

ملزمة الهيكل لمادة الكيمياء



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇨ المناهج الإماراتية ⇨ الصف الثاني عشر المتقدم ⇨ كيمياء ⇨ الفصل الثالث ⇨ ملفات متنوعة ⇨ الملف

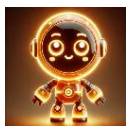
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ملفات اكتب للمعلم اكتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل
منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

المزيد من مادة
كيمياء:

إعداد: طارق محمد

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة كيمياء في الفصل الثالث

ملزمة الهيكل لمادة الكيمياء

1

سلسلة أسئلة الامتحانات السابقة: الهيدروكربونات

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مراجعة المنهج خطة تغطية أسئلة الامتحان النهائي 2026م النسخة الانجليزية

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مراجعة المنهج خطة تغطية أسئلة الامتحان النهائي 2026م

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Your Guide
to Success



THE GARDEN
ACADEMY

بوابتك نحو التميز



ملزمة الهيكل

Grade 12 Advanced

الصف الثاني عشر متقدم

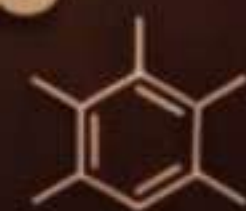
الفصل الدراسي الثالث | 2025 - 2026



مادة الكيمياء

$NaCl$

Chemistry



Inspire

English

المدرس: طارق محمد

C-102 Curriculum

تذكير

إعلان هام من الأكاديمية

تنوه أكاديميتنا إلى ضرورة الحفاظ على حقوق الملكية الفكرية الخاصة بالمحتوى التعليمي الذي نقدمه في بطاقاتنا التعليمية من فيديوهات، أوراق عمل واختبارات وغيره. في هذه الفترة الخاصة بمراجعات "الهيكل" لمادة الفصل الدراسي الثالث نود التأكيد على التالي:

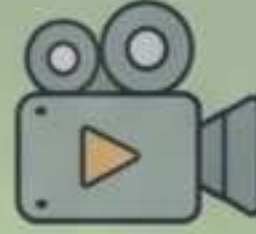
يمنع منعاً باتاً نشر أوراق الشرح المحولة أو تصوير فيديوهات الشرح الخاصة بنا أو إعادة توزيعها بأي شكل من الأشكال إذ يعتبر نشر أي من هذه المواد دون إذن مسبق مخالفة قانونية، ويعرض الفاعل للمساءلة والملاحقة القانونية، لكن يسمح فقط بنشر ملزمة الهيكل (غير المحولة)

نشكركم على تفهمكم وتعاونكم في حماية حقوق الجميع ودعم الأكاديمية في توفير محتوى تعليمي آمن وموثوق .



بطاقة الكيمياء صف 12 متقدم

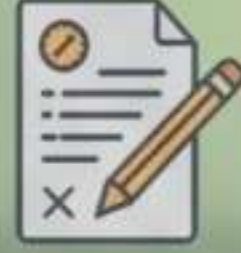
شرح أ. طارق محمد



فيديوهات



ملخصات شرح



أوراق عمل



اختبارات

مراجعة تفصيلية شاملة للهيكـل



جاهز للنجاح وإطلاق إبداعاتك



للاشتراك واتساب الدعم الفني
للكاديمية: 0569174493





1	CHM.5.3.05.007.02 Identify components of a voltaic or galvanic cell (anode, cathode, salt bridge or porous barrier, wires, electrolyte compartments); while explaining the role of each component, when does the reaction start and determining the direction of electron and current flow	Textbook + figures 1, 2	25, 26
2	CHM.5.3.05.007.02 Identify components of a voltaic or galvanic cell (anode, cathode, salt bridge or porous barrier, wires, electrolyte compartments); while explaining the role of each component, when does the reaction start and determining the direction of electron and current flow	Textbook + figure 2	26,

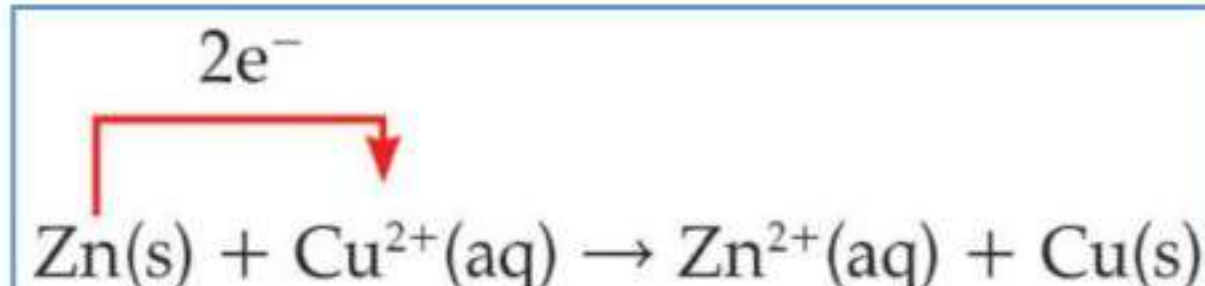
Redox in Electrochemistry

Electrochemistry is the study of the redox processes by which chemical energy is converted to electrical energy and vice versa.

All redox reactions involve a transfer of electrons from the species that is to the species that is

Half Reactions

Write the two half-reactions make up this redox process:



Oxidation half-reaction:

Reduction half-reaction:



Figure 1 In **a**, zinc metal is immersed in 1M zinc sulfate solution, and copper metal in 1M copper(II) sulfate. In **b**, a wire joining the zinc and copper strips provides a pathway for the flow of electrons, but the pathway is not complete. Electron transfer is still not possible.

What is the role of the wire?

When the metal strips are placed in their solutions, oxidation begins at the zinc strip and reduction begins at the copper strip—but these reactions cannot continue.

The reason is that as zinc is oxidized, positive zinc ions build up around the zinc electrode. As copper in the copper sulfate solution is reduced, negative sulfate ions build up around the copper electrode. **The buildup of charges stops any further reaction.**

A **salt bridge** is a pathway to maintain solution neutrality by allowing the passage of ions from one side to another. It consists of a tube containing a conducting solution of a soluble salt, such as KCl, held in place by an agar gel or other permeable plug. Ions can move through the plug, but the solutions in the two beakers cannot mix.

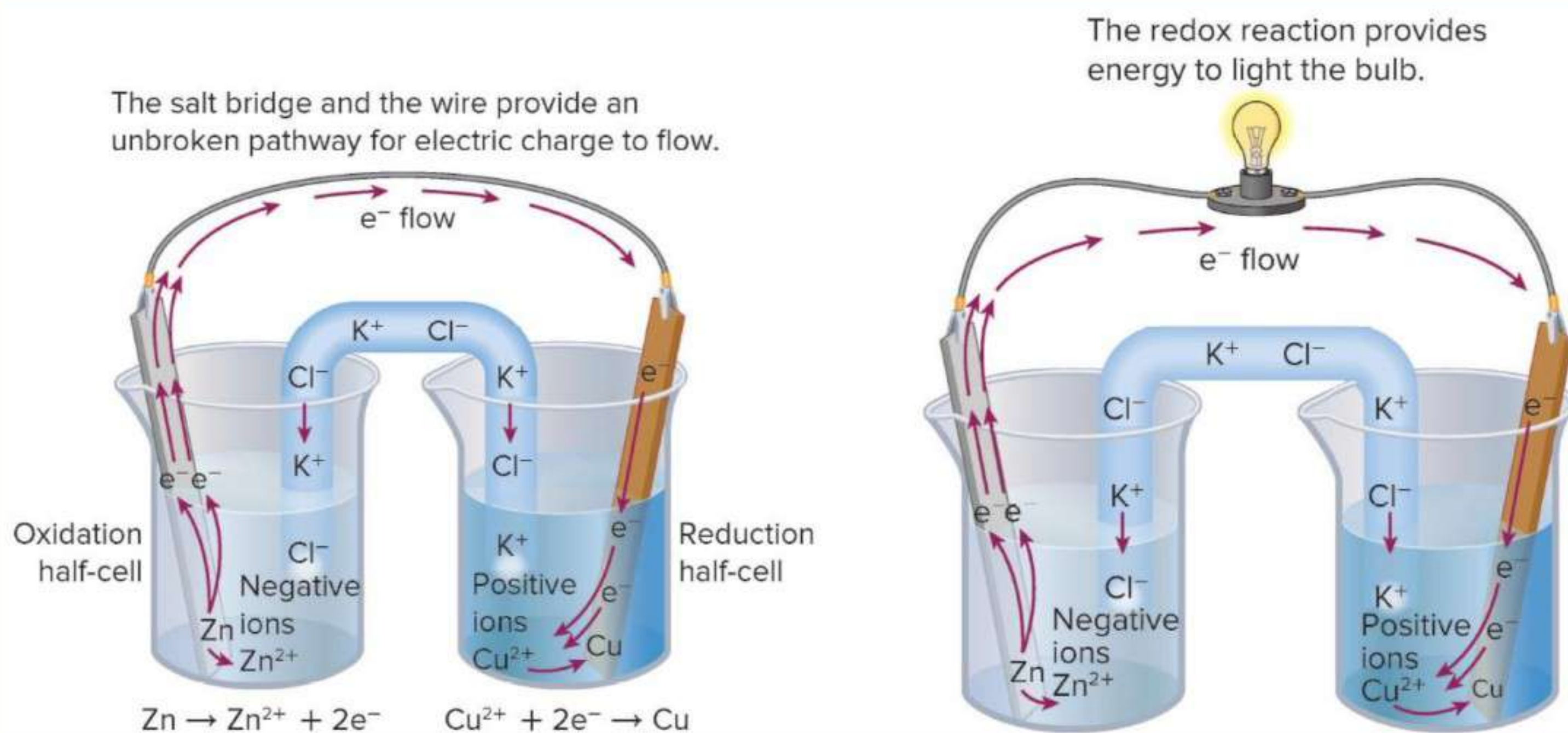


Figure 2 The addition of a salt bridge completes the pathway. Negative ions move through the salt bridge to the zinc side. Positive ions move through the bridge to the copper side.

When the connecting metal wire and the salt bridge are in place, Electrons flow through the wire from the oxidation half-reaction to the reduction half-reaction, while positive and negative ions move through the salt bridge.

The flow of electrons through the wire and the flow of ions through the salt bridge make up the **electric current**.

Electrochemical cells

An **electrochemical cell** is an apparatus that uses a redox reaction to produce electrical energy or uses electrical energy to cause a chemical reaction.

A **voltaic cell** is a cell that converts chemical energy to electrical energy by a spontaneous redox reaction.

Chemistry of Voltaic Cells

An electrochemical cell consists of two parts called **half-cells**, the separate oxidation and reduction reactions take place.

Each half-cell contains an electrode and a solution containing ions.

An **electrode** is an electrically conductive material, usually a metallic strip or graphite, that conducts electrons into and out of the solution in the half cell.

Question: in the previous cell, where do oxidation and reduction take place?

The reaction that takes place in each half-cell is called a half-cell reaction.

The electrode where oxidation takes place is the **anode**.

The electrode where reduction takes place is the **cathode**.

OXIDATION
ANODE
REDUCTION
CATHODE



Voltaic cells and energy

Electric potential energy is a measure of the amount of current that can be generated from a voltaic cell to do work.

Electric charge can flow between two points only when a difference in electric potential energy exists between the two points.

What are these two points?

The **electromotive force (EMF)** pushes the electrons toward the cathode. This force is due to the difference in electric potential energy between the two electrodes and is referred to as the **cell potential**.

A **volt** (V) is a unit used to measure cell potential.

The **electric potential difference** of a voltaic cell is an indication of the energy that is available to move electrons from the anode to the cathode.

The voltage of a cell is determined by comparing the difference in the tendency of the two electrode materials to accept electrons.

The greater the difference, the greater the potential energy difference between the two electrodes and the larger the voltage of the cell will be.

In the zinc-copper cell, copper(II) ions at the cathode accept electrons more readily than the zinc ions at the anode. Thus, the redox reaction occurs spontaneously only when the electrons flow from the zinc to the copper.

Question: Identify the components of a voltaic cell. Explain the role of each component in the operation of the cell.

Anode	
Cathode	
Salt bridge	
Wire	



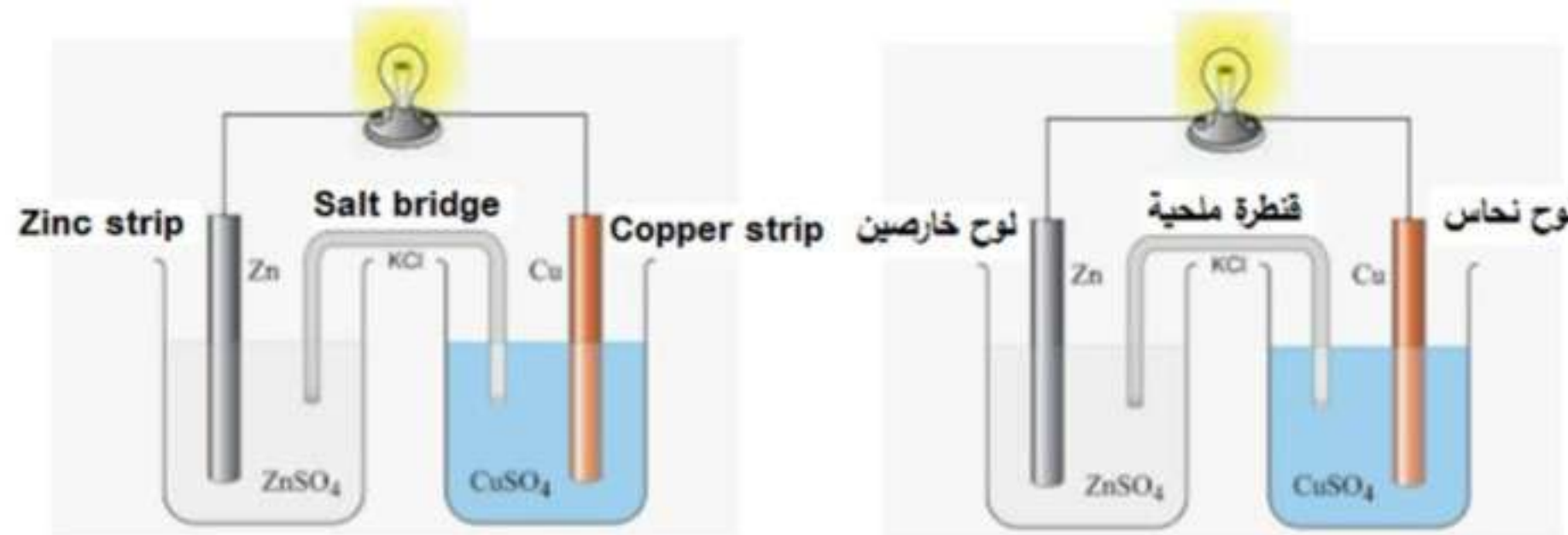
Final Exam Question

Regarding the cell in the figure below. Which of

فيما يتعلق بالخلية الموضحة في الشكل أدناه.

The following is **incorrect**?

أي مما يأتي **غير** صحيح؟



A salt bridge allows ions to pass from one side to another

تسمح القنطرة الملحية بمرور الأيونات من جهة إلى أخرى

Electrons flow through the wire from the oxidation half-reaction to the reduction half-reaction

تنتقل الإلكترونات عبر السلك من تفاعل الأكسدة النصفية إلى تفاعل الاختزال النصفية

This cell converts electrical energy to chemical energy

تُحول هذه الخلية الطاقة الكهربائية إلى طاقة كيميائية

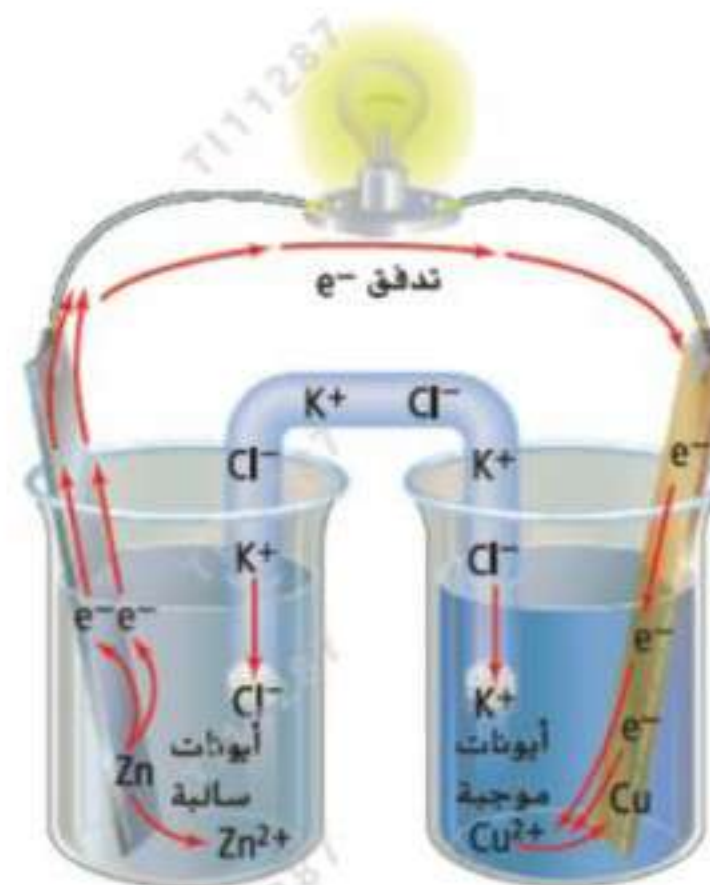
A spontaneous redox reaction takes place

تحدث عمليات أكسدة واختزال تلقائية

In the figure below, which of the following is **not**

في الشكل أدناه، أي مما يأتي **ليست** من وظائف القنطرة الملحية؟

a function of the salt bridge?



Prevents the mixing of the two solutions

☐ تمنع اختلاط المحلولين

Prevents ions building up around the electrodes

☐ تمنع تراكم الأيونات حول القطبين

Allows the passage of ions from one side to another

☐ تسمح بمرور الأيونات من جهة إلى أخرى

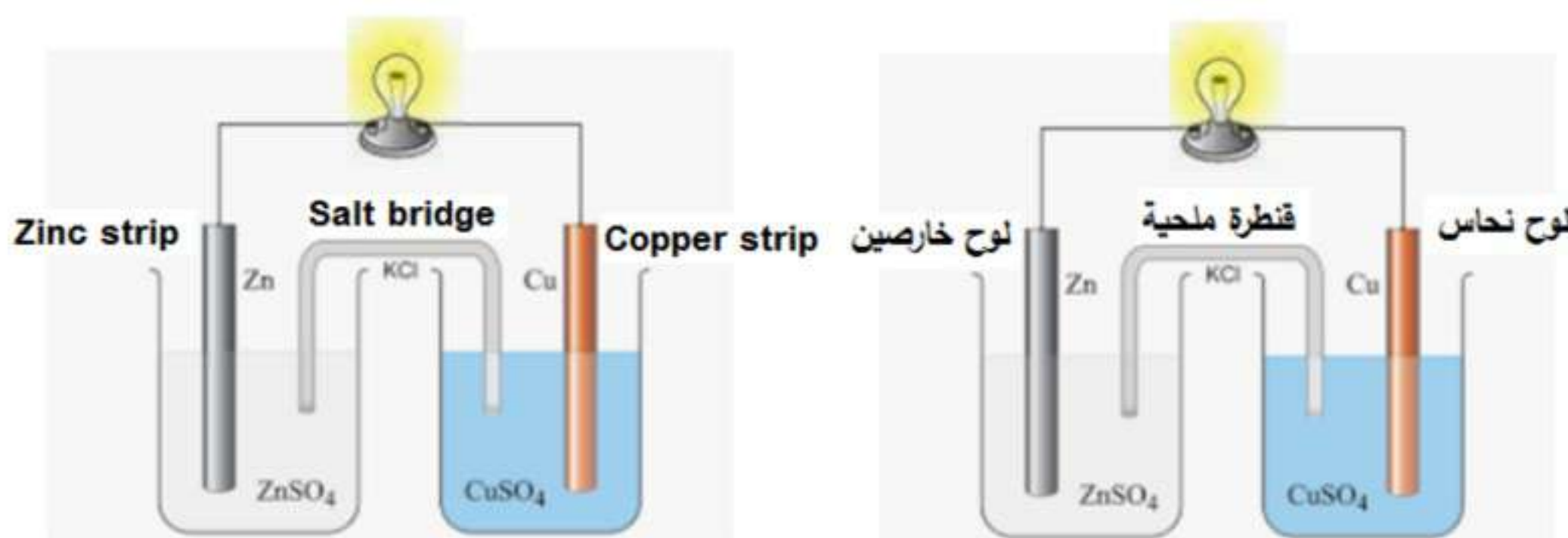
Allows the passage of electrons from one side to another

☐ تسمح بمرور الإلكترونات من جهة إلى أخرى



In the voltaic cell shown in the figure below, which of the following statements is true?

في الخلية الفولتية الموضحة في الشكل أدناه، أي العبارات التالية صحيحة؟



Uses electrical energy to cause a chemical reaction

تستخدم الطاقة الكهربائية لإحداث تفاعل كيميائي

Electrons move through the salt bridge to the copper side

تتحرك الإلكترونات عبر القنطرة الملحية وصولاً إلى جهة النحاس

Positive zinc ions build up around the zinc electrode

تتراكم أيونات الخارصين الموجبة حول القطب الكهربائي للخارصين

The wire can serve as a pathway for electrons to flow from the zinc strip to the copper strip

يعمل السلك كمسار لانتقال الإلكترونات من لوح الخارصين إلى لوح النحاس

In the figure below, what do the two half-cells need so that you can convert chemical energy into electrical energy?

