

Lead Acid Car Batteries. In class exercise/ Discussion/Semester review

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The lead storage battery can be represented as



Write the balanced chemical equation represented by this notation.

$E^\circ_{\text{cell}} = 2.04\text{V}$ (12 V is achieved by connecting 6 of these in series)

Calculate E_{cell} at 25°C for this battery when $[\text{H}_2\text{SO}_4] = 4.5\text{ M}$.

Using the Thermodynamic data given below, calculate ΔH° , ΔG° and ΔS° for the reaction.

Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S_f° (kJ/mol)
$\text{Pb}_{(s)}$	0	0	64.89
$\text{PbO}_{2(s)}$	-276.65	-218.99	76.57
$\text{PbSO}_{4(s)}$	-918.4	-811.2	147.28
$\text{H}^+_{(aq)}$	0	0	0
$\text{HSO}_4^-_{(aq)}$	-885.75	-752.87	126.86
$\text{H}_2\text{O}_{(l)}$	-258.8	-237.2	69.9

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Battery acid (in a fresh battery) is 37% by mass H_2SO_4 . Calculate the molality and the molarity. The density of the solution is 1.29g/mL.

Calculate the freezing point of this solution. Assume HSO_4^- dissociation is negligible. (k_f for water is $1.86^\circ\text{C}/m$)

What happens to the freezing point as the battery discharges?

Discuss any possible reasons why/circumstances where this battery might not be useful.