A water supply system leading up to and through a shower head consists of a hot water feed (T = 55 C), a cold water feed (T = 15 C), a mixer, and the shower head itself. The hot and cold water feed lines are Cu tubing having an inside diameter of 18.9 mm, as is the mixer outlet line that runs to the shower head. The shower head has 34 holes having diameters of 2.5 mm. The manufacturer indicates the shower flows 9.6 liters/min at a supply pressure of 550 kPa (that’s above atmospheric pressure).

- What is the water temperature[degC] when the mixer is set to pass 75% hot and 25% cold water?
- What are the cold and hot water velocities at that condition[m/s]? The mixer outlet water velocity[m/s]? The velocity of jets leaving the shower head[m/s]?

Suppose there was heat transfer, 100 W, from the mixing water through the mixer body and into the surrounding wall. Compute the new water temperature[degC] at the shower head.
Gear pumps are used when higher pressure liquids are desired. Note that positive displacement gear pumps produce flow, not a pressure rise. The pressure rise is the result of a restriction at, or downstream of, the pump exit. This understanding leads the following: when operating with water and a pressure difference of 7 bar, a pump operating at 1750 rpm will flow about 26 litres/min (LPM) and require a little over 1.1 hp (~0.843 kW).

From the example above, you are to compute the flow rate (litres/min) and power (transform to kW) for oil being pumped at 900 rpm while supplying 10 bar pressure. Also compute the pump efficiency, defined as the increase in oil energy divided by the required power.
1 kg/s of air at 35 C and 1 bar enters a duct. A 10 g/s water spray (20 C, sat liq) enters the duct parallel to the air. At the duct exit all the water has evaporated so is a saturated vapor.

What is the new air (and water) temperature [degC]? Assume there is no stray heat transfer.