

ME 201

Thermodynamics

Homework #2 Solutions

Explain whether the following situations and should be modeled as closed systems, control volume systems, or transient systems.

1. Hot Water Heater
2. Refrigerator
3. Washing Machine
4. Catalytic Converter in an automobile
5. Oven
6. Fire inside a room
7. Jet Aircraft Engine

Solution: Depending on the student's description of the process associated with the devices many of these can be classified as any one of the three different types of systems. Each device is worth 2 points. Here are my most probable choices.

1. Hot Water Heater: When hot water is being used there is a flow of water out of the heater, but an equal flow rate of cold water enters to replace the removed water, so it is most probably a control volume system.
2. Refrigerator: If we consider the situation where food is just cooling inside the refrigerator, then there is no mass flow in or out of the system, so it is most probably a closed system.
3. Washing Machine: If we consider the machine as it is filling up prior to the agitation cycle, then we have one inflow, no outflows, and accumulation of mass in the system, so it is most probably a transient system.

4. Catalytic Converter in an automobile: We consider that we have engine exhaust flowing into the catalytic converter at the same rate that it flows out, so it is most probably a control volume system.
5. Oven: During the cooking the door is closed and no mass enters or leaves the oven, so it is most probably a closed system.
6. Fire inside a room: If we consider a raging fire in a room that already has blown out windows, then we can imagine that we have mass inflows and mass outflows, and mass accumulation or depletion, so it is most probably a transient system.
7. Jet Aircraft Engine: In steady operation we have air and fuel enter the engine and combustion gases leave at the flow rates, so it is most probably a control volume system.