Water & Steam Properties – Problem-Solving Applications Worksheet

This worksheet focuses on real-life and engineering applications of water and steam thermodynamic and transport properties. Students should perform hand calculations using tables or handbooks. Calculators may be used for verification.

Part A – Everyday & Household Applications

1. Hot Shower: Water is heated from 8 °C to 40 °C at a flow rate of 2.0 gallons per minute. Determine the required heat input rate.
2. Electric Kettle: 1.5 kg of water is heated from 20 °C to 95 °C using a 1.8 kW heater. Determine the heating time.
3. Cooking Water: Water is heated from 25 °C to 100 °C at atmospheric pressure. Explain why temperature remains constant during boiling.
4. Cold Storage Leak: A pipe carrying water at 5 °C is exposed to –5 °C ambient air. Explain the role of thermal conductivity and freezing risk.
5. Hot Water Tank: A 200 L tank contains water at 60 °C. Determine stored thermal energy relative to 20 °C.

Part B – HVAC & Building Systems

6 Radiator Heating: Water enters a radiator at 80 °C and exits at 60 °C with a mass flow rate of 0.05 kg/s. Determine the heat transfer rate.

7 Chilled Water Loop: Water flows from 7 °C to 12 °C in an air-handling unit. Explain why Cp is important.

8 Pumping Power: Explain how viscosity affects pressure losses in water piping systems.

9 Cooling Tower Makeup: Explain why evaporation causes cooling and increases entropy.

10 Hot Water Mixing: Hot water at 60 °C is mixed with cold water at 15 °C to produce 40 °C water. Determine the mixing ratio.

Part C – Industrial & Power Applications

11 Boiler Feedwater Heating: Feedwater enters a boiler at 120 °C and leaves as saturated vapor at 1 MPa. Determine the total heat added.

12 Steam Turbine Inlet: Steam enters a turbine at 3 MPa and 450 °C. Explain why superheated steam is preferred.

13 Condenser Operation: Steam enters a condenser at 0.01 MPa. Explain large heat rejection with small temperature change.

14 Throttling Valve: Steam expands from 5 MPa to 0.5 MPa. Explain constant enthalpy behavior.

15 Steam Quality: Wet steam with quality x = 0.85 enters a heat exchanger. Explain design implications.

Part D – Transport & Safety Considerations

16 Steam Pipeline: Explain why insulation is required considering thermal conductivity and viscosity.

17 Water Hammer: Explain why density and compressibility affect pressure surges.

18 Fire Protection Systems: Explain why water is suitable for fire suppression systems.

19 Heat Exchanger Selection: Compare water and steam as heating media.

20 Engineering Judgment: Explain why understanding property trends is critical when using software tools.