DO NOT WRITE ON THE BLUE TABLES. RETURN THE BLUE TABLES WITH YOUR EXAM. DO NOT STAPLE THE EXAM SHEETS TOGETHER. Put your answers on the same sheet as the question, Use at least 5 digits in your computations and answers where possible. You must give the units of your answers. You must write clearly. Encircle the right answer number in multiple choice. To correct, erase the wrong circle as well as you can and encircle the corrected answer number twice. Best possible answer for multiple choice. For questions asking a number, putting the clear correct formula(s) below the question might result in partial credit even if the answer is wrong. *Not following those requirements will result in reduced or no credit.*

1. (5%) If you isothermally increase the pressure of saturated liquid a bit, it turns into
   1. compressed liquid.
   2. 2 phase.
   3. superheated vapor.

2. (5%) Assuming the density of water at 25°C and standard atmospheric pressure, if you go down 500 m into the ocean, the pressure outside your submarine is 4990 kPa. The gauge pressure inside your submarine is then -4888.6 kPa.

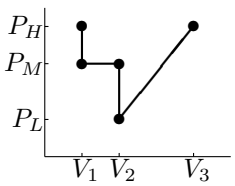
3. (5%) Given tables for the substance, what would be enough information to determine the volume:
   1. v and m
   2. v and P.
   3. v and x

4. (5%) A substance is held in a cylinder with a 2 cm^2 cross-sectional area below a 4 kg piston. If the atmospheric pressure is 100 kPa, the pressure inside the substance is 296.13 kPa.

5. (5%) 5 kg of helium contains 1.2491 kmol.

6. (5%) If the atmospheric pressure is 75 kPa, a thermometer inserted in a pot of boiling water will read 91.77 °C.

7. (5%) Write the expression for the total work done in the shown process, in terms of V_1, V_2, V_3, P_L, P_M, and P_H. Use the standard formulae for each subprocess.



$0 + P_M(V_2 - V_1) + 0 + \frac{1}{2}(P_L + P_H)(V_3 - V_2)$.

8. (33%) A steel container contains 3 kg of water at 750 kPa and 0.05 m^3/kg. Then the water is heated until the pressure becomes 5,000 kPa.

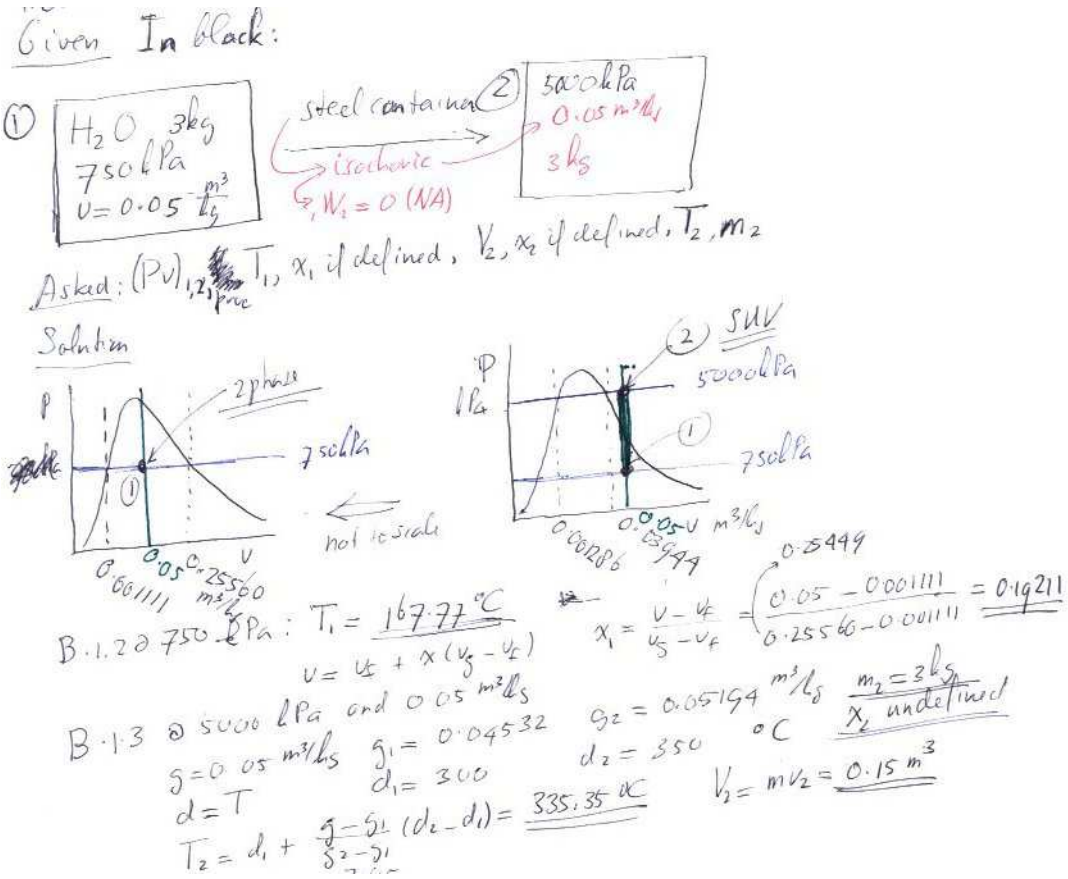
   (a) Construct the initial and final phases of the water in two *separate* very neat Pv-diagrams, marking all lines and points used to do it with their values. State the phases. Do not put more info in the diagrams than is needed to construct the phase.

   (b) Show the process as a fat line in the diagram for the final phase.

   (c) Find the initial temperature and quality if defined.

   (d) Find the final temperature, mass, volume, and quality, if defined.

   You must show the derivations and reasoning completely and correctly for full credit. You must give simplified units for your answers. Most accurate procedure only unless stated otherwise. Use at least 5 significant digits in your computations and answers. *Give the source of every number.*



9. (32%) A piston-cylinder combination contains 3 kg of neon at 20°C in an initial volume of 0.7 m^3. Then the neon is compressed until the pressure is 800 kPa in an isothermal process.

   (a) What are the final temperature and volume?

   (b) What is the work done by the neon in the process?

   (c) Do you expect the neon to be a good ideal gas under the given conditions? Discuss both criteria, then give your final conclusion

   (d) Show the process and work graphically in a very neat PV diagram.

   You must show the derivations and reasoning completely and correctly for full credit. You must give simplified units for your answers. Most accurate procedure only unless stated otherwise. Use at least 5 significant digits in your computations and answers. *Give the source of every number.*