تجميعة أسئلة وفق الهيكل الوزاري منهج بريدج

موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الثاني عشر العام ⇦ كيمياء ⇦ الفصل الأول ⇦ ملفات متنوعة ⇦ الملف

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المزيد من مادة كيمياء:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس
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التواصل الاجتماعي بحسب الصف الثاني عشر العام

صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

المزيد من الملفات بحسب الصف الثاني عشر العام والمادة كيمياء في الفصل الأول

1	تجميعة أسئلة وفق الهيكل الوزاري الخطة M101
2	الهيكل الوزاري الجديد المسار العام منهج بريدج الخطة M-101
3	حل أسئلة الامتحان النهائي
4	نموذج الهيكل الوزاري الفصل الأول
5	مراجعة شاملة

دعاء النجاح

اللهم إني أسألك فهم النبيين، وحفظ المرسلين والملائكة المقربين، برحمتك يا أرحم الراحمين، اللهم اجعل ألسنتنا عامرة بذكرك، وقلوبنا بخشيتك، وأسرارنا بطاعتك، إنك على كل شيء قدير، وحسبي الله ونعم الوكيل.

CHEMISTRY
12 GENERAL

Review Semester 1

2024-2025

Done by : MS .Klaitham Alaryani
Alshiyam School

Section1:
Defining Stoichiometry

تذكري أن النجاح ليس مجرد درجة على ورقة، بل هو نتيجة للإصرار والعمل المستمر. لا تدعي القلق يعيقك، بل اجعليه دافعًا للتفوق. ثقي بنفسك وبقدراتك، فقد بذلتِ الكثير من الجهد والمثابرة، والآن حان وقت الحصاد.

1	يوضح العلاقات التي يمكن اشتقاقها من معادلة كيميائية موزونة Illustrate relationships can be derived from a balanced chemical equation

نص الكتاب + الجدول 1 + مثال 1
Textbook + table 1 + example 1

Table 1 Relationships Derived from a Balanced Chemical Equation

$4Fe(s)$	+	**$3O_2(g)$**	→	**$2Fe_2O_3(s)$**
iron	+	oxygen	→	iron(III) oxide
4 atoms Fe	+	3 molecules O_2	→	2 formula units Fe_2O_3
4 mol Fe	+	3 mol O_2	→	2 mol Fe_2O_3
223.4 g Fe	+	96.00 g O_2	→	319.4 g Fe_2O_3
319.4 g reactants			→	319.4 g products

The balanced chemical equation for the chemical reaction shown in **Figure 1** is as follows.

$$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$$

You can interpret this equation in terms of representative particles by saying that four atoms of iron react with three molecules of oxygen to produce two formula units of iron(III) oxide. Remember that coefficients in an equation represent not only numbers of individual particles but also numbers of moles of particles. Therefore, you can also say that four moles of iron react with three moles of oxygen to produce two moles of iron(III) oxide.

The chemical equation does not directly tell you anything about the masses of the reactants and products. However, by converting the known mole quantities to mass, the mass relationships become obvious. Recall that moles are converted to mass by multiplying by the molar mass. The masses of the reactants are as follows.

$$4 \text{ mol Fe} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 223.4 \text{ g Fe}$$

$$3 \text{ mol } O_2 \times \frac{32.00 \text{ g } O_2}{1 \text{ mol } O_2} = 96.00 \text{ g } O_2$$

The total mass of the reactants is: (223.4 g + 96.00 g) = 319.4 g

Similarly, the mass of the product is calculated as follows:

$$2 \text{ mol } Fe_2O_3 \times \frac{159.7 \text{ g } Fe_2O_3}{1 \text{ mol } Fe_2O_3} = 319.4 \text{ g}$$

Note that the mass of the reactants equals the mass of the product.

$$\text{mass of reactants} = \text{mass of products}$$

$$319.4 \text{ g} = 319.4 \text{ g}$$

As predicted by the law of conservation of mass, the total mass of the reactants equals the mass of the product. The relationships that can be determined from a balanced chemical equation are summarized in **Table 1.**

☑ **READING CHECK** **List** the types of relationships that can be derived from the coefficients in a balanced chemical equation.

EXAMPLE 1

INTERPRETING CHEMICAL EQUATIONS The combustion of propane (C_3H_8) provides energy for heating homes, cooking food, and soldering metal parts. Interpret the equation for the combustion of propane in terms of representative particles, moles, and mass. Show that the law of conservation of mass is observed.

1 ANALYZE THE PROBLEM

The coefficients in the balanced chemical equation shown below represent both moles and representative particles, in this case molecules. Therefore, the equation can be interpreted in terms of molecules and moles. The law of conservation of mass will be verified if the masses of the reactants and products are equal.

Known

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

Example:

What do the coefficients in the following balanced chemical equation indicate?

ما الذي تشير إليه المعاملات في المعادلة الكيميائية الموزونة التالية؟

$$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$$

Moles number	عدد المولات	I
Molecules number	عدد الجزيئات	II
Atoms number	عدد الذرات	III

- I, II — I و II
- Only I — I فقط
- I, II and III — I، II و III
- Only II — II فقط

Example:

Which of the following is directly represented by the coefficients of the balanced chemical equation?

أي مما يلي تُمثله معاملات المعادلة الكيميائية الموزونة بشكل مباشر؟

أعداد الجسيمات المنفردة (ذرات ، جزيئات ، وحدات صيغة) Numbers of individual particles (atoms,molecules,and formula units)	.1
أعداد مولات الجسيمات Numbers of moles of particles	.2
كتل المواد المتفاعلة والنواتج The masses of reactants and products	.3

a. 1 and 2

b. 2 and 3

c. 1 and 3

d. 1,2 , and 3

Example:

Stoichiometry is based on the law of ....

Learning Outcomes Covered

- CHM.5.3.01.009
- CHM.5.3.01.011

a. Constant mole ratios

b. Avogadro's constant

c. Conservation of energy

d. Conservation of mass

Example:

What is the scientific law that states that matter is not created or destroyed but only transformed in a chemical reaction?

- A) law of conservation of energy
- B) law of conservation of mass
- C) law of conservation of momentum
- D) law of gravity

2	يوضح العلاقات التي يمكن اشتقاقها من معادلة كيميائية موزونة - العلاقة بين كتل المتفاعلات وكتل النواتج Illustrate relationships can be derived from a balanced chemical equation - relation between masses of reactants and masses of products

1. Interpret the following balanced chemical equations in terms of particles, moles, and mass. Show that the law of conservation of mass is observed.
   - **a.** $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
   - **b.** $HCl(aq) + KOH(aq) \longrightarrow KCl(aq) + H_2O(l)$
   - **c.** $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$

نص الكتاب + مثال 1 + تطبيقات

Textbook + example 1 + Applications

Example:

What is the total mass of the reactants in the following balance chemical equation?

ما مجموع كتل المواد المتفاعلة في المعادلة الكيميائية الموزونة التالية ؟

$$4\ Fe_{(s)} + 3O_{2(g)} \longrightarrow 2Fe_2O_{3(s)}$$

Element العنصر	Molar mass الكتلة المولية (g / mol)
O	16
Fe	55.85

291.5 g

415.6 g

271.4 g

319.4 g

Example:

What is the mass of the product in the following balanced chemical equation?

