PRACTICE SET 6

Passage VII: Electrochemistry Unknowns

4 questions (41–44) · suggested time 7 minutes

1. Read the passage and answer all 4 questions on your own. No notes, no calculator.
2. Check your answers with the key on the last page.
3. Watch the walkthrough video to see how each question is broken down.

Passage VII

A class was studying electrochemistry. The instructor gave each student an unknown. Some of the data are shown in Table 1.

Table 1 Student Data

Student	Nature of unknown	Measurement
1	0.01 *M* monoprotic acid	pH = 4.0
2	0.001 *M* monoprotic acid	pH = 3.0
3	1.0 *M* cation	E° = 1.10 V
4	White solid (58.5 g/mol)	–
5	Solution of $Fe_2(SO_4)_3$	–

Some students required the Nernst equation, Equation 1.

$$E_{cell} = E°_{cell} - (0.0592/n)\log_{10}(Q)$$

Equation 1

In Equation 1, n equals the number of moles of electrons transferred in the redox reaction, and Q is the reaction quotient. The expression for Q in terms of concentrations of reactants and products is written in the same manner as is the expression for the equilibrium constant, K_{eq}, for a reaction. The standard cell potential $E°_{cell}$ (in volts) of a galvanic cell is obtained when all the components of the cell are in their standard (thermodynamic) states. Thus, E_{cell} equals zero, when Q equals K_{eq}.

Passage continues on next page

All of the students studied the reaction given by Equation 2 (unbalanced), for which $E°_{cell} = 0.32$ V.

$$MnO_4^-(aq) + H^+(aq) + ClO_3^-(aq) \rightarrow ClO_4^-(aq) + Mn^{2+}(aq) + H_2O(l)$$

Equation 2

Standard reduction potentials for certain electrodes are given in Table 2.

Table 2 Standard Reduction Potentials

Half-reaction	E°, Volts
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.34
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	−0.76
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	−1.66
$Ca^{2+}(aq) + 2e^- \rightarrow Ca(s)$	−2.76

41 If Student 3's measurement (Table 1) was obtained from a cell made by connecting the unknown solution to a standard zinc electrode (Table 2) by means of a salt bridge, which of the following ions was Student 3's unknown?

(A) Ag^+

(B) Cu^{2+}

(C) Al^{3+}

(D) Ca^{2+}

Continued on next page

42 If Student 4 prepared a solution by dissolving 29.25 g of the assigned unknown in water to a total volume of 250.0 mL, the molarity of the solution was:

A) 0.250 *M*.
B) 0.500 *M*.
C) 1.00 *M*.
D) 2.00 *M*.

43 The name of Student 5's unknown is:

A) iron(II) sulfate.
B) iron(II) sulfite.
C) iron(III) sulfate.
D) iron(III) sulfite.

44 Which expression gives the reaction quotient for a spontaneous reaction between standard silver and aluminum electrodes (Table 2)?

A) $[Al^{3+}][Ag^{+}]$
B) $[Al^{3+}]/[Ag^{+}]^3$
C) $[Ag^{+}]^3/[Al^{3+}]$
D) $[Al^{3+}][Ag(s)]^3/[Ag^{+}]^3[Al(s)]$

Finished all 4 questions?

Only check the key once you've committed to an answer for every question.

YOUR ANSWERS

41	42	43	44	Score
_____	_____	_____	_____	/ 4

Q	ANSWER	
41	B	Cu^{2+}
42	D	2.00 *M*.
43	C	iron(III) sulfate.
44	B	$[Al^{3+}]/[Ag^{+}]^3$

NOW WATCH THE WALKTHROUGH

Breaking Down AAMC Passage-Based Questions (Chemistry Passage Part 3)

Every question broken down step by step: where the information is in the passage, and why each wrong option is wrong.