20 A sign says:

Using variables like t for time of day and d for day of week, write a binary expression that says when there is no parking.

After trying the question, scroll down to the solution.

§ My first attempt is

$$(7\text{am} \le t < 9\text{am} \ \vee \ 4\text{pm} \le t < 6\text{pm}) \ \wedge \ \text{Mon} \le d \le \text{Fri}$$

For the time t, it is not important whether we use $<$ or $\le$. But the problem is that the days cycle. Saturday comes after the preceding Monday and before the following Friday. Likewise the times of day cycle, so that midnight comes after the preceding 4pm and before the following 6pm. So I will represent a time as a string of length 4:

year; *week*; *day*; *time*

I need the weeks to start on a Saturday or a Sunday or a Monday; let's say Monday, so

Mon < Tue < Wed < Thu < Fri < Sat < Sun

Now my answer is

$$\begin{aligned} & y; w; \text{Mon}; \text{noon} \le y; w; d; \text{noon} \le y; w; \text{Fri}; \text{noon} \\ \wedge \quad & (\quad y; w; d; 7\text{am} \le y; w; d; t < y; w; d; 9\text{am} \\ \vee \quad & \quad y; w; d; 4\text{pm} \le y; w; d; t < y; w; d; 6\text{pm}) \end{aligned}$$

In any given year y and week w, if the day d is between Mon and Fri, and on that day the time t is between 7am and 9am or between 4pm and 6pm, then there is no parking.

Even this is not correct because a year might not start on Monday and might not end on a Sunday. Let's say that in any year, week 1 (it hurts to number from 1, but that's what everyone else does) starts on the first Monday of the year. And the last week of the year starts on the last Monday of the year and continues until Sunday, which might be in the following year. For example, in 2019, week 52 starts on Monday December 30. So Monday December 30 through Sunday January 5 are all part of year 2019 week 52. Now my previous answer is correct (I think).