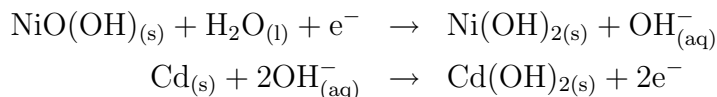


Chemistry 2850 Test 2

Time: 50 min Questions: 8 Marks: 49
Aids permitted: calculator, one 8.5 × 11-inch formula sheet
Useful data is given on the reverse of this page.
Write all answers in the booklets provided.

1. Briefly describe the standard hydrogen electrode. [3 marks]
2. What does “salting in” mean? What theory studied in class predicts this effect? Explain briefly. [4 marks]
3. Many reactions involve water as a reactant or product. When treating such reactions, we generally ignore the activity of the water, i.e. set its value to unity. Why is it often reasonable to do this? [2 marks]
4. Suppose that we measured the equilibrium constant of a reaction as a function of temperature. Briefly describe the procedure you could use to obtain the enthalpy of reaction from these data. [3 marks]
5. There are some cases where simple solubility calculations for ionic compounds based on K_{sp} give very bad answers, even when we properly account for the effects of nonideal behavior. Describe a possible chemical complication which might throw off a naïve calculation. What chemical principle is involved? [4 marks]
6. The entropy of liquid water at 25°C is 69.95 J K⁻¹ mol⁻¹. The heat capacity of liquid water is 75.40 J K⁻¹ mol⁻¹. The enthalpy of fusion (melting) of ice at 0°C is 6007 J/mol. What is the entropy of ice at 0°C? [6 marks]
7. (a) Assuming that ΔH° and ΔS° are constant, calculate the standard Gibbs energy change for the reaction of calcium oxide with carbon dioxide to form calcium carbonate at 5°C. [10 marks]
(b) The partial pressure of carbon dioxide in air is about 4×10^{-4} bar. If we keep a sample of calcium oxide in air at 5°C, will it spontaneously convert to calcium carbonate? [4 marks]
8. Nickel-cadmium (nicad) batteries are based on the following half-cell reactions:



- (a) The emf of a nicad cell is 1.4 V. The standard reduction potential of cadmium (II) hydroxide is -0.809 V. What is the standard reduction potential of NiO(OH)? [3 marks]
- (b) What is the standard free energy of formation of NiO(OH)? [10 marks]

Useful data

$$F = 96\,485.3383 \text{ C/mol}$$

$$R = 8.314\,472 \text{ J K}^{-1}\text{mol}^{-1}$$

To convert degrees Celsius to Kelvin, add 273.15.

Standard thermodynamic data at 1 bar and 25°C

Species	$\frac{\Delta_f H^\circ}{\text{kJ/mol}}$	$\frac{\Delta_f G^\circ}{\text{kJ/mol}}$	$\frac{C_{P,m}}{\text{J K}^{-1}\text{mol}^{-1}}$
CO _{2(g)}	-393.51	-394.37	37.1
CaCO _{3(s)}	-1206.9	-1128.8	81.9
CaO _(s)	-634.92	-603.30	42.8
Cd(OH) _{2(s)}		-469.8	
H ₂ O _(l)	-285.830	-237.140	75.40
Ni(OH) _{2(s)}		-444	