

CUT & GLUE SORT

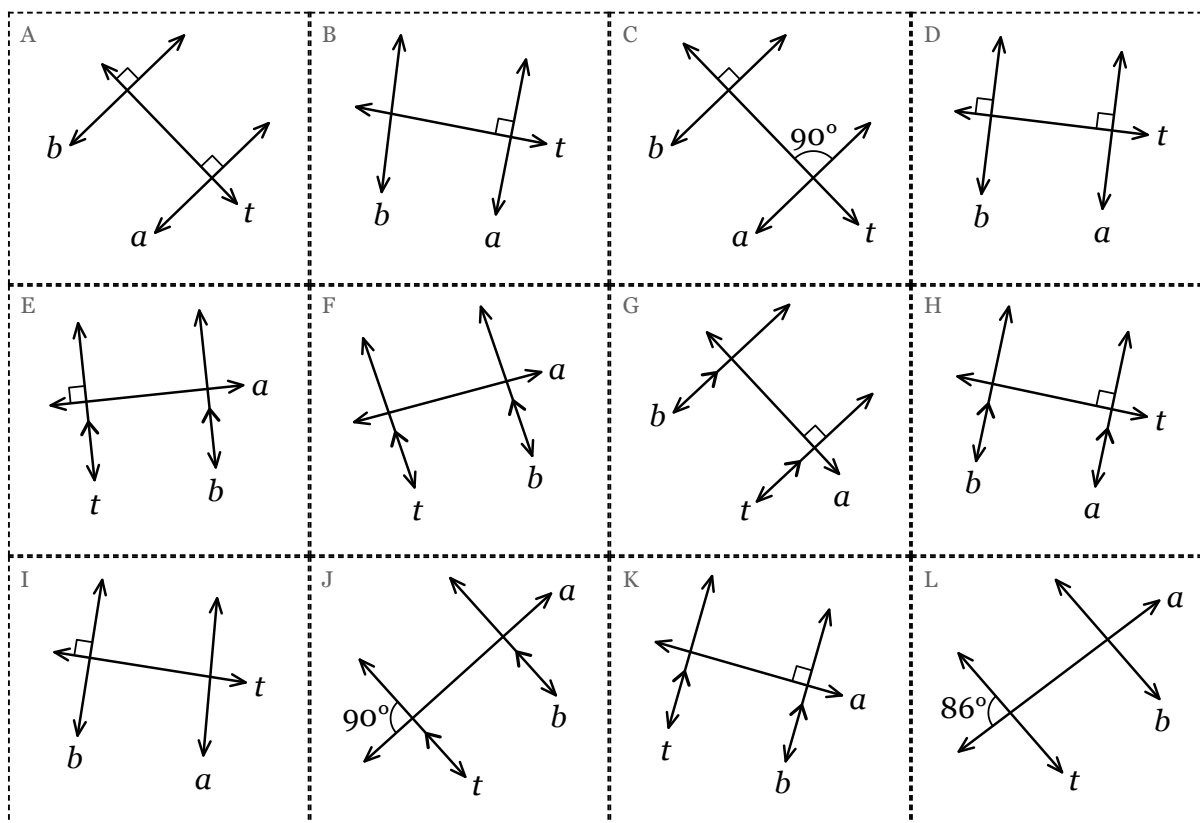


PERPENDICULAR LINES AND THEIR ANGLES

Perpendicular Lines: Which Theorem Applies?

Must be parallel · must be perpendicular · no way to tell

FREE



1. **Hand out both sheets, scissors and glue.** You cut nothing.
2. **Say this once:** *“Two right angles on the same line make the lines parallel. One right angle and a pair of arrowheads make the third line perpendicular to both. One right angle on its own makes nothing.”*
3. **Cut out the twelve pieces.** Glue each one into its row: what do the marks tell you about a and b ? **Every row gets exactly 4.**

Both sheets pages 3 and 4, one of each per student.

Answers page 5.

The two rows at the top are the two theorems, and they point in opposite directions. Two lines square to the same line are *parallel*: that is the top row, and the conclusion is parallelism. A line square to one of two *parallels* is square to the other: that is the middle row, and there parallelism is what you were given. Both sentences are true of the same three lines and only one of them applies to a given piece. Asked which sentence licenses a conclusion, students reliably choose whichever true sentence mentions the right words — it is the single most examined thing on this material and the one that moves most when it is taught.

The bottom row is the hardest one. It is pieces B, F, I, L, and on each of them the marks simply never reach from a to b : one crossing is square and the other carries nothing, or two lines are marked parallel and the third is left free, or the measure written at a crossing is not 90. Nothing follows — and *not enough information* is an answer, not a failure.

Nothing here can be sorted by eye, and that is deliberate. The drawings are to scale, so a piece whose marks make a and b parallel really is drawn parallel. The four pieces in the bottom row are drawn 4° off — two of them just off parallel and two just off square — which nobody can see on a 35 mm piece. A student who sorts by the look of the drawing gets every one of them wrong, and the row counts say so before you read a single piece.

Marking takes ten seconds a sheet. Every row holds 4 pieces. A row holding 3 or 5 is wrong before you look at anything.

Twenty-five minutes, not fifteen. Cutting twelve pieces is five to eight minutes on its own for hands this age, before anybody has thought about an angle.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
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Where does each one go?

