# **Equilibrium Calculations**

#### Apprentice Difficulty Level Question 1

Consider the reversible system:  $CO_{(g)} + CI_{2(g)} \rightleftharpoons COCI_{2(g)}$ 

Several trials are run at different temperatures. Results are shown. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[CO]	[Cl <sub>2</sub> ]	[COCl <sub>2</sub> ]	Kc
A	0.0492	0.0710	0.8381	
в	0.00540	0.00821	0.01245	
С		0.0345	0.7650	175
D	0.0548		0.6005	135
Ε	0.00792	0.00981		212

#### Question 2

Consider the reversible system:  $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ 

	[CO]	[Cl <sub>2</sub> ]	[COCl <sub>2</sub> ]	Kc
A	0.0673	0.0809	0.9254	
в	0.00480	0.00727	0.01481	
C		0.0426	0.8170	185
D	0.0605		0.6832	145
E	0.00927	0.00816		235

Consider the reversible system:  $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ 

Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[CO]	[Cl <sub>2</sub> ]	[COCl <sub>2</sub> ]	Kc
A	0.0705	0.0791	0.8719	
в	0.00524	0.00818	0.02075	
С		0.0386	0.8074	205
D	0.0590		0.5028	165
Е	0.00649	0.00752		195

## **Question 4**

Consider the reversible system:  $Cl_2(g) + NCl_3(g) \rightleftharpoons NCl_5(g)$ 

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	[Cl <sub>2</sub> ]	[NCI <sub>3</sub> ]	[NCI₅]	Kc
A	0.0382	0.0259	0.0445	
В	0.00983	0.00806	0.00277	
С		0.0599	0.0748	33.5
D	0.0727		0.0911	28.0
Е	0.00639	0.00881		52.5

Consider the reversible system:  $Cl_2(g) + NCl_3(g) \rightleftharpoons NCl_5(g)$ 

Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[Cl <sub>2</sub> ]	[NCI <sub>3</sub> ]	[NCl₅]	Kc
A	0.0456	0.0719	0.0897	
В	0.00519	0.00770	0.00129	
С		0.0625	0.0819	34.0
D	0.0428		0.0859	26.5
Ε	0.00492	0.00545		44.0

## **Question 6**

Consider the reversible system:  $Cl_{2(g)} + NCl_{3(g)} \rightleftharpoons NCl_{5(g)}$ 

	[Cl <sub>2</sub> ]	[NCI <sub>3</sub> ]	[NCI <sub>5</sub> ]	Kc
A	0.0517	0.0693	0.0925	
В	0.00758	0.00845	0.00285	
С		0.0492	0.0675	38.0
D	0.0591		0.0720	29.5
Е	0.00892	0.00948		42.0

### Master Difficulty Level Question 7 Consider the reversible system: $2 \text{ SO}_{2(g)} + \text{ O}_{2(g)} \rightleftharpoons 2 \text{ SO}_{3(g)}$

Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[SO <sub>2</sub> ]	[O <sub>2</sub> ]	[SO <sub>3</sub> ]	Kc
A	0.0482	0.0715	0.3170	
в	0.00239	0.00488	0.00437	
С		0.0356	0.1208	525
D	0.0186		0.0817	715
Е	0.00335	0.00572		585

### Question 8

Consider the reversible system:	2 SO <sub>2(g)</sub>	+	O <sub>2(g)</sub>	$\rightleftharpoons$	2 SO <sub>3(g)</sub>
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	[SO <sub>2</sub> ]	[O <sub>2</sub> ]	[SO <sub>3</sub> ]	Kc
A	0.0692	0.0767	0.5250	
в	0.00448	0.00271	0.00602	
С		0.0288	0.2520	625
D	0.0116		0.0759	582
Е	0.00739	0.00242		698

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Consider the reversible system: 2 \text{ SO}_{2(g)} + O_{2(g)} \rightleftharpoons 2 \text{ SO}_{3(g)}
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Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[SO <sub>2</sub> ]	[O <sub>2</sub> ]	[SO₃]	Kc
A	0.0638	0.0625	0.4410	
в	0.00559	0.00332	0.00821	
С		0.0144	0.0895	829
D	0.0195		0.0713	744
Е	0.00589	0.00354		612

