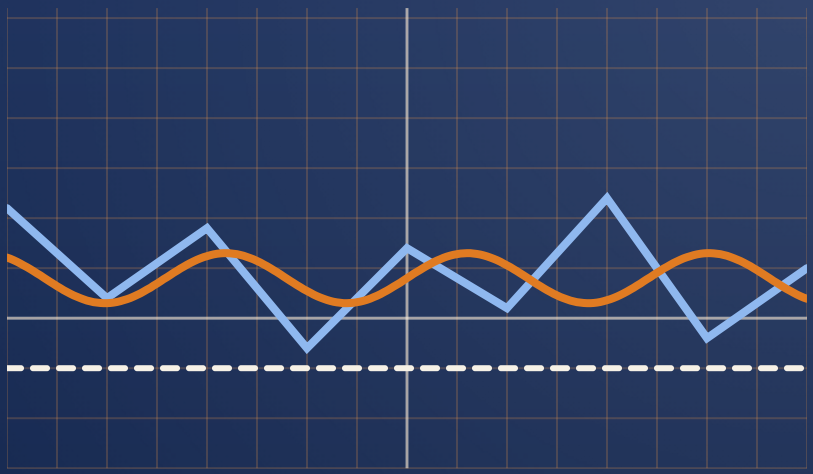
KECUDO

2026 EDITION · COLLEGE MATH SERIES



DISCRETE MATHEMATICS

Class G4

Graph Theory

Networks of points and connections

PREMIUM EDITION · KECUDO · G4

13 CHAPTERS · 120 SELF-ASSESSMENT QUESTIONS

INTERACTIVE EDITION + PRINT PDF

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●○○ FOUNDATION

Chapter 1

What Is a Graph?

A **graph** G = (V, E) has **vertices** (points) and **edges** (connections between pairs of vertices). The **degree** of a vertex is the number of edges touching it.

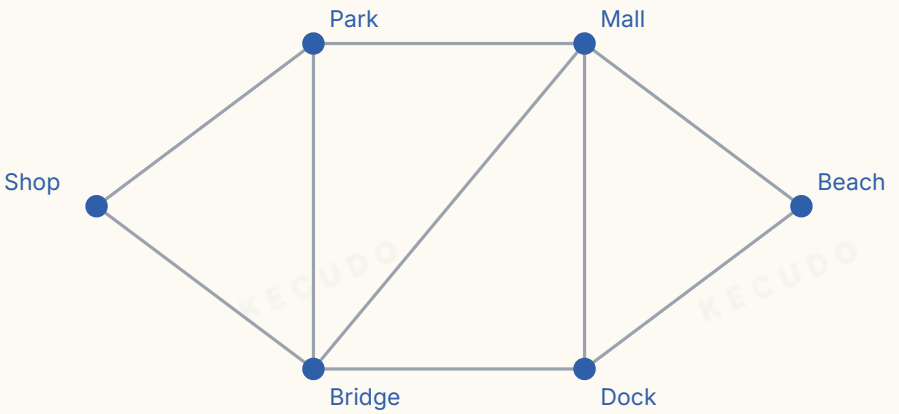


FIG 1.1 Kecudo's station network: 6 vertices (stations) and 9 edges (bike paths).

HANDSHAKE THEOREM

The sum of all degrees equals $2|E|$, since each edge has two ends. So the number of odd-degree vertices is always even.

WORKED EXAMPLE **Degrees in Kecudo's network**

1. Shop 2, Park 3, Bridge 4, Mall 4, Dock 3, Beach 2.
2. Sum 18 = 2 × 9 edges.

✓ **Two odd-degree vertices (Park, Dock)**

FOUNDATION

Chapter 2

Types & Representations

Type	Meaning
simple	no loops, at most one edge per pair
directed	edges have direction (one-way paths)
weighted	edges carry numbers (distances, costs)
complete K_n	every pair joined: n(n − 1)/2 edges
bipartite	two groups, edges only between groups

WORKED EXAMPLE **Adjacency matrix**

1. For vertices 1–3 with edges 1–2 and 2–3: $A = [0\ 1\ 0;\ 1\ 0\ 1;\ 0\ 1\ 0]$.

✓ **Entry (i, j) = 1 if i and j are joined**

COUNTING WALKS

Entry (i, j) of A^k counts walks of length k from i to j. Here A^2 has (1, 3) entry 1: the walk 1–2–3.

WORKED EXAMPLE **Adjacency list**

1. Store each vertex's neighbors: Shop: Park, Bridge; Park: Shop, Bridge, Mall; ...

✓ **Better for large sparse networks**

CHECK YOUR UNDERSTANDING

Chapter 1: What Is a Graph?

5 questions · your answer locks when you choose it

1. A graph consists of:

- **A** vertices and edges
- **B** numbers
- **C** only points
- **D** only lines

2. Sum of degrees with 12 edges:

- **A** 12
- **B** 36
- **C** 24
- **D** 6

3. Can a graph have exactly 3 odd-degree vertices?

- **A** No
- **B** Only if disconnected
- **C** Only trees
- **D** Yes

4. Degree of the Bridge station:

- **A** 3
- **B** 5
- **C** 2
- **D** 4

5. A graph with degrees 3, 3, 2, 2 has how many edges?

- **A** 6
- **B** 4
- **C** 5
- **D** 10

FINAL EXAM

25 Questions on the Whole Book

Parts A–E · 5 questions each

Part A · Basics

1. Sum of degrees equals:

A faces
B vertices
C 2 × edges
D edges

2. A tree with n vertices has:

A n^2 edges
B n − 1 edges
C n edges
D n + 1 edges

3. Euler circuits need:

A all odd degrees
B all even degrees (connected)
C a complete graph
D a tree

4. Euler's formula for planar graphs:

A V − E + F = 2
B E = 3V
C V + E = F
D F = V

5. $\chi(G)$ is:

A the number of edges
B the minimum number of colors
C the number of faces
D max degree

KECUDO

Thank you for learning with Kecudo.

NEXT IN THE SERIES

Series H · Probability & Statistics (Class H1: Descriptive Statistics)