Problem type 1:

Briefly describe a reduction that shows the following:

(See variants below)

Assume $P \neq NP$

a. **BYD/BYG**

3Color: (**3Color(G)**)

- INPUT: A undirected graph G
- OUTPUT: True if the vertices in G can be marked with **3** colors such that no adjacent vertices share the same color, False otherwise

4Color: (**4Color(G')**)

- INPUT: A undirected graph G'
- OUTPUT: True if the vertices in G' can be marked with **4** colors such that no adjacent vertices share the same color, False otherwise

Reduction: 3Color $\leq_P$ 4Color

b. **BYA/BYH**

SAT: (**SAT(ϕ)**)

- INPUT: A conjunctive normal formula ϕ
- OUTPUT: True if there exists a truth assignment that let's ϕ evaluate to True, False otherwise

AlmostSAT: (**AlmostSAT(ϕ')**)

- INPUT: A conjunctive normal formula ϕ'
- OUTPUT: True if there exists a truth assignment that satisfies **all but one** clauses in ϕ', False otherwise

Reduction: SAT $\leq_P$ AlmostSAT

c. **BYC/BYE**

Hamiltonian Path: (**HamPath(G)**)

- INPUT: A undirected graph G
- OUTPUT: True if there exists a simple path that visits all vertices exactly once, False otherwise

Almost Hamiltonian Path: (**AlmostHamPath(G')**)

- INPUT: A undirected graph G

- OUTPUT: True if there exists a simple path that visits **all but one** vertices exactly once, False otherwise

Reduction: HamPath $\leq_P$ AlmostHamPath

d. **BYB/BYF**

Undirected Hamiltonian Path: (**UndirHamPath(G)**)

- INPUT: A undirected graph G
- OUTPUT: True if there exists a simple path that visits all vertices exactly once, False otherwise

Directed Hamiltonian Path: (**DirHamPath(G')**)

- INPUT: A directed graph G'
- OUTPUT: True if there exists a simple path that visits all vertices exactly once, False otherwise

Reduction: UndirHamPath $\leq_P$ DirHamPath