في الشكل أدناه، ما الذي يحتاجه نصف الخلية حتى يمكنك تحويل الطاقة الكيميائية إلى طاقة كهربائية؟



Only connecting the zinc and copper strips with a metal wire to serve as a pathway for electrons to flow

فقط ربط لوجي الخارصين والنحاس بسلك نحاسي لتوفير مسار لنقل الإلكترونات

A salt bridge and a metal wire to provide an unbroken pathway for electrical charge to flow

قنطرة ملحية وسلك نحاسي معاً لتوفير مسار غير منقطع لانتقال الشحنات الكهربائية

A salt bridge to serve as a pathway for electrons to flow and a metal wire to serve as a pathway for ions to flow

قنطرة ملحية لنقل الإلكترونات وسلك نحاسي لنقل الأيونات

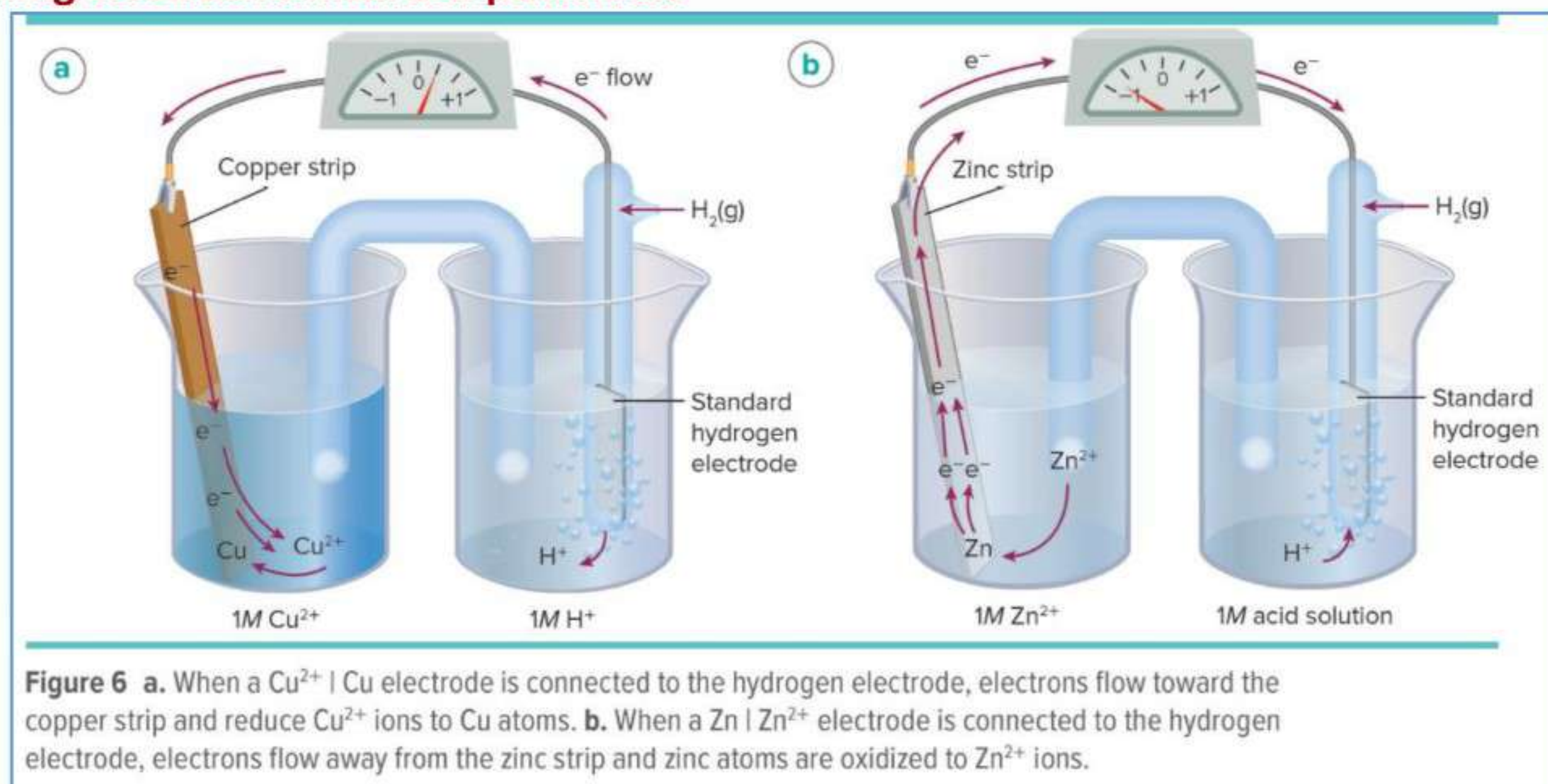
Only a salt bridge to serve as a pathway for ions to flow

فقط قنطرة ملحية لتوفير مسار لنقل الأيونات



3	CHM.5.3.05.007.05 Use the half-cell standard reduction potentials to calculate the electrochemical cell standard potential, while determining whether the redox reactions are spontaneous or non-spontaneous	Textbook + Example problem1 + Practice problems+ check your progress	31 ,32,33 ,34 ,35
4	CHM.5.3.05.007.04 Write the cell notation and the overall chemical equation for a redox reaction occurring in a voltaic cell	Textbook + Example problem1 + Practice problems	31 ,32 ,33
5	CHM.5.3.05.008.01 Use the standard reduction potentials to predict if a reaction occurs or not, while identifying the strongest reducing or oxidizing agent and the substance that is easily oxidized or reduced	Textbook + figure 6	31

Determining electrochemical cell potentials



In Cell **a**, electrons flow from the to

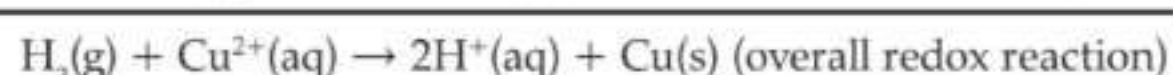
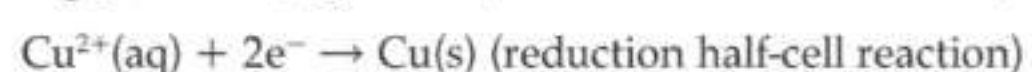
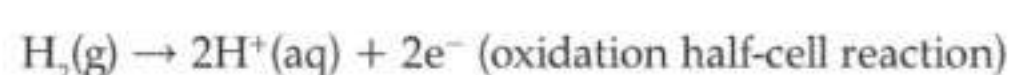
The oxidation at

The reduction at

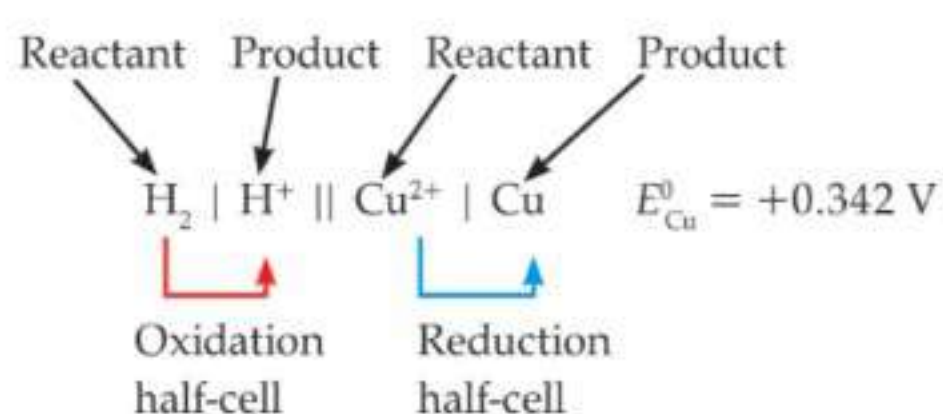
The E^0 , measured by a voltmeter, is +0.342 V.

The positive voltage indicates that Cu^{2+} ions at the copper electrode accept electrons more readily than do H^+ ions.

Study the overall redox reaction and cell notation. (cell a)



This reaction can be written in a form called cell notation.



In Cell **b**, electrons flow from the to

The oxidation at

The reduction at

The E^0 , measured by a voltmeter, is -0.762 V.

The negative voltage indicates that

Write the overall redox reaction and cell notation. (cell b)

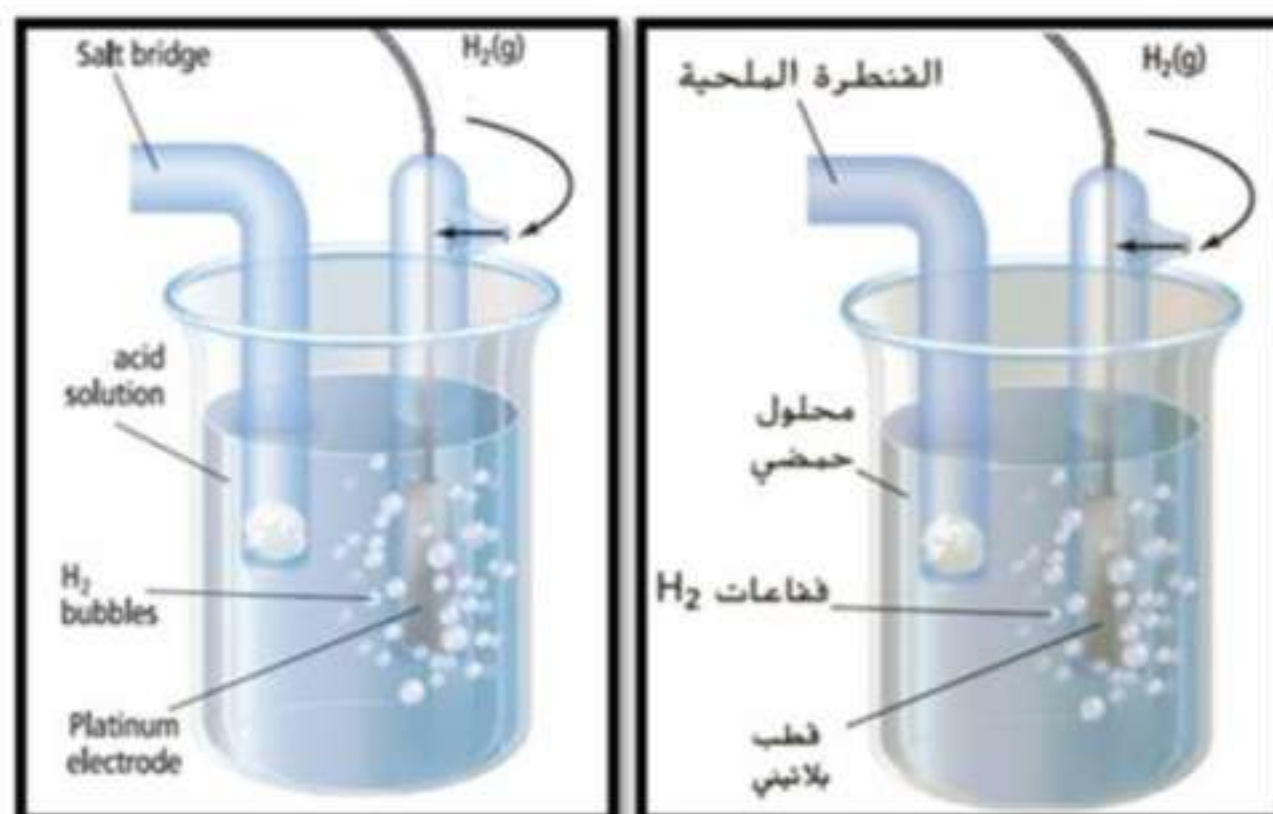
The double vertical line in the cell notation ($||$) represents and



Final Exam Questions

Which of the following is true for the standard hydrogen electrode shown in the figure below?

أي مما يأتي صحيح فيما يتعلق بقطب الهيدروجين القياسي الموضح في الشكل أدناه؟



It is the cathode in all the voltaic cells in which it is connected

يكون كاثودًا في جميع الخلايا الفولتية التي يُوصَل فيها

It is the anode in all the voltaic cells in which it is connected

يكون أنودًا في جميع الخلايا الفولتية التي يُوصَل فيها

The reduction potential of this electrode is 0.000V when the concentration of the acid solution is 1 M and hydrogen gas is pumped under pressure 1 atm and the temperature is maintained at 25°C

جهد اختزال هذا القطب يساوي 0.000V عندما يكون تركيز محلول الحمض 1 M ويضخ غاز الهيدروجين تحت ضغط 1 atm وتبقى درجة الحرارة ثابتة عند 25°C

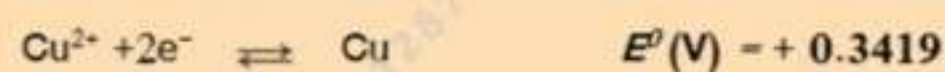
The reduction potential of this electrode is 0.000V at all conditions

جهد اختزال هذا القطب يساوي 0.000V عند جميع الظروف

Regarding the standard hydrogen electrode in the figure below. Which of the following is **correct**?

فيما يتعلق بقطب الهيدروجين القياسي في الشكل أدناه.

أي مما يأتي **صحيح**؟



It will be an anode when connected to Zn | Zn²⁺ electrode

يكون أنودًا عند توصيله مع قطب Zn | Zn²⁺ ☐

It will be a cathode when connected to Cu|Cu²⁺ electrode

يكون كاثودًا عند توصيله مع قطب Cu|Cu²⁺ ☐

The standard reduction potential (E⁰), of the standard hydrogen electrode is defined as 1.104 V

جهد الاختزال القياسي (E⁰) لقطب الهيدروجين يساوي 1.104 V ☐

The standard reduction potential (E⁰), of the standard hydrogen electrode is defined as 0.000 V

جهد الاختزال القياسي (E⁰) لقطب الهيدروجين يساوي 0.000 V ☐



Regarding the figure below. What are the conditions required to make sure that the standard hydrogen electrode potential (E°) equals 0.000 V ?

فيما يتعلق بالشكل أدناه. أي مما يأتي هي الظروف الواجب توفرها حتى يكون جهد الاختزال القياسي (E°) لقطب الهيدروجين مساوياً 0.000 V ؟



بقاء درجة الحرارة ثابتة عند 25°C	1
The temperature is maintained at 25°C	
ضخ غاز الهيدروجين (H_2) في المحلول عند ضغط 1 atm	2
Hydrogen gas (H_2) at a pressure of 1 atm is bubbled into the solution	
وجود محلول حمض الهيدروكلوريك (HCl) الذي يحتوي على أيونات الهيدروجين بتركيز 1 M	3
The presence of hydrochloric acid (HCl) solution that has a hydrogen-ion concentration of 1 M .	

3 only

3 فقط

1 , 2

1 و 2

1 , 2 , and 3

1 و 2 و 3

1 only

1 فقط

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To calculate the electric potential of a voltaic cell consisting of a copper electrode and a zinc electrode, combine the copper and zinc half-cells as a voltaic cell.

Because reduction occurs at the copper electrode and oxidation occurs at the zinc electrode, the E^0 values are substituted as follows.

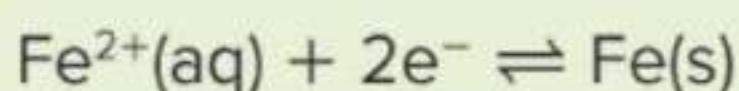
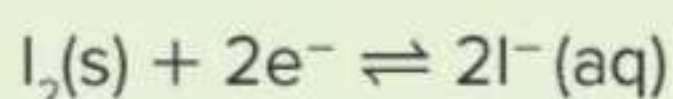
$$\begin{aligned} E_{\text{cell}}^0 &= E_{\text{Cu}^{2+}|\text{Cu}}^0 - E_{\text{Zn}^{2+}|\text{Zn}}^0 \\ &= +0.342 \text{ V} - (-0.762 \text{ V}) \\ &= +1.104 \text{ V} \end{aligned}$$

Formula for Cell Potential

$$E_{\text{cell}}^0 = E_{\text{reduction}}^0 - E_{\text{oxidation}}^0$$

EXAMPLE Problem 1

CALCULATE A CELL POTENTIAL The following reduction half-reactions represent the half-cells of a voltaic cell.



$$E_{\text{I}_2|\text{I}^-}^0 = +0.536 \text{ V}$$

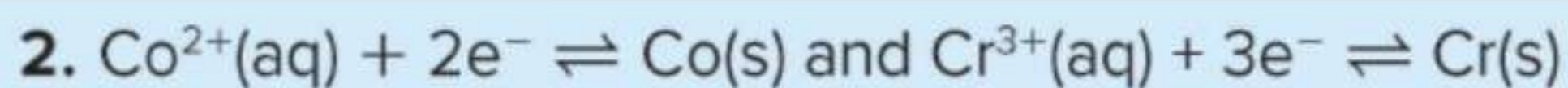
$$E_{\text{Fe}^{2+}|\text{Fe}}^0 = -0.447 \text{ V}$$

Determine the overall cell reaction and the standard cell potential. Describe the cell using cell notation.

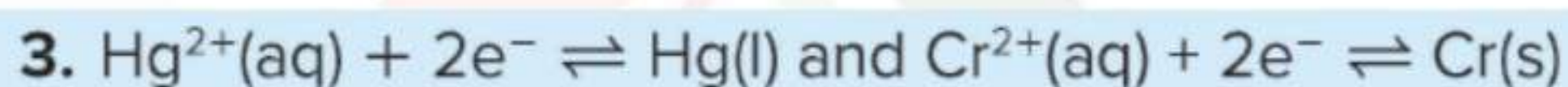
For each of these pairs of half-reactions, write the balanced equation for the overall cell reaction, and calculate the standard cell potential. Describe the reaction using cell notation. Refer to the module on redox reactions to review writing and balancing redox equations.

1. $\text{Pt}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Pt}(\text{s})$ and $\text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Sn}(\text{s})$



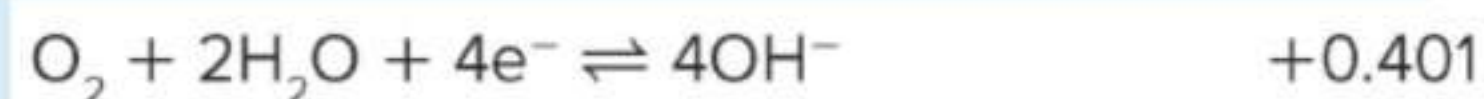
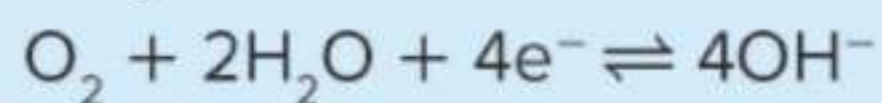
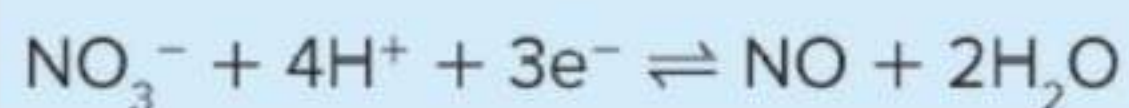


$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.744
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0.28



$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.913
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}$	+0.851

CHALLENGE Write the balanced equation for the cell reaction and calculate the standard cell potential for the reaction that occurs when these half-cells are connected. Describe the reaction using cell notation.



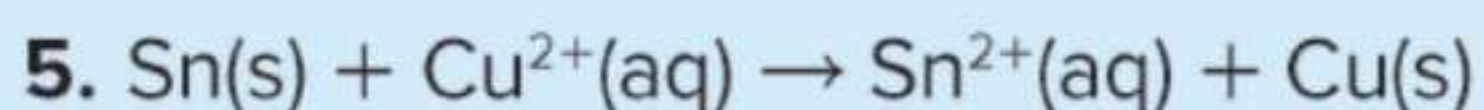


Using Standard Reduction Potentials to indicate spontaneity

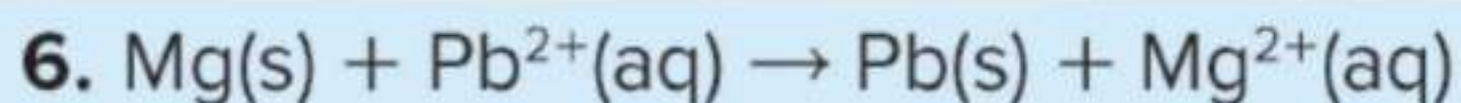
To predict whether any proposed redox reaction will occur spontaneously:

- 1- Write the process in the form of half-reactions.
- 2- Look up the reduction potential of each.
- 3- Use the values to calculate the potential of a voltaic cell operating with these two half-cell reactions.
- 4- If the calculated potential is **positive**, the reaction is **spontaneous**. If the value is **negative**, the reaction is **not spontaneous**.
- 5- The reverse of a nonspontaneous reaction will occur spontaneously because it will have a positive cell voltage.

Calculate the cell potential to determine if each of the following balanced redox reactions is spontaneous as written. Use **Table 1** to help you determine the correct half-reactions.

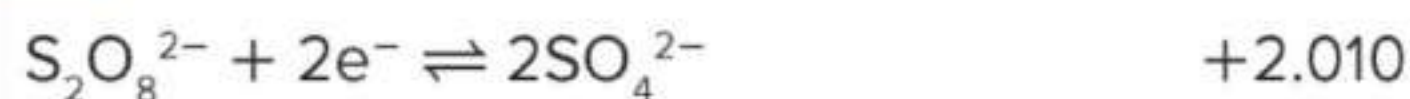
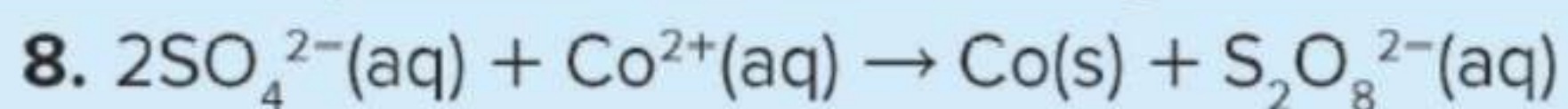
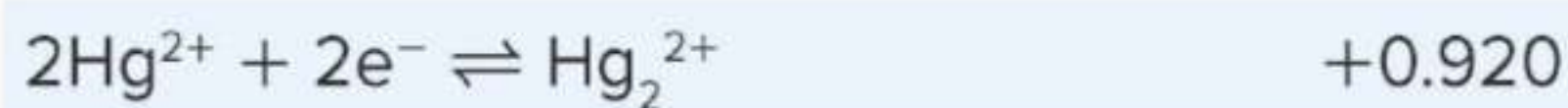
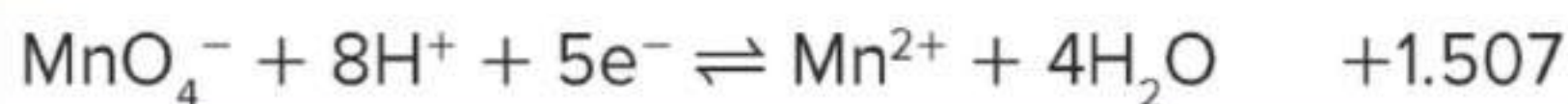
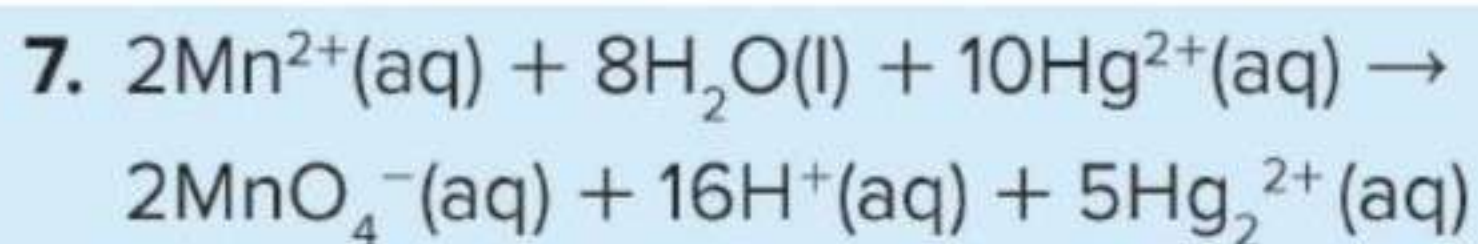


$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0.1375
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0.3419

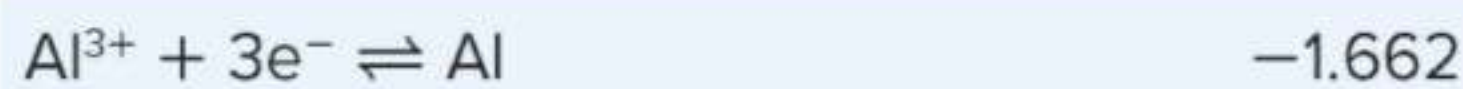
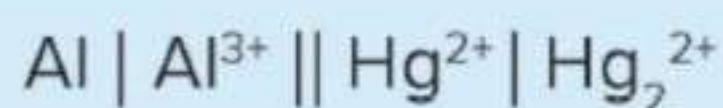


$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2.372
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0.1262

Your Guide



9. **CHALLENGE** Using **Table 1**, write the equation and determine the cell voltage (E^0) for the following cell. Is the reaction spontaneous?