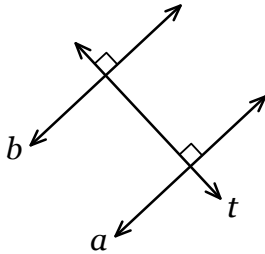
Perpendicular lines

Name _____

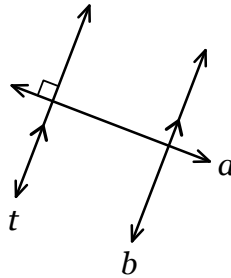
Period _____

Date _____

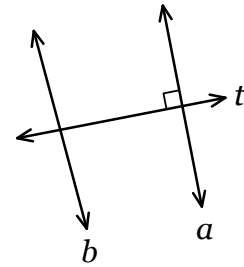
Every piece shows the same three lines. **What do the marks tell you about a and b ?** Cut out the twelve pieces and glue each one into the row it belongs in. **The marks are the only evidence. Do not measure. Do not decide from how it looks.** Every row gets 4.



Both perpendicular to the same line
so a and b are parallel



Perpendicular to one of two parallels
so a is perpendicular to b as well



One square, and nothing else
 b is not marked at all

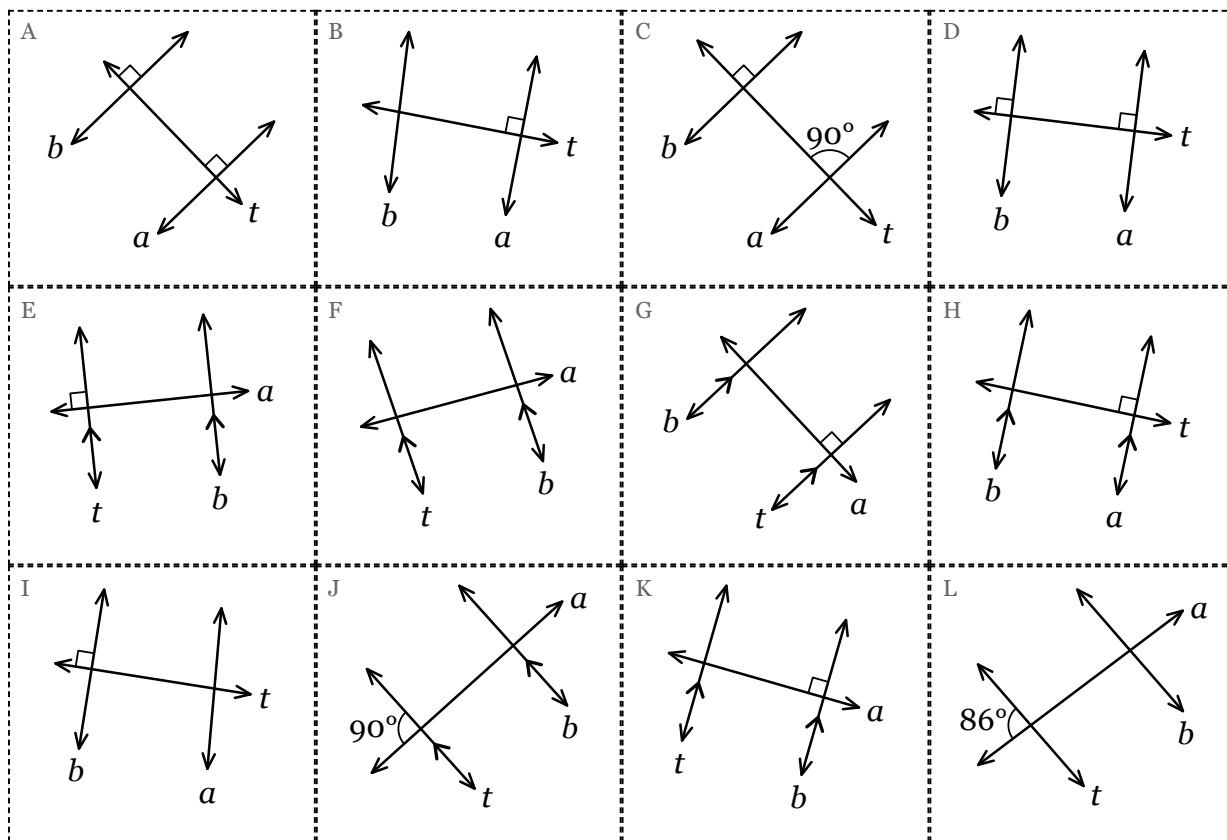
a and b MUST be parallel

a and b MUST be perpendicular

There is no way to tell *Nothing on the piece connects a and b .*

The twelve pieces

Cut along the dotted lines



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Cut & Glue Sort — answers

For the teacher

4 pieces to a row, always. A row holding 3 or 5 is wrong before any piece is read.

a and b MUST be parallel	A — both crossings square — T1 C — a square at one crossing and 90° written at the other — T1 D — both crossings square — T1 H — a and b carry the arrowheads themselves — nothing to deduce
a and b MUST be perpendicular	E — b and t marked parallel, a square to t — T2 G — the parallel pair marked, a square to the nearer of them — T2 J — a parallel pair and 90° written at one crossing — T2 K — the square is on a and b themselves — nothing to deduce
There is no way to tell	B — one crossing square, b not marked at all F — a parallel pair, and nothing said about a at all I — one crossing square, a not marked at all L — a measure at one crossing, and it is not 90°

Why the top two rows are two different jobs. In the top row the right angles are the *given* and parallelism is the conclusion: the two right angles are corresponding angles at the third line, and congruent corresponding angles make lines parallel. In the middle row parallelism is the given and the right angle is the conclusion: the marked right angle and the angle at the other crossing are corresponding angles, and parallel lines make corresponding angles congruent. The same picture, the same three words, opposite directions.

Why the bottom row has no answer. A right angle at one crossing says nothing whatever about a line that crosses somewhere else and carries no mark. The drawings in that row are to scale and are deliberately a few degrees off parallel or off square, so that a student who measured instead of reading would be wrong — and so that this page is not calling a picture undecidable when the picture plainly decides it.