Elsa's Equations

Elsa, the cafeteria manager, likes to keep track of the things she can count or measure in the cafeteria. She hopes this will help her improve the efficiency of the cafeteria. To remind herself to keep track of important quantities, she has made a table of variables and descriptions of the things she wants to record. Here is the table of things she has decided to keep track of.

Symbol	**Meaning** (description of what the symbol means in context)
S	Number of students that buy lunch in the salad line
W	Number of students that buy lunch in the sandwich line
P	Number of students that buy lunch in the pizza line
F	Number of food servers in the cafeteria
M_t	Number of minutes it takes to serve lunch to all students
C	Number of classes in the school
P_l	Price per lunch
A	
R	
T	
D_f	
M	

Elsa has written the following equation to describe a cafeteria relationship that seems meaningful to her. She has introduced a new variable A to describe the relationship.

$$A = \frac{S + W + P}{C}$$

1. What does A represent in term of the school and cafeteria? Record this information in the table above.

2. Using what you know about manipulating equations, solve this equation for S.

3. Does your expression for S make sense in terms of the meanings of the other variables? Why or why not?

Here is another one of Elsa's equations.

$$R = P_L(S + W + P)$$

4. What does R represent in terms of the school and the cafeteria? Record this information in the table above.

5. Solve this equation for $\boldsymbol{P_L}$.

6. Does your expression for $\boldsymbol{P_L}$ make sense in terms of the meanings of the other variables? Why or why not?

7. Elsa notices that she uses the expression S+W+P a lot in writing other expressions. She decides to represent this expression using the variable T, so $T = S + W + P$. What does T represent in terms of the school and cafeteria? Record this information in the table above.

Elsa is having a meeting with the staff members who work in the lunchroom. She has created a couple of new equations for the food servers.

$$D_F = \frac{T \times P_L}{F} \qquad\qquad M = \frac{M_T}{T}$$

8. a. What does D_F represent in terms of the school and the cafeteria? Record this information in the table above.

   b. Solve this equation for P_L . Describe why your solution makes sense in terms of the other variables.

9. a. What does *M* represent in terms of the school and the cafeteria? Record this information in the table above.

   b. Solve this equation for *T*. Describe why your solution makes sense in terms of the other variables.

10. One of the staff members suggests that they need to write expressions for each of the following. Using the variables in the table, what would these expressions look like?

    a. The average number of students served each minute

    b. The average number of minutes students wait in the pizza line