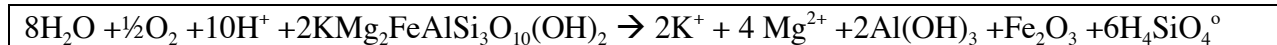


Provide answers in the space below each question. Each question is 25 points.

1. Write and balance the hydrolysis/redox reaction between:

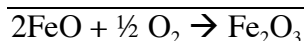
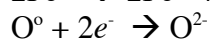


Overall Reaction:



Checks: 33 Oxygen on each side, 30 Hydrogen on each side.

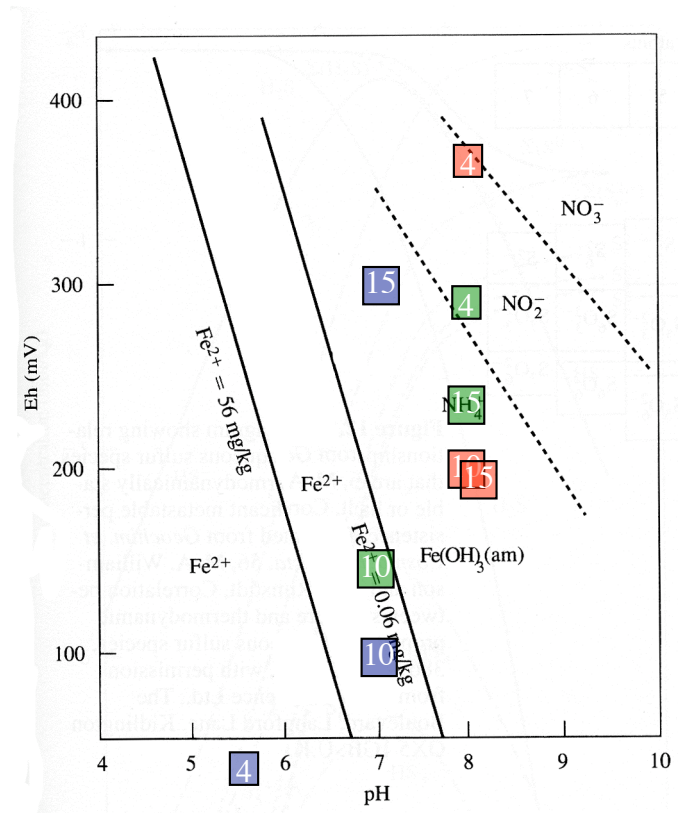
Half-cell reactions:



