# Problems October 4, 2020

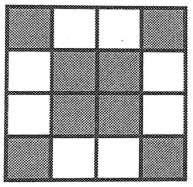
A *magic square* is a square filled with numbers so that the sum in every row, every column, and each diagonal is the same number ("magic number"). For example, today we came up with this magic $3 \times 3$ square with numbers $1, \ldots, 9$:

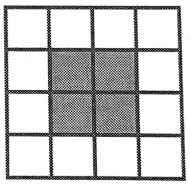
$$\begin{array}{ccc} 8 & 3 & 4 \\ 1 & 5 & 9 \\ 6 & 7 & 2 \end{array}$$

For this square the magic number is 15. Here are a couple of problems about $4 \times 4$ magic squares:

**1**. (a) During the meeting today we showed that the sum of the numbers in the shaded cells in a magic square on the left is equal to twice the magic number. (This is just because the shaded cells are precisely along the two diagonals.)

(b) Show that the sum of the numbers in the shaded cells in a magic square on the right (the $2 \times 2$ central square) is equal to the magic number of this magic square.

a) 

b) 

**2**. The $4 \times 4$ magic square was filled with the numbers from $1$ to $16$. Some of these numbers were erased. Restore the square:

| | | | |
|---|---|---|---|
| 4 | 15 | | 5 |
| | | 8 | |
| 7 | | | |