Example Given points $S(5, -1)$ and $T(-3, 3)$, find the slope of every line (a) parallel to $\overleftrightarrow{ST}$ and (b) perpendicular to $\overleftrightarrow{ST}$.

Solution Slope of $\overleftrightarrow{ST} = \dfrac{3-(-1)}{-3-5} = \dfrac{4}{-8} = -\dfrac{1}{2}$

a. Any line parallel to $\overleftrightarrow{ST}$ has slope $-\dfrac{1}{2}$. (Theorem 13-3)

b. Any line perpendicular to $\overleftrightarrow{ST}$ has slope

$$-\frac{1}{-\frac{1}{2}} = -1 \cdot (-2) = 2.$$ (Theorem 13-4)

Classroom Exercises

1. Given: $l \perp n$. Find the slope of line n if the slope of line l is:

a. 2 **b.** $\frac{4}{5}$ **c.** -4 **d.** not defined **e.** 0

The slopes of two lines are given. Are the lines parallel, perpendicular, or neither?

2. $\frac{3}{4}; \frac{12}{16}$ **3.** $1; -1$ **4.** $3; -3$ **5.** $-\frac{3}{4}; \frac{4}{3}$

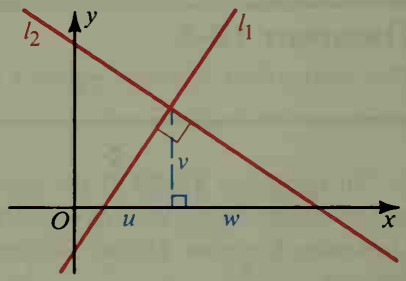
6. $3; \frac{-1}{3}$ **7.** $\frac{-2}{3}; \frac{2}{-3}$ **8.** $0; -1$ **9.** $\frac{5}{6}; \frac{6}{5}$

10. State two conditionals that are combined in the biconditional of Theorem 13-3.

11. The purpose of this exercise is to prove the statement: If two nonvertical lines are perpendicular, then the product of their slopes is -1. Supply the reason for each step.

Given: l_1 has slope m_1;
l_2 has slope m_2;
$l_1 \perp l_2$

Prove: $m_1 \cdot m_2 = -1$



Key steps of proof:

1. Draw the vertical segment shown.
2. $\dfrac{u}{v} = \dfrac{v}{w}$
3. $m_1 = \dfrac{v}{u}$
4. $m_2 = -\dfrac{v}{w}$
5. $m_1 \cdot m_2 = \left(\dfrac{v}{u}\right) \cdot \left(-\dfrac{v}{w}\right)$
6. $m_1 \cdot m_2 = \left(\dfrac{v}{u}\right) \cdot \left(-\dfrac{u}{v}\right) = -1$