1. **Graphs [8 points]**

Consider the following graphs $G_1$ and $G_2$.

$$
G_1: \quad F \quad A \quad B \\
\quad \quad \downarrow \quad \downarrow \\
\quad C \quad D \\
\quad \downarrow \quad \downarrow \\
E
$$

$$
G_2: \quad 1 \quad 2 \quad 3 \\
\quad \downarrow \quad \downarrow \\
\quad 4 \quad 5 \\
\quad \downarrow \quad \downarrow \\
6 \quad 7
$$

Is there an isomorphism between graphs $G_1$ and $G_2$? Prove your claim. If you want to show that there is an isomorphism, show the appropriate function $f : V_1 \rightarrow V_2$. If you want to show there is no isomorphism, you need to prove that.

2. **Chromatic Number [12 points]**

What is the chromatic number of the graph below? You need to carefully prove the chromatic number you give is correct by using 2-way bounding, establishing the lower bound and upper bound using separate arguments.

Moreover, in order to establish the upper bound, show a coloring of the graph by drawing a picture of the graph and labeling it with colors. Use a diagram drawing package to do this (see page on homework style under the Homework link on the course website for guidance).
3. **Graphs [8 points]**

A set of people meet in a room, and over the day, people clink glasses with their friends. Prove that there always will be an even number of people who have done an odd number of clinks.

Give a clear modeling of this scenario as a graph, and a subsequent argument.

4. **Proof: Induction [14 points]** Use induction to prove that \[ \sum_{i=1}^{d} 2^i = 2^{d+1} - 2 \]