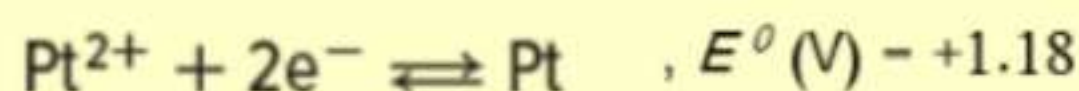
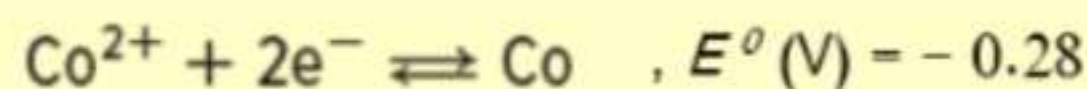




Final Exam Question

The following reduction half-reactions represent the half-cells of a voltaic cell. which of the following is correct?

تمثل تفاعلات الاختزال النصفية التالية الخلايا النصفية للخلية الفولتية، أي مما يأتي صحيح؟



	الأنود Anode	الكاثود cathode	جهد الخلية (E°) Electrochemical Cell Potential (E°)	نوع التفاعل Reaction Type
A	Pt	Co	+ 0.9 V	تلقائي Spontaneous
B	Co	Pt	+ 1.46 V	تلقائي Spontaneous
C	Pt	Co	- 0.9 V	غير تلقائي Nonspontaneous
D	Co	Pt	- 1.46 V	غير تلقائي Nonspontaneous

The following reduction half-reactions represent the half-cells of a voltaic cell.

تمثل تفاعلات الاختزال النصفية التالية الخلايا النصفية للخلية الفولتية.

ما الجهد القياسي للخلية؟

What is the standard cell potential?



(+0.667 V)

(+3.027 V)

(-3.027 V)

(- 0.667 V)

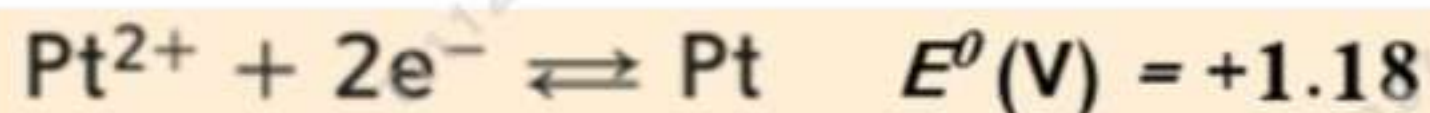


The voltaic half-cell expressed by the following reaction has been connected with one of the half-cells shown in the table below, and the standard cell potential found to be (+3.89 V).

تم توصيل نصف الخلية الفولتية الذي يُعبر عنه التفاعل التالي مع أحد أنصاف الخلايا الواردة في الجدول أدناه، ووجد أن الجهد القياسي للخلية الناتجة هو (+3.89 V).

What is the half-cell connected?

فما نصف الخلية الذي تم توصيله؟



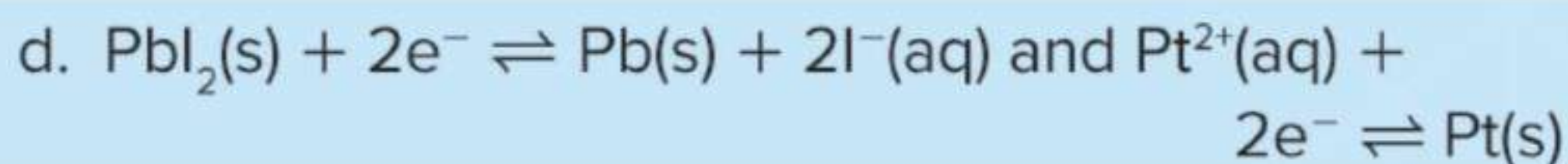
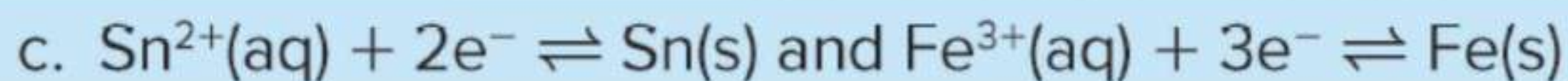
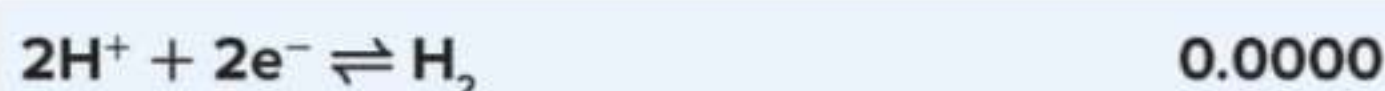
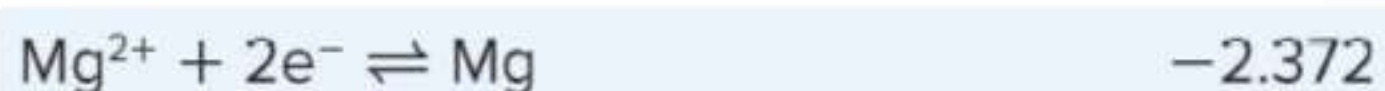
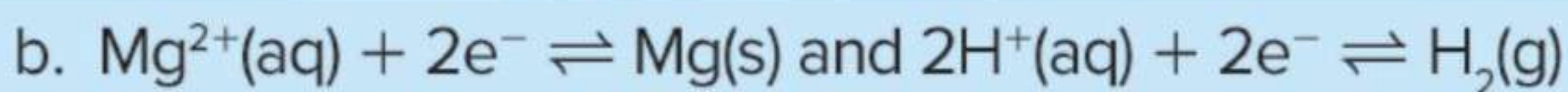
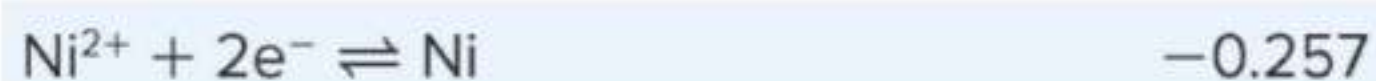
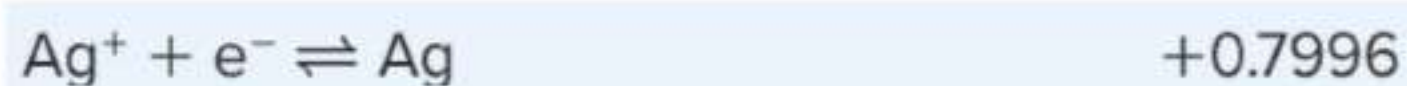
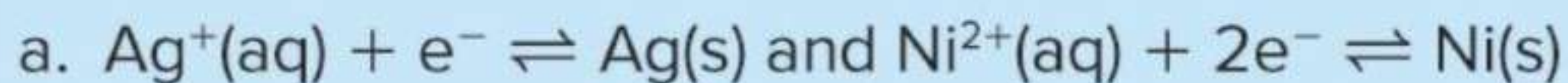
Half reaction نصف التفاعل	$E^{\circ}(\text{V})$
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2.71
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1.185
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.744
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0.447

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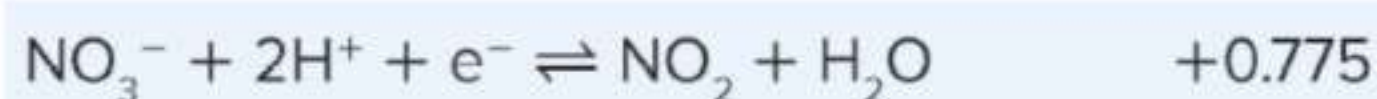
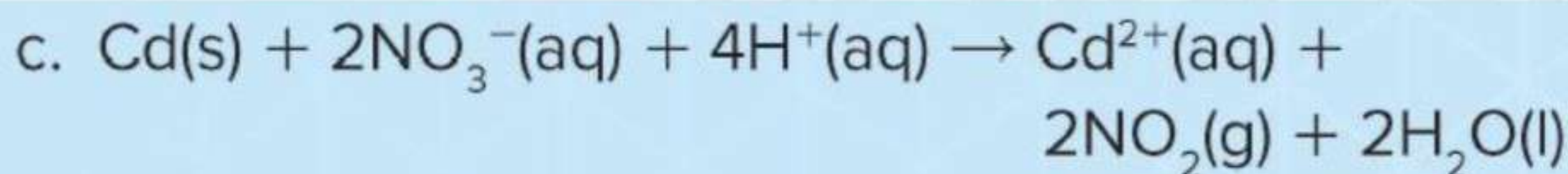
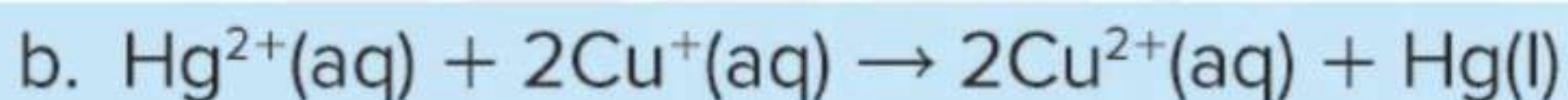
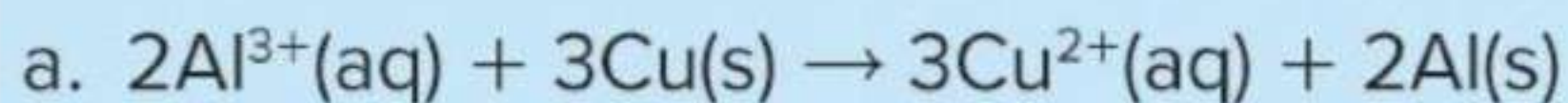
Extra Practice

Write the balanced equation for the spontaneous cell reaction that occurs in a cell with these reduction half-reactions.





Determine the standard potential for electrochemical cells in which each equation represents the overall cell reaction. Identify the reactions as spontaneous or nonspontaneous as written.





In a voltaic cell represented by $\text{Al}|\text{Al}^{3+} || \text{Cu}^{2+}|\text{Cu}$, what is oxidized and what is reduced as the cell delivers current?

Under what conditions are standard reduction potentials measured?

In **Figure 24**, identify the metal that is being oxidized. Identify the cathode.

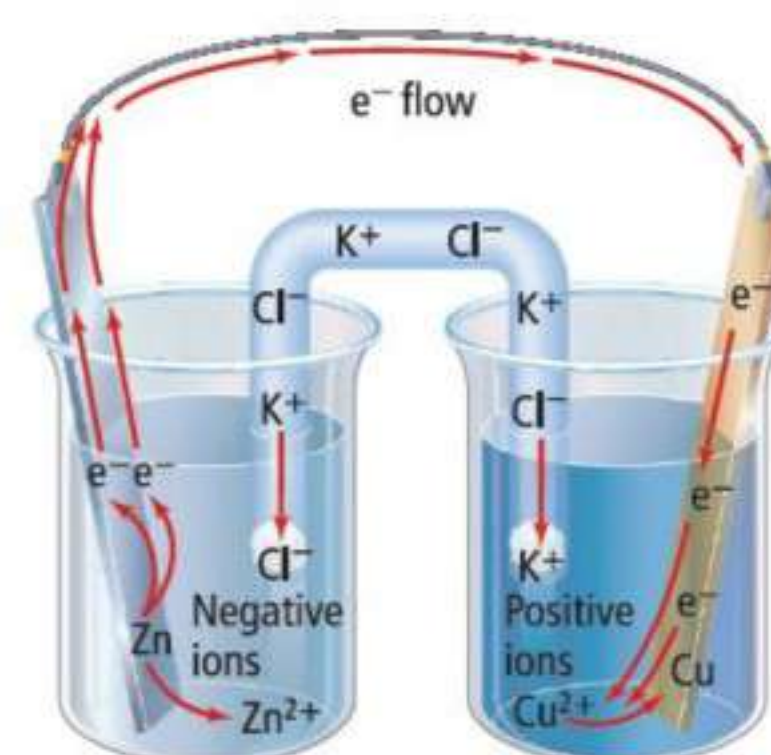
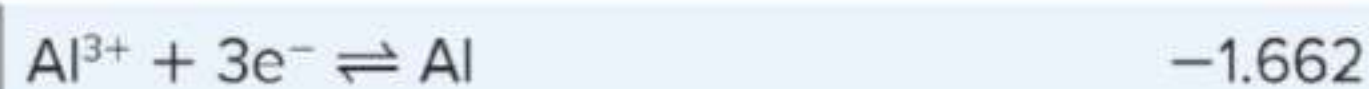
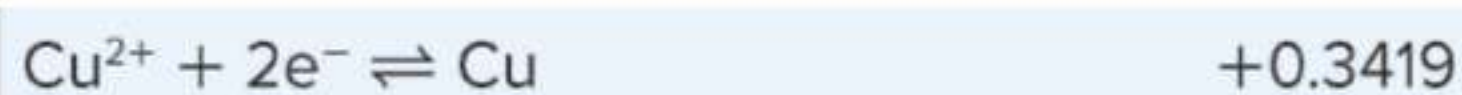
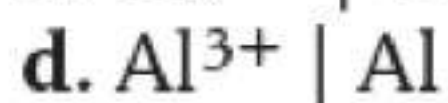
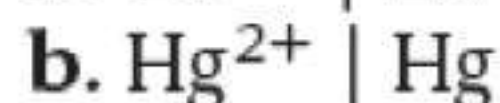
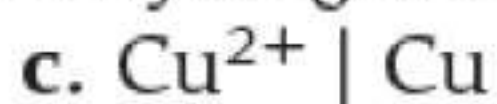
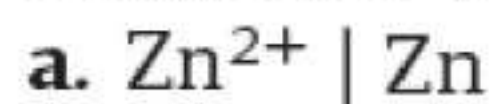


Figure 24

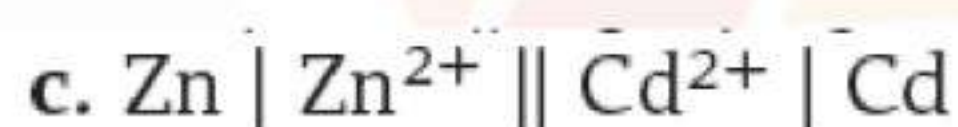
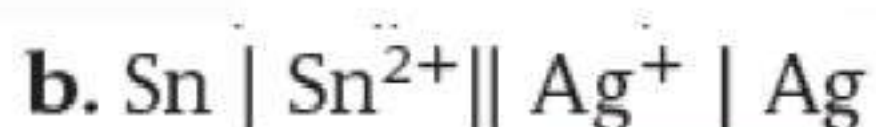
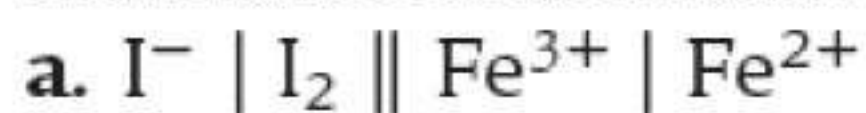
A salt bridge is filled with KNO_3 . Explain why it is necessary that the potassium ions move through the salt bridge to the cathode.

Using **Table 1**, write the standard cell notation for each cell in which each of the following half-cells is connected to the standard hydrogen electrode.

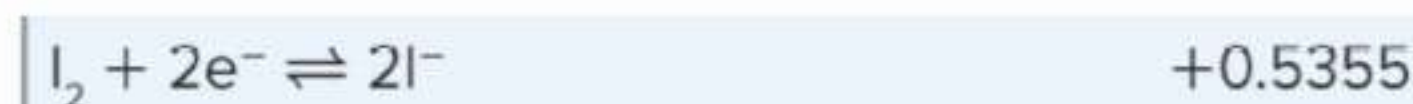
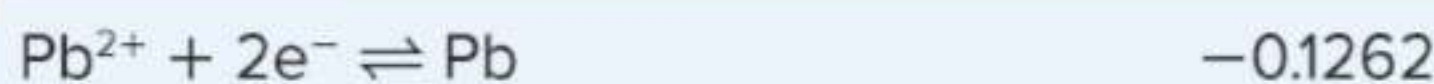
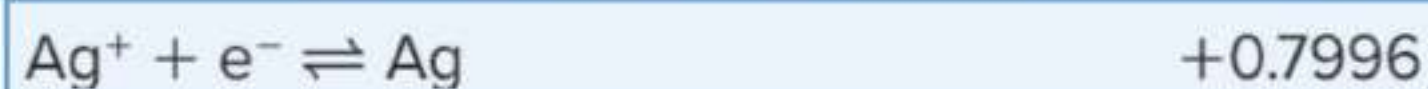
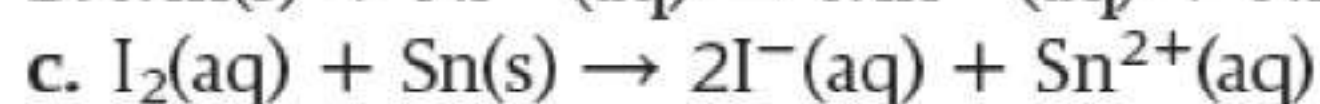
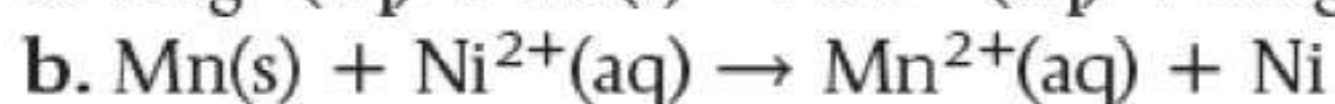
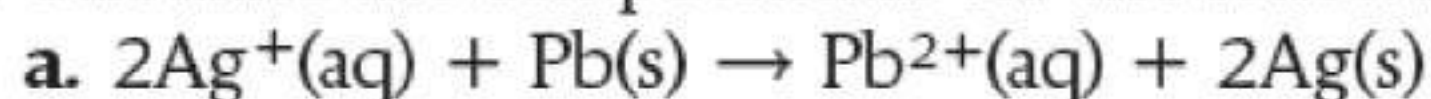




Write the balanced chemical equation for the standard cell notations listed below.

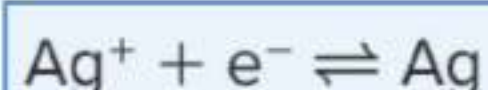


41. Calculate the cell potentials for the following reactions.



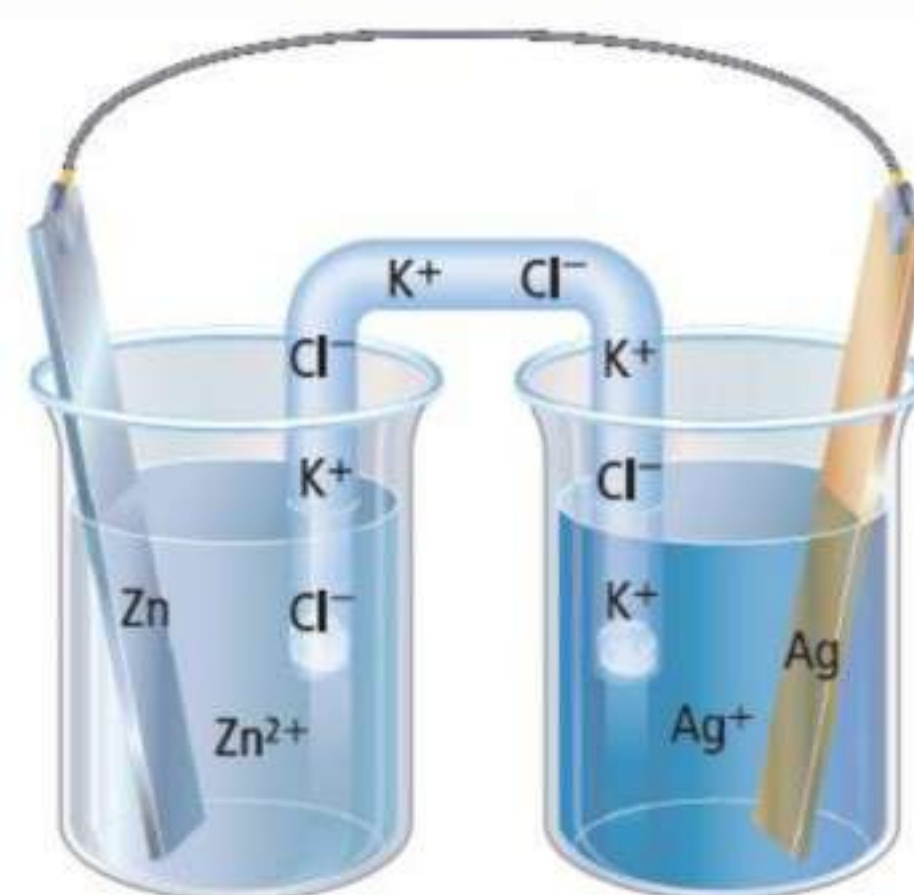


-0.7618



+0.7996

Figure 25 illustrates a voltaic cell consisting of a strip of zinc in a 1.0M solution of zinc nitrate and a strip of silver in a 1.0M solution of silver nitrate. Use the diagram and **Table 1** to answer these questions.



■ Figure 25

- Identify the anode.
- Identify the cathode.
- Where does oxidation occur?
- Where does reduction occur?
- In which direction is the current flowing through the connecting wire?
- In which direction are positive ions flowing through the salt bridge?
- What is the cell potential at 25°C and 1 atm?



