CS3133
HW#6 SOLUTIONS

1. All productions are useless because each variable is nongenerating. The language the grammar generates is $\varnothing$.

2. C is not generating, so removing all productions containing C yields

$$S \to a|aA|B$$
$$A \to aB|e$$
$$B \to Aa$$
$$D \to ddd$$

D, c and d are not reachable, so the final grammar is

$$S \to a|aA|B$$
$$A \to aB|e$$
$$B \to Aa$$

3. Removing useless productions yields

$$S \to aA$$
$$A \to aaA|e$$

To remove e-productions, we first compute Nullable={A}, and then we derive

$$S \to aA|a$$
$$A \to aaA|aa$$

There are no unit productions, so we are done.

4. The unit pairs are $(S,S),(S,B),(S,A),(B,B),(B,A),(A,A),(A,B)$. The new equivalent grammar without unit productions is

$$S \to aA|ab|a|bc$$
$$B \to ab|a|bc$$
$$A \to a|bc|ab$$

and, removing useless symbols,

$$S \to aA|ab|a|bc$$
$$A \to a|bc|ab$$