

Remember that when working with equations that whatever you do to one side, you must do to the other side.

Also, when working with unknown quantities, **use variables.**

When solving applied problems, it might be helpful to ask yourself questions to help set-up equations that you can solve. Examples of questions you could ask yourself are given in red below. Keep in mind that the questions below in red will not appear in the homework, or on quizzes and exams; these are simply questions that you should be asking yourself when you see problems like these in order to help get equations that you can solve.

**Examples:**

1. A subway ride is \$2.75 per ride. Write an equation for the cost  $C$  of riding the subway to and from work, for  $x$  working days.

*What is the cost of a subway ride?*

*How many subway rides will someone take to get to and from work?*

*Number of working days? (if you don't know, assign a variable)*

*What is the total cost of riding the subway? (write an equation):  
(cost of a subway ride)  $\cdot$  (number of subway rides per day)  $\cdot$  (number of working days) = total cost*

- a. A commuter can purchase an unlimited-ride MetroCard for \$89 per month. What is the minimum number of working days the commuter would need to have to save money by buying the MetroCard?

2. A salesperson makes \$35,000 a year plus 4% commission on all sales. They are offered a commission only sales job that pays 11% commission on all sales, with no base salary.

- a. Write a model representing the salesperson's pay  $P_1$  for a given year, based on their total sales  $x$ .

*How much stuff do they sell, in dollars? (if you don't know, assign a variable to represent this value)*

**$x$**

*How much commission do they earn on their sales?*

**0.04**

*How much is their base salary?*

**35,000**

*What is the equation?*

$$P_1 = 35,000 + 0.04x$$

- b. Write a model representing what the salesperson's pay would be for the commission only job they are offered. Use  $P_2$  to represent pay for a given year, based on their total sales  $x$ .

*How much stuff do they sell, in dollars? (if you don't know, assign a variable to represent this value)*

**$x$**

*How much commission do they earn on their sales?*

**0.11**

*How much is their base salary?*

**0**

*What is the equation?*

$$P_2 = 0.11x$$

- c. What amount of sales (in dollars) will make the pay for the two sales jobs the same?

$$P_1 = P_2$$

$$35,000 + 0.04x = 0.11x$$

3. A large solar heating panel requires a fluid that is 50% antifreeze. The fluid comes in either a 75% solution or a 10% solution. If you have 200 gallons of the 75% solution on hand, how many gallons of the 10% solution would need to be mixed with it to get the 50% antifreeze solution that is needed?

*How much of the 10% solution is needed? (if you don't know, assign a variable to represent this value)*

*How much of that will be actual antifreeze?*

*How much of the 75% solution will be used? (if you don't know, assign a variable to represent this value)*

*How much of that will be actual antifreeze?*

*How much of the 50% solution will we have?*

*How much of that will be actual antifreeze?*

*Write an equation.*

4. An electrician and his apprentice both work 10 hours on a particular job. If they bill a customer \$735 for labor on a job, and the apprentice pay rate is  $\frac{1}{4}$  that of the electrician, how much does **each** make per hour?

*How much does the electrician make per hour?*

*How many hours did the electrician work?*

*How much does the apprentice make per hour?*

*How many hours did the apprentice work?*

*How much did the pair make together? (write an equation;  
\$ for electrician + \$ for apprentice = total \$)*

5. When a popular band played at Elliott Hall, the box-office receipts totaled \$120,000. Non-student tickets cost 3 times more than student tickets. If 4,000 students attended the concert, as well as 2,000 non-students, what was the ticket charge for **each**?

*How much did student tickets cost ?*

$x$  dollars

*How many students attended the concert?*

4,000 students

*How much did non-student tickets cost ?*

$3x$  dollars

*How many non-students attended the concert?*

2,000 students

*How much total box-office revenue was generated? (write an equation; \$ from student tickets + \$ from non-student tickets = total \$)*

\$ from students + \$ from non – students = Total \$

$$\left(x \frac{\text{dollars}}{\text{student}}\right) \cdot (4000 \text{ students}) + \left(3x \frac{\text{dollars}}{\text{non – student}}\right) (2000 \text{ non – students}) = \$120000$$

$$4000x \text{ dollars} + 6000x \text{ dollars} = \$120000$$

$$\$10000x = \$120000$$

$$x = 12$$

So student tickets cost \$12 each while non-student tickets cost \$36 each.

6. A salesperson purchased a car that is advertised as getting half as many miles per gallon of gasoline in the city than it does on the highway. On a recent sales trip that covered 1200 miles in total, the car used up 25 gallons on the highway and 10 gallons in the city. Assuming that the advertised mileage estimates were correct, what is the mileage of the car in the city and on the highway?

*How many miles per gallon does the car get on the highway?*

$$x \frac{\text{miles}}{\text{gallon}}$$

*How many gallons of gas were used on the highway?*

25 gallons

*How many miles per gallon does the car get in the city?*

$$\frac{1}{2}x \frac{\text{miles}}{\text{gallon}}$$

*How many gallons of gas were used in the city?*

10 gallons

*How many total miles were driven? (write an equation; miles driven on the highway + miles driven in the city = total miles)*

Highway miles + City miles = Total miles

$$\left(x \frac{\text{miles}}{\text{gallon}}\right) \cdot (25 \text{ gallons}) + \left(\frac{1}{2}x \frac{\text{miles}}{\text{gallon}}\right) (10 \text{ gallons}) = 1200 \text{ miles}$$

$$25x \text{ miles} + 5x \text{ miles} = 1200 \text{ miles}$$

$$30x \text{ miles} = 1200 \text{ miles}$$

$$x = 40$$

So the car gets 40  $\frac{\text{miles}}{\text{gallon}}$  on the highway and 20  $\frac{\text{miles}}{\text{gallon}}$  in the city.

*Answers to Examples:*

1.  $5.5x$  ; 1a. 17 ;
- 2a.  $0.04x + 35,000$  ; 2b.  $0.11x$  ; 2c. \$500,000 ;
3. 125 gallons ;
4. Electrician makes \$58.80 per hour;  
Apprentice makes \$14.70 per hour ;
5. Student tickets cost \$12 ; Non – student tickets cost \$36 ;
6. 40 mpg on the Highway ; 20 mpg in the City ;