Math 96--Rate, Time, Distance--page 1

Rate/time/distance problems. You need some background thinking for rate, time, and distance problems.

1. When you work with rate, time, and distance problems, the formula is rt = d.

2. It is helpful to organize your information in a rate, time, and distance chart.

	Rate (Object 1st)	Time	Distance
with current	object + current		distance
against current	object – current		distance

   a. Under the rate column in the "with current" row, it's always the object + current.

   b. Under the rate column in the "against current" row, it's always the object – current.
   c. Then fill in the distance column appropriately.
   d. What you will not know is a specific time. However, you can fill that column in with a fraction. That fraction is rt= d rearranged to $t = \frac{d}{r}$. The time column will be the distance over the rate.
   e. You will set the fractions equal to each other because the problem says "in the same time" or words to that effect.

Look at a couple of examples.

3. The current of a river is 3 mph. A boat takes the same time to go 12 miles downstream as it takes to go 8 miles upstream. Find the speed of the boat in still water.

   It helps to identify all the numbers and all the unknowns and state what they mean. Observe.
   3 mph = speed of current = current
   12 miles = distance with
   8 miles = distance against
   speed of boat = x = object
   Then fill in chart appropriately.

	Rate (Object 1st)	Time	Distance
Boat downstream	boat + current x + 3		12 miles
Boat upstream	boat – current x – 3		8 miles

   There is a gap in the chart where the time is located. Fill in with the fractions $\frac{d}{r}$. On downstream, fill in the time column with $\frac{12}{x+3}$. On upstream, fill in the time colum $\frac{8}{x-3}$. Observe what the chart l like now:

	Rate (Object 1st)	Time	Distance
Boat downstream	x + 3	$\frac{12}{x+3}$	12
Boat upstream	x – 3	$\frac{8}{x-3}$	8

Now what? The problem said the SAME time; that means time = time. Look at the equation:

$$\frac{12}{x+3}=\frac{8}{x-3}$$ Solve by multiplying by LCD of (x+ 3)(x –3)

12(x – 3) = 8(x + 3)
12x – 36 = 8x + 24
4x = 60
x = 15
x = the speed of the boat = 15 mph

4. A plane travels 885 miles against the wind in the same time it takes to fly 1035 miles with the wind. If the speed of the plane is 320 mph, what was the speed of the wind?

Identify/state what each number and unknown means:
885 miles = distance against
1035 miles = distance with
320 mph = speed of plane = object
speed of wind = x = current
Fill in the chart.

	Rate (Object 1st)	Time	Distance
Plane with wind	plane + current 320 + x		1035
Plane against wind	plane – current 320 – x		885

There is a gap in the chart where the time is located. Fill in with the fractions $\frac{d}{r}$. On with the wind, fill in the time column with $\frac{1035}{320+x}$. On against the wind, fill in the time colu$\frac{885}{320-x}$. Observe chart looks like now:

	Rate (Object 1st)	Time	Distance
Plane with wind	320 + x	$\frac{1035}{320+x}$	1035
Plane against wind	320 – x	$\frac{885}{320-x}$	885

Now what? The problem said the SAME time; that means time = time. Look at the equation:

$$\frac{1035}{320+x}=\frac{885}{320-x}$$ multiply by LCD (320 + x)(320 – x)

1035(320 – x) = 885(320 + x)
331200 – 1035x = 283200 + 885x
–1920x = –48000
x = 25
x = the speed of the wind = 25 mph

5. If you get good with these charts, there is a "formula" you can use to get to the equation, when the time is the same:

$$\frac{distnce\ with}{object\ +\ current}=\frac{distnce\ against}{object\ -\ current}$$

These become easier after you've had some practice. Remember on the rate column to always set it up so the OBJECT is first and the CURRENT is second, using x as appropriate for whatever you do not know.

Notice: All these equations contained fractions. The strategy on all of them was to clear the fraction by multiplying by a common denominator. Then solve the new equation.

If you want some practice, try these.

1. A boat can go 20 miles against a current in the same time that it can go 60 miles with the current. The current is 4 mph. Find the speed of the boat in still water.

2. A plane travels 500 miles against the wind in the same time it takes to fly 600 miles with the wind. If the speed of the wind is 10 mph, what was the speed of the plane in still air?

3. A boat can travel 8 mph in still water. If it can travel 15 miles downstream in the same time that it can travel 9 miles up the stream, what is the rate of the stream?

4. A plane can fly 320 mph in still air. Flying with the wind, the plane can fly 1400 miles in the same time that it requires to fly 1160 miles against the wind. Find the rate of the wind.

Math 96--Rate, Time, Distance--page 4

Answer Key. Some details will be shown on this answer key.

1. 20 miles = distance against
60 miles = distance with
4 mph = speed of current = current
x = speed of boat = object

$$\frac{60}{x+4}=\frac{20}{x-4}$$

x = speed of boat = 8 mph

2. 500 miles = distance against
600 miles = distance with
10 mph = speed of wind = current
x = speed of plane = object

$$\frac{600}{x+10}=\frac{500}{x-10}$$

x = speed of plane = 110 mph

3. x = speed of stream = current
8 mph = speed of boat = object

$$\frac{15}{8+x}=\frac{9}{8-x}$$

x = speed of stream = 2 mph

6. x = speed of wind = current
320 mph = speed of plane = object

$$\frac{1400}{320+x}=\frac{1160}{320-x}$$

x = speed of wind = 30 mph