

Newton's Law of Cooling Problems

1. Mr. Body has been found dead at 8:05 a.m. in the lake (where the temperature is 70°F). His temperature at that time is found to be 94°F . Three hours later, the police allow Mr. Body's body to be taken away by the coroner, who finds Mr. Body's temperature to be 81°F . Medical records indicate that Mr. Body's normal body temperature is 99°F . When did Mr. Body die?
2. A mug of hot water whose initial temperature is 200°F is placed in a 68°F room. After 10 minutes the temperature of the water is 120°F . What will the temperature of the water be at the end of class (i.e., after 45 minutes)?
3. Suppose we are preparing a lovely Canard `a l'Orange (roast duck with orange sauce). We first take our duck out of a 36°F refrigerator and place it in a 350°F oven to roast. After 10 minutes the internal temperature is 53°F . If we want to roast the duck until just under well-done (about 170°F internally), when will it be ready?
4. A cake is removed from a 180°F oven and placed in a 70°F room. 3 minutes later it has cooled to 160°F .
 - (a) What is its temperature after 20 minutes?
 - (b) How long will it take for the cake to cool to 90°F ?
5. A small metal bar whose temperature is 30°C is dropped into a container of 75°C water. After 1 second the temperature of the bar has increased 1°C .
 - (a) How long will it take for the temperature of the bar to reach 70°C ?
 - (b) 74°C ?
6. A 40°F roast is cooked in a 350°F oven. After 2 hours, the temperature of the roast is 125°F . The roast is done when the internal temperature reaches 165°F . When will the roast be done?
7. A thermometer is taken from a room that is 20°C to the outdoors where the temperature is 5°C . After one minute, the thermometer reads 12°C .
 - (a) What will the reading on the thermometer be after one more minute?
 - (b) When will the thermometer read 6°C ?
8. At midnight, with the temperature inside your house at 70°F and the temperature outside at 20°F , your furnace breaks down. Two hours later, the temperature in your house has fallen to 50°F . Assume that the outside temperature remains constant at 20°F . At what time will the inside temperature of your house reach 40°F ?
9. (Challenge Problem) A thermometer is taken from an inside room to the outdoors, where the air temperature is 5°F . After 1 minute the thermometer reads 55°F , and after 5 minutes it reads 30°F . What was the temperature of the room?

Answers

1. 7:21 am
2. 70 °F
3. 100 minutes
4. a. 98.87 °F
b. 25.49 minutes
5. a. 97.77 seconds
b. 169.39 seconds
6. 3.22 hours after going in the oven.
7. a. 8.3°C
b. 3.5 minutes
8. 3:30 am
9. 64.46 °F