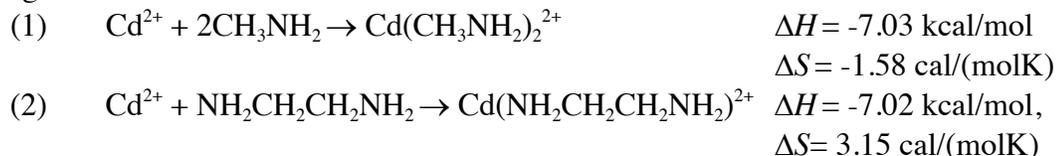


# LECTURE 17

1. The health risks of accidental exposure to a toxic heavy metal, such as lead, mercury, or cadmium, may be reduced through treatment with a chelating agent, which binds to the metal and forms a complex that can be eliminated from the body. Methylamine ( $\text{CH}_3\text{NH}_2$ ) and ethyldiamine ( $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ ) chelate cadmium as shown in the following reactions.



- (a) Based on strictly thermodynamic analysis, and assuming a body temperature of  $37^\circ\text{C}$  and that  $\Delta H$  and  $\Delta S$  are independent of temperature, which would you administer to a patient exposed to cadmium? Explain.
- (b) Over what temperature ranges are reaction (1) and reaction (2) spontaneous?
2. Consider the following compounds: (a)  $\text{Al}_2\text{O}_3(\text{s})$ ; (b)  $\text{H}_2\text{O}_2(\text{l})$ ; (c)  $\text{NO}(\text{g})$ . Using the table of thermodynamic data below:
- (i) Determine which of the above compounds are **stable with respect to decomposition** into their elements under standard conditions at room temperature. Explain your answer.
- (ii) Determine which of the above compounds become **more stable** and which become **less stable** with respect to their elements as the temperature is raised. Explain your answer.

Selected thermodynamic data at  $25^\circ\text{C}$  from Appendix 2A (Adapted from Atkins and Jones)

Substance	Mass (g/mol)	$\Delta H_f^\circ$ (kJ/mol)	$\Delta G_f^\circ$ (kJ/mol)	$S^\circ$ (J/Kmol)
Al(s)	26.98	0	0	28.33
$\text{Al}_2\text{O}_3(\text{s})$	101.96	-1676	-1582	50.92
$\text{AlCl}_3(\text{s})$	133.33	-704.2	-628.8	110.67
$\text{Cl}_2(\text{g})$	70.9	0	0	223.07
Cl(g)	35.45	121.7	105.7	165.2
HCl(g)	36.46	-92.31	-95.3	29.12
$\text{H}_2(\text{g})$	2.0158	0	0	130.7
$\text{H}_2\text{O}_2(\text{l})$	34.02	-187.8	-120.35	109.6
$\text{N}_2(\text{g})$	28.02	0	0	191.61
NO(g)	30.01	90.25	86.55	210.76
$\text{O}_2(\text{g})$	32	0	0	205.14
$\text{O}_3(\text{g})$	48	142.7	163.2	238.93

3. For (a)  $\text{CH}_3\text{OCH}_3$ ; (b)  $\text{CH}_3\text{COOH}$ ; (c)  $\text{CH}_3\text{CHO}$ ; (d)  $\text{CH}_3\text{CH}_2\text{OH}$ .
- (i) Which of the above can act as a hydrogen bond donor?
- (ii) Which of the above can act as a hydrogen bond acceptor?
- Hint: draw Lewis structures before answering this question.

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