12.32

	HN_3	+ H_2O ⇌	H_3O^+	+ N_3^-
start	C_0		0	0
change	$-x$		$+x$	$+x$
equilibrium	$C_0 - x$		x	x

$$K = 1.9 \times 10^{-5} = \frac{[H_3O^+][N_3^-]}{[HN_3]}$$

the equilibrium constant is 1.9×10^{-5} which means that x is small compared to C_0 so avoid using the quadratic equation by making the assumption: $C_0 - x \approx C_0$.

(a) $C_0 = \frac{1.00\ mol}{0.10\ L} = 10.\ M$ so $K = \frac{x^2}{10 - x} \approx \frac{x^2}{10}$ $\quad x = 1.4 \times 10^{-2}$

so, at equilibrium: $[HN_3] = C_0 - x = (10. - 0.014)M \approx 10.\ M$

$[N_3^-] = [H_3O^+] = x = 0.014\ M$

(b) $C_0 = \frac{1.00\ mol}{1.00\ L} = 1.00\ M$ so $K = \frac{x^2}{1.00 - x} \approx \frac{x^2}{1.00}$ $\quad x \approx 4.4 \times 10^{-3}$

so, at equilibrium: $[HN_3] = C_0 - x = (1.00 - 0.0044)M \approx 1.00\ M$

$[N_3^-] = [H_3O^+] = x = 0.0044\ M$

(c) $C_0 = \frac{1.00\ mol}{10.0\ L} = 0.100\ M$ so $K = \frac{x^2}{0.100 - x} \approx \frac{x^2}{0.100}$ $\quad x \approx 0.0014\ M$

so, at equilibrium: $[HN_3] = C_0 - x = (0.100 - 0.0014)M \approx 0.099\ M$

$[N_3^-] = [H_3O^+] = x = 0.0014\ M$

12.45 (a) 1 & 3 are driven out of equilibrium

(b) If pressure increases, reaction 1 more toward product to decrease pressure while reaction 3 more toward reactants.