressure relative to point B would I need to be in order to vaporize? Explain. (2 points)

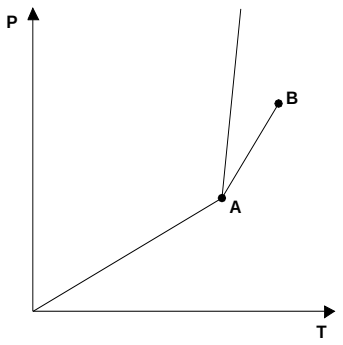

Figure 1: Typical phase diagram with line indicating the transitions between different phase of the system.