LESSON MAKER PRO

# Tree Paths and Choices

*Connect networks and follow smart branches.*

**HIGH SCHOOL · MA.912.LT.2.5**

**MA.912.LT.2.5** "Apply spanning trees, rooted trees, binary trees and decision trees to solve problems."

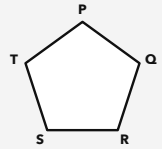
NAME _____ DATE _____

## TREE RULES

A spanning tree connects every vertex with no cycle. If a network has v vertices, its spanning tree has v - 1 links. In a rooted tree, each child has one parent, and a binary tree gives each node no more than two children.

## WORKED EXAMPLE

Use the network shown. Its links are the sides of the pentagon. Name one spanning tree.




1. Count 5 hubs.
2. A spanning tree needs 5 - 1 = 4 links.
3. Keep P-Q, Q-R, R-S, and S-T.

**Answer: P-Q, Q-R, R-S, S-T**

## PRACTICE 4 problems

**1** A connected network has 7 computers. How many links are in any spanning tree of the network?

**ANSWER** _____

**2** In a rooted tree, A is the root. A has children B and C. B has children D and E. C has child F. What is E's parent, and what is E's sibling?

**ANSWER** _____

**3** A rooted tree has root J with children K, L, and M. Can it be a binary tree? Explain briefly.

**ANSWER** _____

**4** A decision tree asks: "Playing alone?" Yes leads to Puzzle. No leads to "On a team?" Yes leads to Sports. No leads to Strategy. What choice results for someone who is not playing alone or on a team?

**ANSWER** _____

## APPLY IT Show your work

**1** A student concert needs cables connecting stages A, B, C, and D. Use the table to choose a least-cost spanning tree. List its links and total cost.

**CABLE OPTIONS**

| Link | Cost |
|---|---|
| A-B | 3 |
| A-C | 8 |
| B-C | 2 |
| B-D | 9 |
| C-D | 6 |

**ANSWER** _____

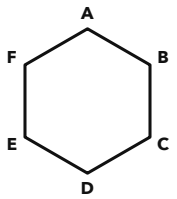
**2** The school store uses this decision tree. Is the item waterproof? If yes, is the budget at least $30? Yes means Jacket, and no means Poncho. If no, does the student want pockets? Yes means Cargo Pants, and no means Hoodie. A buyer wants waterproof gear and has $24. What item is chosen, and how many yes/no questions are asked?

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

Use the cycle network shown. How many different spanning trees can be made from it? Explain your reasoning.




WORK SPACE AND ANSWER

ANSWER KEY

# Tree Paths and Choices

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## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | A connected network has 7 computers. How many links are in any spanning tree of the network? | **6 links** |
| 2 | In a rooted tree, A is the root. A has children B and C. B has children D and E. C has child F. What is E's parent, and what is E's sibling? | **Parent: B; sibling: D** |
| 3 | A rooted tree has root J with children K, L, and M. Can it be a binary tree? Explain briefly. | **No. J has 3 children, but a binary tree can have at most 2 children per node.** |
| 4 | A decision tree asks: "Playing alone?" Yes leads to Puzzle. No leads to "On a team?" Yes leads to Sports. No leads to Strategy. What choice results for someone who is not playing alone or on a team? | **Strategy** |

## PART 2 · APPLY IT

1. **A-B, B-C, and C-D; total cost 11** Choose B-C for 2, A-B for 3, and C-D for 6. These three links connect all four stages with no cycle.
2. **Poncho; 2 questions** The buyer follows yes for waterproof, then no for a budget of at least $30. That route ends at Poncho after two tests.

## CHALLENGE

**6 different spanning trees. Remove any 1 of the 6 links. The remaining links connect all vertices and have no cycle.**

For the worked example, accept any set of four side links that connects all five hubs without making a cycle. For the cable problem, accept links in any order, but the least-cost total must be 11.