ما كتلة المادة الناتجة في المعادلة الكيميائية الموزونة التالية؟

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

Molar mass الكتلة المولية	Element العنصر
1.0078 g/mol	H
14.0067 g/mol	N

34.0602 g

17.0301 g

15.0145 g

28.0134 g

3	يوضح العلاقات التي يمكن اشتقاقها من معادلة كيميائية موزونة - وزن المعادلات الكيميائية
	Illustrate relationships can be derived from a balanced chemical equation - balancing chemical equations

نص الكتاب + تطبيقات
Textbook + Applications

2. Challenge For each of the following, balance the chemical equation; interpret the equation in terms of particles, moles, and mass; and show that the law of conservation of mass is observed.

a. ___$Na(s)$ + ___$H_2O(l)$ → ___$NaOH(aq)$ + ___$H_2(g)$

b. ___$Zn(s)$ + ___$HNO_3(aq)$ → ___$Zn(NO_3)_2(aq)$ + ___$N_2O(g)$ + ___$H_2O(l)$

Example:

What is the correct balanced skeleton equation that represents the chemical reaction below?

ما المعادلة الموزونة بالصيغ الصحيحة التي تُمثل التفاعل الكيميائي أدناه؟

Solid sodium (Na) reacts vigorously with water (H_2O) to yield gaseous hydrogen (H_2) and a solution of sodium hydroxide (NaOH).

يتفاعل الصوديوم الصلب (Na) بشدة مع الماء (H_2O) لينتج غاز الهيدروجين (H_2) ومحلول هيدروكسيد الصوديوم (NaOH) .

- $Na_{(s)} + H_2O_{(aq)} \longrightarrow NaOH_{(aq)} + H_{2(aq)}$ ○
- $2NaOH_{(aq)} + H_2O_{(\ell)} \longrightarrow 2H_{2(g)} + 2Na_{(s)}$ ○
- $3Na_{(aq)} + 2H_2O_{(aq)} \longrightarrow 2NaOH_{(s)} + 3H_{2(g)}$ ○
- $2Na_{(s)} + 2H_2O_{(\ell)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$ ○

4	writting mole ratios from a balanced chemical equation
	يكتب النسب المولية من معادلة كيميائية موزونة

نص الكتاب + تطبيقات
Textbook + practice Problems

Mole ratios You have read that the coefficients in a chemical equation indicate the relationships between moles of reactants and products. You can use the relationships between coefficients to derive conversion factors called mole ratios. A **mole ratio** is a ratio between the numbers of moles of any two of the substances in a balanced chemical equation. Consider the reaction between potassium (K) and bromine (Br_2) to form potassium bromide (KBr). The product of the reaction, the ionic salt potassium bromide, is prescribed by veterinarians, like the one in **Figure 2,** as an antiepileptic medication.

$$2K(s) + Br_2(l) \rightarrow 2KBr(s)$$

What mole ratios can be written for this reaction? Starting with the reactant potassium, you can write a mole ratio that relates the moles of potassium to each of the other two substances in the equation. Thus, one mole ratio relates the moles of potassium used to the moles of bromine used. The other mole ratio relates the moles of potassium used to the moles of potassium bromide formed.

$$\frac{2 \text{ mol K}}{1 \text{ mol Br}_2} \text{ and } \frac{2 \text{ mol K}}{2 \text{ mol KBr}}$$

Two other mole ratios show how the moles of bromine relate to the moles of the other two substances in the equation–potassium and potassium bromide.

$$\frac{1 \text{ mol Br}_2}{2 \text{ mol K}} \text{ and } \frac{1 \text{ mol Br}_2}{2 \text{ mol KBr}}$$

Similarly, two ratios relate the moles of potassium bromide to the moles of potassium and bromine.

$$\frac{2 \text{ mol KBr}}{2 \text{ mol K}} \text{ and } \frac{2 \text{ mol KBr}}{1 \text{ mol Br}_2}$$

These six ratios define all the mole relationships in this equation. Each of the three substances in the equation forms a ratio with the two other substances.

☑ READING CHECK **Identify** the source from which a chemical reaction's mole ratios are derived.

Figure 2 Potassium metal and liquid bromine react vigorously to form the ionic compound potassium bromide. Bromine is one of the two elements that are liquids at room temperature (mercury is the other). Potassium is a highly reactive metal. Potassium bromide is an ionic salt that is used to treat epilepsy.

Example:

Which of the following mole ratios is NOT true for the balanced chemical equation shown below?

أي النسب المولية التالية غير صحيحة للمعادلة الكيميائية الموزونة الموضحة أدناه؟

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

$$\frac{2\ mol\ KClO_3}{2\ mol\ KCl}$$

$$\frac{2\ mol\ KCl}{3\ mol\ O_2}$$

$$\frac{2\ mol\ KClO_3}{3\ mol\ O_2}$$

$$\frac{2\ mol\ KCl}{4\ mol\ KClO_3}$$

Example:

In the following equation, which mole ratio to be used to convert from moles of O_2 to moles of CO_2?

في المعادلة التالية، ما المُعامل المُستخدم للتحويل من عدد مولات O_2 إلى عدد مولات CO_2؟

$$C_5H_{12\,(l)} + 8O_{2\,(g)} \rightarrow 6H_2O_{\,(g)} + 5CO_{2\,(g)}$$

$$\frac{5\ mol\ O_2}{1\ mol\ CO_2}$$

$$\frac{5\ mol\ CO_2}{8\ mol\ O_2}$$

$$\frac{8\ mol\ O_2}{6\ mol\ CO_2}$$

$$\frac{5\ mol\ CO_2}{6\ mol\ O_2}$$

Example:

In the balanced chemical reaction shown above, what is the molar ratio of Fe to Al?

$Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(s) + Al_2O_3(s)$

- A) 2 to 1
- B) 1 to 1
- C) 3 to 1
- D) 1 to 2

Example:

What is the number of mole ratios you can write for the balanced chemical equation shown below?

ما عدد النسب المولية التي يمكنك كتابتها للمعادلة الكيميائية الموزونة الموضحة أدناه؟

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

3
6
9
12

Example:

In the equation below,

Which of the following mole ratio is **NOT** correct?

$$4A + 3B \rightarrow 2C$$

- $\frac{4\ mol\ A}{3\ mol\ B}$
- $\frac{4\ mol\ A}{2\ mol\ C}$
- $\frac{2\ mol\ C}{3\ mol\ B}$
- $\frac{3\ mol\ C}{2\ mol\ B}$

5	يوضح العلاقة بين المتفاعلات والنواتج
	Illustrate therelationship beween reactants and products

نص الكتاب - بداية القسم 1

Textbook - beginning of section 1

Stoichiometry The study of quantitative relationships between the amounts of reactants used and amounts of products formed by a chemical reaction is called **stoichiometry.** Stoichiometry is based on the law of conservation of mass. Recall that the law states that matter is neither created nor destroyed in a chemical reaction. In any chemical reaction, the amount of matter present at the end of the reaction is the same as the amount of matter present at the beginning. Therefore, the mass of the reactants equals the mass of the products. Note the reaction of powdered iron (Fe) with oxygen (O_2) shown in **Figure 1.** Although iron reacts with oxygen to form a new compound, iron(III) oxide (Fe_2O_3), the total mass is unchanged.

Figure 1 The balanced chemical equation for this reaction between iron and oxygen provides the relationships between amounts of reactants and products.