Reversing Redox Reactions

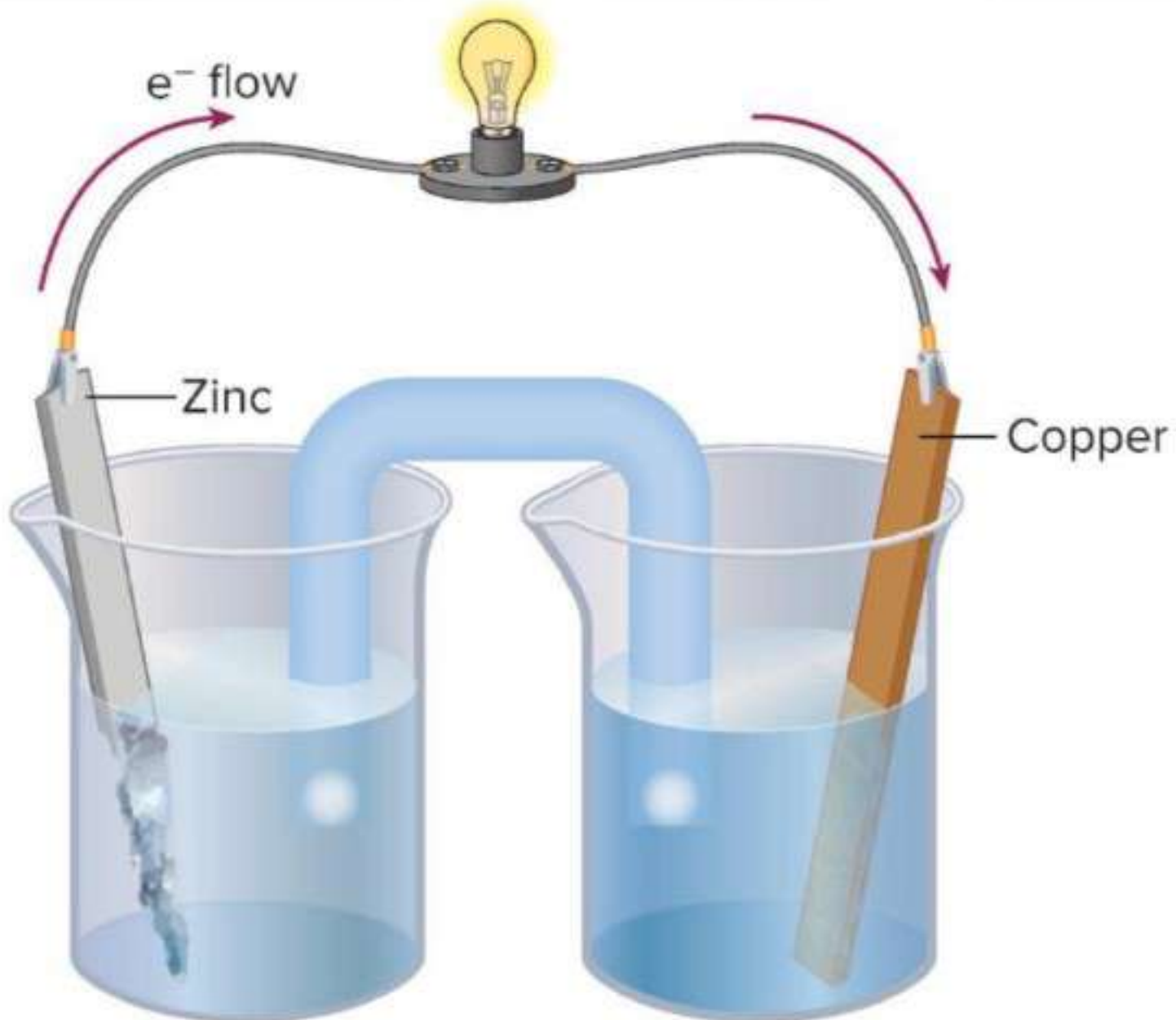
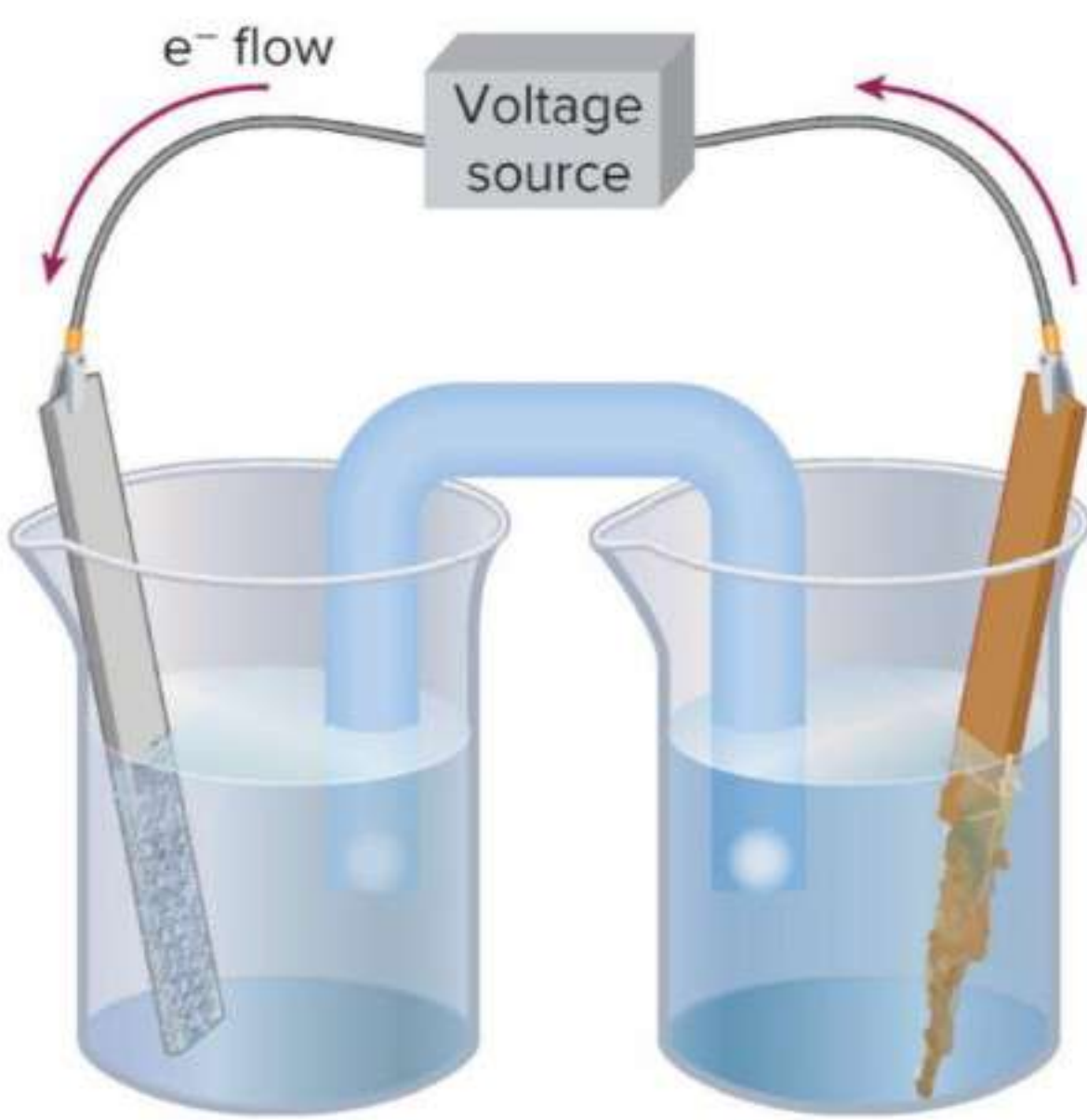
When a battery is connected in a circuit, electrons from the anode flow to the cathode, where they are used in a reduction reaction.

A secondary battery is one that can be recharged by passing a current through it in the opposite direction.

The use of electrical energy to bring about a chemical reaction is called **electrolysis**.

An electrochemical cell in which electrolysis occurs is called an **electrolytic cell**.

Compare the electrochemical cells in Figure 18.

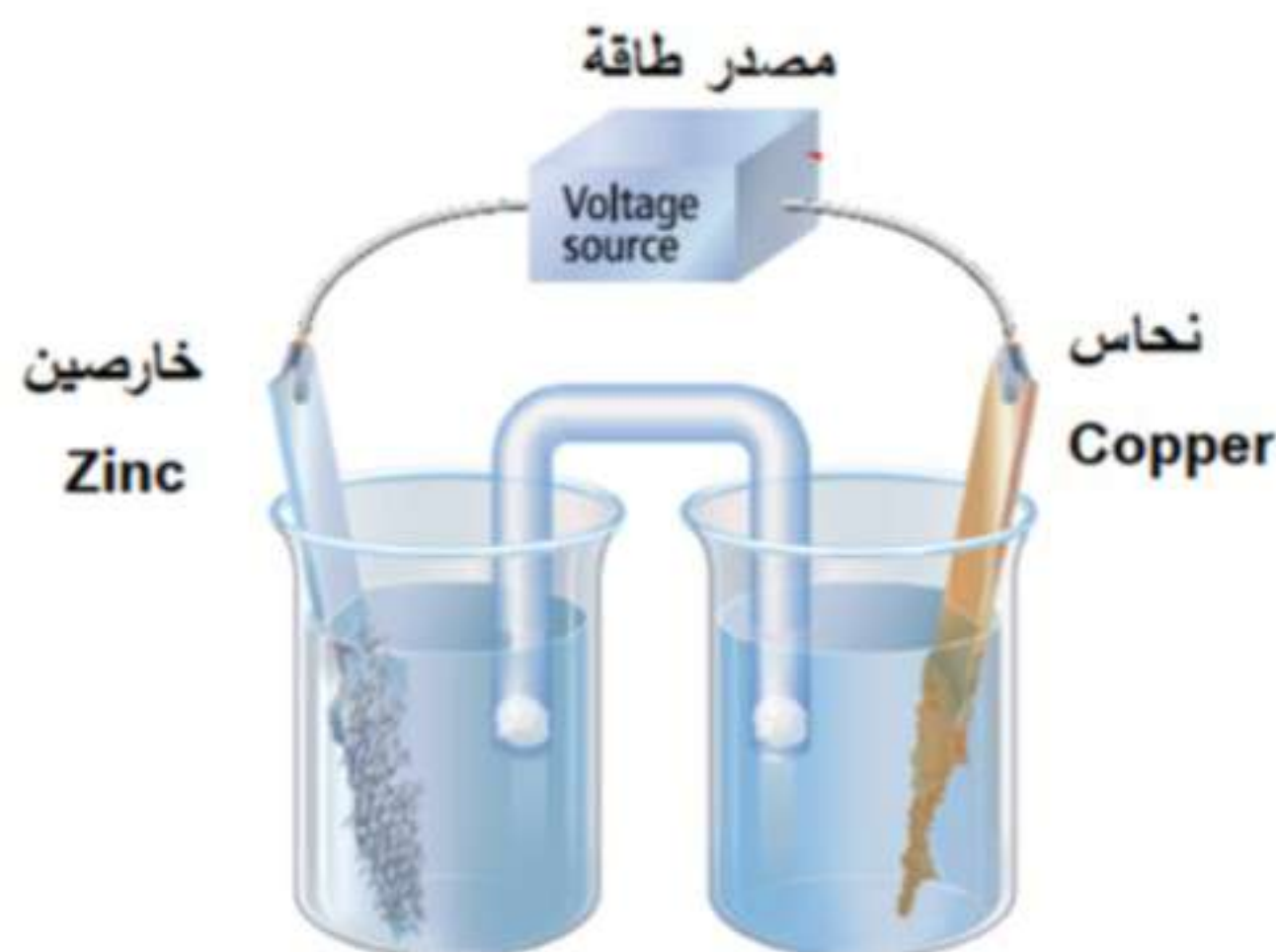
 Voltaic cell	 Electrolytic cell
Electrons flow from To	Electrons flow from To
..... is oxidized is reduced	 is oxidized is reduced
..... is anode is cathode	 is anode is cathode
Is the cell spontaneous?	Is the cell spontaneous?
The cell convert energy to energy	The cell convert energy to energy
The zinc strip is	The zinc strip is
Is external voltage source required?	Is external voltage source required?



Final exam questions

Regarding the cell in the figure below. Which of the following is **correct**?

فيما يتعلق بالخلية الموضحة في الشكل أدناه.
أي مما يأتي **صحيح**؟



The reaction continues until the zinc strip is used up, and then the reaction stops

يستمر التفاعل حتى يستهلك قطب الخارصين ثم يتوقف التفاعل

Oxidation takes place at zinc electrode

تحدث عملية أكسدة عند قطب الخارصين

Reduction takes place at copper electrode

يحدث اختزال عند قطب النحاس

The external power supply (voltage) works on cell regeneration and the cell returns to almost its original strength

يعمل مصدر الطاقة (الجهد الكهربائي) الخارجي على تجديد الخلية وتعود الخلية إلى قوتها الأصلية تقريبًا

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For the two cells in the figure below,
which of the following is **correct**?

فيما يتعلق بالخليتين في الشكل أدناه،
أي مما يأتي **صحيح**؟



1

2

1 is a voltaic cell and converts chemical energy
to electrical energy

الخلية **1** فولتية وتحول الطاقة الكيميائية إلى طاقة كهربائية

In cell **2** the reaction continues until the zinc strip
is used up and then the reaction stops

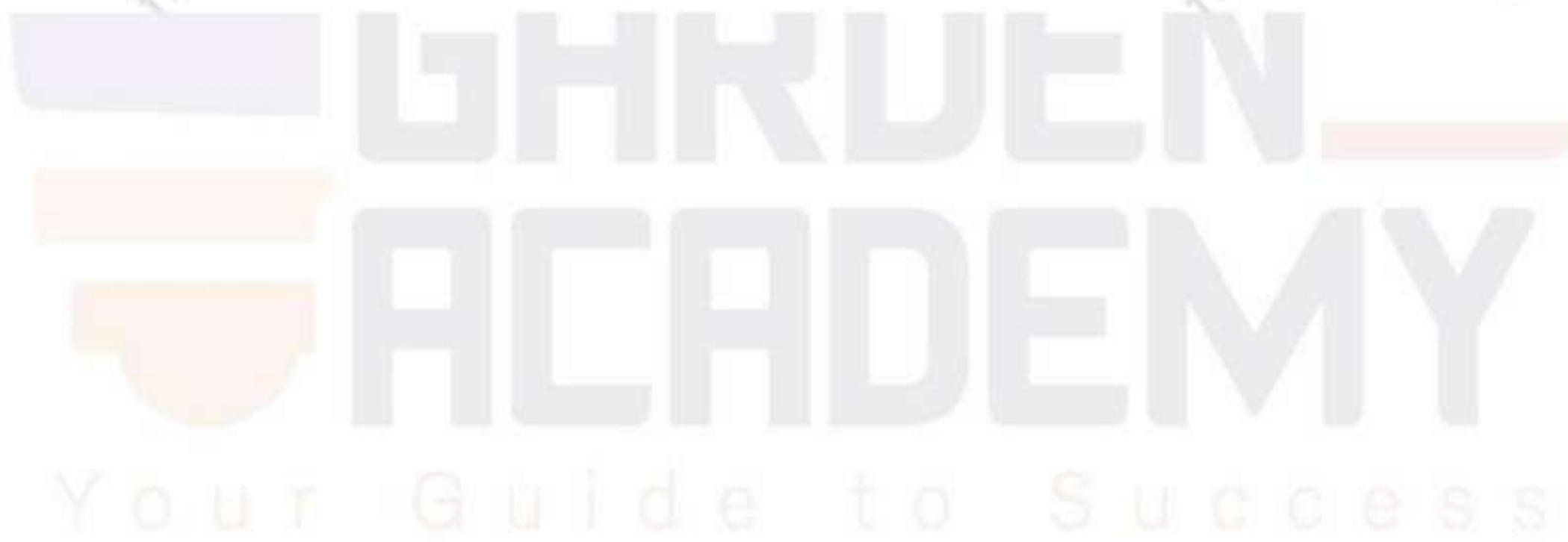
في الخلية **2** يستمر التفاعل حتى يستهلك قطب الخارصين
ثم يتوقف التفاعل

2 is an electrolytic cell and converts chemical energy
to electrical energy

الخلية **2** إلكترونية وتحول الطاقة الكيميائية إلى طاقة كهربائية

In cell **1** the reaction is spontaneous

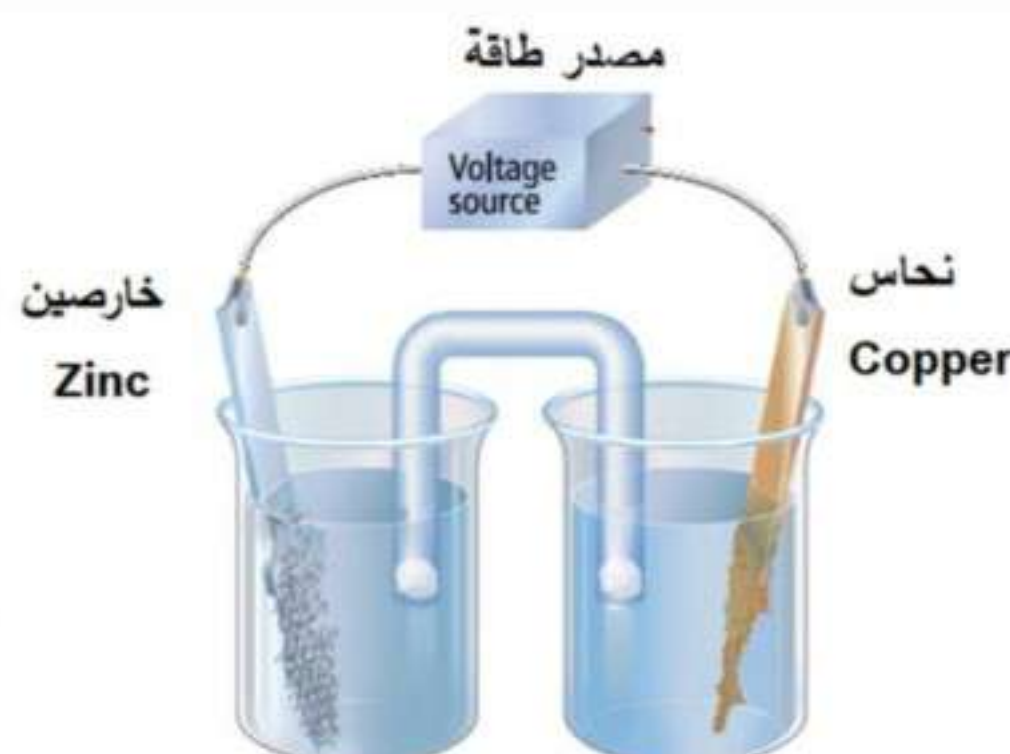
في الخلية **1** يكون التفاعل تلقائياً





Which of the following is true regarding the electrochemical cell in the figure below?

أي مما يأتي صحيح فيما يتعلق بالخلية الكهروكيميائية في الشكل أدناه؟



Non-spontaneous oxidation and reduction reactions occur

تحدث تفاعلات أكسدة واختزال غير تلقائية

Converts chemical energy to electrical energy

تحول الطاقة الكيميائية إلى طاقة كهربائية

Spontaneous oxidation and reduction reactions occur

تحدث تفاعلات أكسدة واختزال تلقائية

The reaction continues until the zinc strip is used up, and then the reaction stops

يستمر التفاعل حتى يُستهلك قطب الخارصين ثم يتوقف التفاعل

Your Guide to Success



Regarding the cell in the figure below,

فيما يتعلق بالخلية في الشكل أدناه،

which of the following is **correct**?

أي مما يأتي **صحيح**؟



It is a voltaic cell and a spontaneous redox reactions take place

الخلية فولتية وتحدث فيها تفاعلات أكسدة واختزال تلقائية

It is an electrolytic cell and a spontaneous redox reactions take place

الخلية إلكتروليتيّة وتحدث فيها تفاعلات أكسدة واختزال تلقائية

It is a voltaic cell and nonspontaneous redox reactions take place

الخلية فولتية وتحدث فيها تفاعلات أكسدة واختزال

غير تلقائية

It is an electrolytic cell and nonspontaneous redox reactions take place

الخلية إلكتروليتيّة وتحدث فيها تفاعلات أكسدة واختزال

غير تلقائية



HLHUEMY

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7

CHM.5.3.05.011.05 Define electroplating while describing how it works, identifying anode, cathode and electrolyte needed for an electrolytic cell in which a selected metal is to be plated on an object (car or spoon,...etc)

Textbook + figure 22

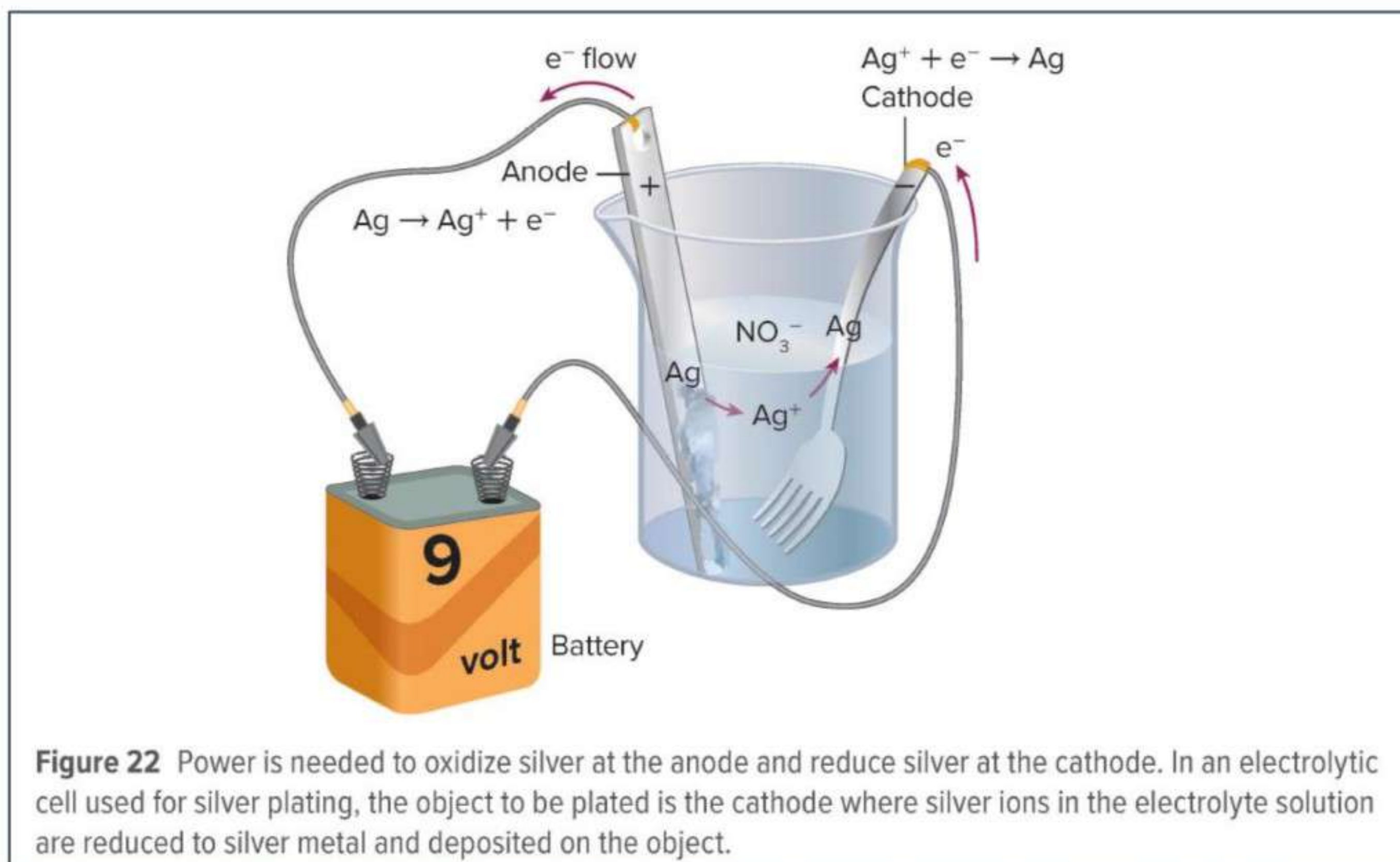
51,52

Electroplating

Objects can be electroplated with a metal such as silver.

The **object** to be silver-plated is the **cathode** of an electrolytic cell.

The **anode** is a **silver** bar or sheet.



At the anode, silver is oxidized to silver ions as electrons are removed by the power source.

At the cathode, the silver ions are reduced to silver metal by electrons from the external power source. The silver forms a thin coating over the object being plated.

Current passing through the cell must be carefully controlled in order to get a smooth, even metal coating.

Other metals are also used for electroplating. You might have seen items that are electroplated with gold.

Exposed steel parts on bicycles and automobiles can be plated by nickel and then chrome to prevent corrosion.



Figure 23 A pen made of solid gold would be very expensive and heavy. Electroplating gold gives the same effect with a smaller mass and lower cost.

