

CH142 Exam 3
Spring 2019
Answer Key

Multiple Choice

1. All answers receive credit.
2. C
3. C
4. B
5. D
6. A
7. E
8. C

Short Answer

1. All are false.

2. All are positive.

3. A) Reaction of interest: $\text{CH}_3\text{NH}_2 (\text{aq}) + \text{H}_2\text{O} (\text{l}) \rightleftharpoons \text{CH}_3\text{NH}_3^+ (\text{aq}) + \text{OH}^- (\text{aq})$

$$\Delta G^\circ = \sum n G_f^\circ (\text{products}) - \sum m \Delta G_f^\circ (\text{reactants})$$

$$= 1 \text{ mol} \times -13.58 \text{ kJ/mol} + 1 \text{ mol} \times -157.0 \text{ kJ/mol} - (1 \text{ mol} \times -32.73 \text{ kJ/mol} + 1 \text{ mol} \times -237.13 \text{ kJ/mol})$$

$$= 99.3 \text{ kJ}$$

B) Proceeds backwards (positive ΔG° suggests that the back reaction is spontaneous).

4. $\Delta G = \Delta G^\circ + RT \ln Q$ $Q = (0.11)(0.23)^4 / (1.5)^2$

$$= 154 \text{ kJ} + (8.315 \times 10^{-3} \text{ kJ/mol-K}) (800 \text{ K}) \ln Q = 95 \text{ kJ}$$

5. A) $\text{OH}^- + \text{H}_2\text{O} + \text{NO}_2^- + 2 \text{ Al} \rightarrow \text{NH}_3 + 2 \text{ AlO}_2^-$

B) Al

6. A) +5.65 kJ/mol

B) +28.89 J/mol-K

C) 195 K

D) Gas is favored over liquid and solid at $T > 240 \text{ K}$

7. -474 kJ

8. A) $\Delta G^\circ = -nFE^\circ = -2 \text{ mol} \times 96485 \text{ J/V-mol} \times 2.04 \text{ V} = -394 \text{ kJ}$

$$\text{B) } E = E^\circ - (0.0592/n) \log Q \quad Q = 1/(4.5)^2(4.5)^2$$

$$E = 2.04 \text{ V} - (0.0592/2) \log (0.0024) = 2.1 \text{ V}$$

C) $125 \text{ C/s} \times 15 \text{ s} \times 1 \text{ mol e}^- / 96485 \text{ C} \times 1 \text{ mol Pb} / 2 \text{ mol e}^- \times 207 \text{ g Pb/mol Pb} = 2.01 \text{ g}$