

GAC Mathematics

Name: _____ Score: _____

1. In a class of 30, 18 study French, 15 study German and 7 study both. How many study neither?

2. Convert binary 1101 to decimal.

3. In binary, what is $1 + 1$?

4. Which are required for a sequence of steps to be an algorithm? Choose all that apply.

- ☐ Each step is unambiguous
- ☐ It terminates
- ☐ It is written in a programming language
- ☐ It is finite

Tick every correct option.

5. In a simple undirected graph without loops, four edges meet a vertex. What is its degree?

6. In the same class, how many study French only?

7. Write decimal 10 in binary.

8. How many rows does a truth table with three inputs have?

9. For an already sorted million-item list, approximately how many middle-value comparisons can binary search need in the worst case?

- ☐ About twenty
- ☐ One
- ☐ A million
- ☐ A thousand

10. In a connected undirected network with strictly positive edge costs, why does a minimum-cost connected subgraph spanning all vertices contain no cycle?

- ☐ Cycles cost more per edge
- ☐ A cycle contains an edge you could remove and still reach everywhere
- ☐ Cycles are hard to draw
- ☐ It might, depending on the weights

1. **4**

$18 + 15 - 7 = 26$ study at least one, so $30 - 26 = 4$ study neither.

2. **13**

Places 8, 4, 2, 1 with digits 1, 1, 0, 1 gives $8 + 4 + 0 + 1 = 13$.

3. **10**

There is no digit for two, so it carries – the same rule as $9 + 1$ in decimal.

4. **Each step is unambiguous; It terminates; It is finite**

A procedure solving the stated finite task needs unambiguous steps, correct results and termination on allowed inputs. Pseudocode and flowcharts are representations, not requirements to use a particular programming language.

5. **4**

Its degree is 4, the number of incident edges under the stated graph convention.

6. **11**

$18 - 7 = 11$. Filling the Venn diagram from the middle outwards never double-counts.

7. **1010**

8 and 2 are used, 4 and 1 are not. Writing the place values first makes this immediate.

8. **8**

$2^3 = 8$. Every input doubles the number of combinations.

9. **About twenty**

Each comparison halves the remaining search range; about 20 comparisons suffice for a million ordered items. This excludes any cost of sorting beforehand.

10. **A cycle contains an edge you could remove and still reach everywhere**

Removing any cycle edge preserves connectivity and lowers total cost because its weight is strictly positive. Thus a cyclic subgraph cannot be minimum under these assumptions.