A

Reaction Quotient Answers

1.

	$Cl_{2\,(g)}$	+	$F_{2\,(g)}$	$\rightleftharpoons$	$2\ ClF_{(g)}$
I	0.400		0.200		7.3

$Q = \frac{[ClF]^2}{[Cl_2][F_2]} = \frac{(7.3)^2}{(0.4)(0.2)} = 666$ Q > K, therefore shifts left

2. Q = 0.2 Q > K, shifts left

3.

(a)

	$CO_{(g)}$	+	$H_2O_{(g)}$	$\rightleftharpoons$	$CO_{2\,(g)}$	+	$H_{2\,(g)}$
I	0.01		0.01		0.01		0.01

$Q = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{(0.01)(0.01)}{(0.01)(0.01)} = 1$ Q > K, shifts left

(b)

	$CO_{(g)}$	+	$H_2O_{(g)}$	$\rightleftharpoons$	$CO_{2\,(g)}$	+	$H_{2\,(g)}$
I	0.01		0.01		0.01		0.01
C	+x		+x		-x		-x
E	0.01 +x		0.01 +x		0.01 - x		0.01 – x

$K = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{(0.01 - x)(0.01 - x)}{(0.01 + x)(0.01 + x)} = 0.4$

$\frac{(0.01 - x)}{(0.01 + x)} = 0.632$

$x = 2.25 \times 10^{-3}$

$[CO_2]_{eq'm} = [H_2]_{eq'm} = 7.75 \times 10^{-3}$ mol /L

$[CO]_{eq'm} = [H_2O]_{eq'm} = 1.25 \times 10^{-2}$ mol/L

4. Q < K, shifts right

$[F_2]_{eq'm} = [Br_2]_{eq'm} = 0.22$ mol / L

$[BrF]_{eq'm} = 1.64$ mol/L

(B)

$SO_{3(g)} \rightleftharpoons SO_{2(g)} + \frac{1}{2} O_{2(g)}$ $\Delta H = 98.9k$

a)

	SO_3	SO_2	O_2		
add O_2	↑	↓	↓	shifts left	rvs rxn will consume the added O_2 and ↓ $[O_2]$
↓V/↑P constant T	↑	↓	↓	shifts left	fewer moles on the reactant side, result in fewer collisions w side of the container ↓P
add Ar	—	—	—	no change	noble gas does not affect position of eq'm
remove SO_2	↓	↑	↑	shift right	fwd rxn will produce SO_2 and replace some of the lost SO_2
↓T	↑	↓	↓	shift left	rvs rxn is exothermic and will produce some E

$4NH_{3(g)} + 3O_{2(g)} \rightleftharpoons 2N_{2(g)} + 6H_2O_{(l)}$ $\Delta H = -1530 KJ$

	NH_3	O_2	N_2	H_2O		
remove O_2	↑	↑	↓	—	shift left	- rvs rxn will produce O_2 and replace the removed O_2
add N_2	↑	↑	↓	—	shift left	- rvs rxn will consume the added N_2 and decrease $[N_2]$
add H_2O	—	—	—	—	—	no affect ; not [ ]
↑V at constant P	—	—	—	—	—	no change in P results in neither side having a preference
↑T	↑	↑	↓	↓	shift left	- rvs rxn is endothermic and will consume the added energy

→ only a temp change will change K_{Eq}

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51. a) $H_2O_{(g)} + C_{(s)} \rightleftharpoons CO_{(g)} + H_2{}_{(g)}$

↑P/↓V → shift left bcz fewer reactant particles
→ result in fewer collisions w side of container
→ P ↓

b) $SbCl_5{}_{(g)} \rightleftharpoons SbCl_3{}_{(g)} + Cl_2{}_{(g)}$

↑P/↓V → shift left

c) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_2{}_{(g)} + H_2{}_{(g)}$

↑P/↓V → no shift
→ same # of gas particles on both sides so neither side is prefered

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52. a) $Ni_{(s)} + 4CO_{(g)} \rightleftharpoons Ni(CO)_4{}_{(g)}$ ↓P/↑V → shift left; more moles of gas particles, increasing the collisions w side of the container; ↑P

b) $ClF_5{}_{(g)} \rightleftharpoons ClF_3{}_{(g)} + F_2$ ↓P/↑V → shift right

c) $HBr_{(g)} \rightleftharpoons \frac{1}{2}H_2{}_{(g)} + \frac{1}{2}Br_2{}_{(g)}$ ↓P/↑V → no affect

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56. $A_{(g)} + 3B_{(g)} \rightleftharpoons 2C_{(g)} + 3D_{(g)}$ $\Delta H < 0$

	Keq	
a) ↑T at constant V	decrease	(rvs rxn endothermic; consume add E creating more reactants & fewer products)
b) add A	no affect	only change in temp affects Keq
c) add C	no affect	
d) remove D	no affect	
e) ↑P/↓V	no affect	