The following are a set of reduction problems in approximate order of difficulty.

1. Consider the two problems:

   - FACTOR: Given a number $n = pq$, the product of two distinct primes p and q, find p and q.
   - EULERTOTIENT: Given a number $n = pq$, where p and q are unknown primes, find $\phi(n) = (p-1)(q-1)$, the number of numbers less than n relatively prime to n.

   Reduce FACTOR to EULERTOTIENT.

2. Consider the following two problems:

   - FEEDBACKNODESET: Given a directed graph $G = (V, E)$, find a set of vertices $U \subseteq V$ of minimal size such that if U is removed from V, G has no cycles.
   - VERTEXCOVER: Given an undirected graph $G = (V, E)$, find a minimum set of vertices $U \subseteq V$ such that for all $(u, v) \in E$, either $u \in U$ or $v \in U$ or both.

   Reduce VERTEXCOVER to FEEDBACKNODESET.

3. Consider the following problem:

   - SETCOVER: Given a set of sets $S = \{\{a_{11}, a_{12}, ..., a_{1n_1}\}, \{a_{21}, ..., a_{2n_2}\}, ..., \{a_{m1}, ..., a_{mn_m}\}\}$ where the a_{ij}'s may not necessarily be distinct, find the minimum number of sets, $A_1, ..., A_k$, necessary such that every element in any set in S is in at least one of the A_i.

   Reduce VERTEXCOVER to SETCOVER.

4. Consider the following two problems:

   - PARTITION: Given a set n of non-negative integers $\{a_1, ..., a_n\}$, decide if there is there a subset $P \subseteq [1, n]$ such that $\sum_{i \in P} a_i = \sum_{i \notin P} a_i$.
   - KNAPSACK: Given a set $S = \{a_1, ..., a_n\}$ of non-negative integers, and an integer K, decide if there is there a subset $P \subseteq S$ such that $\sum_{a_i \in P} = K$.

   Reduce KNAPSACK to PARTITION.

5. Consider the two problems:

   - CNFSATISFIABILITY: Given a set of boolean variables (i.e. variables that can only be TRUE or FALSE), $\{v_1, ..., v_n\}$ and the boolean operators $\wedge$ (AND), $\vee$ (OR), $\neg$ (NOT), a boolean expression written in conjunctive normal form (CNF) has the form $(x_{11} \vee x_{12} \vee ...x_{1m_1}) \wedge (x_{21} \vee ... \vee x_{2m_2}) \wedge ... \wedge (x_{k1} \vee ... \vee x_{km_k})$ where each x_{ij} is either a boolean variable or the negation of a boolean variable. Given a boolean expression written in CNF, determine if there is some assignment of TRUE/FALSE to each of the boolean variables $v_1, ..., v_n$ such that the expression evaluates to TRUE. Assume that $m_i \geq 3$ for all i.
   - 3-SAT: A boolean expression written in 3-CNF form has the form $(x_{11} \vee x_{12} \vee x_{13}) \wedge ... \wedge (x_{k1} \vee x_{k2} \vee x_{k3})$ where each clause has exactly 3 literals. Given a boolean expression written in 3-CNF form, determine if there is some assignment to each of the boolean variables such that the expression evaluates to TRUE.

   Reduce CNFSATISFIABILITY to 3-SAT.