Math 112: Geometric Group Theory
Fall 2015 - Assignment 1

Return date: Tuesday 09/22/15

keyword: graph morphism

**exercise 1.** Let $\Gamma_1$ and $\Gamma_2$ be two undirected graphs without singular vertices. Here a vertex $v$ is called singular, if $\text{val}(v) = 0$. Let furthermore $f = (f_V, f_E) : \Gamma_1 \to \Gamma_2$ be a graph morphism.

a) Which of the following statements is true? (Please provide a proof or a counterexample)

- $f_V$ is completely determined by $f_E$.
- $f_E$ injective $\Rightarrow$ $f_V$ injective.
- $f_E$ surjective $\Rightarrow$ $f_V$ surjective.
- $f_V$ injective $\Rightarrow$ $f_E$ injective.
- $f_V$ surjective $\Rightarrow$ $f_E$ surjective.

b) Which of the above statements are true, if $\Gamma_1$ and $\Gamma_2$ are two directed graphs without singular vertices?