Chemical Reactions And Equations

1 Which equation represents conservation of charge?
(1) $I^- + 2e^- \rightarrow I_2$
(2) $2I^- \rightarrow I_2 + 2e^-$
(3) $Br_2 \rightarrow 2Br^- + 2e^-$
(4) $Br + 2e^- \rightarrow Br^-$

2 Which equation represents a conservation of atoms?
(1) $2Fe + 2O_2 \rightarrow Fe_2O_3$
(2) $2Fe + 3O_2 \rightarrow Fe_2O_3$
(3) $4Fe + 2O_2 \rightarrow 2Fe_2O_3$
(4) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

3 During all chemical reactions, charge, mass and energy are
(1) condensed
(2) conserved
(3) decayed
(4) decomposed

4 Which quantities are conserved in all chemical reactions?
(1) charge, pressure, and energy
(2) charge, mass, and energy
(3) volume, pressure, and energy
(4) volume, mass, and pressure

5 Which equation shows conservation of mass and energy for a reaction at 101.3 kPa and 298 K?
(1) $2H_2(g) + O_2(g) \rightarrow 2H_2O(g) + 483.6$ kJ
(2) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell) + 285.8$ kJ
(3) $H_2(g) + O_2(g) \rightarrow H_2O(g) + 483.6$ kJ
(4) $H_2(g) + O_2(g) \rightarrow H_2O(\ell) + 285.8$ kJ

6 What is conserved during all chemical reactions?
(1) charge
(2) density
(3) vapor pressure
(4) melting point

7 Which equation shows conservation of charge?
(1) $Cu + Ag^+ \rightarrow Cu^{2+} + Ag$
(2) $Mg + Zn^{2+} \rightarrow 2Mg^{2+} + Zn$
(3) $2F_2 + Br^- \rightarrow 2F^- + Br_2$
(4) $2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$

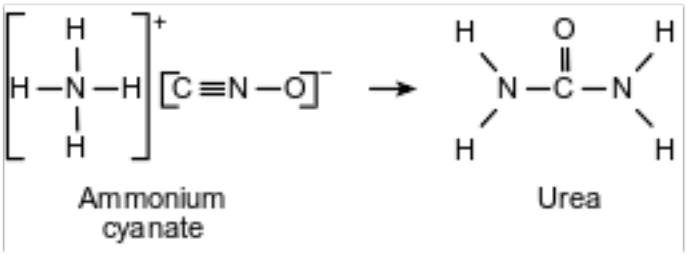
8 Given the balanced equation representing a reaction occurring at 101.3 kilopascals and 298 K:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell) + \text{energy}$

What is the net amount of energy released when one mole of $H_2O(\ell)$ is produced?
(1) 241.8 kJ
(2) 285.8 kJ
(3) 483.6 kJ
(4) 571.6 kJ

Base your answers to questions 9 on the information below and on your knowledge of chemistry.

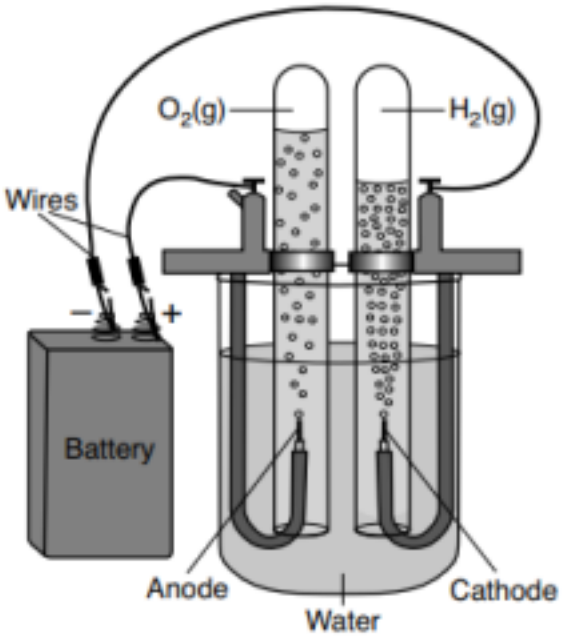
In 1828, Friedrich Wöhler produced urea when he heated a solution of ammonium cyanate. This reaction is represented by the balanced equation below.



