

- b) If this work could be converted into kinetic energy of this quantity of water, what would be the speed? Give your answer in m/s and in mph.
- c) If the work of part (a) were used to raise this quantity of water by a distance  $h$ , what would be that distance? Report the result in m and in ft.

**Problem 3.4:** a) Calculate the amount of work necessary for the reversible compression of 1 kg of steam from 3 bar to 7 bar. The compression is to take place in a cylinder fitted with a weightless piston at the constant temperature of 250 °C.

b) Calculate the amount of heat, if any, associated with this process.

**Problem 3.5:** a) Calculate the amount of work necessary for the reversible ~~compression~~ <sup>expansion</sup> of 1 kg of steam from 10 bar to 5 bar. The expansion is to take place in a cylinder fitted with a weightless piston at the constant temperature of 400 °C.

b) Calculate the amount of heat associated with this process.

**Problem 3.6:** A sealed tank contains saturated steam at 5 bar. The volume of the tank is 1 m<sup>3</sup>.

- a) Heat is added until the pressure in the tank pressure doubles. What is the final temperature?
- b) Calculate the necessary amount of heat.

**Problem 3.7:** A closed rigid tank contains saturated water vapor at 100 °C. The tank has a safety relief valve that will go off at 2.5 bar. How much heat can be added to the steam before the valve goes off?

**Problem 3.8:** A sealed pressure cooker contains steam at 5 bar and 200 °C. Subsequently, the cooker is cooled until the contents become saturated vapor.

- a) What is the final temperature?
- b) How much heat is removed during the cooling step?
- c) How much additional heat must be removed in order to completely condense the steam in the cooker and produce saturated liquid?

**Problem 3.9:** A sealed rigid tank is filled with 1 kg of steam at 200 °C and 10 bar.

- a) What is the volume of the tank?
- b) 0.5 kg of steam are removed from the tank. If the temperature remains at 200 °C, what is the new pressure in the tank?
- c) What is the state of the steam at the end of part b (e.g., liquid, vapor, saturated, superheated)?
- d) How much heat must be added to bring the pressure back to 10 bar?
- e) What is the temperature at the end of step (d)?