PART B. Mapping Stock and Flow Networks

A manufacturing plant such as an oil refinery or assembly line has many thousands of machines and tools that require maintenance. The goal of maintenance is to maximize equipment availability (up time) while keeping maintenance costs low. Consider all the pumps in a chemical manufacturing plant. A typical plant might have several thousand pumps. Pumps are either running, in working condition and available to run if needed, broken down and awaiting repair, under repair, or taken down for preventive maintenance. Map the stock and flow structure relating these various states.

PART D. Modeling Goal-Seeking Processes

HVAC system maintains constant temperature of the room. At some point in time, due to the peak load in the grid, the electricity goes out and the temperature in the room starts rising until it reaches the outside level. Consider for simplicity that outside temperature is constant and equal to 90F. Waiting for utility company to fix the blackout, people begin to record the temperature in the room.

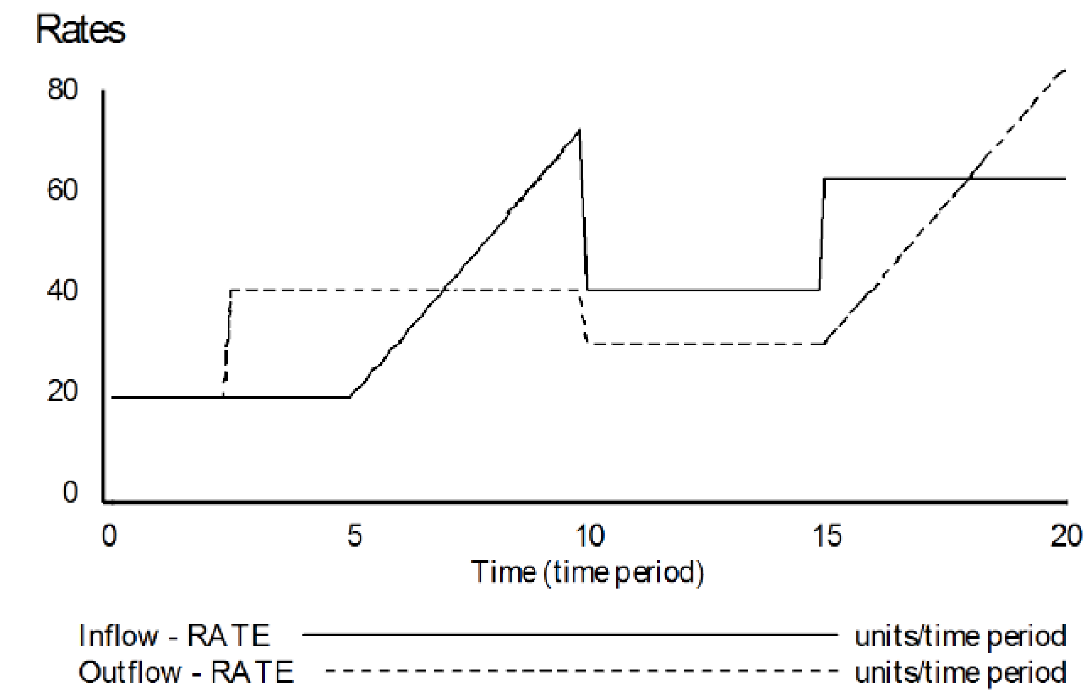
Time after electricity went out, hr	Temperature inside the room, F
0	70
10	80
20	85

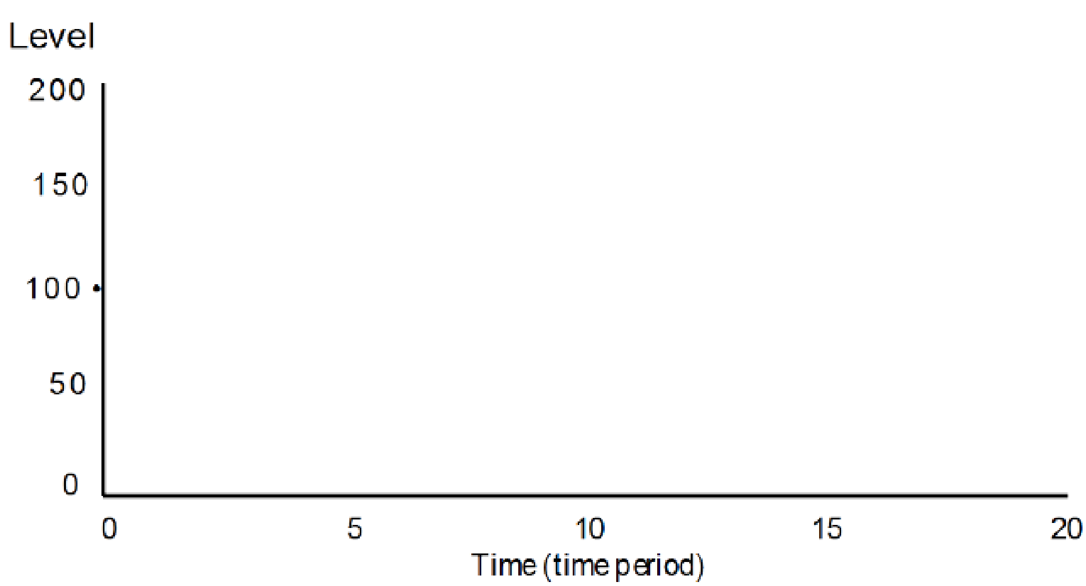
What information can you get from this table? Hint: think about half-life.