9 Explain why this balanced equation represents a conservation of atoms.

Base your answers to questions 10 on the information below and on your knowledge of chemistry.

In a laboratory investigation, a student constructs an electrochemical cell to decompose water, as represented in the diagram below. The water in the electrochemical cell contains a small amount of dissolved sodium sulfate, to increase conductivity. The three equations represent the reaction in each test tube and the overall reaction. During this laboratory activity, appropriate safety equipment is used and safety procedures are followed.



O_2 Test Tube: $2H_2O(\ell) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$

H_2 Test Tube: $2H^+(aq) + 2e^- \longrightarrow H_2(g)$

Overall Reaction: $2H_2O(\ell) \longrightarrow O_2(g) + 2H_2(g)$

10 Determine the number of moles of hydrogen gas produced when 0.0004 mole of oxygen gas is produced in the cell by the overall reaction.

Base your answers to questions 11 on the information below and on your knowledge of chemistry.

A metal worker uses a cutting torch that operates by reacting acetylene gas, $C_2H_2(g)$, with oxygen gas, $O_2(g)$, as shown in the unbalanced equation below.

$C_2H_2(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g) + \text{heat}$

11 Balance the equation in your answer booklet for the reaction of acetylene and oxygen, using the smallest whole-number coefficients.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

Automobile catalytic converters use a platinum catalyst to reduce air pollution by changing emissions such as carbon monoxide, CO(g), into carbon dioxide, $CO_2(g)$. The uncatalyzed reaction is represented by the balanced equation below.

$2CO(g) + O_2(g) \rightarrow 2CO_2(g) + \text{heat}$

12 Determine the number of moles of $O_2(g)$ required to completely react with 28 moles of CO(g) during this reaction.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

In a laboratory investigation, an HCl(aq) solution with a pH value of 2 is used to determine the molarity of a KOH(aq) solution. A 7.5-milliliter sample of the KOH(aq) is exactly neutralized by 15.0 milliliters of the 0.010 M HCl(aq). During this laboratory activity, appropriate safety equipment is used and safety procedures are followed.

13 Complete the equation below by writing the chemical formula for each product.

$HCl(aq) + KOH(aq) \rightarrow$ _____ + _____

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

During a laboratory activity, appropriate safety equipment was used and safety procedures were followed. A laboratory technician heated a sample of solid $KClO_3$ in a crucible to determine the percent composition by mass of oxygen in the compound. The unbalanced equation and the data for the decomposition of solid $KClO_3$ are shown below.

$KClO_3(s) \rightarrow KCl(s) + O_2(g)$

Lab Data and Calculated Results

Object or Material	Mass (g)
empty crucible and cover	22.14
empty crucible, cover, and $KClO_3$	24.21
$KClO_3$	2.07
crucible, cover, and KCl after heating	23.41
KCl	?
O_2	0.80

14 Balance the equation below for the decomposition of $KClO_3$, using the smallest whole-number coefficients.

_____ $KClO_3(s) \rightarrow$ _____ $KCl(s)$ + _____ $O_2(g)$

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

The balanced equation below represents the reaction between carbon monoxide and oxygen to produce carbon dioxide.

$2CO(g) + O_2(g) \rightarrow 2CO_2(g) + \text{energy}$

15 Determine the number of moles of $O_2(g)$ needed to completely react with 8.0 moles of $CO(g)$.

Answer Keys

1 2

2 4

3 2

4 2

5 1

6 1

7 4

8 2

9 Allow 1 credit. Acceptable responses include, but are not limited to:
- There are the same number of atoms of each element on both sides of the equation.
- No atoms are lost or gained.

10 Allow 1 credit for 0.0008 mol or 8×10^{-4} mol. Significant figures do not need to be shown.

11 Allow 1 credit for
- 2
- 5
- 4
- 2 _____ $C_2H_2(g)$ + _____ $O_2(g) \rightarrow$ _____ $CO_2(g)$ + _____ $H_2O(g)$ + heat

12 Allow 1 credit for 14 mol.

13 Allow 1 credit. Acceptable responses include, but are not limited to:
- $KCl(aq) + H_2O(\ell)$
- HOH + KCl

14 Allow 1 credit for:
- $2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$.

15 Allow 1 credit for 4.0 mol or 4 mol.