Solutions to Equation Application Worksheet

1. This is very similar to Example 5 on page 94 (which you should have read). If x is the amount of fluid we drain and replace with pure antifreeze, we have:

$$(25\% \text{ of } (10-x) \text{ quarts}) + (100\% \text{ of } x \text{ quarts}) = (40\% \text{ of } 10 \text{ quarts}).$$

$$\begin{aligned} .25(10-x)+x &= .4(10) \\ 2.5-.25x+x &= 4 \\ .75x &= 1.5 \\ x &= 2. \end{aligned} \tag{1}$$

So, Linnea should drain 2 quarts from the radiator and pour in 2 quarts of antifreeze.

2. This is very similar to Example 6 on p. 95. If r is the speed during the first direction, and t is the time spent going the first direction, then using distance = rate $\times$ time, we have:

$$(\text{rate 1st dir.})\,(\text{time 1st dir.}) + (\text{rate 2nd dir.})\,(\text{time 2nd dir.}) = \text{total distance}$$

$$\begin{aligned} 160 &= rt + (r-10)(3.6-t) \\ 160 &= rt - rt + 3.6r + 10t - 36 \\ 160 &= 3.6r + 10t - 36 \\ 196 - 3.6r &= 10t \\ 19.6 - .36r &= t \end{aligned} \tag{2}$$

We also know that $rt = 80$, so we have:

$$\begin{aligned} 80 &= rt \\ 80 &= (19.6 - .36r)r \\ 80 &= 19.6r - .36r^2 \\ .36r^2 - 19.6r + 80 &= 0 \\ 36r^2 - 1960r + 8000 &= 0 \end{aligned} \tag{3}$$

Applying the quadratic formula, we get $r = 50$ or $r = 40/9$. However, the second solution makes no sense, as it would require the Sarah to drive $40/9 - 10 < 0$ mph the second direction. So, we have $r = 50$ mph, and $t = 19.6 - .36r = 1.6$ hours. So, Sarah drives to Portland at 50 mph for 1.6 hours, and back at 40 mph for 2 hours. You can substitute this back into the original equation to check that it is correct.

3. If r is the rate of the person walking down 11th, using the Pythagorean Theorem, we have:

$$\begin{aligned} 50^2 &= (20r)^2 + (20(r-.5))^2 \\ 2500 &= 400r^2 + 400(r^2 - r + .25) \\ 2500 &= 400r^2 + 400r^2 - 400r + 100 \\ 0 &= 800r^2 - 400r - 2400 \end{aligned} \tag{4}$$

Applying the quadratic formula, we have $r = -1.5$ or $r = 2$. The only answer that makes sense is $r = 2$. We can substitute back into the original equation to check. So, one person walks down 11th at 2 m/s while the other walks down Willamette at 1.5 m/s.