Example:

What is the study of quantitative relationships between the amounts of reactants used and amounts of products formed by a chemical reaction called?	ماذا تُسمى دراسة العلاقات الكمية بين المواد المتفاعلة المستخدمة والنواتج المتكونة على إثر تفاعل كيميائي؟
The mole ratios	النسب المولية
The stoichiometry	الحسابات الكيميائية
The balanced chemical equation	المعادلة الكيميائية الموزونة
The law of conservation of mass	قانون حفظ الكتلة

6	يكتب النسب المولية من معادلة كيميائية موزونة	
	writting mole ratios from a balanced chemical equation	

نص الكتاب + تطبيق 3 و 4
Textbook + Application 3 , 4

3. Determine all possible mole ratios for the following balanced chemical equations.

a. $4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$

b. $3Fe(s) + 4H_2O(l) \longrightarrow Fe_3O_4(s) + 4H_2(g)$

c. $2HgO(s) \longrightarrow 2Hg(l) + O_2(g)$

Applications:

4. **Challenge** Balance the following equations, and determine the possible mole ratios.
   a. $ZnO(s) + HCl(aq) \longrightarrow ZnCl_2(aq) + H_2O(l)$
   b. butane (C_4H_{10}) + oxygen $\longrightarrow$ carbon dioxide + water

7	يكتب النسب المولية من معادلة كيميائية موزونة	
	writting mole ratios from a balanced chemical equation	

نص الكتاب

Note that the number of mole ratios you can write for a chemical reaction involving a total of n substances is $(n)(n-1)$. Thus, for reactions involving four and five substances, you can write 12 and 20 moles ratios, respectively.

$$\text{Four substances: } (4)(3) = 12 \text{ mole ratios}$$

$$\text{Five substances: } (5)(4) = 20 \text{ mole ratios}$$

8	يوضح كيفية وزن معادلة كيميائية Illustrate how to balance a chemical equation

نص الكتاب + تطبيقات
Textbook + Applications

What are the correct coefficients when this equation is balanced ?

$$Sb + O_2 \longrightarrow Sb_4O_6$$

A. 1 , 2 , 10
B. 4 , 6 , 1
C. 4 , 3 , 1
D. 10 , 5 , 1

What is the correct coefficient to balance the following equation?

$$2K_{(s)} + Br_{2(l)} \longrightarrow \text{-----} \; KBr_{(s)}$$

✍ 1 ✍ 2 ✍ 3 ✍ 7

Example:

What do the coefficients in the following balanced chemical equation mean?

$2H_2 + O_2 \rightarrow 2H_2O$

- A) 2 moles of hydrogen and 1 mole of oxygen in the reactants
- B) 2 moles of oxygen and 1 mole of hydrogen in the reactants
- C) 2 moles of oxygen and 1 mole of hydrogen in the products
- D) 2 moles of hydrogen and 1 mole of oxygen in the products

Example:

What is the balanced chemical equation for the reaction between hydrochloric acid and calcium carbonate when the products of the reaction are calcium chloride, carbon dioxide, and water?

- A) $HCl + CaCl_2 \rightarrow CaCO_3 + CO_2 + H_2O$
- B) $HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$
- C) $2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$
- D) $2HCl + CaCl_2 \rightarrow CaCO_3 + CO_2 + 2H_2O$

Example:

Balance the following equation with the smallest whole-number coefficients. What is the coefficient for H_2O in this equation?

$$PBr_3 + H_2O \longrightarrow H_3PO_3 + HBr$$

- A) 2
- B) 3
- C) 4
- D) 2

Section 2:

Stoichiometric Calculations

كل لحظة قضيتها في المذاكرة وكل فكرة تركزتِ فيها هي خطوة نحو النجاح، وكل تعب مررتِ به سيعود إليكِ الآن على شكل إنجاز وفخر. اعلمي أن طريق النجاح ليس سهلاً، لكنه ممتع ومليء بالفرص,,,

9	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح
	apply the steps used in solving stoichiometric problems with the correct sequence

نص الكتاب + استراتيجيات حل المسائل + مثال 2 + تطبيقات
Textbook + Problem solving strategy + example 2 + Applications

Problem-Solving Strategy

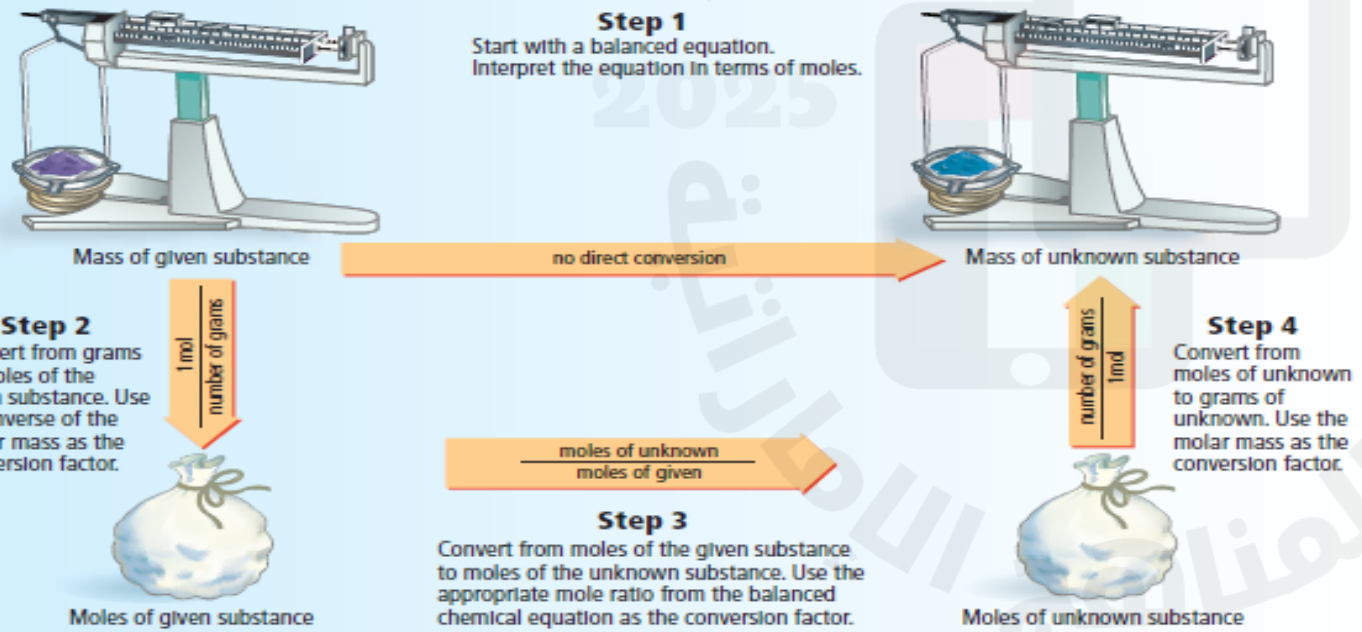
Mastering Stoichiometry

The flowchart below outlines the steps used to solve mole-to-mole, mole-to-mass, and mass-to-mass stoichiometric problems.

1. Complete Step 1 by writing the balanced chemical equation for the reaction.
2. To determine where to start your calculations, note the unit of the given substance.
   - If mass (in grams) of the given substance is the starting unit, begin your calculations with Step 2.
   - If amount (in moles) of the given substance is the starting unit, skip Step 2 and begin your calculations with Step 3.
3. The end point of the calculation depends on the desired unit of the unknown substance.
   - If the answer must be in moles, stop after completing Step 3.
   - If the answer must be in grams, stop after completing Step 4.

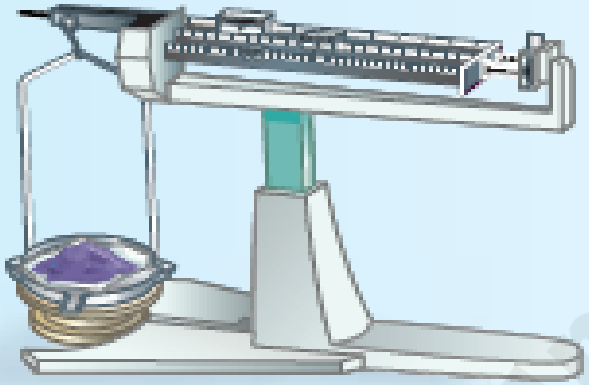
Apply the Strategy

Apply the Problem-Solving Strategy to Example Problems 11.2, 11.3, and 11.4.