2. Using the figure below plot the positions of following measures on the Eh-pH diagram.

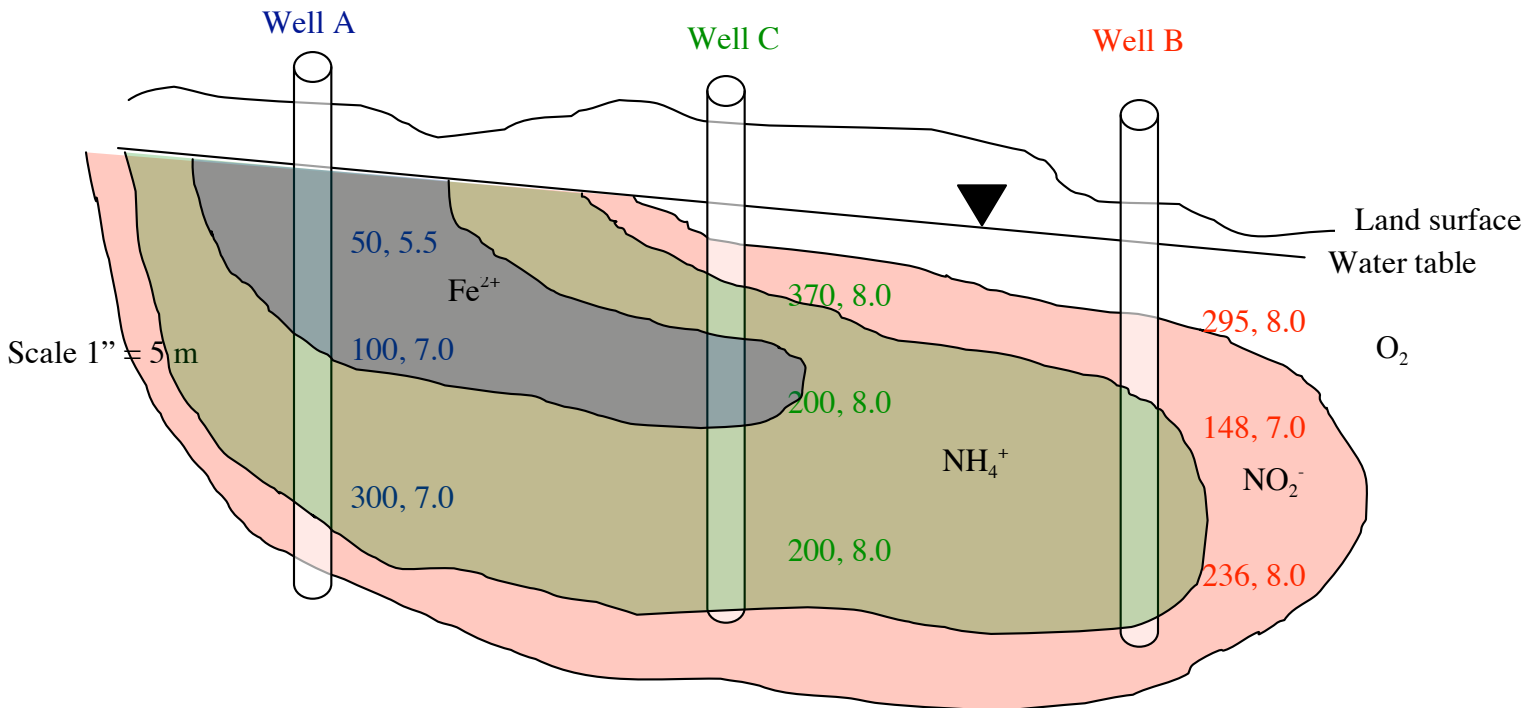
Recall at 25°C, Eh (V) = 0.059 pe 5 pe = 295 mV; 2.5 pe = 148 ; 4 pe = 236

Depth (m)	Well A		Well B		Well C	
	Eh (mV)	pH	Eh (V)	log a _{H+}	pe	[H ⁺]
4	50	5.5	0.37	-8.0	5	0.0000001
10	100	7.0	0.20	-8.0	2.5	0.0000001
15	300	7.0	0.20	-8.0	4	0.0000001



Solid lines are boundaries computed assuming $\text{Fe}^{2+} = 56$ ppm and 0.06 ppm at 25°C. Dashed lines are equal concentration boundaries amongst the respective nitrogen species.

3. The analyses from Question 2 above result from a landfill study of groundwater sampled from three wells at depths shown in the previous table. One well is located in the landfill. Another well is proximally located next to the landfill. The third well is distally located in a direct line away from the other two, with the proximal well located between the others. Using the data from the table, first determine which of the wells below are A, B, and C. Then sketch a two-dimensional contour map of the redox zones (plumes) for peak concentration of each of the following species, Fe^{2+} , NH_4^+ , NO_2^- , and O_2 . Let the vertical scale be 0.5" ~ 5 m.



4. Define ionic potential. For K^+ , As^{3+} , and P^{5+} with atom radii of 1.33\AA , 0.52\AA , and 0.32\AA respectively, determine how you would expect these cations to complex in an aqueous solution. Show all your calculations.

Ionic potential = charge / ionic radius

IP for K^+ = $1 / 1.33 = 0.75$ Soluble free ion (e.g., K^+)

IP for As^{3+} = $3 / 0.52 = 5.77$ Insoluble complex (e.g., $\text{As}(\text{OH})_3$)

IP for P^{5+} = $5 / 0.32 = 15.6$ Soluble complex (e.g., PO_4^{2-})

