Algebra II Chapter 1 Supplemental Problems

Name Solution Guide ________ Period _____ Date __________

Use the Five-Step plan to solve these two problems. Be sure to label your steps and show your work. Include a graphic of some sort. The graphic can be a table, figure, diagram, or sketch.

1. At noon a train leaves Bridgton heading east at 90 mi/h to Cogsville, 450 mi away. At 12:15 P.M. a train leaves Cogsville heading west to Bridgton at 100 mi/h. At what time will they pass each other?

Step 1 (1 point)

The problem asks the time the trains will pass each other.

Step 2 (3 points)

Let ***t*** be the time after the first train leaves. Then, using the rate equation *distance* = *rate* × *time*, the distance the first train travels is,

$d_1 = 90t$,and the distance the second train travels is,

$d_2 = 100(t - 0.25)$.

Either a table or a diagram may be used. Both are shown below.

	Rate (mi/h)	*Time* (h)	*Distance* (mi)
Eastbound train	90	t	$90t$
Westbound train	100	$t - 0.25$	$100(t - 0.25)$

Notice that the time delay for the second train's departure must be converted from minutes to hours. Alternatively, the speeds for the trains could be converted from miles per hour to miles per minute. (The latter is more cumbersome, but it is correct.)

Step 3 (2 points)

The two trains reach and pass each other when the total distance they have traveled equals the total distance between Bridgton and Cogsville. The equation that describes this situation is,

$$90t + 100(t - 0.25) = 450$$

Step 4 (2 points)

Solve the equation:

$90t + 100(t - 0.25) = 450$	
$90t + 100t - 25 = 450$	Simplify
$190t - 25 = 450$	Combine like terms
$190t = 475$	Add 25 to both sides
$t = 2.5$	Divide both sides by 190

Step 5 (2 points)

In 2.5 hours, the first train has traveled, $90 \cdot 2.5 = 225$ mi.

In 2.5 hours, the second train has traveled, $100 \cdot (2.5 - 0.25) == 10 \cdot 2.25 = 225$ mi.

The total the two trains have traveled is, $225 + 225 = 450$ mi.

The solution checks; therefore, the two trains pass each other 2.5 h after the first train leaves.

The two trains pass at 2:30 P.M.

2. A pollution control device reduces the rate of emission of an air pollutant in a car's exhaust by 56 ppm (parts per million) per hour. When the device is installed, it will take the car 10 h to emit the same amount of pollutant that it formerly did in 3 h. What was the original rate of emission of the pollutant in the car's exhaust?

Step 1 (1 point)

The problem asks was the pollutant emission rate in the engine before the pollution control device was installed.

Step 2 (3 points)

Let ***r*** be the original rate of pollutant emission in the car's exhaust.

The pollution rate after the pollution control device was installed is, $\boldsymbol{r-56}$.

This problem also uses the rate equation. In this case, the *distance* is interpreted as the

total pollution = *rate* × *time*.

The total pollution emitted in 3 hours before installation of the pollution control device was,

$$total\ polution_{before} = r \cdot 3 \quad .$$

The total pollution emitted in 10 hours after installation of the pollution control device is,

$$total\ polution_{after} = (r-56) \cdot 10 \quad .$$

The most appropriate graphic for this problem is a table,

	Rate (ppm/h)	*Time* (h)	*Total pollution* (ppm)
Without pollution control device	r	3	$3r$
With pollution control device	$r-56$	10	$10(r-56)$

Step 3 (2 points)

The pollution emitted in three hours before installing the pollution control device is the same as the pollution emitted in ten hours after installing the pollution control device. Therefore,

$$3r = 10(r-56)$$

Step 4 (2 points)

Solve the equation:

$$3r = 10(r - 56)$$

$$3r = 10r - 560 \qquad \text{Simplify}$$

$$-7r = -560 \qquad \text{Subtract } 10r \text{ from both sides}$$

$$r = 80 \qquad \text{Divide both sides by } -7$$

Step 5 (2 points)

Over a period of 3 h at a rate of 80 ppm/h, the car will emit $3 \cdot 80 = 240$ ppm.

Over a period of 10 h at a rate of $(80 - 56)$ ppm/h, the car will emit $10 \cdot 24 = 240$ ppm.

This agrees with the original problem statement; therefore, the original pollution rate was, **80 ppm/h**