Apply the Strategy

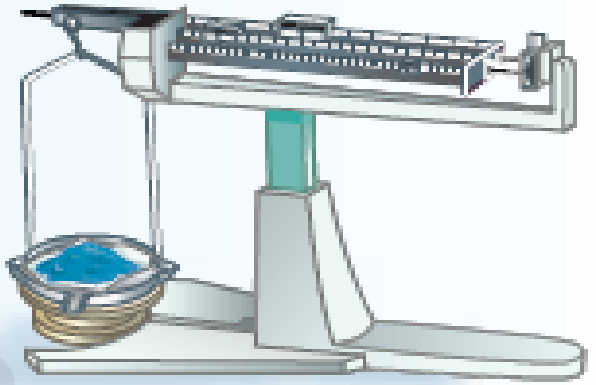
Apply the Problem-Solving Strategy to Example Problems 11.2, 11.3, and 11.4.



Mass of given substance

Step 1
Start with a balanced equation.
Interpret the equation in terms of moles.

no direct conversion



Mass of unknown substance

Step 2
Convert from grams to moles of the given substance. Use the inverse of the molar mass as the conversion factor.

$$\frac{1\ \text{mol}}{\text{number of grams}}$$

Moles of given substance

$$\frac{\text{moles of unknown}}{\text{moles of given}}$$

Step 3
Convert from moles of the given substance to moles of the unknown substance. Use the appropriate mole ratio from the balanced chemical equation as the conversion factor.

$$\frac{\text{number of grams}}{1\ \text{mol}}$$

Step 4
Convert from moles of unknown to grams of unknown. Use the molar mass as the conversion factor.

Moles of unknown substance

Example:

What is the first step in solving stoichiometry problems?	ما الخطوة الأولى في حل مسائل الحسابات الكيميائية؟
Writing the unit of the given substance	كتابة وحدة المادة المعطاة
Writing the unit of the unknown substance	كتابة وحدة المادة غير المعروفة
Writing the mole ratios	كتابة النسب المولية
Writing the balanced chemical equation	كتابة المعادلة الكيميائية الموزونة

Mole-to-Mole Stoichiometry One disadvantage of burning propane (C_3H_8) is that carbon dioxide (CO_2) is one of the products. The released carbon dioxide increases the concentration of CO_2 in the atmosphere. How many moles of CO_2 is produced when 10.0 mol of C_3H_8 is burned in excess oxygen in a gas grill?

2 Solve for the Unknown

Write the balanced chemical equation for the combustion of C_3H_8. Use the correct mole ratio to convert moles of known (C_3H_8) to moles of unknown (CO_2).

10.0 mol ? mol

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$$

Mole ratio: $\frac{3 \text{ mol } CO_2}{1 \text{ mol } C_3H_8}$

$$10.0 \cancel{\text{ mol } C_3H_8} \times \frac{3 \text{ mol } CO_2}{1 \cancel{\text{ mol } C_3H_8}} = \mathbf{30.0 \text{ mol } CO_2}$$

Applications

11. Methane and sulfur react to produce carbon disulfide (CS_2), a liquid often used in the production of cellophane.

$$\_\_\_CH_4(g) + \_\_\_S_8(s) \rightarrow \_\_\_CS_2(l) + \_\_\_H_2S(g)$$

a. Balance the equation.

b. Calculate the moles of CS_2 produced when 1.50 mol S_8 is used.

c. How many moles of H_2S is produced?

Applications

12. **Challenge** Sulfuric acid (H_2SO_4) is formed when sulfur dioxide (SO_2) reacts with oxygen and water.
    a. Write the balanced chemical equation for the reaction.
    b. How many moles of H_2SO_4 is produced from 12.5 moles of SO_2?
    c. How many moles of O_2 are needed?

Example:

How many moles of CO_2 are produced when 5 moles of C_3H_8 are reacted?

كم مول من CO_2 سينتج عند تفاعل 5 mol من C_3H_8؟

$$C_3H_{8(g)} + 5\ O_{2(g)} \rightarrow 3\ CO_{2\ (g)} + 4\ H_2O_{(g)}$$

30 mol

3 mol

5 mol

15 mol

Example:

How many moles of H_2S are produced when 1.50 **moles** of S_8 are reacts?

كم مولًا من H_2S سينتج عند تفاعل 1.50 mol من S_8؟

$$2CH_{4(g)} + S_{8(g)} \rightarrow 2CS_{2(l)} + 4H_2S_{(g)}$$

8 mol

4 mol

2 mol

6 mol

Example:

Based on the following equation, how many moles of hydrochloric acid are needed to react with 0.64 moles of potassium permanganate?

$$2KMnO_4 + 8\ HCl \longrightarrow 3\ Cl_2 + 2\ MnO_2 + 4\ H_2O + 2KCl$$

- A) 0.21 mol HCl
- B) 0.64 mol HCl
- C) 2.7 mol HCl
- D) 5.1 mol HCl

10	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح apply the steps used in solving stoichiometric problems with the correct sequence
11	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح apply the steps used in solving stoichiometric problems with the correct sequence

نص الكتاب + مثال 3 + تطبيقات

Textbook + example 3 + Applications

Mole-to-Mass Stoichiometry Determine the mass of sodium chloride (NaCl), commonly called table salt, produced when 1.25 mol of chlorine gas (Cl_2) reacts vigorously with excess sodium.

2 Solve for the Unknown

$$\overset{1.25\ mol}{2Na(s)} + Cl_2(g) \longrightarrow \overset{?\ g}{2NaCl(s)}$$

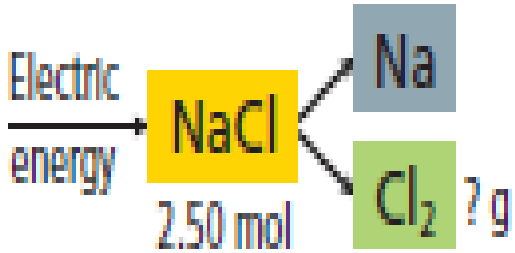
Mole ratio: $\frac{2\ mol\ NaCl}{1\ mol\ Cl_2}$

$$1.25\ \cancel{mol\ Cl_2} \times \frac{2\ mol\ NaCl}{1\ \cancel{mol\ Cl_2}} = 2.50\ mol\ NaCl$$

$$2.50\ \cancel{mol\ NaCl} \times \frac{58.44\ g\ NaCl}{1\ \cancel{mol\ NaCl}} = \mathbf{146\ g\ NaCl}$$

Applications

13. Sodium chloride is decomposed into the elements sodium and chlorine by means of electrical energy. How much chlorine gas, in grams, is obtained from the process diagrammed at right?



Applications

14. Challenge Titanium is a transition metal used in many alloys because it is extremely strong and lightweight. Titanium tetrachloride ($TiCl_4$) is extracted from titanium oxide (TiO_2) using chlorine and coke (carbon).

$$TiO_2(s) + C(s) + 2Cl_2(g) \longrightarrow TiCl_4(s) + CO_2(g)$$

a. What mass of Cl_2 gas is needed to react with 1.25 mol of TiO_2?

b. What mass of C is needed to react with 1.25 mol of TiO_2?

c. What is the mass of all of the products formed by reaction with 1.25 mol of TiO_2?

Example:

How many grams of **NaCl** are produced when 2.50 mol of Cl_2 is reacted?

(Molar mass of NaCl=55.44 g/mol)

كم جرام من **NaCl** سينتج عند تفاعل 2.50 mol من Cl_2؟

(الكتلة المولية لـ NaCl = 55.44 g/mol)

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

277.2 g

182.3 g

55.44 g

146 g

Example:

How many grams of Cl_2 gas is needed to react with **1.25** moles of TiO_2?