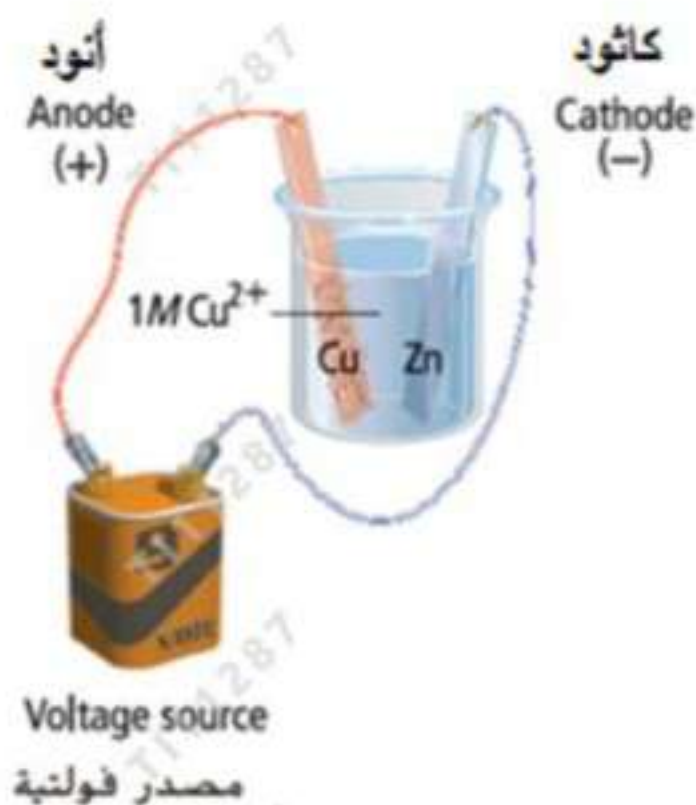




Final exam questions

Based on figure below.

Which of the following is **correct**?



استنادًا على الشكل أدناه. أي مما يأتي **صحيح**؟

A reduction of copper ions takes place at the anode

يحدث اختزال لأيونات النحاس عند الأنود



An oxidation of zinc atoms takes place at the cathode

تحدث أكسدة لذرات الخارصين عند الكاثود



The mass of zinc electrode decreases

تقل كتلة قطب الخارصين



The mass of copper electrode decreases

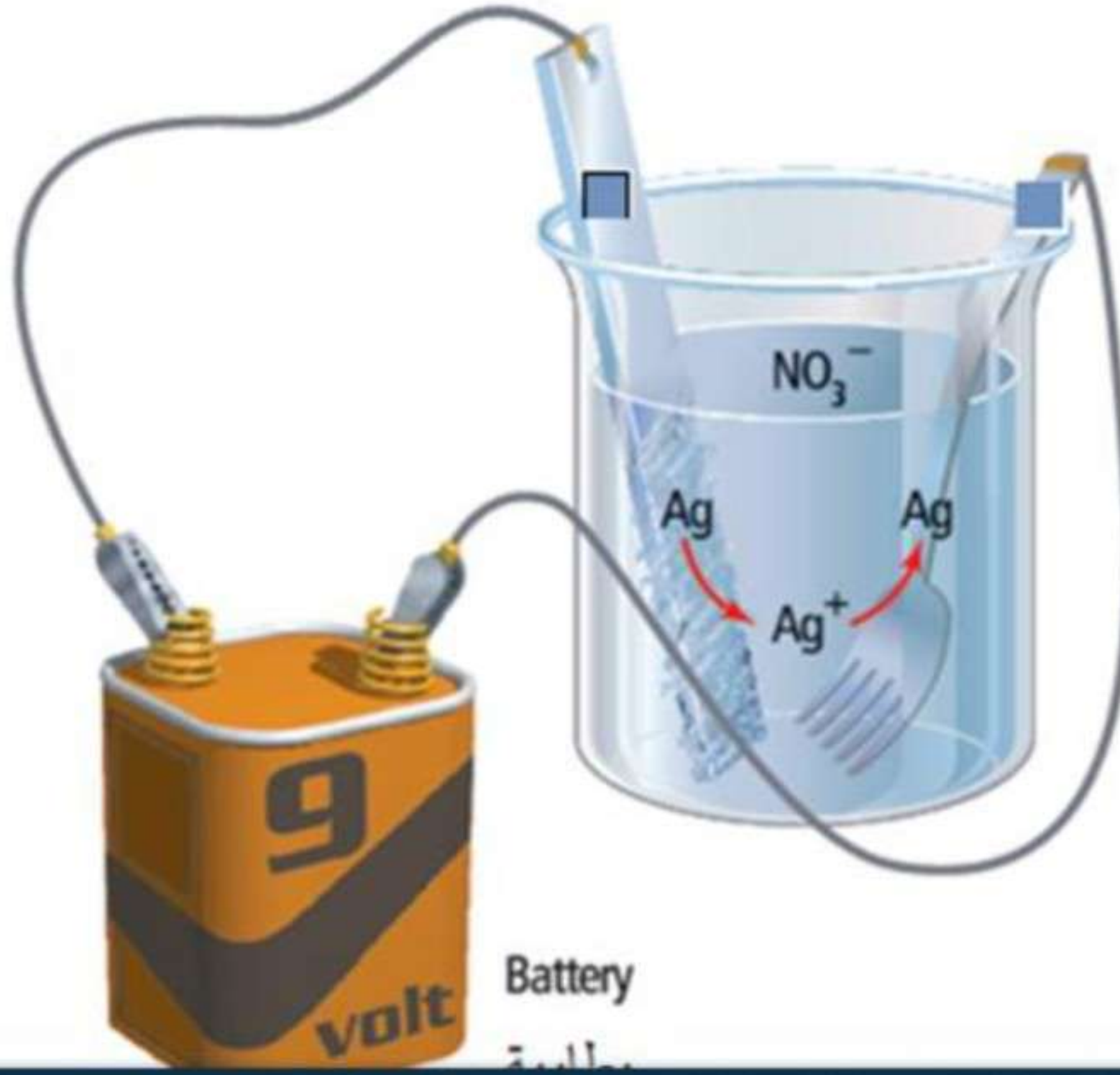
تقل كتلة قطب النحاس





Objects are electroplated when a uniform coating is deposited as a protective or decorative layer, as shown in the figure below. Which of the following is true?

يتم طلاء الأشياء كهربائياً حين تُوضع طبقة رقيقة وموحدة لتكون طبقة واقية أو جمالية كما في الشكل أدناه. أي مما يأتي صحيح؟



The metal used for coating is the cathode

يكون الفلز المراد الطلاء به هو الكاثود



The object to be plated is the anode

يكون الجسم المراد طلاؤه هو الأنود



Silver is oxidized to silver ions at the anode

تتأكسد الفضة إلى أيونات الفضة عند الأنود



Silver is oxidized to silver ions at the cathode

تتأكسد الفضة إلى أيونات الفضة عند الكاثود





Khalifah tried to electroplate an iron key with a layer of copper. He designed the electroplating cell shown in the figure below.

What is the error(s) in the cell?



حاول خليفة طلاء مفتاح من الحديد بطبقة من النحاس، فقام بتصميم خلية الطلاء الموضحة في الشكل أدناه.
ما الخطأ (الأخطاء) في الخلية؟

توصيل أقطاب البطارية	1
The connection of the battery poles	
الإلكتروليت المستخدم لا يحتوي على أيونات Cu^{2+}	2
The electrolyte used does not contain Cu^{2+} ions	
لم يوصل المفتاح مع مصباح كهربائي	3
The key was not connected to a light bulb	

3 only

3 فقط

Both 1 and 3

1 و 3 معًا

1 only

1 فقط

Both 1 and 2

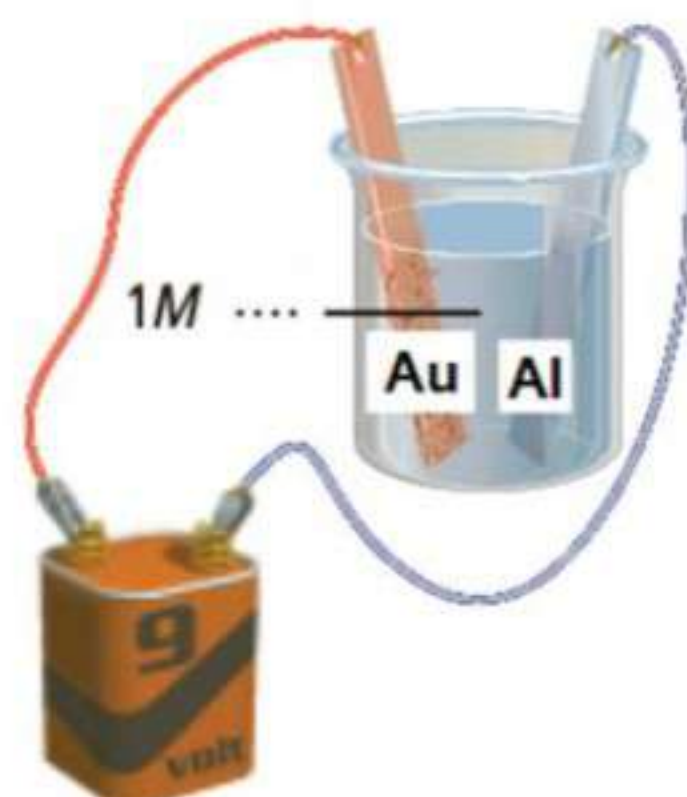
1 و 2 معًا

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In the process of electroplating of aluminum plate with a layer of gold, as in the figure below. Which of the following is **correct**?

في عملية طلاء صفيحة من الألمنيوم بطبقة من الذهب كما في الشكل أدناه. أي مما يأتي **صحيح**؟

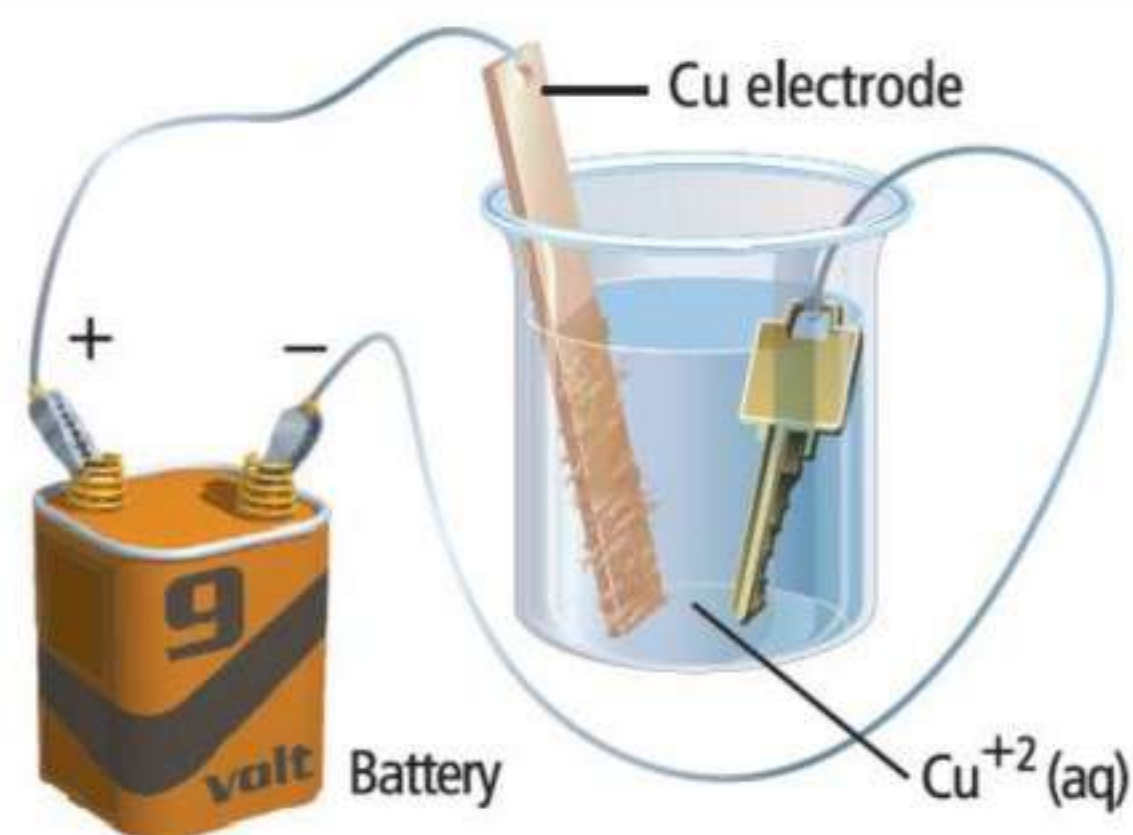


الإلكتروليت المستخدم Used electrolyte	تفاعل الكاثود Cathode reaction	تفاعل الأنود Anode reaction	التغير في كتلة صفيحة الألمنيوم Change in mass of aluminum sheet	
يحتوي على Au^{3+} Contains Au^{3+}	$\text{Au}^{3+} + 3\text{e}^- \longrightarrow \text{Au}$	$\text{Au} \longrightarrow \text{Au}^{3+} + 3\text{e}^-$	Increases تزداد	1
يحتوي على Al^{3+} Contains Al^{3+}	$\text{Al}^{3+} + 3\text{e}^- \longrightarrow \text{Al}$	$\text{Al} \longrightarrow \text{Al}^{3+} + 3\text{e}^-$	Decreases تقل	2
يحتوي على Au^{3+} Contains Au^{3+}	$\text{Al}^{3+} + 3\text{e}^- \longrightarrow \text{Al}$	$\text{Au} \longrightarrow \text{Au}^{3+} + 3\text{e}^-$	Increases تزداد	3
يحتوي على Al^{3+} Contains Al^{3+}	$\text{Al} \longrightarrow \text{Al}^{3+} + 3\text{e}^-$	$\text{Au}^{3+} + 3\text{e}^- \longrightarrow \text{Au}$	Decreases تقل	4



Extra Practice

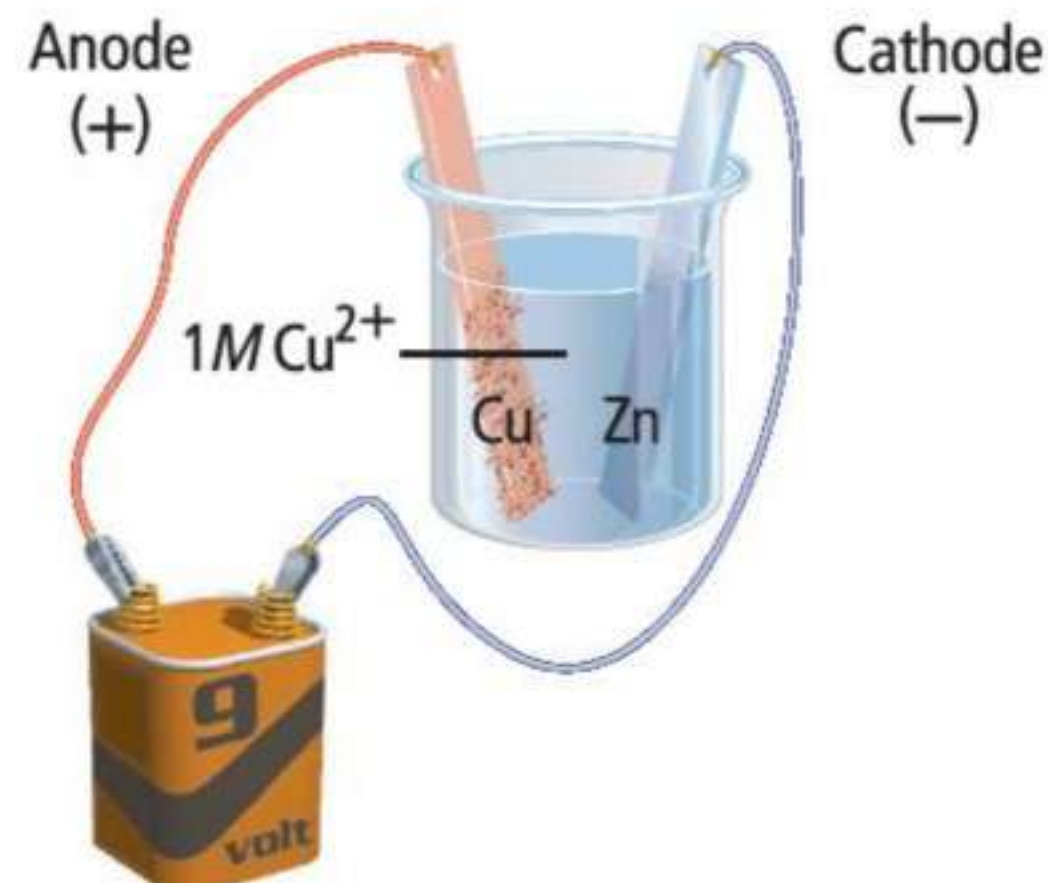
Electroplating Figure 27 shows a key being electroplated with copper in an electrolytic cell. Where does oxidation occur? Explain your answer.



■ Figure 27

Answer the following questions based on **Figure 28**.

- a. Which electrode grows? Write the reaction that occurs at this electrode.



Voltage source

■ Figure 28

- b. Which electrode disappears? Write the reaction that occurs at this electrode.

Using **Figure 28**, explain what happens to the copper ions in solution.



بطاقة الكيمياء صف 12 متقدم

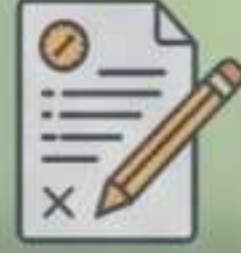
شرح أ. طارق محمد



فيديوهات



ملخصات شرح



أوراق عمل



اختبارات

مراجعة تفصيلية شاملة للهيكل



جاهز للنجاح وإطلاق إبداعاتك



للاشتراك واتساب الدعم الفني
للاكاديمية: 0569174493





Organic Compounds

- Chemists knew that living things produce a variety of carbon compounds, referred to as organic compounds.
- Scientists at this time felt that all organic compounds came only from living things.
- Scientists incorrectly concluded that they were unable to synthesize organic compounds because of vitalism.
- According to vitalism, organisms possessed a mysterious "vital force", enabling them to assemble carbon compounds.

Disproving vitalism

Wohler was the first scientist to realize that he had produced an organic compound, called urea, by synthesis in a laboratory.

Organic Chemistry

Organic compounds are all carbon – containing compounds except: carbon oxides, carbides, carbonates, which are inorganic.

Question: give examples of carbides, carbonates and carbon oxides.

Carbides	Carbonates	Carbon oxides

Question: Which of the following compounds is not an organic compound?

- a- Benzene
- b- Butane
- c- CaCO_3
- d- $\text{C}_2\text{H}_5\text{OH}$.

- Carbon is in group 14 in the periodic table with the electron configuration of $1s^2 2s^2 2p^2$.
- Carbon has 4 valence electrons and forms four covalent bonds.
- Carbon atoms can form single, double and triple bonds.

Single bonds	Double bonds	Triple bonds

- In organic compounds, carbon atoms are bonded to hydrogen atoms or atoms of other elements that are near carbon in the periodic table-especially nitrogen, oxygen, sulfur, phosphorus, and the halogens.
- Carbon atoms bond to other carbon atoms and form **straight chains**, **branched chains**, **ring structures** and **cagelike structures**.

straight chains	branched chains	ring structures	cagelike structures



Final Exam Questions

Which of the following is **not** a reason for the ability of carbon to form so many different organic compounds?

أي مما يأتي ليس سبباً لقدرة الكربون على تكوين عدد هائل من المركبات العضوية المختلفة؟

Carbon atoms can form both straight chains, branched chains, and rings too

تستطيع ذرات الكربون أن تكون سلاسل مستقيمة وأخرى متفرعة وحلقات أيضاً

Carbon bonding sites allow the formation of single, double and triple bonds

تسمح مواقع الارتباط للكربون بتكوين روابط أحادية وثنائية وثلاثية

Carbon atom has three electrons in the outer energy level

تحتوي ذرة الكربون على ثلاثة إلكترونات في مستوى الطاقة الخارجي

Each carbon atom can form four covalent bonds with atoms of carbon or with other elements

تستطيع كل ذرة كربون أن تكون أربع روابط تساهمية مع ذرات كربون أخرى أو مع عناصر أخرى

Which of the following structures is possible to be formed by carbon atom?

أي التركيبات التالية من المحتمل أن تكونها ذرة الكربون؟

1	تركيبات مستقيمة Chain structures
2	تركيبات ذات سلاسل متفرعة Branched structures
3	تركيبات حلقة Ring structures
4	تركيبات شبيهة بالأقفاص Cagelike structures

1 and 2

1 و 2

3 and 4

3 و 4

1,2 and 3

1 و 2 و 3

1,2,3 and 4

1 و 2 و 3 و 4



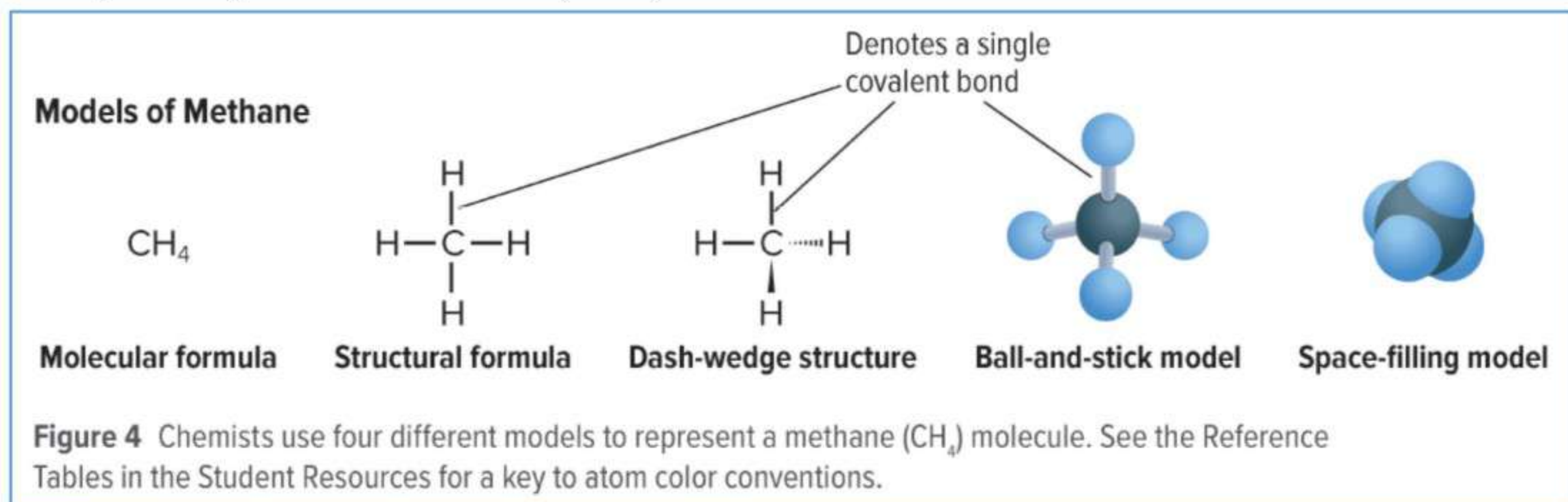
Hydrocarbons

They are the simplest organic compounds, which contain only **carbon** and **hydrogen** atoms.

Methane CH_4 is the simplest hydrocarbon molecule: it is an excellent fuel and is the main component of natural gas.

Models and hydrocarbons

Chemists represent organic molecules in a variety of ways.

