

Fullständiga lösningar på några uppgifter i Kemi 2

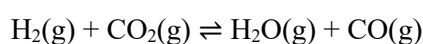
(Bokens tryckning: 2017 eller senare.)

Är det någon uppgift du saknar lösning på? I så fall får du gärna mejla meundervisning@ehinger.nu, så ska jag se om jag kan lägga till den!

Senast uppdaterat 2020-06-27.

Kapitel 2

2.10



$$[\text{H}_2\text{O}] = 0,00468\text{M}$$

$$[\text{CO}] = 0,00468\text{M}$$

$$[\text{H}_2] = 0,00532$$

$$[\text{CO}_2] = 0,00532$$

$$K = \frac{[\text{H}_2\text{O}][\text{CO}]}{[\text{H}_2][\text{CO}_2]} = \frac{0,00468\text{M} \cdot 0,00468\text{M}}{0,00532\text{M} \cdot 0,00532\text{M}} = 0,77387077 \approx 0,774$$

2.12.

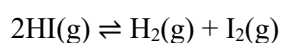
$$K = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]}$$

$$1,4 \cdot 10^{-4} = \frac{x^2}{0,036\text{M} \cdot 0,0089\text{M}}$$

$$x^2 = 1,4 \cdot 10^{-4} \cdot 0,036\text{M} \cdot 0,0089\text{M}$$

$$x = \sqrt{1,4 \cdot 10^{-4} \cdot 0,036\text{M} \cdot 0,0089\text{M}} = 2,117924 \cdot 10^{-4}\text{M} \approx 2,1 \cdot 10^{-4}\text{M}$$

2.13



$$K = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}$$

$$0,020 = \frac{0,0200\text{M} \cdot [\text{I}_2]}{(1,33\text{M})^2}$$

$$[\text{I}_2] = 0,020 \cdot \frac{(1,33\text{M})^2}{0,0200\text{M}} = 1,7689\text{M} \approx 1,8\text{M}$$

2.14

$$K = \frac{[\text{CO}][\text{H}_2]^3}{[\text{CH}_4][\text{H}_2\text{O}]}$$

$$[\text{H}_2] = \sqrt[3]{\frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}]} \cdot K} = \sqrt[3]{\frac{0,200 \cdot 0,150}{1,37 \cdot 10^{-2}} \cdot 3,17 \cdot 10^{-5}} = 0,04109793\text{M} \approx 0,0411\text{M}$$

2.16a

$$Q = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} = \frac{1,00 \cdot 1,00}{1,00^2} = 1 > K = 1,36 \cdot 10^{-3}$$

Eftersom $Q > K$ kommer reaktionen att gå åt höger.

b

	[HI]	[H ₂]	[I ₂]	
f.r.	1,00	1,00	1,00	M
Δ	+2x	-x	-x	M
v.jv.	1,00 + 2x	1,00 - x	1,00 - x	M

$$K = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}$$

$$1,36 \cdot 10^{-3} = \frac{(1,00 - x)(1,00 - x)}{1,00 + 2x} = \frac{(1,00 - x)^2}{1,00 + 2x}$$

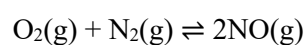
pq-formeln ger:

$$x = 0,937471$$

$$[\text{HI}] = (1,00 + 2x)\text{M} = (1,00 + 2 \cdot 0,937471)\text{M} = 2,874942\text{M} \approx 2,87\text{M}$$

$$[\text{H}_2] = [\text{I}_2] = (1,00 - x)\text{M} = (1,00 - 0,937471)\text{M} = 0,062529\text{M} \approx 0,0625\text{M}$$

2.22a



$$Q = \frac{[\text{NO}]^2}{[\text{O}_2][\text{N}_2]} = \frac{(0,22\text{M})^2}{1,00\text{M} \cdot 1,0\text{M}} = 0,0484 < K = 0,097$$

Reaktionen kommer att gå åt höger.