(Molar mass of Cl_2= 70.90 g/mol)

كم جرامًا من غاز Cl_2 الضرورية للتفاعل مع 1.25 mol من TiO_2؟

(الكتلة المولية لـ Cl_2 = 70.90 g/mol)

$$TiO_{2(s)} + C_{(g)} + 2Cl_{2(g)} \rightarrow TiCl_{4(s)} + CO_{2(g)}$$

106.4 g

44.3 g

88.6 g

177.3 g

Example:

How many moles of carbon dioxide CO_2 will be produced if 100.0 g of potassium hydrogen carbonate $KHCO_3$ have decomposed?

كم مولًا ينتج من ثاني أكسيد الكربون CO_2 إذا تفكك 100.0 g من كربونات البوتاسيوم الهيدروجينية $KHCO_3$ ؟

$$2KHCO_{3\,(s)} \longrightarrow K_2CO_{3\,(s)} + CO_{2\,(g)} + H_2O_{\,(l)}$$

(Molar Mass of $KHCO_3$ = 100 g/mol)

(الكتلة المولية $KHCO_3$ = 100 g/mol)

0.5 mol	○
1 mol	○
0.25 mol	○
2 mol	○

Example:

How many moles of HCl will just react with 0.424 g $Ba(OH)_2$?

$2HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2H_2O$

- A) 4.94×10^{-3} mol
- B) 9.90×10^{-3} mol
- C) 2.48×10^{-3} mol
- D) 1.24×10^{-3} mol

12	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح apply the steps used in solving stoichiometric problems with the correct sequence

نص الكتاب + مثال 4 + تطبيقات

Textbook + example 4 + Applications

EXAMPLE 4

MASS-TO-MASS STOICHIOMETRY Ammonium nitrate (NH_4NO_3), an important fertilizer, produces dinitrogen monoxide (N_2O) gas and H_2O when it decomposes. Determine the mass of H_2O produced from the decomposition of 25.0 g of solid NH_4NO_3.

SOLVE FOR THE UNKNOWN

25.0 g ? g

$$NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(g)$$

$$25.0 \text{ g } \cancel{NH_4NO_3} \times \frac{1 \text{ mol } NH_4NO_3}{80.04 \text{ g } \cancel{NH_4NO_3}} = 0.312 \text{ mol } NH_4NO_3$$

$$\text{Mole ratio: } \frac{2 \text{ mol } H_2O}{1 \text{ mol } NH_4NO_3}$$

$$0.312 \text{ } \cancel{\text{mol } NH_4NO_3} \times \frac{2 \text{ mol } H_2O}{1 \text{ } \cancel{\text{mol } NH_4NO_3}} = 0.624 \text{ mol } H_2O$$

$$0.624 \text{ } \cancel{\text{mol } H_2O} \times \frac{18.02 \text{ g } H_2O}{1 \text{ } \cancel{\text{mol } H_2O}} = \mathbf{11.2 \text{ g } H_2O}$$

APPLICATIONS

15. One of the reactions used to inflate automobile air bags involves sodium azide (NaN_3): $2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$. Determine the mass of N_2 produced from the decomposition of NaN_3 shown at right.

100.0 g $NaN_3 \rightarrow$? g $N_2(g)$

16. **Challenge** In the formation of acid rain, sulfur dioxide (SO_2) reacts with oxygen and water in the air to form sulfuric acid (H_2SO_4). Write the balanced chemical equation for the reaction. If 2.50 g of SO_2 reacts with excess oxygen and water, how much H_2SO_4, in grams, is produced?

Example:

What is the mass of **N_2O** produced from the decomposition of 40.0 g of **NH_4NO_3** ?

(Molar mass of NH_4NO_3 = 80.04 g/mol , and of N_2O = 44.01 g/mol)

ما كتلة **N_2O** الناتجة عن تفكك 40.0 g من **NH_4NO_3** ؟

(الكتلة المولية لـ NH_4NO_3 = 80.04 g/mol، ولـ N_2O = 44.01g/mol)

$$NH_4NO_{3(s)} \rightarrow N_2O_{(g)} + 2H_2O_{(g)}$$

22.0 g

11.0 g

33.0 g

44.0 g

Example:

One of the reactions used to inflate automobile air bags involves sodium azide (NaN_3). What is the **mass** of N_2 produced from the decomposition of 195 g of NaN_3?

أحد التفاعلات المستخدمة لنفخ الأكياس الهوائية في السيارات يتضمن أزايد الصوديوم (NaN_3).
ماهي **كتلة** N_2 الناتجة عن تفكك 195 g من NaN_3 ؟

$$2NaN_3(s) \longrightarrow 2Na(s) + 3N_2(g)$$

Molar mass:
NaN_3 = 65 g/mol
N_2 = 28 g/mol

كتلة مولية:
65 g/mol = NaN_3
28 g/mol = N_2

56.0 g

112.0 g

126.0 g

25.0 g

Example:

What mass of SrF_2 can be prepared from the reaction of 10.0 g $Sr(OH)_2$ with excess HF?

$Sr(OH)2 + 2HF \rightarrow SrF2 + 2H2O$

- A) 9.67 g
- B) 9.82 g
- C) 10.0 g
- D) 10.3 g

Example:

Balance the following equation with the smallest whole—number coefficients. How many grams of O_2 will be produced if 23.2 g of XeF_2 reacts with excess water?

$$XeF_2 + H_2O \rightarrow Xe + HF + O_2$$

- A) 2.19 g
- B) 1.10 g
- C) 3.31 g
- D) 4.42 g

Example:

Natural gas is mostly methane, CH_4. When 128 grams of methane is burned in the chemical reaction shown above, how many grams of water vapor are produced?

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

- A) 8.00 grams
- B) 144 grams
- C) 18.0 grams
- D) 288 grams

13	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح - يستخدم معامل التحويل الصحيح
	apply the steps used in solving stoichiometric problems with the correct sequence - use the correct conversion factor
14	يطبق الخطوات المتبعة في حل مسائل الحسابات الكيميائية بالتسلسل الصحيح
	apply the steps used in solving stoichiometric problems with the correct sequence

نص الكتاب + استراتيجيات حل المسائل

Textbook + Problem solving strategy

Problem-Solving Strategy

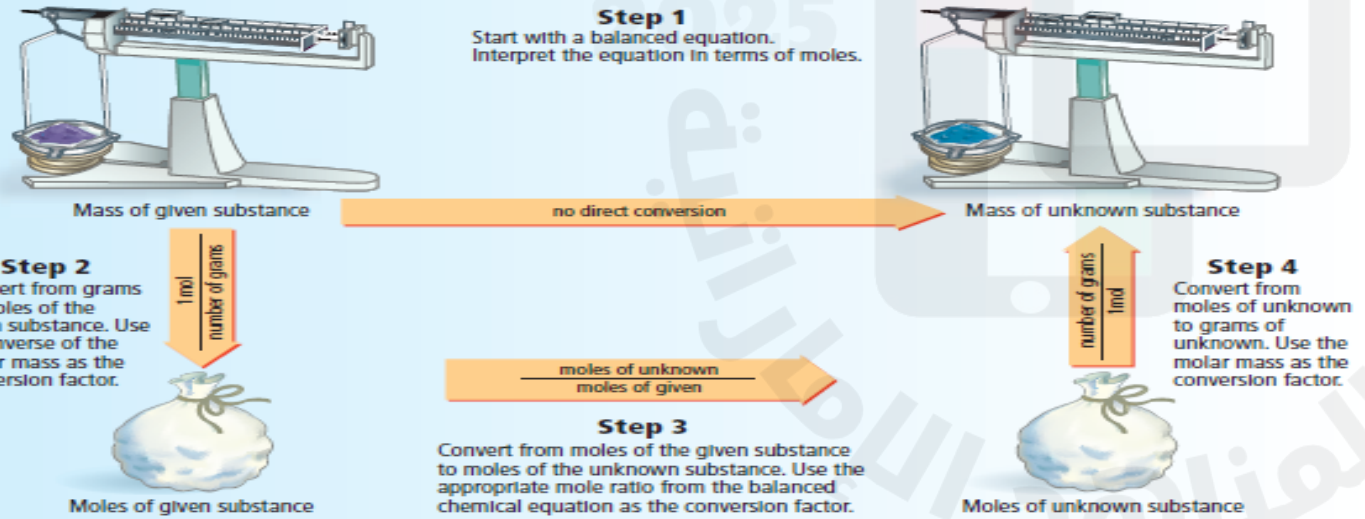
Mastering Stoichiometry

The flowchart below outlines the steps used to solve mole-to-mole, mole-to-mass, and mass-to-mass stoichiometric problems.

