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

The lead storage battery can be represented as

$Pb_{(s)},PbSO_{4(s)}|HSO_4^-{}_{(aq)},H^+_{(aq)}||HSO_4^-{}_{(aq)}\ ,H^+_{(aq)}\ |PbO_{2(s)},PbSO_{4(s)}$

Write the balanced chemical equation represented by this notation.

$E°_{cell}$=2.04V (12 V is achieved by connecting 6 of these in series)

Calculate E_{cell} at 25°C for this battery when [H_2SO_4] = 4.5 *M)*.

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

Substance	$\Delta H_f°$ (kJ/mol)	$\Delta G_f°$ (kJ/mol)	$S_f°$ (kJ/mol)
$Pb_{(s)}$	0	0	64.89
$PbO_{2(s)}$	-276.65	-218.99	76.57
$PbSO_{4(s)}$	-918.4	-811.2	147.28
$H^+_{(aq)}$	0	0	0
$HSO_4^-{}_{(aq)}$	-885.75	-752.87	126.86
$H_2O_{(l)}$	-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°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.