McNewton's Coffee



Your team has been called in to solve a problem encountered by a fast food restaurant. They believe that their coffee should be brewed at 170°F. However, at that temperature it is too hot to drink, and a customer who accidentally spills the coffee might receive third-degree burns.

What they need is a special container that will heat the water from 170°, brew the coffee at that temperature, then

cool it quickly to a drinkable temperature, say 140°F, and hold it there, at least keep it at or above 120°F for a reasonable period of time without further cooking. To cool down the coffee, three companies have submitted proposals with these specifications.

(a) The CentiKeeper Company has a container that will reduce the temperature of a liquid from 200°F to 100°F in 90 minutes by maintaining a constant temperature of 70°F.

(b) The TempControl Company has a container that will reduce the temperature of a liquid from 200°F to 110°F in 60 minutes by maintaining a constant temperature of 60°F.

(c) The Hot'n'Cold, Inc., has a container that will reduce the temperature of a liquid from 210°F to 90°F in 30 minutes by maintaining a constant temperature of 50°F

Your job is to make a recommendation as to which container to purchase. For this you will need Newton's Law of Cooling which follows: $u(t) = T + (u_0 - T)e^{kt}$, k < 0

In this formula, T represents the temperature of the surrounding medium, u_0 is the initial temperature of the heated object, t is the length of time in minutes, k is a negative constant, and u represents the temperature at time t.

- 1. Use Newton's Law of Cooling to find the constant k of the formula for each container
- 2. Sketch a graph of each relation
- 3. How long does it take each container to lower the coffee from 170°F to 140°F?
- 4. How long will the coffee temperature remain between 120°F and 140°F?
- 5. On the basis of this information, which company should get the contract with McNewton's? Defend your answer.