1. Complete Step 1 by writing the balanced chemical equation for the reaction.
2. To determine where to start your calculations, note the unit of the given substance.
   - If mass (in grams) of the given substance is the starting unit, begin your calculations with Step 2.
   - If amount (in moles) of the given substance is the starting unit, skip Step 2 and begin your calculations with Step 3.
3. The end point of the calculation depends on the desired unit of the unknown substance.
   - If the answer must be in moles, stop after completing Step 3.
   - If the answer must be in grams, stop after completing Step 4.

Apply the Strategy

Apply the Problem-Solving Strategy to Example Problems 11.2, 11.3, and 11.4.



Section3:
Limiting reactant

أنتن قادرات على التفوق والنجاح، فامضين قدمًا بثقة، مع كل خطوة تقتربون فيها من تحقيق أحلامكم.

15	يحدد المادة المتفاعلة التي تعتبر متفاعلا محددا في تفاعل كيميائي
	specifie the limiting reactant in a chemical reaction

نص الكتاب + الشكل 4 و 5
Textbook + figure 4 , 5

Limiting and excess reactants Recall the reaction from the Launch Lab. After the colorless solution formed, adding more sodium hydrogen sulfite had no effect because there was no more potassium permanganate available to react with it. Potassium permanganate was a limiting reactant. As the name implies, the **limiting reactant** limits the extent of the reaction and, thereby, determines the amount of product formed. A portion of all the other reactants remains after the reaction stops. Reactants leftover when a reaction stops are **excess reactants.**

To help you understand limiting and excess reactants, consider the analogy in **Figure 11.4.** From the available tools, four complete sets consisting of a pair of pliers, a hammer, and two screwdrivers can be assembled. The number of sets is limited by the number of available hammers. Pliers and screwdrivers remain in excess.

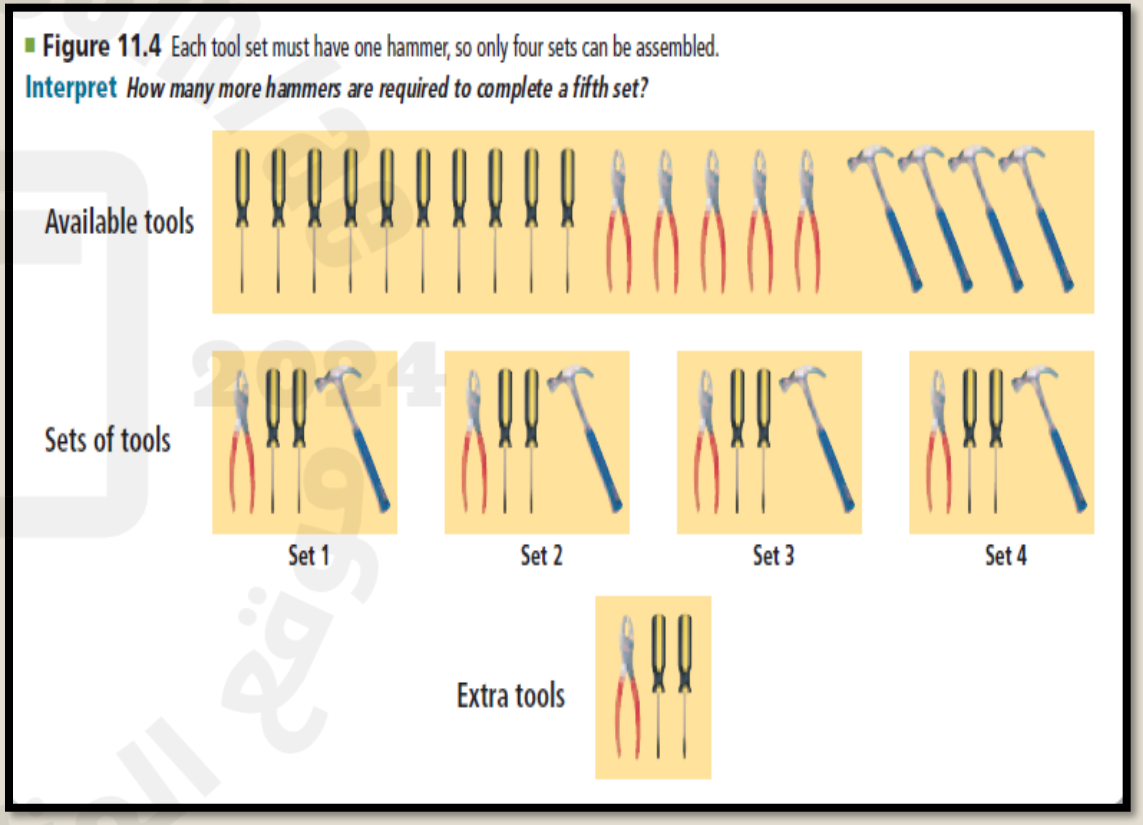


Figure 11.4 Each tool set must have one hammer, so only four sets can be assembled.
Interpret *How many more hammers are required to complete a fifth set?*

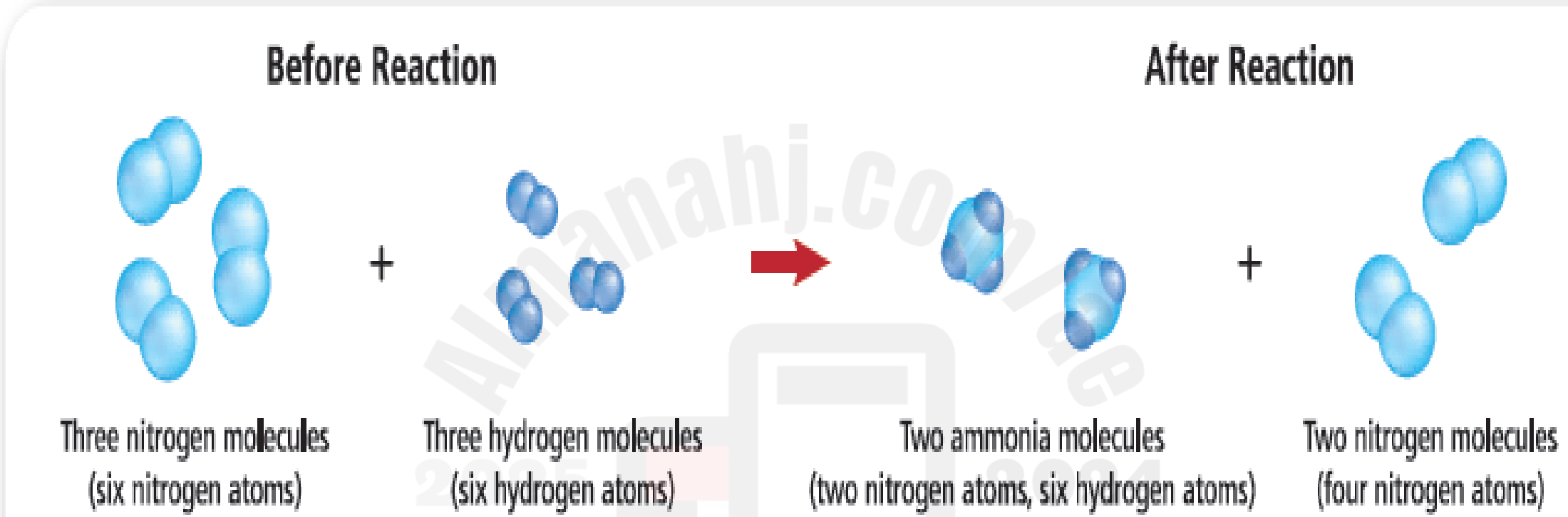


Figure 5 If you check all the atoms present before and after the reaction, you will find that some of the nitrogen molecules are unchanged. These nitrogen molecules are the excess reactant.

