

## Fasit



til 2. uttaksprøve til den  
**44. Internasjonale Kjemiolympiaden 2012**  
i Washington DC, USA

### Oppgave 1 (30 poeng, 2 poeng per deloppgave)

Hvert av spørsmålene i denne oppgaven skal besvares ved å angi bokstavkoden til det alternativet som er korrekt. *Kun ett svar* er korrekt for hvert spørsmål.

- |      |       |
|------|-------|
| 1) C | 9) D  |
| 2) D | 10) C |
| 3) B | 11) B |
| 4) D | 12) C |
| 5) A | 13) D |
| 6) B | 14) A |
| 7) B | 15) C |
| 8) A |       |

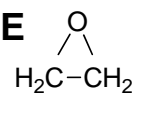
### Oppgave 2 (15 poeng)

- $\text{CaCO}_3 (\text{s}) \rightarrow \text{Ca}^{2+} (\text{aq}) + \text{CO}_3^{2-} (\text{aq})$  (aggregattilstander viktig)
- 0,69 mg  $(4,8 \cdot 10^{-9} = [\text{Ca}^{2+}][\text{CO}_3^{2-}])$
- $\text{Ca}^{2+}$  tilskuer,  $\text{CO}_3^{2-}$  gjør løsningen basisk. (Lite løser seg i rent vann.)  
Beregninger er bra, men ikke nødvendig.
- $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{CO}_3$
- Kalsiumkarbonat heksahydrat, 9,5 g vann.
- $\text{Ca}(\text{HCO}_3)_2 (\text{aq}) \rightarrow \text{CaCO}_3 (\text{s}) + \text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{l})$

### Oppgave 3 (20 poeng)

- $2 \text{Al}(\text{CH}_3)_3 + 3\text{H}_2\text{O} \rightarrow \text{Al}_2\text{O}_3 + 6 \text{CH}_4$
- $\text{TiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{TiO}_2 + 4\text{HCl}$
- $\text{TiCl}_4 + \text{NH}_3 \rightarrow \text{TiN} + \text{HCl}$
- 2,5 mg (Finne antall lag, gange med antall atomer pr kvadratcentimeter, gange med areal, gange med masser (Ti + N), dele på avogadros konstant)
- $\text{TiCl}_4 + \text{Al}(\text{CH}_3)_3 + \text{NH}_3 \rightarrow \text{TiAlN} + \text{CH}_4 + \text{HCl}$

## Oppgave 4 (20 poeng)

<b>A</b> $\text{H}_3\text{C}-\text{CH}_3$	<b>B</b> $\text{ClH}_2\text{C}-\text{CH}_2\text{Cl}$	<b>C</b> $\text{H}_3\text{C}-\text{CH}_2-\text{OH}$	<b>D</b> $\text{H}_3\text{C}-\text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
Etan	1,2-Dikloretan	Etanol	Etylacetat
<b>E</b> 	<b>F</b> $\text{ClH}_2\text{C}-\text{CH}_2\text{OH}$	<b>G</b> $\text{HOH}_2\text{C}-\text{CH}_2\text{OH}$	<b>H</b> $\text{HC}\equiv\text{CH}$
Etylenoksid	2-Kloretanol	Etylenglykol	Acetylen
<b>I</b> $\text{H}_2\text{C}=\underset{\text{H}}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$	<b>J</b> $\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	<b>K</b> $\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$	
Vinylacetat	Acetaldehyd	Eddiksyre	

## Oppgave 5 (15 poeng)

- a)  $c = n/V = m/M/V = 0,0030/57000/1 = 5,26 \cdot 10^{-8} \text{ mol/L}$   $V_{\text{blodplasman}} = n/C = 1/5,26 \cdot 10^{-8} = 19 \cdot 10^6 \text{ L} = \underline{19 \text{ millioner liter}}$ .
- b) Vann mangler, reaksjonen kalles hydrolyse.
- c)  $M_{\text{serin}} = 105,11 \text{ g/mol}$ ,  $n = m/M = 500000000/105,11 = \underline{4,76 \text{ millioner mol}}$
- d)  $\text{HOOC}-\text{CH}(\text{CH}_2\text{OH})\text{NH}_2 + \text{H}_3\text{O}^+ \rightarrow \text{HOOC}-\text{CH}(\text{CH}_2\text{OH})\text{NH}_3^+ + \text{H}_2\text{O}$   
 $\text{HOOC}-\text{CH}(\text{CH}_2\text{OH})\text{NH}_2 + \text{OH}^- \rightarrow \text{OOC}^--\text{CH}(\text{CH}_2\text{OH})\text{NH}_2 + \text{H}_2\text{O}$
- e)  $n_{\text{serin}} = 50 \cdot 0,10 = 5,0 \text{ mmol}$ ,  $n_{\text{HCl}} = 50 \cdot 0,050 = 2,5 \text{ mmol}$ . Etter nøytralisering:  $n_{\text{serin, nøytral form}} = (5,0 - 2,5) = 2,5 \text{ mmol}$ ,  $n_{\text{serin, sur form}} = 2,5 \text{ mmol}$ . Dette er en buffer. Vi er ved halvtitreringspunktet, da er  $\text{pH} = \text{pK}_a = -\log(1 \cdot 10^{-14}/K_b) = -\log(1 \cdot 10^{-14}/1,62 \cdot 10^{-12}) = \underline{2,21}$ . Konsentrasjonene er da  $c_{\text{serin, nøytral form}} = 2,5/100 = \underline{0,025 \text{ M}}$ .