	[O ₂]	[N ₂]	[NO]	
f.r.	1,0	1,0	0,22	M
Δ	-x	-x	+2x	M
v.j.	1,0 - x	1,0 - x	0,22 + 2x	M

$$K = \frac{[\text{NO}]^2}{[\text{O}_2][\text{N}_2]}$$

$$0,097 = \frac{(0,22 + 2x)^2}{(1,0 - x)(1,0 - x)} = \frac{(0,22 + 2x)^2}{(1,0 - x)^2}$$

$$\sqrt{0,097} = \sqrt{\frac{(0,22 + 2x)^2}{(1,0 - x)^2}} = \frac{0,22 + 2x}{1,0 - x}$$

$$\sqrt{0,097} \cdot (1,0 - x) = 0,22 + 2x$$

$$\sqrt{0,097} - \sqrt{0,097} \cdot x = 0,22 + 2x$$

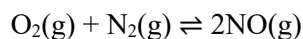
$$\sqrt{0,097} - 0,22 = 2x + \sqrt{0,097} \cdot x = x(2 + \sqrt{0,097})$$

$$x = \frac{\sqrt{0,097} - 0,22}{2 + \sqrt{0,097}} = 0,03956317$$

$$[\text{O}_2] = [\text{N}_2] = (1,0 - x)\text{M} = (1,0 - 0,03956317)\text{M} = 0,96043683\text{M} \approx 0,96\text{M}$$

$$[\text{NO}] = (0,22 + 2x)\text{M} = (0,22 + 2 \cdot 0,03956317)\text{M} = 0,29912635\text{M} \approx 0,30\text{M}$$

2.22b.



	[O ₂]	[N ₂]	[NO]	
f.r.	0,96... + 0,50	0,96...	0,299...	M
Δ	-x	-x	+2x	M
v.j.	0,96... + 0,50 - x	0,96... - x	0,299... + 2x	M

$$K = \frac{[\text{NO}]^2}{[\text{O}_2][\text{N}_2]}$$

$$0,097 = \frac{(0,29912635 + 2x)^2}{(0,96043683 + 0,50 - x)(0,96043683 - x)}$$

Ekvationen förenklas och löses med pq -formeln:

$$x_1 = -0,396803; \text{ orimligt}$$

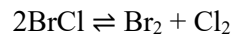
$$x_2 = 0,0300772$$

$$[\text{O}_2] = (0,96\dots + 0,50 - 0,0300772)\text{M} = 1,43035963\text{M} \approx 1,43\text{M}$$

$$[\text{N}_2] = (0,96\dots - 0,0300772)\text{M} = 0,93035963\text{M} \approx 0,93\text{M}$$

$$[\text{NO}] = (0,299\dots + 2 \cdot 0,0300772)\text{M} = 0,35928075\text{M} \approx 0,36\text{M}$$

2.28.



$$Q = \frac{[\text{Br}_2][\text{Cl}_2]}{[\text{BrCl}]^2} = \frac{(0,15\text{M})(0,15\text{M})}{(0,30\text{M})^2} = 0,25 < K = 0,46$$

Eftersom $Q < K$ kommer reaktionen att gå åt höger.

	[BrCl]	[Br ₂]	[Cl ₂]	
f.r.	0,30	0,15	0,15	M
Δ	-2x	+x	+x	M
v.jv.	0,30 - 2x	0,15 + x	0,15 + x	M

$$K = \frac{[\text{Br}_2][\text{Cl}_2]}{[\text{BrCl}]^2}$$

$$0,46 = \frac{(0,15 + x)(0,15 + x)}{(0,30 - 2x)^2} = \frac{(0,15 + x)^2}{(0,30 - 2x)^2}$$

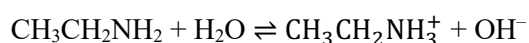
$$\sqrt{0,46} = \sqrt{\frac{(0,15 + x)^2}{(0,30 - 2x)^2}} = \frac{0,15 + x}{0,30 - 2x}$$

$x = 0,0226907$ (Vi kan bortse från rötternas negativa lösningar eftersom de ger orimliga resultat.)

$$[\text{BrCl}] = (0,30 - 2x)\text{M} = (0,30 - 2 \cdot 0,0226907)\text{M} = 0,2546186\text{M} \approx 0,25\text{M}$$

Kapitel 3

3.14.



$$K_b = \frac{[\text{CH}_3\text{CH}_2\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{CH}_2\text{NH}_2]}$$

	$[\text{CH}_3\text{CH}_2\text{NH}_2]$	$[\text{CH}_3\text{CH}_2\text{NH}_3^+]$	$[\text{OH}^-]$	
f.r.	0,750	0	0	M
Δ	$-x$	$+x$	$+x$	M
v.jv.	$0,750 - x$	x	x	M

$$5,6 \cdot 10^{-4} = \frac{x \cdot x}{0,750 - x} = \frac{x^2}{0,750 - x}$$

pq-formeln ger:

$$x = 0,0202158 \text{ (Rotens negativa lösning är orimlig.)}$$

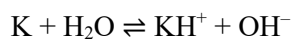
$$[\text{OH}^-] = x\text{M} = 0,0202158\text{M} \approx 0,020\text{M}$$

3.17a.

$$K_b = \frac{K_w}{K_a} = \frac{1,0 \cdot 10^{-14}\text{M}^2}{6,2 \cdot 10^{-9}\text{M}} = 1,61290323 \cdot 10^{-6}\text{M}$$

b.