Example:

Reactants leftover when a reaction stops are called.....	بقايا المواد المتفاعلة بعد انتهاء التفاعل الكيميائي تُسمى.....
limiting reactants	المتفاعل المحدد
limiting products	الناتج المحدد
excess reactants	المتفاعل الفائض
excess product	الناتج الفائض

Example:

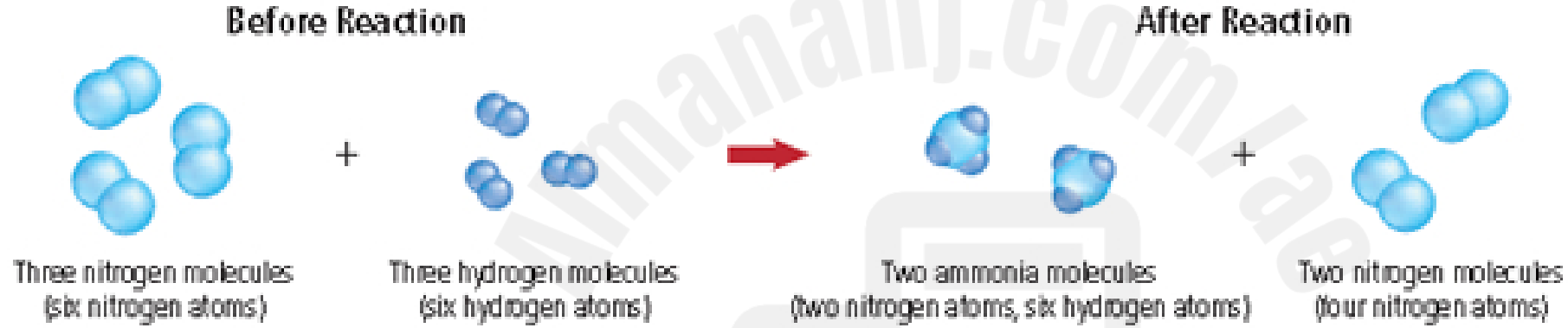
What is the limiting reactant in the figure shown below?

ما المتفاعل المُحدد في الشكل الموضح أدناه؟

Ammonia molecules	جزيئات الأمونيا
No limiting reactant	لا يوجد متفاعل محدد
Nitrogen molecules	جزيئات النيتروجين
Hydrogen molecules	جزيئات الهيدروجين

Example:

What is the limiting reactant in the reaction shown?



- A) ammonia
- B) nitrogen
- C) hydrogen
- D) There is no limiting reactant.

Example:

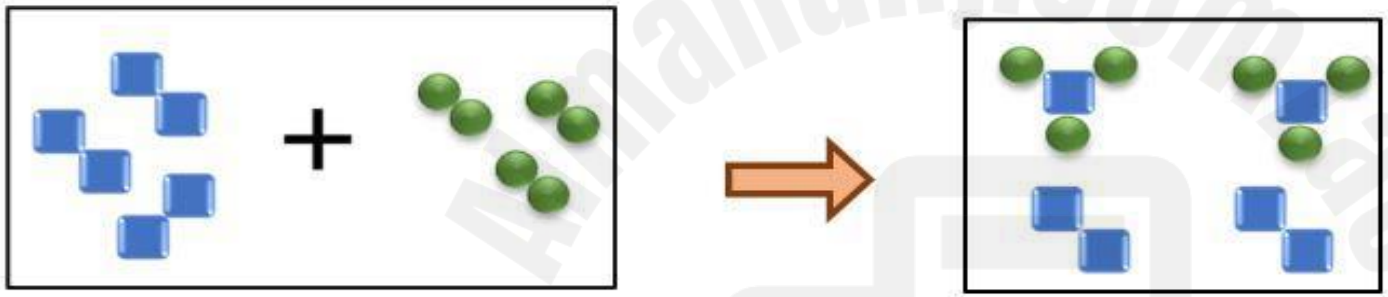
What a substance not completely used up in a chemical reaction is called?

ماذا تُسمى المادة التي لا تُستخدم بشكل تام في التفاعل الكيميائي؟

Example:

blue squares represent element **X**,
green circles represent element **Y**.
Which of the following is correct?

المربعات الزرقاء تُمثل العنصر **X**،
والدوائر الخضراء تُمثل العنصر **Y**.
أي مما يلي صحيح؟



Limiting reactant is X_2	المتفاعل المحدد هو X_2 ○
Limiting reactant is Y_2	المتفاعل المحدد هو Y_2 ○
X_2 is consumed first in the reaction	يتم استهلاك X_2 أولاً في التفاعل ○
At the end of the reaction an amount of Y_2 is leftover unreacted	في نهاية التفاعل تبقى كمية من Y_2 غير متفاعلة ○

Example:

The substance that limits the extent of a chemical reaction has a special name. What is this substance called?

- A) limiting reactant
- B) limiting product
- C) excess reactant
- D) excess product

Example:

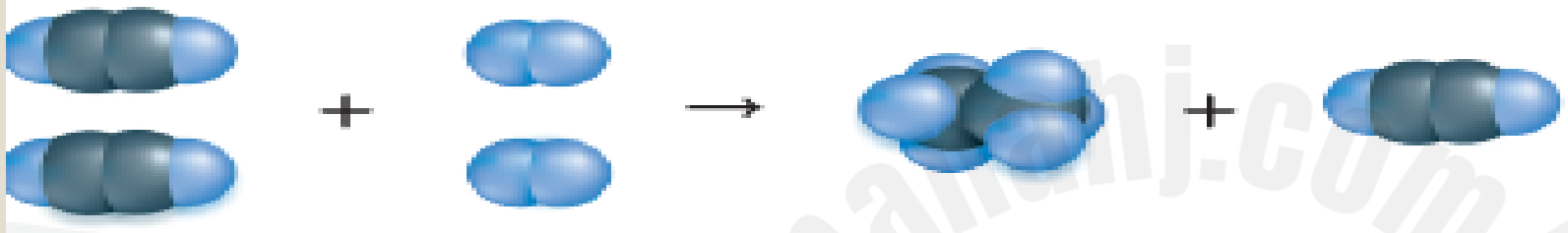


Figure 13

. The reaction between ethyne (C_2H_2) and hydrogen (H_2) is illustrated in **Figure 13.** The product is ethane (C_2H_6). Which is the limiting reactant? Which is the excess reactant? Explain.