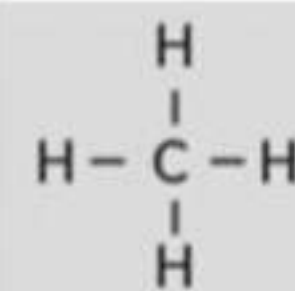


Molecular formula	give no information about the geometry of the molecule
Structural formula	shows the general arrangement of atoms in the molecule but not the exact three-dimensional geometry.
ball-and-stick model	demonstrates the geometry of the molecule clearly.
Space-filling model	gives a more realistic picture of what a molecule would look like if you could see it.

Final Exam Questions

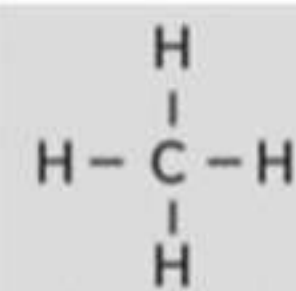
Which of the following methane models (formulas) gives a more realistic picture of what a molecule would look like if you could see it?

أي من نماذج (صيغ) الميثان التالية يُعطي صورة أكثر واقعية لما قد يبدو عليه الجزيء عند رؤيته؟



Which of the following methane models (formulas) shows the general arrangement of atoms in the molecule but not the exact, three-dimensional geometry?

أي من نماذج (صيغ) الميثان التالية يُظهر الترتيب العام للذرات في الجزيء لكنه لا يُظهر التشكيل ثلاثي الأبعاد بدقة؟





Regarding the ways of representing the organic compound in the table below, which of the following is correct?

فيما يتعلق بطرق تمثيل المركب العضوي في الجدول أدناه، أي مما يأتي صحيح؟

	$\begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array}$	CH_4
3	2	1

Chemists most often use the formula **3** to write about reactions

يستخدم الكيميائيون في معظم الأحيان الصيغة **3** لتوضيح التفاعلات

Method **3** is called the space-filling model gives a more realistic picture of the relative size and arrangement of the atoms in the molecule

الطريقة **3** تُسمى نموذج ملء الفراغ، وتُعطى صورة أكثر واقعية لحجم الذرات النسبي وترتيبها في الجزيء

Method **1** is called the structural formula and shows the bonds formed between atoms

الطريقة **1** تُسمى الصيغة البنائية و توضح الروابط المتكوّنة بين الذرات

Method **2** is called the chemical formula and is the simplest way to represent organic compound

الطريقة **2** تُسمى الصيغة الكيميائية وتُعد أبسط طريقة لتمثيل المركب العضوي

Your Guide to Success



Which of the following is true regarding methane models (formulas) and the information they give?

أي مما يأتي صحيح فيما يتعلق بنماذج (صيغ) الميثان والمعلومات التي تُعطيها؟

المعلومات التي تُعطيها The information they give	اسم النموذج (الصيغة) Name of model (Formula)	النموذج (الصيغة) Model (Formula)	
يُظهر هندسة الجزيء بشكل واضح Demonstrates the geometry of the molecule clearly	نموذج ملء الفراغ The space-filling model		1
يُظهر هندسة الجزيء بشكل واضح Demonstrates the geometry of the molecule clearly	نموذج الكرة والعصا The ball-and-stick model		2
تُعطي صورة أكثر واقعية لما قد يبدو عليه الجزيء عند رؤيته Gives a more realistic picture of what a molecule would look like if you could see it	الصيغة البنائية A structural formula	$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array} $	3
تُظهر الترتيب العام للذرات في الجزيء لكنها لا تُظهر التشكيل ثلاثي الأبعاد بدقة Shows the general arrangement of atoms in the molecule but not the exact, three-dimensional geometry	الصيغة الجزيئية Molecular formula	CH ₄	4

Your Guide to Success



Chemists represent organic molecules in a variety of ways as in the table below.

يُمثل علماء الكيمياء الجزيئات العضوية بأساليب متنوعة كما هو موضح في الجدول أدناه.

Which of the following is **correct**?

أي مما يأتي **صحيح**؟

		$\begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array}$
1	2	3

Model **1** is called structural formula, and it shows the general arrangement of atoms in the molecule but not the exact, three-dimensional geometry

النموذج **1** يُسمى الصيغة البنائية وتُظهر الترتيب العام للذرات في الجزيء لكنها لا تظهر التشكيل ثلاثي الأبعاد بدقة

Model **2** is called space – filling model and demonstrates the geometry of the molecule clearly

النموذج **2** يُسمى نموذج ملء الفراغ ويُظهر هندسة الجزيء بشكل واضح

Model **3** is called ball– and–stick model and gives a more realistic picture of what a molecule would look like if you could see

النموذج **3** يُسمى نموذج الكرة والعصا ويُعطي صورة أكثر واقعية لما قد يبدو عليه الجزيء عند رؤيته

Model **1** is called space – filling model and gives a more realistic picture of what a molecule would look like if you could see

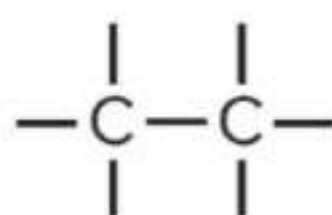
النموذج **1** يُسمى نموذج ملء الفراغ ويُعطي صورة أكثر واقعية لما قد يبدو عليه الجزيء عند رؤيته



Multiple carbon – carbon bonds

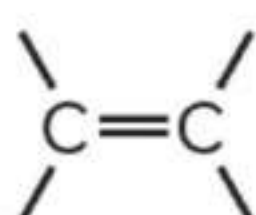
Figure 5 Carbon can bond to other carbon atoms in double and triple bonds. These Lewis structures and structural formulas show two ways to denote double and triple bonds.

One shared pair



Single covalent bond

Two shared pairs



Double covalent bond

Three shared pairs



Triple covalent bond

- = electrons shared between carbon atoms
- = others electrons

Saturated Hydrocarbons	Unsaturated Hydrocarbons
do not react with bromine. The solution is still reddish brown	react with bromine. The reddish-brown color disappears
have only single bonds	have at least one double or triple bond between carbon atoms Bromine is substituted into the molecule, turning all bonds to single bonds.
	$\begin{array}{c} \text{H} & \text{H} \\ & \diagdown & \diagup \\ & \text{C} & \\ & \diagup & \diagdown \\ \text{H} & & \text{H} \end{array} + \text{Br}-\text{Br} \longrightarrow \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{Br} \\ \\ \text{H}-\text{C}-\text{Br} \\ \\ \text{H} \end{array}$

Question: Which hydrocarbon will react with more amount of bromine?

Final exam questions

Which of the compounds in the table is
a saturated hydrocarbon?

أي من المركبات الواردة في الجدول يعتبر هيدروكربون
مشبع؟

- A – The compound **1** only
B – The compounds **2, 3** only
C – The compound **3** only
D - The compounds **1, 4** only

صيغة المركب Compound Formula	رقم المركب Compound Number
$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	1
$\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$	2
$\text{CH} \equiv \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	3
$\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	4

- A – المركب **1** فقط
B - المركبان **2 و 3** فقط
C - المركب **3** فقط
D – المركبان **1 و 4** فقط



Which of the compounds listed in the table below would **react** with bromine?

أي من المركبات الواردة في الجدول أدناه **يتفاعل** مع البروم ؟

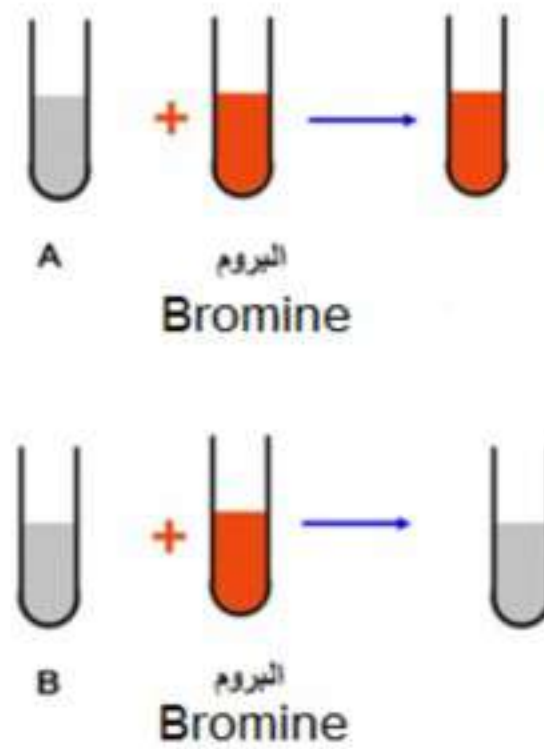
- A – Compound **1** only
 B – Compound **2** only
 C – Compounds **2** , **3** only
 D - Compounds **1** , **4** only

صيغة المركب Compound Formula	رقم المركب Compound Number
$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	1
$\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$	2
$\text{CH} \equiv \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	3
$\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3$	4

- A – المركب **1** فقط
 B - المركب **2** فقط
 C - المركبان **2** و **3** فقط
 D - المركبان **1** و **4** فقط

Bromine was added to two test tubes containing hydrocarbons, and the result of the addition was as shown in the figure below. Which of the following statements is correct?

أضيف البروم إلى أنبوتي اختبار تحتويان على هيدروكربونات، فكانت نتيجة الإضافة كما يظهر في الشكل أدناه. أي العبارات التالية صحيحة؟



Hydrocarbon **A** is saturated while hydrocarbon **B** is unsaturated

الهيدروكربون **A** مشبع بينما الهيدروكربون **B** غير مشبع

Hydrocarbon **A** is unsaturated while hydrocarbon **B** is saturated

الهيدروكربون **A** غير مشبع بينما الهيدروكربون **B** مشبع

Both hydrocarbons **A** and **B** are saturated

كلاً من الهيدروكربون **A** والهيدروكربون **B** مشبعان

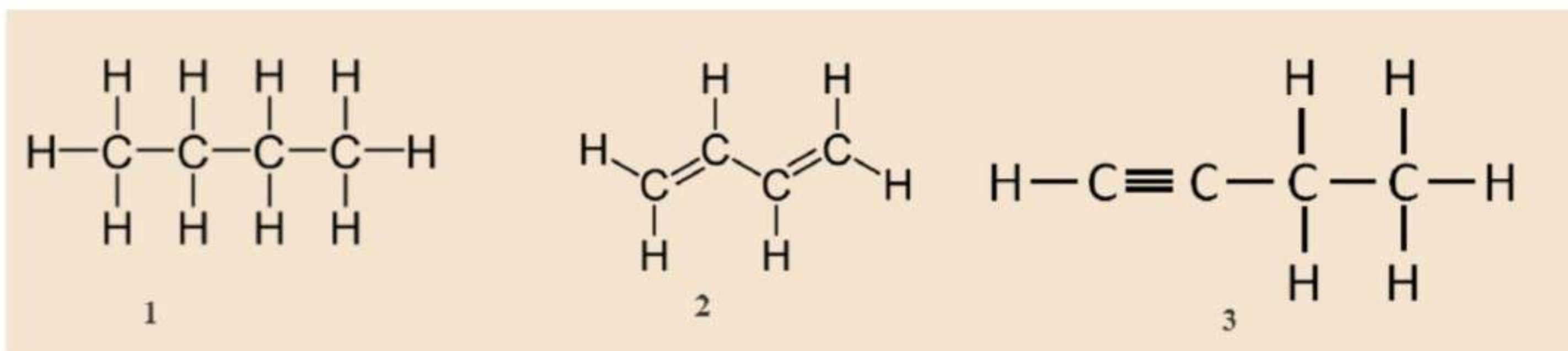
Both hydrocarbons **A** and **B** are unsaturated

كلاً من الهيدروكربون **A** والهيدروكربون **B** غير مشبعين



Which of the hydrocarbons shown below react with bromine?

أي الهيدروكربونات المبينة أدناه يتفاعل مع البروم؟



1 only 1 فقط

3 only 3 فقط

2 and 3 2 و 3

1 and 3 1 و 3

Hydrocarbon was added to bromine in a test tube, the result was as shown in the figure below. Which of the following hydrocarbons most likely was added to the bromine?

تم إضافة هيدروكربون إلى البروم في أنبوبة اختبار، وكانت النتيجة كما يظهر في الشكل أدناه. أي من الهيدروكربونات التالية من المرجح أن يكون أضيف إلى البروم؟

البروم قبل الإضافة
bromine before addition

البروم بعد الإضافة
bromine after addition

$\begin{array}{c} \text{CH}_2 \\ / \quad \backslash \\ \text{CH}_2 \quad \text{CH}_2 \\ \quad \\ \text{CH}_2 \quad \text{CH}_2 \\ \backslash \quad / \\ \text{CH}_2 \end{array}$	$\text{CH} \equiv \text{CCH}_2\text{CH}_2\text{CH}_3$	$\text{CH}_3\text{CH} = \text{CHCH}_2\text{CH}_3$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CHCH}_3 \\ \\ \text{CHCH}_3 \\ \\ \text{CH}_3 \end{array}$
1	2	3	4

1 only 1 فقط

4 only 4 فقط

1 or 4 1 أو 4

2 or 3 2 أو 3



Straight-Chain Alkanes

Alkanes are hydrocarbons that have only single bonds between atoms.

Table 1 Simple Alkanes

Molecular Formula	Structural Formula	Ball-and-Stick Model	Space-Filling Model
Ethane (C ₂ H ₆)	<pre> H H H - C - C - H H H </pre>		
Propane (C ₃ H ₈)	<pre> H H H H - C - C - C - H H H H </pre>		
Butane (C ₄ H ₁₀)	<pre> H H H H H - C - C - C - C - H H H H H </pre>		

Naming straight - chain alkanes:

Table 2 First Ten of the Alkane Series

Name	Molecular Formula	Condensed Structural Formula
Methane	CH ₄	CH ₄
Ethane	C ₂ H ₆	CH ₃ CH ₃
Propane	C ₃ H ₈	CH ₃ CH ₂ CH ₃
Butane	C ₄ H ₁₀	CH ₃ CH ₂ CH ₂ CH ₃
Pentane	C ₅ H ₁₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃
Hexane	C ₆ H ₁₄	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
Heptane	C ₇ H ₁₆	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
Octane	C ₈ H ₁₈	CH ₃ (CH ₂) ₆ CH ₃
Nonane	C ₉ H ₂₀	CH ₃ (CH ₂) ₇ CH ₃
Decane	C ₁₀ H ₂₂	CH ₃ (CH ₂) ₈ CH ₃

- **Homologous series:** A series of compounds that differ from one another by a repeating unit. The repeating unit is
- Alkanes have the general formula of C_nH_{2n+2}, where n is equal to the number of carbon atoms.

Question : Write the molecular formula for an alkane that has 13 carbon atoms in its molecular structure . _____



Branched-Chain Alkanes:

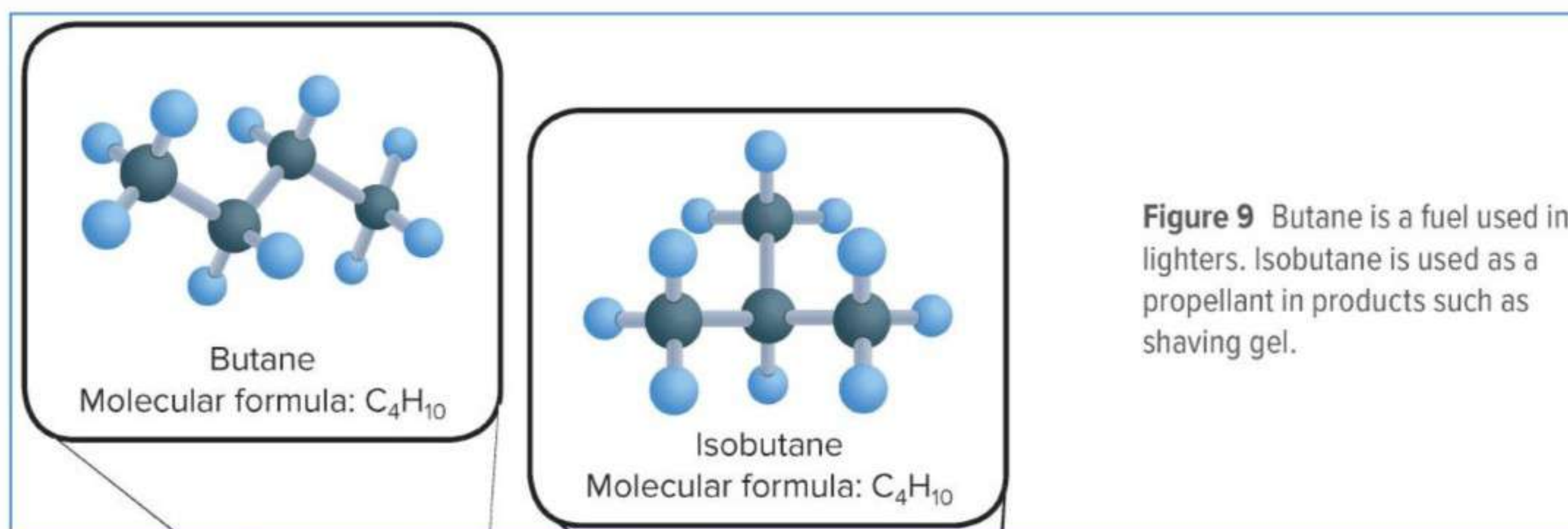


Figure 9 Butane is a fuel used in lighters. Isobutane is used as a propellant in products such as shaving gel.

Question: Describe the difference in the molecular structures of butane and isobutane.

Alkyl groups

- The name of an organic compound must describe the molecular structure of the compound.
- When naming branched-chain alkanes, the longest continuous chain of carbon atoms is called the **parent chain**.
- All side branches are called **substituent groups** because they appear to substitute for a hydrogen atom in the straight chain.
- Each alkane-based substituent group branching from the parent chain is called an **alkyl group**.
- When you name an alkyl group, the ending -ane is replaced with the letters -yl.

Table 3 Common Alkyl Groups

Name	Methyl	Ethyl	Propyl	Isopropyl	Butyl
Condensed structural formula	CH_3-	CH_3CH_2-	$CH_3CH_2CH_2-$	CH_3CHCH_3 	$CH_3CH_2CH_2CH_2-$
Structural formula	<pre> H H - C - H </pre>	<pre> H H - C - H H - C - H </pre>	<pre> H H - C - H H - C - H H - C - H </pre>	<pre> H H - C - H - C - H H - C - H H </pre>	<pre> H H - C - H H - C - H H - C - H H - C - H </pre>



Naming branched-chain alkanes:

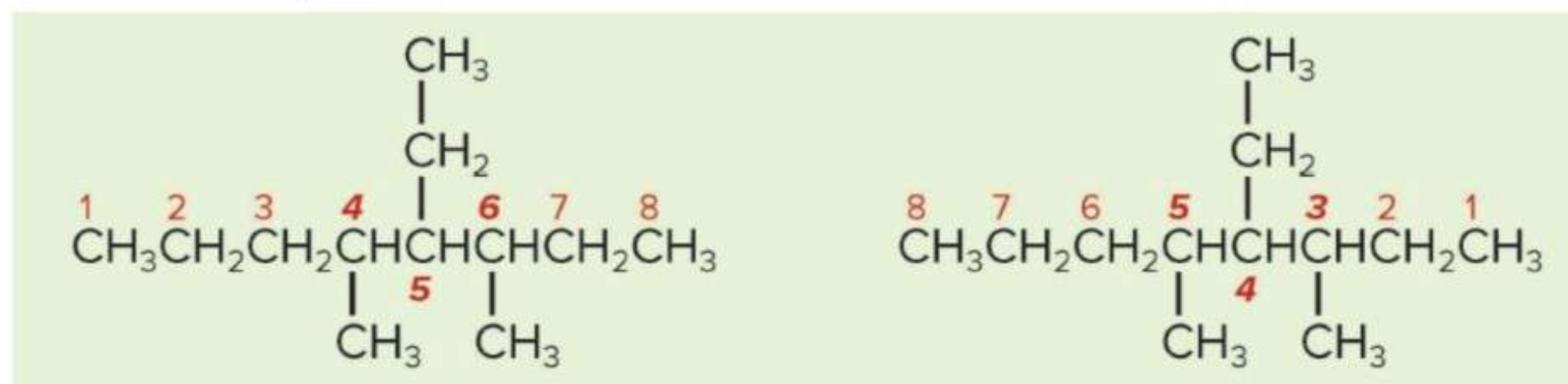
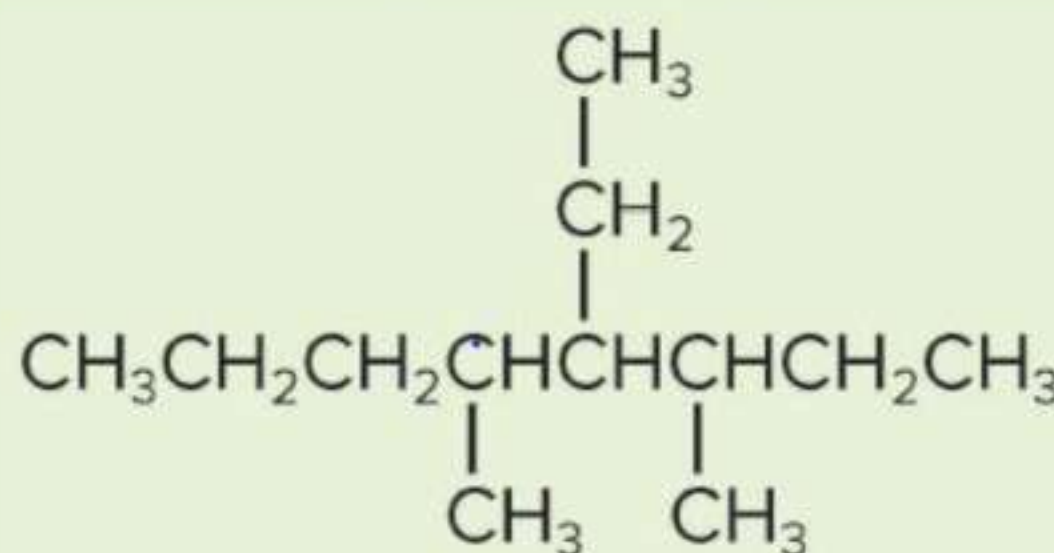
Chemists use the systematic rules approved by the **International Union of Pure and Applied Chemistry (IUPAC)**.

Step 1: Count the number of carbon atoms in the **longest** chain and name it.

The longest chain has eight carbon atoms, so the name of the parent chain is **octane**.

Step 2: Number each carbon in the parent chain. Locate the end carbon closest to a substituent group. Label that carbon Position 1.

This step gives all the substituent groups the lowest position numbers possible.



