1. (See page 1 for answers)

Note: We defined

Two lines are parallel \(\implies\) their direction vectors are parallel.

Otherwise, they either intersect or are skew.

Two planes are parallel \(\iff\) their normals are parallel.
Two planes are perpendicular \(\iff\) their normals are perpendicular.

If two planes are not parallel, then they must intersect (in a line).

 Specific comments:

(a) Two lines perpendicular to the same plane are parallel.

\textbf{True!}

Line perpendicular to plane \(\iff\) line direction vector and plane normal are parallel.

\[ \begin{array}{c}
\text{Counter-example:} \\
\bar{l}_1: x = 2t, y = t, z = 1 \\
\bar{l}_2: x = 7s, y = 3s, z = 2 \\
\text{To xy-plane} \\
\text{and } \bar{l}_1 \text{ and } \bar{l}_2 \text{ are not parallel (they are skew).}
\end{array} \]

(b) Two lines parallel to the same plane are parallel.

\textbf{False!}

The lines could be skew!

\[ \begin{array}{c}
\text{Counter-example:} \\
\bar{l}_1: x = 2t, y = t, z = 1 \\
\bar{l}_2: x = 7s, y = 3s, z = 2 \\
\text{To xy-plane} \\
\text{and } \bar{l}_1 \text{ and } \bar{l}_2 \text{ are not parallel (they are skew).}
\end{array} \]

(c) Two planes perpendicular to the same plane are parallel.

\textbf{False!}

\[ \begin{array}{c}
P_1 \text{ and } P_2 \text{ are both perpendicular to } P_3, \text{ but not to each other.} \\
\text{Another example is } xy, xz \text{ and } yz \text{ planes.}
\end{array} \]

(d) Two planes parallel to the same plane are parallel.

\textbf{True}

\[ \begin{array}{c}
P_1, P_2, P_3 \text{ are all parallel.}
\end{array} \]
(e) **FALSE!** **TWO LINES PERPENDICULAR TO THE SAME LINE ARE PARALLEL.**

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\[ l_1 \perp l_2 \text{ and } l_1 \perp l_3 \text{ don't have to be parallel} \]
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(f) **TRUE!** **TWO LINES PARALLEL TO THE SAME LINE ARE PARALLEL.**

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\[ \overrightarrow{v_1}, \overrightarrow{v_2}, \text{ and } \overrightarrow{v_3} \text{ are all parallel.} \]
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(g) **TRUE!** **TWO PLANES EITHER INTERSECT OR ARE PARALLEL.**

(h) **TRUE!** **TWO PLANES PERPENDICULAR TO THE SAME LINE ARE PARALLEL.**

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\[ \overrightarrow{n_1}, \overrightarrow{n_2}, \text{ and } \overrightarrow{n} \text{ are all parallel.} \]
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(i) **FALSE!** **TWO PLANES PARALLEL TO THE SAME LINE ARE PARALLEL.**

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\[ P_1 \parallel P_2 \text{ are parallel to } l \]
\[ \text{but } P_1 \text{ and } P_2 \text{ are not parallel.} \]
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2. **PARALLEL TO YZ-PLANE AND THROUGH (2, 1, 3)**

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\[ \text{IT IS PERPENDICULAR TO THE XY-PLANE AND XZ-PLANE.} \]
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3. **\( x + z = 2 \Rightarrow z = 2 - x \)**

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\[ \text{IT IS NOT PARALLEL TO ANY COORD. PLANES.} \]
\[ \text{IT IS PERPENDICULAR TO THE XZ-PLANE.} \]
\[ \text{IT IS PARALLEL TO THE Y-AXIS.} \]
\[ \text{IT IS NOT PERPENDICULAR TO ANY COORD. AXIS.} \]
\[ \text{THE NORMAL VECTOR IS } \langle 1, 0, 1 \rangle! \]
\[ \text{(Also contain } x \text{ and } z \text{ and no } y) \]
1. Decide by yourself whether each of the following is true or false. Compare answers with one or two neighbors, then confirm your answers by using pieces of paper and/or a desktop as models for planes, and pens and/or pencils as models for lines.

(a) Two lines perpendicular to the same plane are parallel. \textbf{TRUE}
(b) Two lines parallel to the same plane are parallel. \textbf{FALSE}
(c) Two planes perpendicular to the same (third) plane are parallel. \textbf{FALSE}
(d) Two planes parallel to the same (third) plane are parallel. \textbf{TRUE}
(e) Two lines perpendicular to the same (third) line are parallel. \textbf{FALSE}
(f) Two lines parallel to the same (third) line are parallel. \textbf{TRUE}
(g) Two planes either intersect or are parallel. \textbf{TRUE}
(h) Two planes perpendicular to the same line are parallel. \textbf{TRUE}
(i) Two planes parallel to the same line are parallel. \textbf{FALSE}

Use the following axes for questions 2 and 3.

2. Find the equation and sketch the graph of a plane that is parallel to the $yz$-coordinate plane and contains the point $(2, 1, 3)$. How is this plane related to the other two coordinate planes, the $xy$-coordinate plane and the $xz$-coordinate plane?

3. Graph the plane $P$ given by the equation $x + z = 2$. \rightarrow \text{normal vector $<1,0,1>$} \rightarrow

Is $P$ parallel to any of the coordinate planes?
Is $P$ perpendicular to any of the coordinate planes?
Is $P$ parallel to any of the coordinate axes?
Is $P$ perpendicular to any of the coordinate axes?
What fact about the equation for $P$ immediately gives you the answer to all of these questions?