16	يحسب الكمية المتبقية من المتفاعل الفائض بعد اكتمال التفاعل الكيميائي Calculate the amount of the excess reactant remains after the reaction is complete	
17	يحسب كتلة الناتج عندما تكون كميات أكثر من متفاعل واحد معروفة Calculate the mass of a product when the amounts of more than one reactant are given	
19	يحدد المتفاعل المحدد والمتفاعل الفائض في تفاعل كيميائي determine the limiting reactant and the excess reactant in a chemical reaction	

EXAMPLE 5

DETERMINING THE LIMITING REACTANT The reaction between solid white phosphorus (P_4) and oxygen produces solid tetraphosphorus decoxide (P_4O_{10}). This compound is often called diphosphorus pentoxide because its empirical formula is P_2O_5.

a. Determine the mass of P_4O_{10} formed if 25.0 g of P_4 and 50.0 g of oxygen are combined.

b. How much of the excess reactant remains after the reaction stops?

نص الكتاب + مثال 5 + تطبيقات
Textbook + example 5 + Applications

APPLICATIONS

23. The reaction between solid sodium and iron(III) oxide is one in a series of reactions that inflates an automobile airbag: $6Na(s) + Fe_2O_3(s) \rightarrow 3Na_2O(s) + 2Fe(s)$. If 100.0 g of Na and 100.0 g of Fe_2O_3 are used in this reaction, determine the following.

a. limiting reactant

b. reactant in excess

c. mass of solid iron produced

d. mass of excess reactant that remains after the reaction is complete

24. **Challenge** Photosynthesis reactions in green plants use carbon dioxide and water to produce glucose ($C_6H_{12}O_6$) and oxygen. A plant has 88.0 g of carbon dioxide and 64.0 g of water available for photosynthesis.
    a. Write the balanced chemical equation for the reaction.
    b. Determine the limiting reactant.
    c. Determine the excess reactant.
    d. Determine the mass in excess.
    e. Determine the mass of glucose produced.

Example:

Sodium **Na** and iron (III)oxide Fe_2O_3 reacts according to the following balance chemical equation:

يتفاعل الصوديوم **Na** مع أكسيد الحديد(III) Fe_2O_3 وفق المعادلة الكيميائية الموزونة التالية :

$$6Na_{(s)} + Fe_2O_{3(s)} \rightarrow 3Na_2O_{(s)} + 2Fe_{(s)}$$

If 4.35 mol of **Na** and 0.63 mol of Fe_2O_3 are used in the reaction

Which of the following is the limiting reactant?

إذا استخدم 4.35 mol من **Na** مع 0.63 mol من Fe_2O_3 في التفاعل

أي مما يلي هو المتفاعل المُحدد؟

Na_2O

Fe_2O_3

Na

Fe

Example:

In the following reaction, if we use 100 g of sodium Na and 100 g of iron (III) oxide (Fe_2O_3), what is the limiting reactant?

في التفاعل التالي، أذا استخدمنا 100 g من الصوديوم Na و100 g من أكسيد الحديد (III) Fe_2O_3 ، ما المتفاعل المحدد؟

$$6Na_{(s)} + Fe_2O_{3(s)} \rightarrow 3Na_2O_{(s)} + 2Fe_{(s)}$$

Molar Mass:
Na = 23 g/mol
Fe_2O_3 = 160 g/mol

الكتلة المولية:
23 g/mol = Na
160 g/mol = Fe_2O_3

- Na ○
- Fe ○
- Fe_2O_3 ○
- Na_2O ○

Example:

Hematite Fe_2O_3 and carbon monoxide **CO** react according to the following balanced chemical equation :

يتفاعل الهيماتيت Fe_2O_3 مع أول أكسيد الكربون **CO** وفق المعادلة الكيميائية الموزونة التالية:

$$Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$$

If 25.0 mol of Fe_2O_3 and 30.0 mol of **CO** are used in the reaction

إذا استخدم 25.0 mol من Fe_2O_3 مع 30.0 mol من **CO** في التفاعل

Which of the following is the limiting reactant?

أي مما يلي هو المتفاعل المحدد؟

CO_2

Fe

Fe_2O_3

CO

Example:

Which reactant in the following reaction is in excess when 9.8 grams of $Ca(OH)_2$ is reacted with 9.8 grams of H_3PO_4?

$3Ca(OH)_2 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6H_2O$

- A) $Ca(OH)_2$
- B) H_3PO_4
- C) $Ca_3(PO_4)_2$
- D) H_2O

Example:

Nickel-Iron Battery In 1901, Thomas Edison invented the nickel-iron battery. The following reaction takes place in the battery.

$$Fe(s) + 2NiO(OH)(s) + 2H_2O(l) \longrightarrow Fe(OH)_2(s) + 2Ni(OH)_2(aq)$$

How many mol of $Fe(OH)_2$ is produced when 5.00 mol of Fe and 8.00 mol of NiO(OH) react?

Example:

One of the few xenon compounds that form is cesium xenon heptafluoride ($CsXeF_7$). How many moles of $CsXeF_7$ can be produced from the reaction of 12.5 mol of cesium fluoride with 10.0 mol of xenon hexafluoride?

$$CsF(s) + XeF_6(s) \longrightarrow CsXeF_7(s)$$

Example:

Alkaline Battery An alkaline battery produces electrical energy according to this equation.

$$Zn(s) + 2MnO_2(s) + H_2O(l) \rightarrow Zn(OH)_2(s) + Mn_2O_3(s)$$

a. Determine the limiting reactant if 25.0 g of Zn and 30.0 g of MnO_2 are used.

b. Determine the mass of $Zn(OH)_2$ produced.

18	يحدد المتفاعل المحدد والمتفاعل الفائض في تفاعل كيميائي determine the limiting reactant and the excess reactant in a chemical reaction

نص الكتاب + الشكل 7

Textbook + figure 7

Figure 7 With insufficient oxygen, the burner on the left burns with a yellow, sooty flame. The burner on the right burns hot and clean because an excess of oxygen is available to react completely with the methane gas.

Why use an excess of a reactant? Many reactions stop while portions of the reactants are still present in the reaction mixture. Because this is inefficient and wasteful, chemists have found that by using an excess of one reactant—often the least expensive one—reactions can be driven to continue until all of the limiting reactant is used up. Using an excess of one reactant can also speed up a reaction.

Figure 7 shows an example of how controlling the amount of a reactant can increase efficiency. Your lab likely uses the type of Bunsen burner shown in the figure. If so, you know that this type of burner has a control that lets you adjust the amount of air that mixes with the methane gas. How efficiently the burner operates depends on the ratio of oxygen to methane gas in the fuel mixture. When the air is limited, the resulting flame is yellow because of glowing bits of unburned fuel. This unburned fuel leaves soot (carbon) deposits on glassware. Fuel is wasted because the amount of energy released is less than the amount that could have been produced if enough oxygen were available. When sufficient oxygen is present in the combustion mixture, the burner produces a hot, intense blue flame. No soot is deposited because the fuel is completely converted to carbon dioxide and water vapor.

Example:

In a bunsen burner flame, what does a yellow color signify?

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

- A) Methane gas is the limiting reactant
- B) Oxygen is the limiting reactant.
- C) Carbon dioxide is the limiting reactant.
- D) Water is the limiting reactant.

20	يحسب الكمية المتبقية من المتفاعل الفائض بعد اكتمال التفاعل الكيميائي
	Calculate the mass of excess reactant that remains after the reaction is complete

نص الكتاب + مراجعة الوحدة
Textbook + chapter assessment

. Lithium reacts spontaneously with bromine to produce lithium bromide. Write the balanced chemical equation for the reaction. If 25.0 g of lithium and 25.0 g of bromine are present at the beginning of the reaction, determine

a. the limiting reactant.

b. the mass of lithium bromide produced.

c. the excess reactant and the excess mass.

GOOD LUCK MY LOVELY STUDENTS