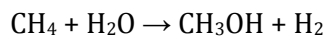


Predicting equilibrium shifts – LeChatelier’s Principle

system	change	result
$\text{CO}_2(g) + \text{H}_2(g) \rightleftharpoons \text{H}_2\text{O}(g) + \text{CO}(g)$	a drying agent is added to absorb H_2O	
$\text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2\text{HI}(g)$	Some nitrogen gas is added	
$\text{NaCl}(s) + \text{H}_2\text{SO}_4(l) \rightleftharpoons \text{Na}_2\text{SO}_4(s) + \text{HCl}(g)$	reaction is carried out in an open container	
$\text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{O}(g)$	water evaporates from an open container	
$\text{HCN}(aq) \rightleftharpoons \text{H}^+(aq) + \text{CN}^-(aq)$	the solution is diluted	
$\text{AgCl}(s) \rightleftharpoons \text{Ag}^+(aq) + \text{Cl}^-(aq)$	some NaCl is added to the solution	
$\text{N}_2(g) + 3 \text{H}_2(g) \rightleftharpoons 2 \text{NH}_3(g) \quad \Delta H = -92 \text{ kJ/mol}$	The volume of the container is reduced at constant temperature	
$\text{N}_2(g) + 3 \text{H}_2(g) \rightleftharpoons 2 \text{NH}_3(g) \quad \Delta H = -92 \text{ kJ/mol}$	The temperature of the reacting system is increased	
$\text{N}_2(g) + 3 \text{H}_2(g) \rightleftharpoons 2 \text{NH}_3(g) \quad \Delta H = -92 \text{ kJ/mol}$	a catalyst is added to speed up this reaction	
$\text{Co}(\text{H}_2\text{O})_6^{2+}(aq) + 4 \text{Cl}^-(aq) \rightleftharpoons \text{Co}(\text{Cl})_4^{2-}(aq) + 6 \text{H}_2\text{O}(l)$	Some acetone is added to the system	
$\text{Co}(\text{H}_2\text{O})_6^{2+}(aq) + 4 \text{Cl}^-(aq) \rightleftharpoons \text{Co}(\text{Cl})_4^{2-}(aq) + 6 \text{H}_2\text{O}(l)$	Some water is added to the system	

Challenge question

The commercial production of hydrogen is carried out by treating natural gas with steam at high temperatures and in the presence of a catalyst ("steam reforming of methane"):



Given the following boiling points:

- CH₄ = -161°C
- H₂O = 100°C
- CH₃OH = 65°
- H₂ = -253°C,

predict the effects of an increase in the total pressure on this equilibrium...

a) at 50°

b) at 75°

c) at 120°C.