Predicting equilibrium shifts – LeChatelier's Principle

system	change	result
$CO_2(g) + H_2(g) \rightleftarrows H_2O(g) + CO(g)$	a drying agent is added to absorb H_2O	
$H_2(g) + I_2(g) \rightleftarrows 2HI(g)$	Some nitrogen gas is added	
$NaCl(s) + H_2SO_4(l) \rightleftarrows Na_2SO_4(s) + HCl(g)$	reaction is carried out in an open container	
$H_2O(l) \rightleftarrows H_2O(g)$	water evaporates from an open container	
$HCN(aq) \rightleftarrows H^+(aq) + CN^-(aq)$	the solution is diluted	
$AgCl(s) \rightleftarrows Ag^+(aq) + Cl^-(aq)$	some NaCl is added to the solution	
$N_2(g) + 3\ H_2(g) \rightleftarrows 2\ NH_3(g) \quad \Delta H = -92$ kJ/mol	The volume of the container is reduced at constant temperature	
$N_2(g) + 3\ H_2(g) \rightleftarrows 2\ NH_3(g) \quad \Delta H = -92$ kJ/mol	The temperature of the reacting system is increased	
$N_2(g) + 3\ H_2(g) \rightleftarrows 2\ NH_3(g) \quad \Delta H = -92$ kJ/mol	a catalyst is added to speed up this reaction	
$Co(H_2O)_6^{2+}(aq) + 4\ Cl^-(aq) \rightleftarrows Co(Cl)_4^{2-}(aq) + 6\ H_2O(l)$	Some acetone is added to the system	
$Co(H_2O)_6^{2+}(aq) + 4\ Cl^-(aq) \rightleftarrows Co(Cl)_4^{2-}(aq) + 6\ H_2O(l)$	Some water is added to the system	

Adapted from: http://www.chem1.com/acad/webtext/chemeq/Eq-02.html

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"):

$$CH_4 + H_2O \rightarrow CH_3OH + H_2$$

Given the following boiling points: CH_4 = –161°C
H_2O = 100°C
CH_3OH = 65°
H_2 = –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.

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