Temperature oscillations inside a refrigerator

You have a refrigerator installed in your kitchen. When air temperature in the kitchen is kept constant at $T_{air} = 20^\circ C$, and the refrigerator is turned on, you find that the temperature inside is $10^\circ C$.

In reality, air temperature in your kitchen oscillates with a period of $\tau = 24$ hours as day turns into night. Its time dependence is given by

$$T_{air}(t) = 20 - 5 \sin(2\pi t/\tau) ^\circ C.$$ 

With variable air temperature, the temperature inside the refrigerator changes as well. In particular, when the refrigerator is turned off, your measurements show that the maximum temperature inside is $22^\circ C$.

You now do the following experiment. Initially, the refrigerator is turned off, its door is open, and temperature inside equals the air temperature. At $t = 0$ you close the door and turn the refrigerator on. Find the wait time before the temperature inside reaches $10^\circ C$ for the first time. The answer should be given in hours, and you can use analytic and/or numeric techniques to find it.