B7 · Extra practice

Worked solutions | Items 1-2

Extra practice for this lesson. Original questions, not released diploma items. Select one option for multiple choice; other tasks state the required response.

Use the givens and conditions in each prompt. Enter the requested count, coefficient, oxidation number or potential with the stated unit and precision.

B7-D01 · Numerical response

A lead half-cell is joined to the standard hydrogen half-cell and reads 0.13 V. Electrons flow from the lead toward the hydrogen half-cell. What is E° for $Pb^{2+} + 2e^- \rightarrow Pb$, in volts to two decimal places?

1. Lead is the anode and hydrogen is the cathode. $0.13 = 0.00 - E°(Pb)$, so $E°(Pb^{2+}/Pb) = -0.13$ V.

2. Electrons flow away from the anode. The sign is negative because lead gives its electrons to the reference.

B7-D02 · Multiple choice

Which of these is the strongest oxidizing agent, given Cl_2/Cl^- +1.36 V, Br_2/Br^- +1.07 V and I_2/I^- +0.54 V?

A. I_2

B. Br_2

C. Cl_2

D. I^-

1. The highest table value belongs to Cl_2/Cl^- at +1.36 V, so Cl_2 is the strongest oxidizing agent.

2. I^- is a reducing agent. Among the halogens, a higher value means a stronger oxidizing agent of electrons.

B7 · Extra practice

Worked solutions | Items 3-4

B7-D03 · Numerical response

For a cell in which Br_2 is reduced and I^- is oxidized (Br_2/Br^- +1.07 V; I_2/I^- +0.54 V), what is E°cell in volts to two decimal places?

1. E°cell = E°cathode − E°anode = 1.07 − 0.54 = +0.53 V.

2. What is reduced is on the cathode side, so its value goes first.

B7-D04 · Multiple choice

Why does the Fe^{3+}/Fe^{2+} half-cell need an inert electrode?

A. Iron metal is too expensive

B. There is no solid metal in the half-cell to carry electrons

C. Fe^{3+} is a solid

D. Inert electrodes make the voltage larger

1. Both are dissolved ions, so a solid that does not react, such as carbon, is used to carry electrons.

2. An inert electrode does not change the voltage. It only provides a surface for the electron transfer.

B7 · Extra practice

Worked solutions | Items 5-6

B7-D05 · Select all that apply

Select every correct statement about reading the table of table values.

A. Every row is written as a reduction
B. A higher value means a stronger oxidizing agent on the left of the row
C. The sign of a value is reversed when that half is oxidized
D. The lowest row has the strongest reducing agent on the right

1. All rows are reductions. Higher means a stronger oxidizing agent. The lowest value belongs to the strongest reducing agent.

2. We never reverse the sign for an oxidation. The subtraction E°cathode − E°anode handles it.

B7-D06 · Numerical response

A cell has Fe^{3+}/Fe^{2+} (+0.77 V) as the cathode and Zn^{2+}/Zn (−0.76 V) as the anode. What is E°cell in volts to two decimal places?

1. E°cell = 0.77 − (−0.76) = +1.53 V.

2. Subtracting a negative value adds its size.

B7 · Extra practice

Worked solutions | Items 7-8

B7-D07 · Ordering / ranking

Arrange the steps for building a cell from two rows of the table.

First to last

1. Calculate E°cell = E°cathode − E°anode
2. Match the electrons and add the halves
3. Choose the higher value as the cathode
4. Write the reduction and the oxidation

1. Choose the cathode first, write the two halves, match the electrons and add them, then calculate the cell value.

2. The cathode choice comes first because it decides which half is reversed.

B7-D08 · Matching

Match each item in the MnO_4^- / Fe^{2+} cell to its role.

Items to match:

1. MnO_4^-
2. Fe^{2+}
3. Carbon electrode
4. Comma in the notation

Targets:

A. Oxidized at the anode
B. Separates ions in the same solution
C. Carries electrons only
D. Reduced at the cathode

1. MnO_4^- is reduced at the cathode. Fe^{2+} is oxidized at the anode. Carbon carries electrons. A comma separates ions in one solution.

2. Use the values +1.51 V and +0.77 V to decide what is reduced.

B7 · Extra practice

Worked solutions | Items 9-10

B7-D09 · Numerical response

In $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + __Fe^{3+}$, what coefficient of Fe^{3+} balances the equation? Enter an integer.

1. Five Fe^{2+} react, and each becomes one Fe^{3+}, so the coefficient is 5.

2. Check charge: $-1 + 8 + 10 = +17$ on the left and $+2 + 15 = +17$ on the right.

B7-D10 · Multiple choice

A calculation gives $E°_{cell} = -0.30$ V for a written reaction. Which statement is correct?

A. The reaction cannot happen under any conditions
B. The written direction is not spontaneous under standard conditions
C. The reaction is very fast
D. The reaction has no electrons transferred

1. A negative value says that the written direction is not spontaneous under standard conditions. The reverse direction is spontaneous.

2. The sign gives no information about speed.

B7 · Extra practice

Worked solutions | Items 11-12

B7-D11 · Multiple choice

In the cell C(s) | $Fe^{2+}(aq)$, $Fe^{3+}(aq)$ || $MnO_4^-(aq)$, $H^+(aq)$, $Mn^{2+}(aq)$ | C(s), what happens to the pH near the cathode?

A. It falls
B. It rises
C. It does not change
D. It becomes zero

1. The cathode half-reaction uses $8H^+$, so the amount of H^+ falls and the pH rises.

2. Look at which side of the half-reaction contains H^+.

B7-D12 · Written response

A student says a positive E°cell proves that a reaction will happen quickly. Explain what is wrong.

1. E° predicts the spontaneous direction under standard conditions. It does not contain information about time.

2. A spontaneous reaction can be slow. Other concentrations also change the voltage, and the Nernst equation is outside this course.