B2 · 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.

B2-D01 · Numerical response

Find the oxidation number of sulfur in SO_4^{2-}. Enter the number with its sign.

1. The charge of the whole ion is -2 and each O is -2. So x + 4(-2) = -2.

2. x - 8 = -2, so x = +6. Check: +6 - 8 = -2. The total is the charge of the ion, not 0.

B2-D02 · Multiple choice

Which equation gives the oxidation number of nitrogen, x, in NO_2^-?

A. x + 2(-2) = 0
B. 2x + (-2) = -1
C. x + 2(-2) = -1
D. x + (-2) = -2

1. C has one nitrogen, two oxygens and the charge of the whole ion, -1.

2. It gives x = +3. A leaves out the charge of the ion. B puts the subscript on the wrong element.

B2 · Extra practice

Worked solutions | Items 3-4

B2-D03 · Select all that apply

Select every oxidation number that is correct.

A. O in O_2 is 0
B. O in H_2O_2 is -1
C. H in NaH is +1
D. F in OF_2 is -1

1. A is an element by itself. B is a peroxide. D is fluorine, which is always -1.

2. C is false. Na is +1, so H must be -1 in NaH, a metal hydride.

B2-D04 · Numerical response

Find the oxidation number of chlorine in ClO_3^-. Enter the number with its sign.

1. Three O at -2 give -6. The charge of the ion is -1. So x - 6 = -1.

2. So chlorine is +5. A halogen is not -1 when it is joined to oxygen.

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Worked solutions | Items 5-6

B2-D05 · Matching

Match each formula to the sum of its oxidation numbers. Let x stand for the first element in the formula.

Items to match:

1. NH_3
2. SO_4^{2-}
3. CO_2

Targets:

A. x + 2(-2) = 0

B. x + 3(+1) = 0

C. x + 4(-2) = -2

1. NH_3 → x + 3(+1) = 0; SO_4^{2-} → x + 4(-2) = -2; CO_2 → x + 2(-2) = 0.

2. Multiply each value by the number of atoms. The numbers add up to the charge of the whole formula.

B2-D06 · Numerical response

For C_4H_{10}, find the average oxidation number of carbon. Use H = +1. Enter the number with its sign, to one decimal place.

1. The formula is neutral, so 4x + 10 = 0. So 4x = -10 and x = -2.5.

2. This is the average for four carbon atoms. No carbon atom has a real charge of -2.5.

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Worked solutions | Items 7-8

B2-D07 · Multiple choice

In $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, which reactant is the oxidizing agent?

A. CH_4
B. O_2
C. CO_2
D. H_2O

1. O in O_2 starts at 0 and ends at -2. O_2 is reduced, so B is the oxidizing agent.

2. CH_4 is the reducing agent. The other two choices are products.

B2-D08 · Multiple choice

Which reaction is a disproportionation?

A. $2H_2 + O_2 \rightarrow 2H_2O$
B. $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$
C. $2H_2O_2 \rightarrow 2H_2O + O_2$
D. $KCl(s) \rightarrow K^+(aq) + Cl^-(aq)$

1. In C, oxygen starts at -1 in one reactant and ends at both -2 and 0.

2. In A and B, the reducing agent and the oxidizing agent are different reactants. In D, no oxidation number changes.

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Worked solutions | Items 9-10

B2-D09 · Numerical response

The oxidation number of a carbon atom changes from -4 to +4. How many electrons does each carbon atom lose? Enter a whole number.

1. The change is the end value minus the start value: +4 - (-4) = +8.

2. Going up by eight means each carbon atom loses eight electrons. The answer is the change, 8, not the end value, +4.

B2-D10 · Ordering / ranking

Put the steps in order for finding an oxidation number in an ion you have not seen before.

First to last

1. Solve for the unknown and check the sum
2. Count the atoms and read the charge of the ion
3. Write the values you know and multiply by the number of atoms
4. Set the sum equal to the charge of the ion

1. Read the formula. Write the values you know and multiply them. Set the sum equal to the charge. Then solve and check.

2. If you start the arithmetic before you read the charge, you may set the sum to 0 by mistake.

B2 · Extra practice

Worked solutions | Items 11-12

B2-D11 · Multiple choice

For NO_3^- a student writes x - 6 = 0 and gets N = +6. Which one change fixes the mistake?

A. Change O to -1
B. Set the sum equal to -1
C. Change the O subscript to 2
D. Call nitrogen an element by itself

1. B sets the sum equal to the charge of the ion: x - 6 = -1, so N = +5.

2. The value for oxygen and the number of atoms were right. Changing them would hide the real mistake.

B2-D12 · Select all that apply

For $2H_2O_2 \rightarrow 2H_2O + O_2$, select every true statement.

A. H_2O_2 is both oxidized and reduced
B. Oxygen is -2 in the H_2O product
C. Oxygen is -2 in O_2
D. Oxygen starts at one value. Some goes up and some goes down

1. A, B and D are true. Oxygen changes from -1 to -2 in water and to 0 in O_2.

2. C is false, because O_2 is an element by itself. One reactant is both oxidized and reduced, so this is disproportionation.

B2 · Extra practice

Worked solutions | Items 13-14

B2-D13 · Numerical response

In the ammonium ion, NH_4^+, hydrogen is +1. The charge of the whole ion is +1. What is the oxidation number of nitrogen? Enter a whole number, with a minus sign if it is negative.

1. Let nitrogen be x. The sum is x + 4(+1) = +1, so x = +1 - 4 = -3.

2. Check: -3 + 4(+1) = +1, the charge of the ion. The ion is positive, but the nitrogen inside it is negative.

B2-D14 · Multiple choice

Which choice gives the charge of the sulfate ion and the oxidation number of the sulfur in it?

A. Ion charge +2; sulfur 6−
B. Ion charge 2−; sulfur +6
C. Ion charge 6+; sulfur −2
D. Ion charge −6; sulfur 2+

1. Sulfate is SO_4^{2-}, so the charge of the ion is 2− (number, then sign). The oxidation number of sulfur is +6 (sign, then number).

2. The other choices swap the two values or write them the wrong way round. The charge is for the whole ion. The oxidation number is for one sulfur atom.