NP-Complete Problems Worksheet

Name: _____ **Date:** _____

Part 1: Matching

Match each NP-Complete problem with its informal description. Write the letter of the correct description in the blank.

Problems:

1. 3-Colorability (3Col) _____
2. Clique Cover (CCov) _____
3. Independent Set (IS) _____
4. Vertex Cover (VC) _____
5. Set Cover _____
6. Hamiltonian Cycle (HC) _____
7. Traveling Salesman (TSP) _____
8. Load Balancing _____

Descriptions:

A. Given a graph, does there exist a set of edges that form a cycle and visit each vertex exactly once?

B. Given a set of objects with weights and m bins, can we partition the objects into the bins such that no bin's weight exceeds k?

C. Given a graph, can we find a subset V' of k vertices such that each edge in G is connected to at least one vertex in V'?

D. Given a complete weighted graph, does there exist a cycle that visits each vertex exactly once with total edge weight at most k?

E. Given a graph, can we partition the vertices into k subsets such that each subset is fully connected?

F. Given a set of elements and a collection of subsets, can we find k subsets whose union equals the whole set?

G. Given a graph, can each of its vertices be labeled $1..k$, such that no two vertices with the same label share an edge?

H. Given a graph, can we find a subset V' of k vertices such that no two vertices in V' share an edge?

Part 2: Categorization

Classify each of the problems from Part 1 into one of the following categories. Write the problem name(s) in the appropriate box. Some categories may have multiple problems.

Category	**Description**	**Problems**
Packing Problems	You're given a collection of objects, and you want to choose at least k of them. Some objects have conflicts, preventing you from choosing certain groups simultaneously.	
Covering Problems	You're given a collection of objects and you want to choose a subset of them that collectively achieves a certain goal. The challenge is to achieve this goal while only selecting k objects.	
Partitioning Problems	Search over all ways to divide up a collection of objects into subsets so that each object appears in exactly one of the subsets.	
Sequencing Problems	Search over all permutations of a collection of objects.	