$$C(s) + H_2O(g) \leftrightarrow CO(g) + H_2(g) \quad \Delta H° = +131\ kJ$$

1. A rigid container holds a mixture of graphite pellets (C(s)), $H_2O(g)$, CO(g), and $H_2(g)$ at equilibrium. State whether the reaction shifts to the right or left and then whether the number of moles of CO(g) in the container will increase, decrease, or remain the same after each of the following disturbances is applied to the original mixture. For each case, assume that other variables remain constant except for the given disturbance. Explain each answer with a short statement.

(a) Additional $H_2(g)$ is added to the equilibrium mixture at constant volume.

shift left, moles CO(g) decrease.
Additional H_2 will make $Q > K$, thus to reestablish equilibrium the rxn will shift left.

(b) The temperature of the equilibrium mixture is increased at constant volume.

shift right, moles CO(g) increase.
The rxn is endothermic, thus heat is a reactant.
Increasing T favors the forward rxn.

(c) The volume of the container is decreased at constant temperature.

shift left, moles CO(g) decrease.
There are less moles of gas on the reactant side than the product side. Decreasing volume, increases pressure causing the system to shift to the side with less moles of gas.

(d) The graphite pellets are pulverized.

No shift, moles CO(g) remain the same.
Graphite, C(s), is a solid. Solids have no effect on the equilibrium since they are not used in K expressio