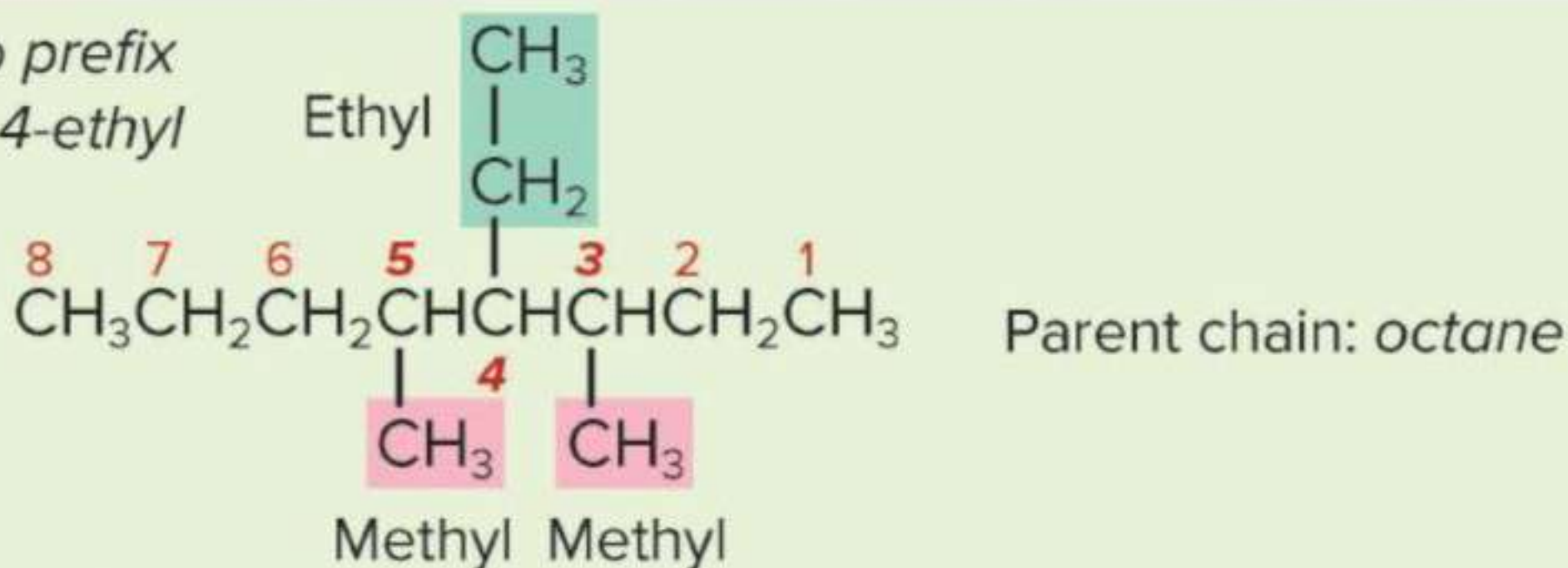
Numbering from the left puts the alkyl groups at Positions 4, 5, and 6. Numbering from the right puts alkyl groups at Positions 3, 4, and 5. Because **3, 4, and 5** are the **lowest position numbers**, they will be used in the name.

Step 3: Name each **alkyl group** substituent. Place the name of the group **before** the name of **the parent chain**.

Step 4: If the same alkyl group occurs more than once as a branch on the parent structure, use a prefix (**di-**, **tri-**, **tetra-**, and so on) before its name to indicate how many times it appears.

Use the number of the carbon to which each alkyl group is attached to indicate its position.

One ethyl group: *no prefix*
Position and name: **4-ethyl**



Two methyl groups: use *dimethyl*
Position and name: **3,5-dimethyl**

Step 5: When different alkyl groups are attached to the same parent structure, place their names in alphabetical order.

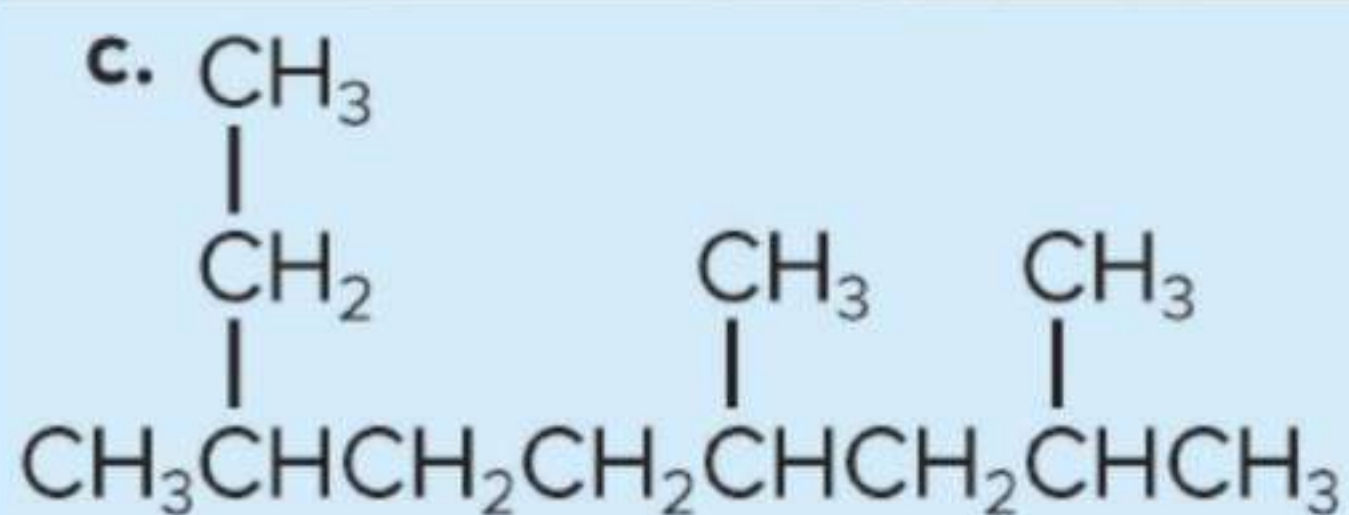
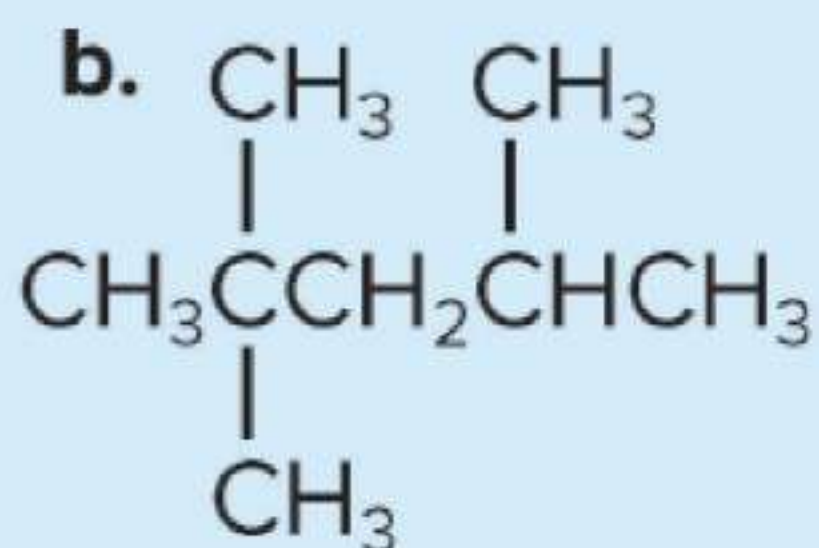
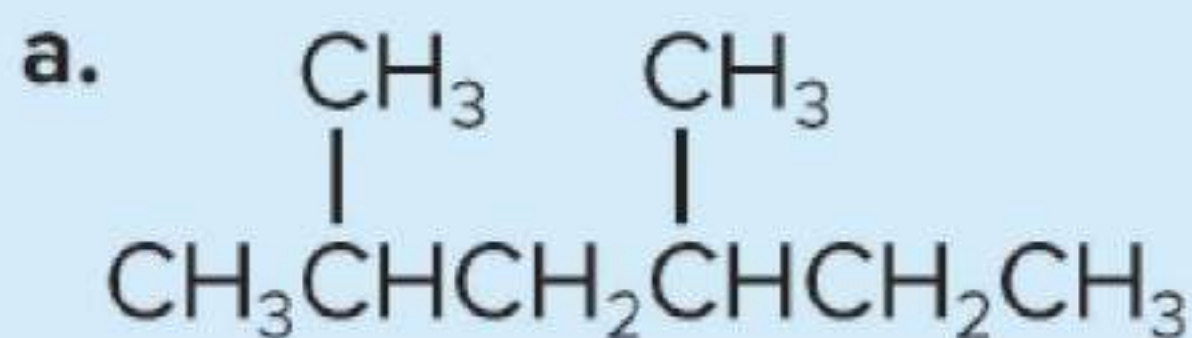
In this example: Alphabetical order puts the name **ethyl** before **dimethyl**.

Step 6: Write the entire name, using hyphens(-) to separate numbers from words and commas(,) to separate numbers.

In this example: The name should be written as **4-ethyl-3,5-dimethyloctane**.



Use the IUPAC rules to name the following structures.



CHALLENGE Draw the structures of the following branched-chain alkanes.

a. 2,3-dimethyl-5-propyldecane

b. 3,4,5-triethyloctane



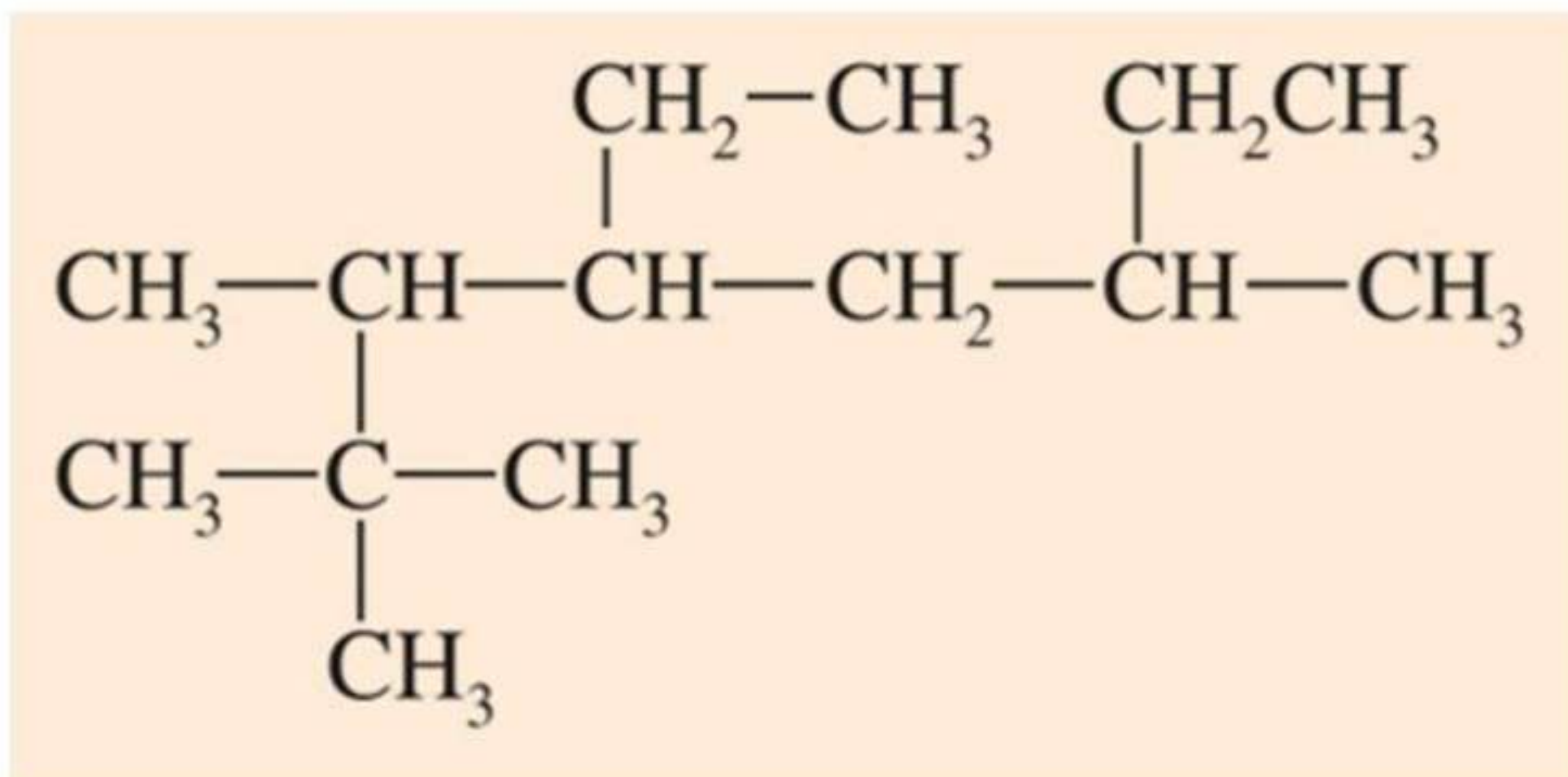
Final exam questions

What is the **correct** name for the following alkane?

(Using IUPAC rules)

ما الاسم **الصحيح** للألكان التالي؟

(مُستخدماً قواعد IUPAC)



2, 2, 3, 6 – tetramethyl – 4 – ethyl octane

4 – ethyl – 2, 2, 3, 6 – tetramethyl octane

5 – ethyl – 3, 6, 7, 7 – tetramethyl octane

3, 6, 7, 7 – tetramethyl – 5 – ethyl octane

2, 2, 3, 6 – رباعي ميثيل – 4 – إيثيل أوكتان

4 – إيثيل – 2, 2, 3, 6 – رباعي ميثيل أوكتان

5 – إيثيل – 3, 6, 7, 7 – رباعي ميثيل أوكتان

3, 6, 7, 7 – رباعي ميثيل – 5 – إيثيل أوكتان

What is the name of the following alkane using IUPAC rules?

A - 4,5 – dimethyl – 3 – ethyl heptane

B - 3 – ethyl – 4,5 – dimethyl heptane

C - 2,4 – diethyl – 3 – methyl hexane

D - 3 – methyl – 2,4 – diethyl hexane

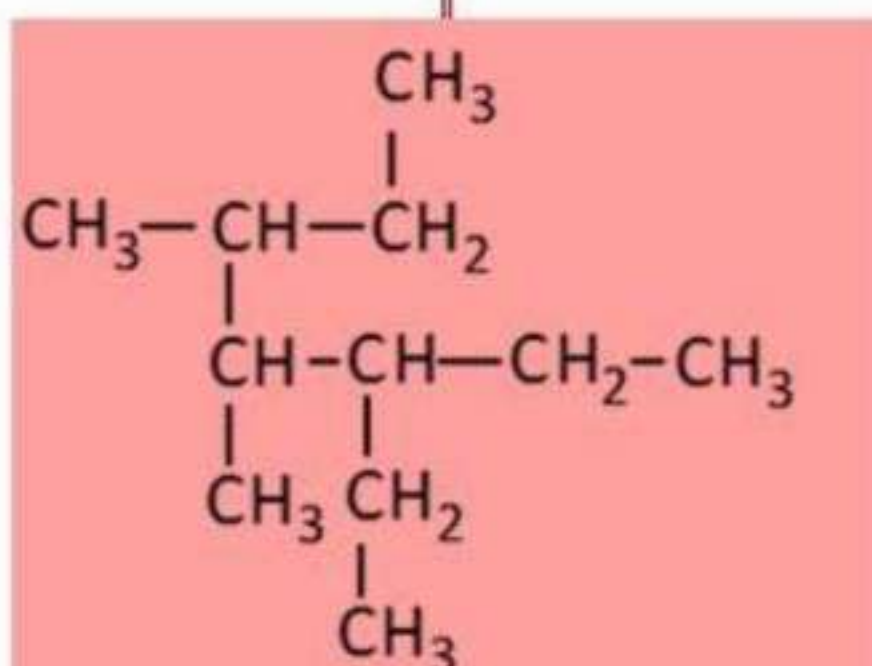
ما اسم الألكان التالي باستخدام قواعد IUPAC ؟

A - 4, 5 – ثنائي ميثيل – 3 – إيثيل هبتان

B - 3 – إيثيل – 4, 5 – ثنائي ميثيل هبتان

C - 2, 4 – ثنائي إيثيل – 3 – ميثيل هكسان

D - 3 – ميثيل – 2, 4 – ثنائي إيثيل هكسان

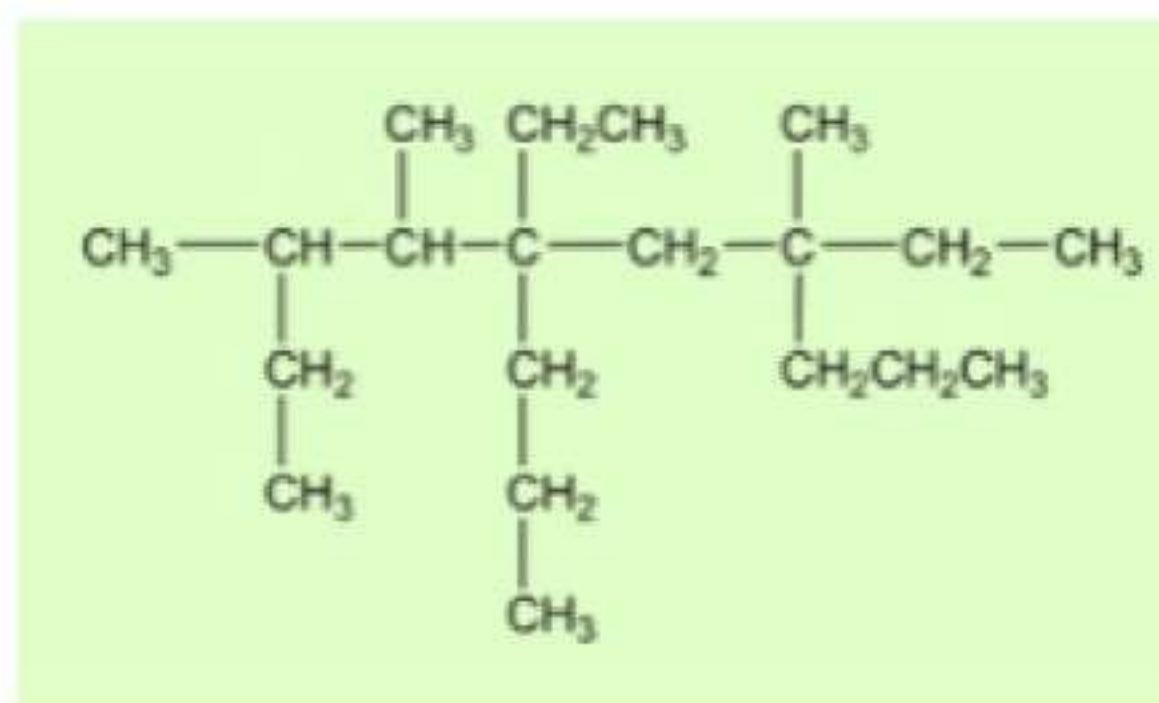


Activat
Go to S



What is the name of the following hydrocarbon according to the (IUPAC) system?

ما اسم الهيدروكربون التالي تبعًا لنظام (IUPAC)؟



5, 7 - diethyl - 3,4,7 - trimethyl - 5 - propyl
decane

5 ، 7 - ثنائي إيثيل - 3 ، 4 ، 7 - ثلاثي ميثيل - 5 - بروبيل
ديكان

5 - propyl - 5, 7 - diethyl - 3,4,7 - trimethyl
decane

5 - بروبيل - 5 ، 7 - ثنائي إيثيل - 3 ، 4 ، 7 - ثلاثي
ميثيل ديكان

3,4,7 - trimethyl - 5 - ethyl - 5, 7 - dipropyl nonane

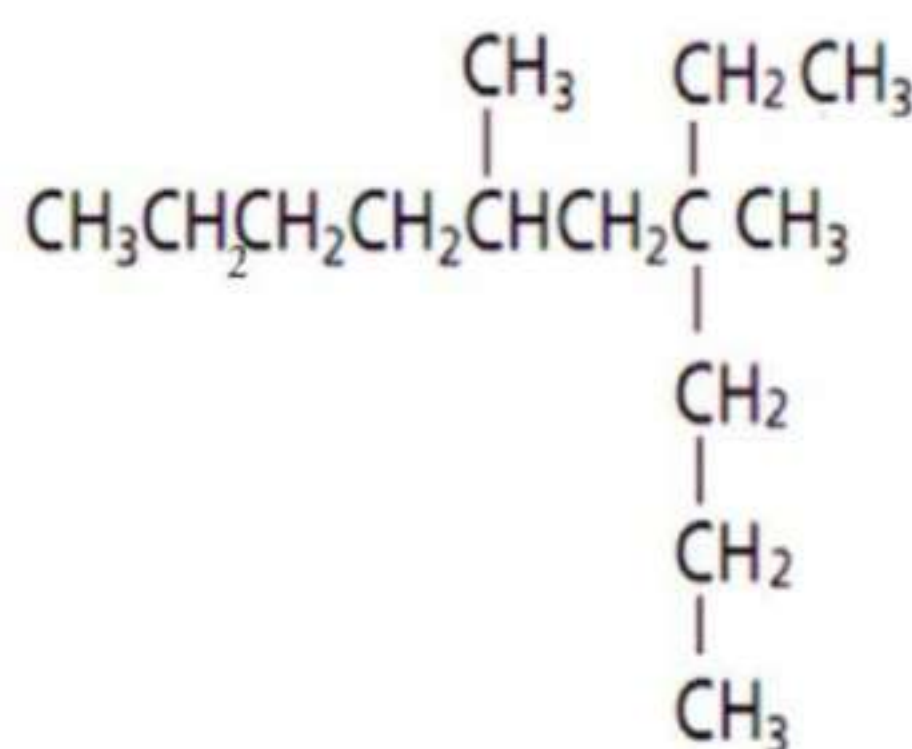
3 ، 4 ، 7 - ثلاثي ميثيل - 5 - إيثيل - 5 ، 7 - ثنائي بروبيل نونان

5 - ethyl - 3,4,7 trimethyl - 5, 7 - dipropyl nonane

5 - إيثيل - 3 ، 4 ، 7 - ثلاثي ميثيل - 5 ، 7 - ثنائي بروبيل نونان

Using IUPAC rules, what is the correct name of the structure shown below?

مُستخدماً قواعد (IUPAC)، ما الاسم الصحيح للصيغة البنائية الموضحة أدناه؟



4-ethyl-4,6-dimethyldecane

4-إيثيل-4،6-ثنائي ميثيل ديكان

4,6-dimethyl-4-ethyldecane

4،6-ثنائي ميثيل -4-إيثيل ديكان

7-ethyl-5,7-dimethyldecane

7-إيثيل-5،7-ثنائي ميثيل ديكان

5,7-dimethyl-7-ethyldecane

5،7-ثنائي ميثيل -7-إيثيل ديكان



Cycloalkanes (C_nH_{2n})

- An organic compound that contains a hydrocarbon ring is called a **cyclic hydrocarbon**.
- To indicate that a hydrocarbon has a ring structure, the prefix **cyclo-** is used.
- Thus, cyclic hydrocarbons that contain only single bonds are called **cycloalkanes**.
- Cycloalkanes can have rings with three, four, five, six, or even more carbon atoms.
- The name for the six-carbon cycloalkane is cyclohexane. It is used in **paint and varnish removers** and for **extracting essential oils to make perfume**.
- Note that cyclohexane (C_6H_{12}) has two fewer hydrogen atoms than straight-chain hexane (C_6H_{14}). That is because a valence electron from each of two carbon atoms is now forming a carbon-carbon bond rather than a carbon-hydrogen bond.
- Cyclic hydrocarbons such as cyclohexane are represented by **condensed, skeletal, and line** structures.

