Section 1.5

33. (a) average velocity = $\frac{\text{change in distance}}{\text{change in time}}$

Since the train ends up exactly where is started, the change in distance is 0 $\Rightarrow$ **avg. vel. = 0.**

(b) Suppose the train travels for t units of time in the forward direction. When it reverses direction, it has to go a distance of $40 \cdot t$. At 60 miles/hour, this will take it $\frac{40 \cdot t}{60} = \frac{2}{3}t$ units of time.

Thus, the train has covered a total distance of $40t + 40t = 80t$ in $t + \frac{2}{3}t = \frac{5}{3}t$ units of time. $\Rightarrow$ average speed is

$$\frac{80t}{\frac{5}{3}t} = 16 \cdot 3 = \boxed{48 \text{ mi/hr}}$$

(c) If the total trip took 5 hours, this means that, using the variables from part (b), $t + \frac{2}{3}t = 5$

$\Rightarrow \frac{5}{3}t = 5 \Rightarrow t = 3$. Thus, the total distance covered is $80t = 80 \cdot 3 = \boxed{240 \text{ miles}}$

41. (a) $T_C = mT_F + b$.

$0 = m32 + b$

$\Rightarrow b = -32m$.

$T_C = m(T_F - 32)$

$100 = m(212 - 32)$

$\Rightarrow 100 = m \cdot 180$

$\Rightarrow m = \frac{100}{180} = \frac{5}{9}$.

Thus, $\boxed{T_C = \frac{5}{9}(T_F - 32)}$

(b) The slope of the line is clearly $\frac{5}{9}$.

(c) We want to know when $T_C = \frac{5}{9}(T_C - 32)$

$\Rightarrow 9T_C = 5T_C - 5 \cdot 32$

$\Rightarrow 4 \cdot T_C = -5 \cdot 32$

$\Rightarrow T_C = -5 \cdot 8 = \boxed{-40^\circ}$

(d) $T_c = \frac{5}{9}(T_F - 32)$

$T_F = 98.6 \Rightarrow T_c = \frac{5}{9}(98.6 - 32) = \frac{5}{9}(66.6)$

$= \frac{5}{3} \cdot 22.2 = \frac{111}{3} = \boxed{37^\circ c}$