#### **Question 10**

Consider the reversible system:  $2 \text{ NO}_{(g)} + O_{2(g)} \rightleftharpoons 2 \text{ NO}_{2(g)}$ 

	[NO]	[ <b>O</b> <sub>2</sub> ]	[NO <sub>2</sub> ]	Kc
A	0.00665	0.00189	0.07250	
в	0.00138	0.00757	0.03520	
С		0.00722	0.08950	45200
D	0.00395		0.07880	61500
E	0.00724	0.00488		79500

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Consider the reversible system: 2 \text{ NO}_{(g)} + O_{2(g)} \rightleftharpoons 2 \text{ NO}_{2(g)}
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Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[NO]	[O <sub>2</sub> ]	[NO <sub>2</sub> ]	Kc
A	0.00238	0.00669	0.05650	
В	0.00428	0.00526	0.07160	
С		0.00412	0.09650	72500
D	0.00485		0.06880	59500
Е	0.00688	0.00225		63500

#### **Question 12**

Consider the reversible system:  $2 \text{ NO}_{(g)} + O_{2(g)} \rightleftharpoons 2 \text{ NO}_{2(g)}$ 

	[NO]	[O <sub>2</sub> ]	[NO <sub>2</sub> ]	Kc
A	0.00482	0.00189	0.05910	
В	0.00415	0.00480	0.08270	
С		0.00366	0.08110	68800
D	0.00326		0.07220	61500
Е	0.00547	0.00184		77500

## Wizard Difficulty Level Question 13 Consider the reversible system: $N_{2(g)} + 3 H_{2(g)} \rightleftharpoons 2 NH_{3(g)}$

Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Kc
A	0.1250	0.2590	0.02410	
в	0.03280	0.08160	0.00272	
С		0.0982	0.0108	0.785
D	0.5260		0.0467	0.362
Е	0.0450	0.0732		0.878

#### **Question 14**

Consider the reversible system:  $N_{2(g)}$  + 3  $H_{2(g)}$   $\rightleftharpoons$  2  $NH_{3(g)}$ 

	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Kc
A	0.3650	0.3810	0.0875	
в	0.06720	0.07510	0.00396	
С		0.2880	0.0508	0.675
D	0.1920		0.0652	0.586
E	0.0622	0.0853		0.840

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Consider the reversible system: N_{2(g)} + 3 H_{2(g)} \rightleftharpoons 2 NH_{3(g)}
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Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH₃]	Kc
A	0.2660	0.3090	0.0715	
В	0.08250	0.08660	0.00684	
С		0.4240	0.0819	0.385
D	0.3260		0.0541	0.547
Е	0.0853	0.0616		0.628

#### **Question 16**

Consider the reversible system:  $N_{2(g)}$  +  $3 H_{2(g)} \rightleftharpoons 2 NH_{3(g)}$ 

	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Kc
A	0.2170	0.3440	0.0827	
в	0.06730	0.07540	0.00438	
С		0.3620	0.0598	0.250
D	0.2540		0.0399	0.725
Е	0.0651	0.0767		0.654

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Consider the reversible system: N_{2(g)} + 3 H_{2(g)} \rightleftharpoons 2 NH_{3(g)}
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Several trials are run at different temperatures. Results are shown in the table. Concentrations are equilibrium concentrations. Determine the missing value in each row.

	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH₃]	Kc
A	0.6720	0.2150	0.0639	
В	0.05250	0.08020	0.00489	
С		0.4770	0.0893	0.384
D	0.1760		0.0693	0.908
Е	0.0537	0.0622		0.754

### Question 18

Consider the reversible system:	<b>N</b> <sub>2(g)</sub>	+	3 H <sub>2(g)</sub>	⇄	2 NH <sub>3(g)</sub>
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	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Kc
A	0.2850	0.3080	0.0472	
В	0.05390	0.08840	0.00521	
С		0.3290	0.0658	0.305
D	0.2150		0.0812	0.472
Е	0.0736	0.0558		0.804