

Name: _____

date: _____ period: _____

Ch. 14.3 equilibrium

test

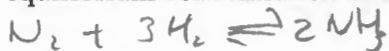
45 points

ngss chemistry

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) proper number of significant figures in your answer.

1. In regards to the reaction: $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightleftharpoons 2 \text{NH}_3(\text{g})$, there is initially 4.0 mM and 9.0 mM N_2 and H_2 , respectively. At equilibrium, there is 2.0 mM N_2 ; what is ... [10 points]

a. the equilibrium concentration of H_2 and NH_3 ? basis / rationale?



I	4 mM	9 mM	0
C	-2	-6	+4
E	2 mM	3 mM	4 mM

3 + 3 + 5

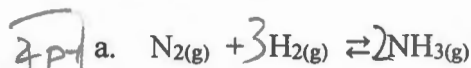
b. the numeric value of the equilibrium constant? basis / rationale?

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{(4 \cdot 10^{-3})^2}{(2 \cdot 10^{-3})(3 \cdot 10^{-3})^3} = \frac{16 \cdot 10^{-6}}{54 \cdot 10^{-12}} = 0.296 \cdot 10^6$$

or
equivalent

1 + 3 + 1

2. Write the algebraic expression of the equilibrium constant for the reaction ... [15 points]



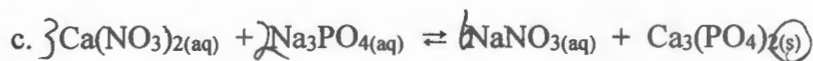
3

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$



3

$$K_p = \frac{P_{\text{NH}_3}^2}{P_{\text{N}_2} P_{\text{H}_2}^3}$$



3

$$K_c = \frac{[\text{NaNO}_3]^6}{[\text{Ca}(\text{NO}_3)_2]^3 [\text{Na}_3\text{PO}_4]^2}$$

3. The chemical reaction: $2\text{NH}_3(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$ is at equilibrium and is an endothermic reaction. What is the effect on the number of moles of N_2 by a disturbance of the reaction at equilibrium due to ...? basis / rationale? [20 points]

a. addition of an inert gas, helium, at constant volume and temperature

$$Q = \frac{[\text{N}_2][\text{H}_2]^3}{[\text{NH}_3]^2} = \frac{n_{\text{N}_2} n_{\text{H}_2}^3 (\frac{1}{V})^4}{n_{\text{NH}_3}^2 (\frac{1}{V})^2} = \frac{n_{\text{N}_2} n_{\text{H}_2}^3}{n_{\text{NH}_3}^2 V^2}$$

$\pm n_{\text{He}}$ b/c P still \in equilibrium

b. addition of an inert gas, neon, at constant pressure and temperature

$$\text{i)} P V = n R T \rightarrow P = \frac{n R T}{V}$$

ii) $\uparrow n_{\text{Ne}} \rightarrow \uparrow n_{\text{total}} \rightarrow \uparrow P \rightarrow \uparrow V$ to maintain $P \rightarrow \downarrow Q \rightarrow \uparrow Q$ to establish equilibrium

$$\text{iii)} \dots \left[Q = \frac{n_{\text{N}_2} n_{\text{H}_2}^3}{n_{\text{NH}_3}^2 V^2} \right]$$

\downarrow
 $\uparrow n_{\text{N}_2}$

c. removal of NH_3

i) $\downarrow n_{\text{NH}_3} \rightarrow \uparrow Q \rightarrow \downarrow Q$ to establish equilibrium $\rightarrow \downarrow n_{\text{N}_2}$

$$\text{ii)} Q = \frac{n_{\text{N}_2} n_{\text{H}_2}^3}{n_{\text{NH}_3}^2 V^2}$$

d. cooling the reaction



$\downarrow T \rightarrow$ "want" $\uparrow T =$ forward $\rightarrow \uparrow n_{\text{H}_2} \rightarrow \downarrow n_{\text{N}_2}$