1) Build a simple Vensim model simulating the process of increasing temperature in the room following exponential decay process.
2) Using the same model, predict what would happen to the same room in wintertime if the heating were broken. Assume initial room temperature is 70F and the outside temperature is constant and is 30F. In how many hours would the room temperature reach 50F?

PART C: Dynamics of Accumulation

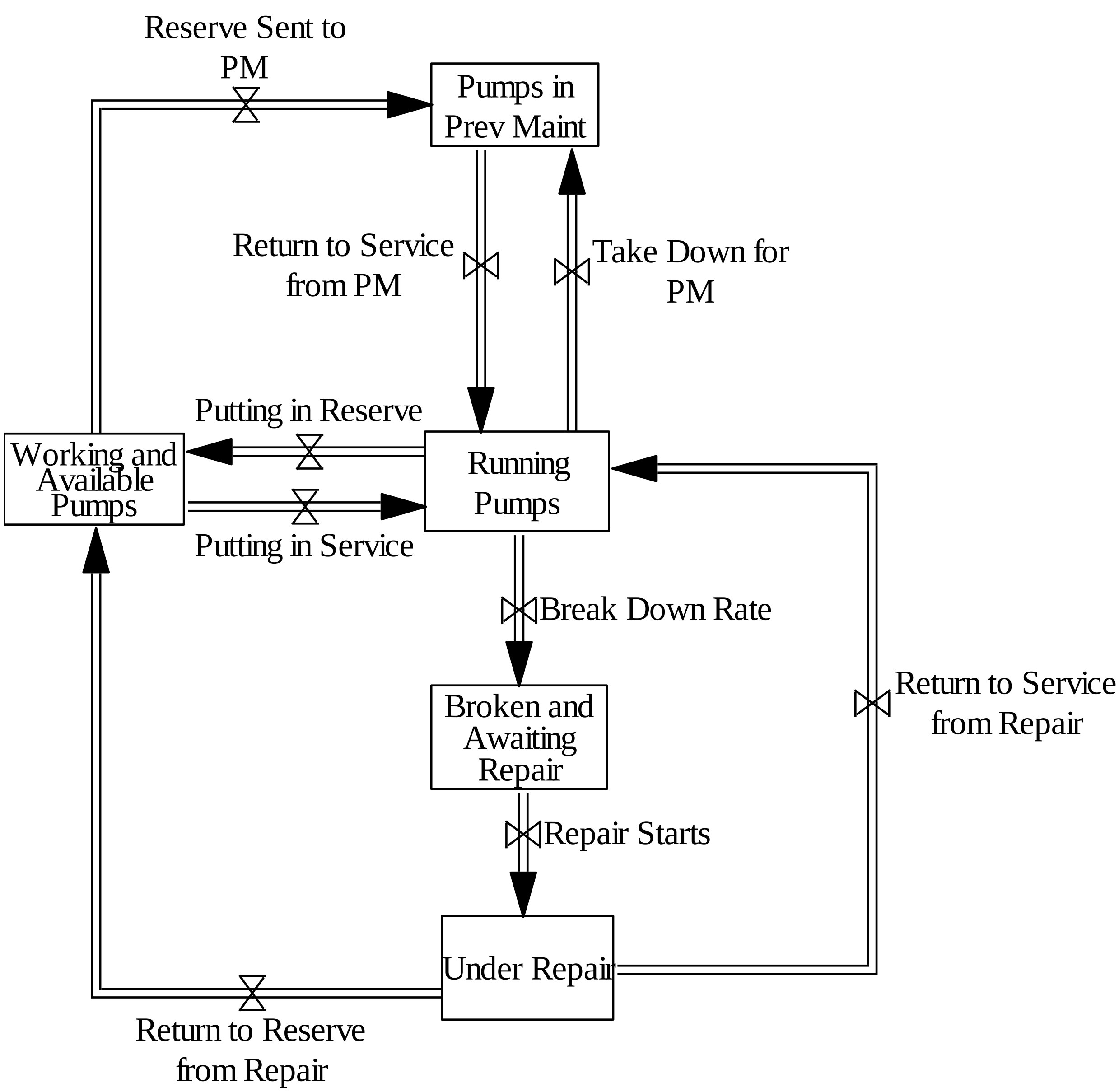
Graphically integrate the inflow and outflow rates: Draw the behavior of the stock called Level, given the rates Inflow and Outflow. Provide a short explanation for the behavior you draw.



