Independent Set is in $\mathcal{NP}$: our certificate is a set V' of vertices.

1. If $|V'| \not\subseteq V$, reject
2. If $|V' < k$, reject
3. For each edge $e = (u, v)$, if $u \in V'$ and $v \in V'$, reject
4. If all requirements thus far pass, accept.

3-Sat(n variables, k clauses)
  for each clause $A \vee B \vee C$ **do**
    Create 3 vertices // one each A, B, C
    Add edges $(A, B), (B, C), (A, C)$
  for each variable x_i **do**
    Connect any "x_i" node to all $\overline{x_i}$ nodes
  return Independent Set(G, k)

Explanation: The idea is that each clause forms a clique, from which at most one vertex can be chosen by the Independent Set solver. Because there are k clauses and k cliques, at most one in each will be chosen. The chosen vertex represents a literal to set to be true or false to satisfy the clause. We add edges between literals and their negations so prohibit them from both being chosen.

No false positives: a return value of true indicates that there are k vertices that are chosen. Because at most one can be chosen from each clique, and there are k cliques, there must have been exactly one chosen in each. By construction, no literal and its negation was chosen. This means we can set the chosen vertices' associated variables to be the truth value for that literal, satisfying each clause.

No false negatives: Suppose the 3-Sat instance has a satisfying assignment. Then each clause is satisfied in the 3-Sat instance, given that truth value assignment. We can choose arbitrarily one of the set-to-true literals in each clause and select its vertex in the corresponding clause. No such chosen vertices have an edge to a chosen vertex in any other clique (because the truth value assignment would not set a variable to both true and false). Thus, the graph has a valid independent set, and it is of size k because one was chosen in each of the k independent cliques. Therefore, Independent Set will return true for that graph with the parameter k.

Vertex Cover

VERTEX COVER is in $\mathcal{NP}$: our certificate is a set V' of vertices.

1. If $|V'| \not\subseteq V$, reject
2. If $|V' > k$, reject
3. For each edge $e = (u, v)$, if $u \notin V'$ and $v \notin V'$, reject
4. If all requirements thus far pass, accept.

INDEPENDENT SET(G, k)
return Vertex Cover$(G, |G.V| - k)$

I claim that if a graph G has an Independent Set of size k, call it $\mathcal{I}$, then the set $\mathcal{C} = V - \mathcal{I}$ constitutes a vertex cover, and vice versa.

Suppose $\mathcal{I}$ is an Independent Set of size k. Then, for each edge, $u \notin \mathcal{I}$ or $v \notin \mathcal{I}$ (or both). Because $\mathcal{C}$ is the complement, this means that $u \in \mathcal{C}$ or $v \in \mathcal{C}$ (or both). Thus, $\mathcal{C}$ constitutes a valid vertex cover of G. The proof in the other direction is symmetric to this.