B11 · 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.

B11-D01 · Numerical response

A cathode gains 3.18 g of copper in 1000 s from $Cu^{2+} + 2e^- \rightarrow Cu$. What constant current was used, in amperes to two decimal places? Use M = 63.55 g/mol.

1. n(Cu) = 3.18 ÷ 63.55 = 0.05004 mol, so $n(e^-)$ = 0.10008 mol. q = 0.10008 × (9.65×10^4) = 9658 C and I = 9658 ÷ 1000 = 9.66 A.

2. Start from the mass and go backward through the chain.

B11-D02 · Numerical response

Copper is plated at 2.00 A. A mass of 1.271 g forms from $Cu^{2+} + 2e^- \rightarrow Cu$. How long did the plating run, in seconds? Enter an integer. Use M = 63.55 g/mol.

1. n(Cu) = 1.271 ÷ 63.55 = 0.02000 mol, so $n(e^-)$ = 0.04000 mol. q = 3860 C and t = 3860 ÷ 2.00 = 1930 s.

2. Use t = q ÷ I after finding the charge.

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Worked solutions | Items 3-4

B11-D03 · Numerical response

A metal of molar mass 107.87 g/mol is plated by 1.00 A for 965 s. A mass of 1.08 g forms. What is the charge on the ion? Enter an integer.

1. q = 965 C and n(e^-) = 0.0100 mol. n(metal) = 1.08 ÷ 107.87 = 0.01001 mol. z = 0.0100 ÷ 0.01001 = 1.

2. Divide the moles of electrons by the moles of metal.

B11-D04 · Numerical response

A zinc and copper voltaic cell gives 0.500 A for 30.0 minutes. What mass of zinc dissolves from the anode, in grams to three decimal places? Use M = 65.41 g/mol.

1. q = 0.500 × 1800 = 900 C and n(e^-) = 0.009326 mol. Zn → Zn^{2+} + $2e^-$, so n(Zn) = 0.004663 mol and m = 0.305 g.

2. The electrons in the wire come from the zinc half-reaction.

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Worked solutions | Items 5-6

B11-D05 · Multiple choice

In a voltaic cell, which electrode loses mass and which gains mass?

A. The anode loses mass and the cathode gains mass
B. The cathode loses mass and the anode gains mass
C. Both electrodes gain mass
D. Both electrodes lose mass

1. Metal is oxidized at the anode and dissolves. Metal ions are reduced at the cathode and deposit.

2. Oxidation happens at the anode.

B11-D06 · Numerical response

Aqueous Na_2SO_4 is electrolyzed with inert electrodes at 1.50 A for 1930 s. How many moles of hydrogen form, to four decimal places?

1. q = 1.50 × 1930 = 2895 C and n(e^-) = 0.0300 mol. $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$, so n($H_2$) = 0.0150 mol.

2. Divide the moles of electrons by 2 for hydrogen.

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Worked solutions | Items 7-8

B11-D07 · Numerical response

For the same electrolysis, how many moles of oxygen form, to four decimal places?

1. $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$, so $n(O_2) = 0.0300 \div 4 = 0.0075$ mol.

2. Divide the moles of electrons by 4 for oxygen.

B11-D08 · Multiple choice

Which quantity is found first when the mass of metal and the current are given and the time is asked?

A. The moles of metal
B. The charge
C. The time
D. The moles of electrons

1. Start from the mass and find the moles of metal. Then find the electrons, the charge and the time.

2. Start at a given and move toward the unknown.

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Worked solutions | Items 9-10

B11-D09 · Select all that apply

Select every correct statement about finding the mass from a cathode weighed before and after plating.

A. Use the gain in mass
B. Use the final mass
C. The starting mass was not made by the current
D. Subtract the starting mass from the final mass

1. Only the gain was made by the current, so subtract the starting mass from the final mass.

2. The final mass includes the starting mass.

B11-D10 · Ordering / ranking

Arrange the steps for finding an unknown ion charge z.

First to last

1. Divide the moles of electrons by the moles of metal
2. Find the moles of metal from the mass
3. Find the charge and the moles of electrons
4. Round z to a whole number

1. Find the electrons, find the metal, divide the electrons by the metal, then round to a whole number.

2. z is the electrons for each ion.

B11 · Extra practice

Worked solutions | Items 11-12

B11-D11 · Matching

Match each unknown to the quantity that is found immediately before it in the chain.

Items to match:

1. Mass of metal
2. Moles of electrons
3. Charge
4. Current

Targets:

A. Charge
B. Moles of metal
C. Moles of electrons
D. Charge and time

1. The chain is charge, moles of electrons, moles of metal, then mass. The current comes from the charge and the time.

2. Follow the direction of the chain.

B11-D12 · Written response

A student uses the final mass of a cathode to find the time. Explain whether the time is too large or too small.

1. The final mass includes the starting mass, which the current did not make, so the time is too large.

2. Use the gain in mass only.