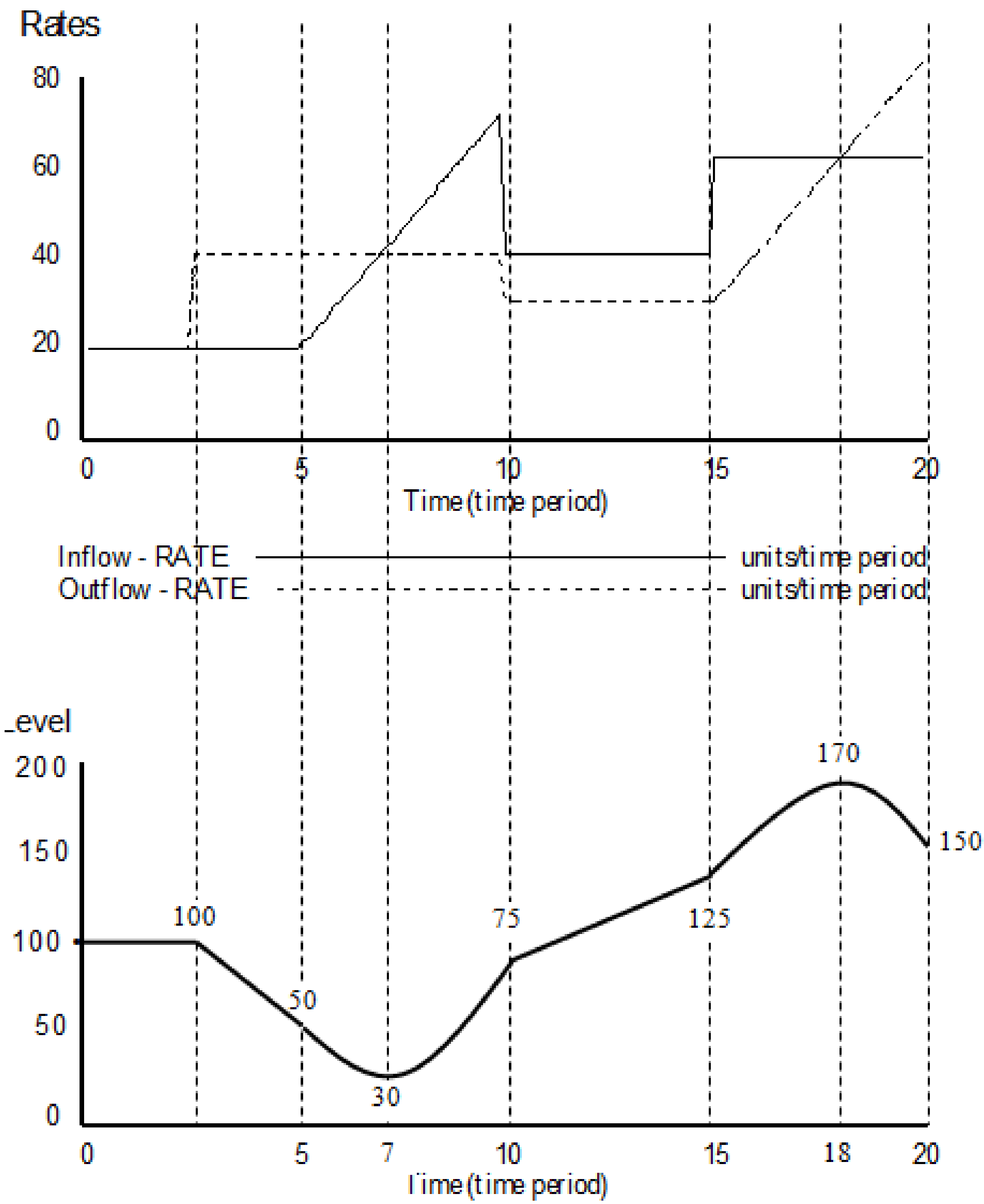


PART B SOLUTION:

Pumps are either running, in working condition and available to run if needed, broken down and awaiting repair, under repair, or taken down for preventive maintenance.



PART C SOLUTION:



PART D. SOLUTION

Half-life of the temperature increase is 10 hours (from the table, as initial gap was 20F and half of it was closed in 10 hours, second line is confirmation of this). We know that

$$t_{1/2} = \ln(2) * AT = 0.7 * AT \xrightarrow{yields} AT = \frac{t_{1/2}}{0.7}$$