Vi kan skriva kodeinet K.



$$K_b = \frac{[\text{KH}^+][\text{OH}^-]}{[\text{K}]}$$

	$[\text{K}]$	$[\text{KH}^+]$	$[\text{OH}^-]$	
f.r.	0,0020	0	0	M
Δ	$-x$	$+x$	$+x$	M
v.jv.	$0,0020 - x$	x	x	M

$$1,61290323 \cdot 10^{-6} = \frac{x \cdot x}{0,0020 - x} = \frac{x^2}{0,0020 - x}$$

pq-formeln ger:

$x = 5,59955 \cdot 10^{-5}$ (Rotens negativa lösning är orimlig.)

$$[\text{OH}^-] = x\text{M} = 5,59955 \cdot 10^{-5}\text{M}$$

$$\text{pOH} = -\lg[\text{OH}^-] = -\lg(5,59955 \cdot 10^{-5}) = 4,25184687$$

$$\text{pH} = 14,00 - \text{pOH} = 14,00 - 4,25184687 = 9,74815313 \approx 9,75$$

3.30a.

$$\text{pH} = \text{p}K_a - \lg\left(\frac{c_{\text{syra}}}{c_{\text{bas}}}\right) = 4,76 - \lg\left(\frac{0,050}{0,10}\right) = 5,06103000 \approx 5,06$$

b.

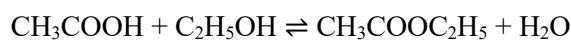
$$\text{pH} = \text{p}K_a - \lg\left(\frac{c_{\text{syra}}}{c_{\text{bas}}}\right) = 9,24 - \lg\left(\frac{0,25}{0,15}\right) = 9,01815125 \approx 9,02$$

c.

$$\text{pH} = \text{p}K_a - \lg\left(\frac{c_{\text{syra}}}{c_{\text{bas}}}\right) = 7,05 - \lg\left(\frac{0,15}{0,45}\right) = 7,52712125 \approx 7,53$$

Kapitel 5

5.32.



$$Q = \frac{[\text{CH}_3\text{COOC}_2\text{H}_5][\text{H}_2\text{O}]}{[\text{CH}_3\text{COOH}][\text{C}_2\text{H}_5\text{OH}]} = \frac{0,40\text{M} \cdot 0,40\text{M}}{0,15\text{M} \cdot 0,15\text{M}} = 7,11111111 > K = 4,0$$

Eftersom $Q > K$ kommer reaktionen att gå åt vänster.

	$[\text{CH}_3\text{COOH}]$	$[\text{C}_2\text{H}_5\text{OH}]$	$[\text{CH}_3\text{COOC}_2\text{H}_5]$	$[\text{H}_2\text{O}]$	
f.r.	0,15	0,15	0,40	0,40	M
Δ	+x	+x	-x	-x	M
v.jv.	0,15 + x	0,15 + x	0,40 - x	0,40 - x	M

$$K = \frac{[\text{CH}_3\text{COOC}_2\text{H}_5][\text{H}_2\text{O}]}{[\text{CH}_3\text{COOH}][\text{C}_2\text{H}_5\text{OH}]}$$

$$4,0 = \frac{(0,40 - x)(0,40 - x)}{(0,15 + x)(0,15 + x)} = \frac{(0,40 - x)^2}{(0,15 + x)^2}$$

$$\sqrt{4,0} = \sqrt{\frac{(0,40 - x)^2}{(0,15 + x)^2}}$$

$$2,0 = \frac{0,40 - x}{0,15 + x}$$

$x = 0,03333333$ (Rotens negativa lösning är orimlig.)

$$[\text{CH}_3\text{COOH}] = [\text{C}_2\text{H}_5\text{OH}] = (0,15 + x)\text{M} = (0,15 + 0,03333333)\text{M} = 0,18333333\text{M} \approx 0,18\text{M}$$

$$[\text{CH}_3\text{COOC}_2\text{H}_5] = [\text{H}_2\text{O}] = (0,40 - x)\text{M} = (0,40 - 0,03333333)\text{M} = 0,36666667\text{M} \approx 0,37\text{M}$$