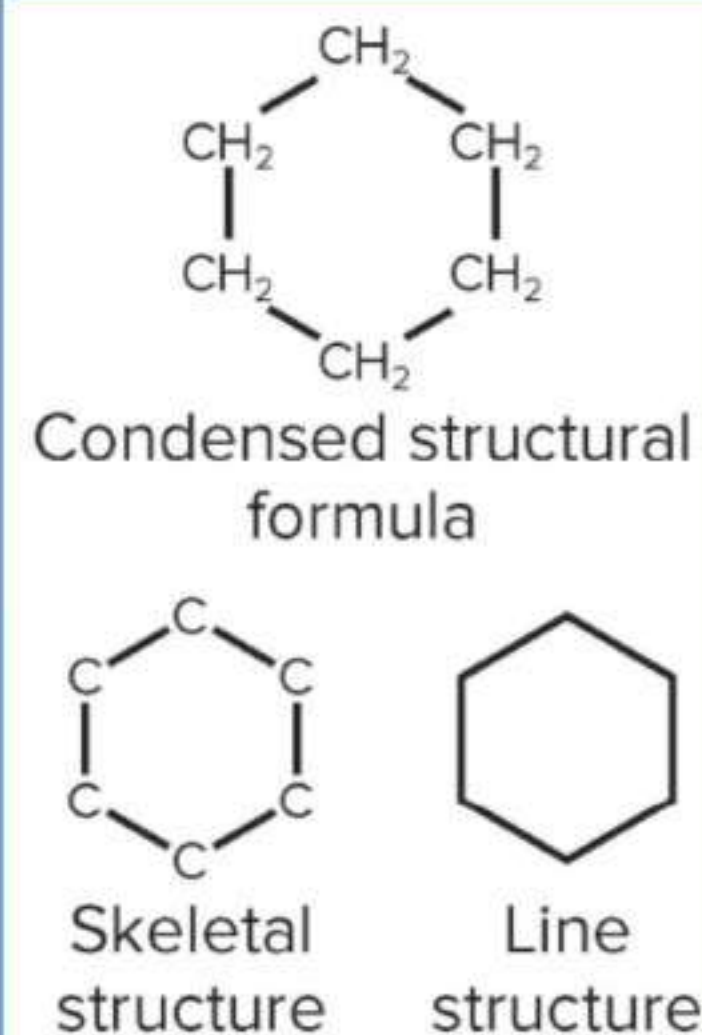


Figure 10 Cyclohexane can be represented in several ways.

Which of the following molecular formulas represents **a cycloalkane** with six carbon atoms?

- A - C_6H_6
- B - C_6H_{10}
- C - C_6H_{12}
- D - C_6H_{14}

أي من الصيغ الجزيئية التالية تمثل **ألكاناً حلقياً** يحتوي على ست ذرات كربون؟

- C_6H_6 - A
- C_6H_{10} - B
- C_6H_{12} - C
- C_6H_{14} - D

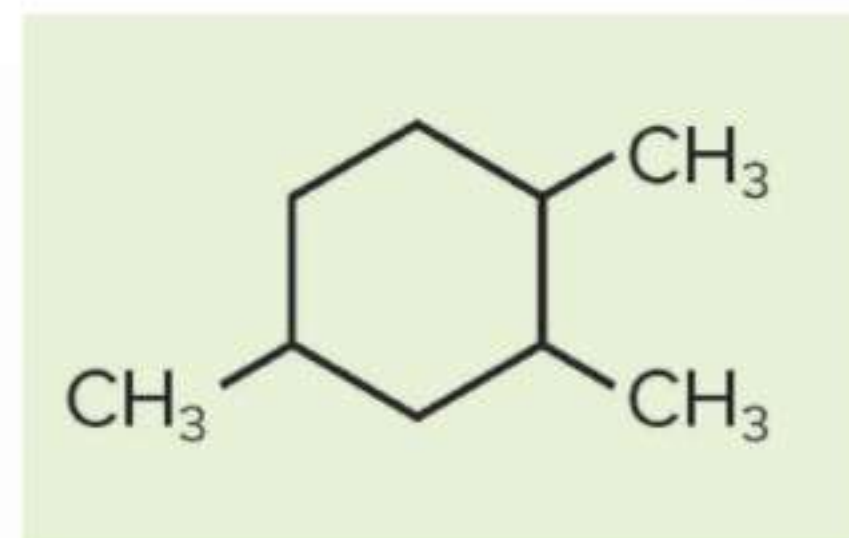
Naming substituted cycloalkanes:

Follow the same IUPAC rules used for straight-chain alkanes, but with a few modifications:

- **The ring** is always the **parent chain**.

The parent name is

- Numbering starts on the carbon that is bonded to the substituent group.
- When there are two or more substituents, the carbons are **numbered** around the ring in a way that gives **the lowest-possible set** of numbers for the substituents.





- If only one group is attached to the ring, no number is necessary.

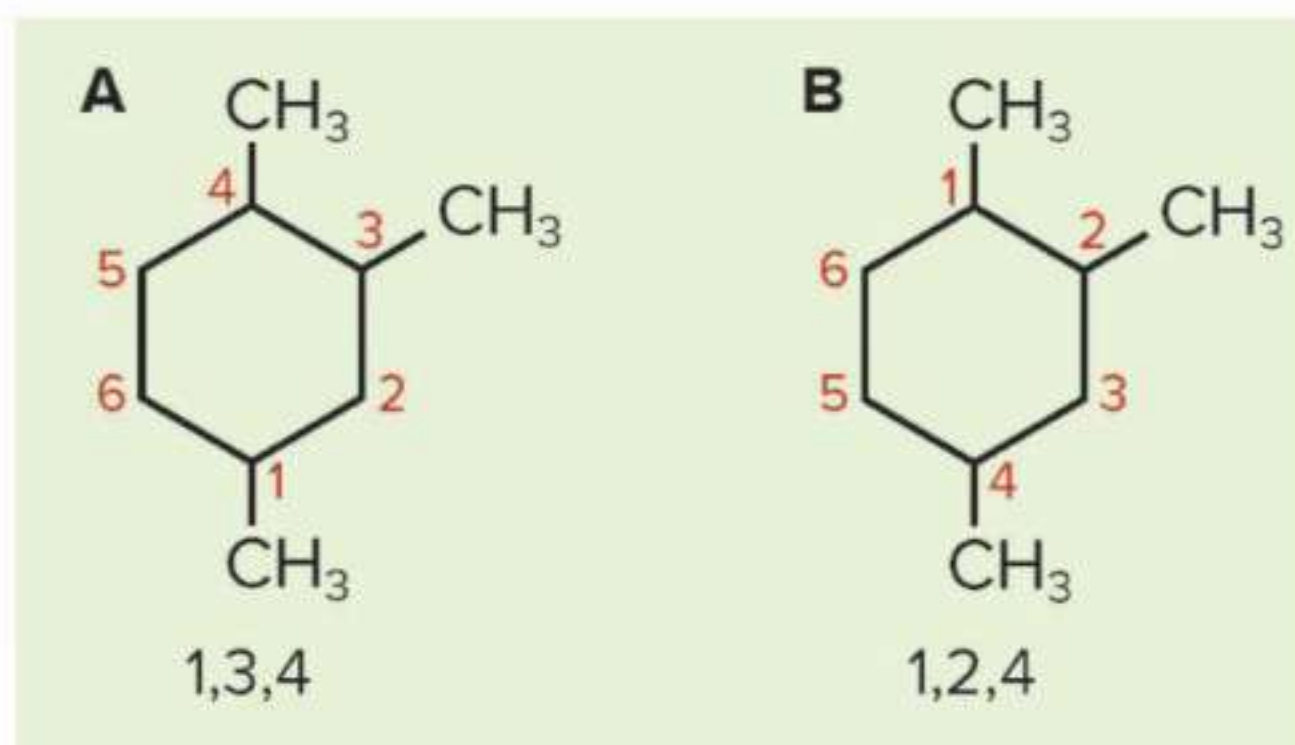
What are the lowest possible position numbers?

.....

What are the substituents?.....

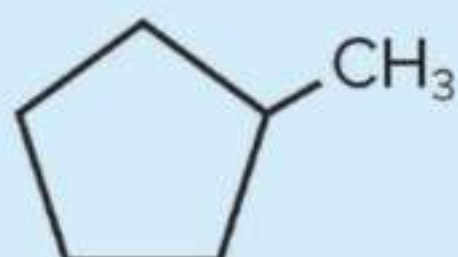
What is the name of the compound?

.....

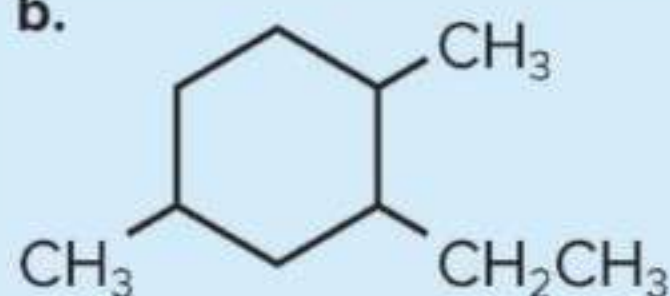


Use IUPAC rules to name the following structures.

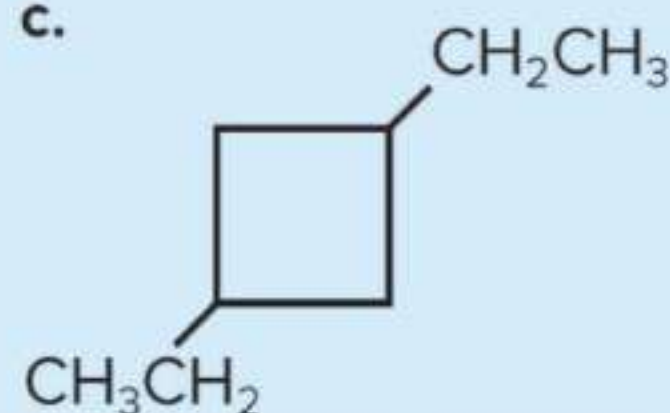
a.



b.



c.



Your Guide to Success

CHALLENGE Draw the structures of the following cycloalkanes.

a. 1-ethyl-3-propylcyclopentane

b. 1,2,2,4-tetramethylcyclohexane



Final exam questions

What is the correct structural formula for the following alkane?

(3, 5-diethyl - 1, 2 - dimethyl cyclohexane)

ما الصيغة البنائية الصحيحة للألكان التالي.

(3, 5 - ثنائي إيثيل - 1, 2 - ثنائي ميثيل هكسان حلقي)

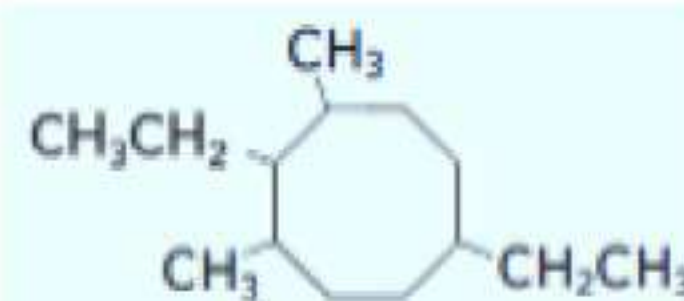
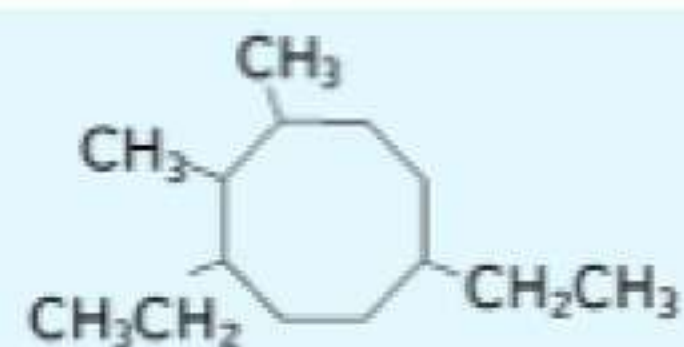
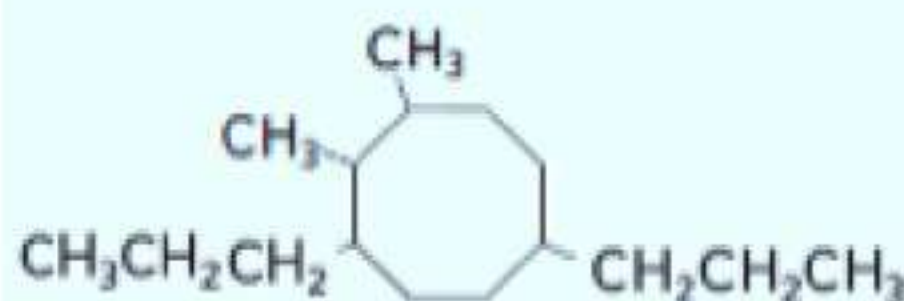
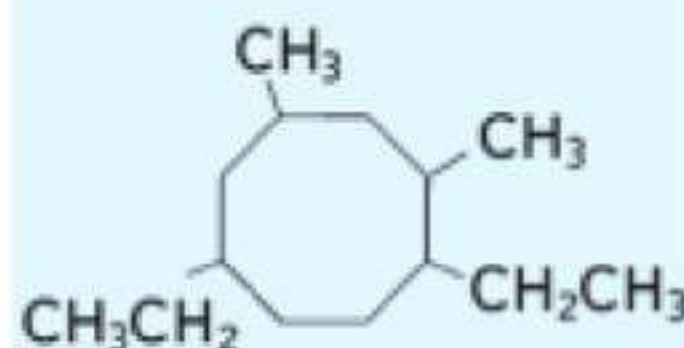
D	C	B	A

What is the correct structural formula for the compound:

ما الصيغة البنائية الصحيحة للمركب:

1,6 - diethyl - 2, 3 - dimethyl cyclooctane?

1, 6 - ثنائي إيثيل - 2, 3 - ثنائي ميثيل أوكتان حلقي ؟



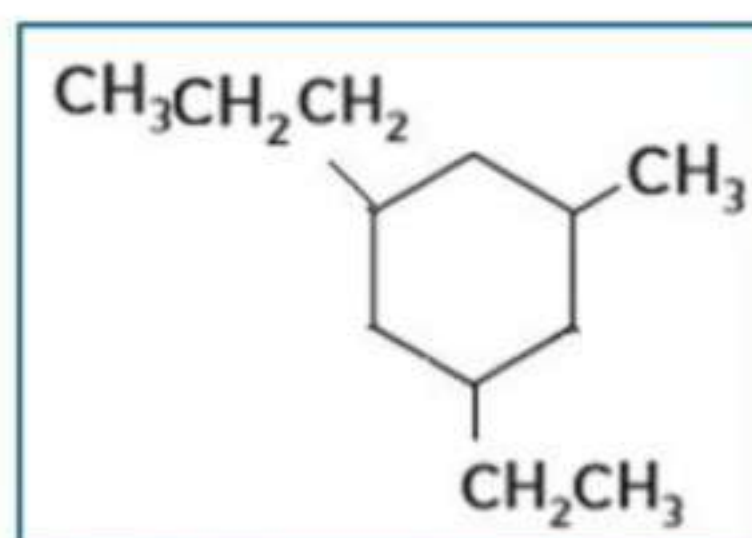
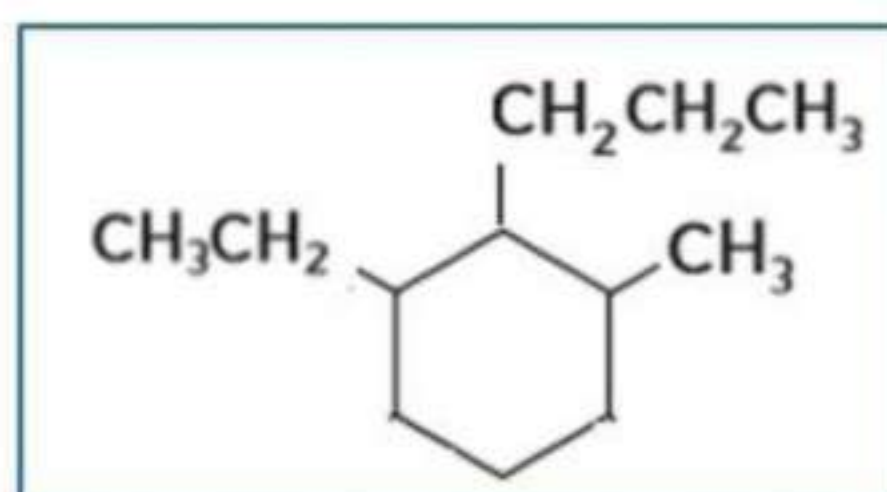
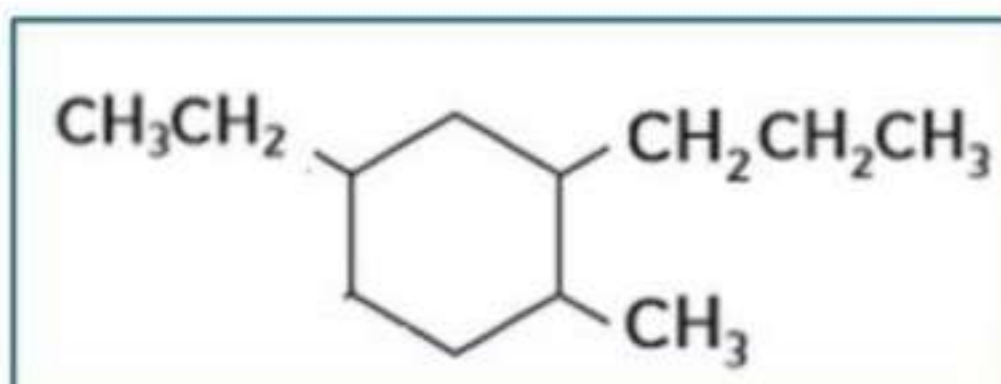
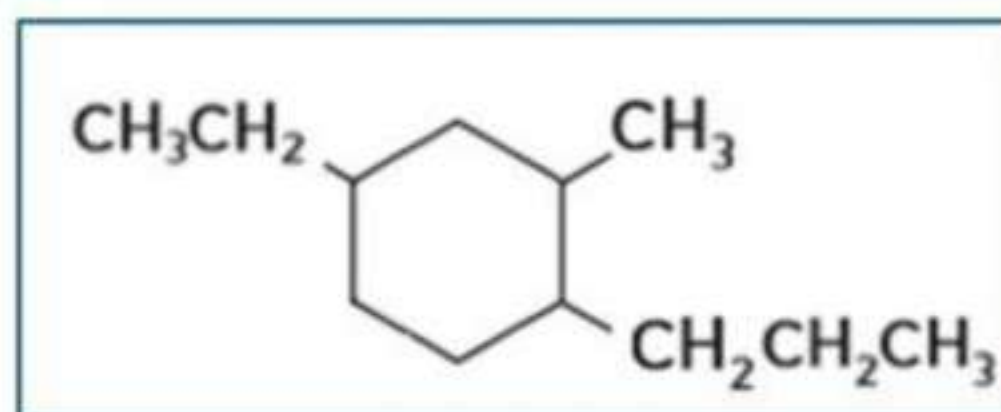


What is the **correct** structural formula for the following cycloalkane?

(4-ethyl-2-methyl-1-propylcyclohexane)

ما الصيغة البنائية الصحيحة للألكان الحلقي التالي؟

(4-إيثيل-2-ميثيل-1-بروبيل هكسان حلقي)



What is the correct structural formula for the next cycloalkane?

(1, 5-diethyl-2, 4-dimethyl cyclohexane)

ما الصيغة البنائية الصحيحة للألكان الحلقي التالي؟

(1, 5-ثنائي إيثيل-2, 4-ثنائي ميثيل هكسان حلقي)

D	C	B	A



Properties of Alkanes

- All the bonds in alkanes are between either a carbon atom and a hydrogen atom or between two carbon atoms.
- A bond between two identical atoms, such as carbon, can never be polar. Also, the C-H bonds have only a small electronegativity difference and are nonpolar.
- Alkane molecules are **nonpolar**, which makes them good solvents for other nonpolar substances.

Physical Properties of Alkanes

- Water and methane molecules are similar in size and molecular mass, but they differ (in a significant way) in melting and boiling points.
- These temperatures differ greatly because methane molecules have little intermolecular attraction compared to water molecules.
- Methane molecules **do not form hydrogen bonds** with each other, whereas water molecules are polar and form hydrogen bonds.
- The difference in polarity and hydrogen bonding also explains the immiscibility of alkanes and other hydrocarbons with water.
- Lubricating oils in water, the two liquids separate almost immediately into two phases. This separation happens **because** the attractive forces between alkane molecules are stronger than the attractive forces between the alkane and water molecules.
- Therefore, alkanes are more soluble in solvents composed of nonpolar molecules like themselves than in water, a polar solvent.

Table 4 Comparing Physical Properties

Substance and formula	Water (H ₂ O)	Methane (CH ₄)
Molecular mass	18 amu	16 amu
State at room temperature	liquid	gas
Boiling point	100°C	-162°C
Melting point	0°C	-182°C

Chemical properties of alkanes:

- Alkanes are **low reactive** because:
 - Alkanes molecules have **nonpolar bonds**, have **no charge**, so they have **little attraction for ions or polar molecules**.
 - C—C and C—H bonds are relatively strong. More energy is needed to cause a reaction.

Final exam questions

What explains the immiscibility of alkanes with water?

- A - **1** , **3** only
 B - **2** , **4** only
 C - **1** only
 D - **4** only

ما الذي يُفسر عدم قابلية الألكانات للامتزاج مع الماء؟

- A - **1** و **3** فقط
 B - **2** و **4** فقط
 C - **1** فقط
 D - **4** فقط

الرقم Number	التفسير Explanation
1	جزيئات الألكانات غير قطبية ولا تُشكل روابط هيدروجينية Alkanes molecules are nonpolar and do not form hydrogen bonds
2	جزيئات الألكانات قطبية وتُشكل روابط هيدروجينية Alkanes molecules are polar and form hydrogen bonds
3	قوى التجاذب بين جزيئات الألكان أقوى من قوى التجاذب بين جزيئات الألكان والماء The attraction forces between alkane molecules are stronger than the attraction forces between the alkane and water molecules
4	قوى التجاذب بين جزيئات الألكان أضعف من قوى التجاذب بين جزيئات الألكان والماء The attraction forces between alkane molecules are weaker than the attraction forces between the alkane and water molecules



The table below shows the similarity of Methane and water in molecular mass. They are also similar in both size and shape. Why does Methane exist in the gas state with a very low boiling point?

- A – Methane molecules are polar while water molecules are nonpolar
- B - Methane molecules are nonpolar while water molecules are polar
- C - Methane molecules form hydrogen bonds with each other
- D – The attraction forces between Methane molecules are very strong

يُبين الجدول التالي تشابه الميثان والماء في الكتلة الجزيئية كما يتشابهان في الحجم والشكل أيضًا. ما سبب وجود الميثان في الحالة الغازية والانخفاض الكبير في درجة غليانه؟

- A - جزيئات الميثان قطبية بينما جزيئات الماء غير قطبية
- B - جزيئات الميثان غير قطبية بينما جزيئات الماء قطبية
- C - تُشكل جزيئات الميثان روابط هيدروجينية بين بعضها البعض
- D - قوى التجاذب بين جزيئات الميثان كبيرة جدًا

المركب	الميثان Methane	الماء Water	خصائصه
الكتلة الجزيئية Molecular Mass	16 amu	18 amu	
الحالة عند درجة حرارة الغرفة State at room temperature	غاز gas	سائل liquid	
درجة الغليان Boiling Point	-162° C	100° C	

The molecular mass of methane is close to the molecular mass of water as shown in the table below, the two compounds are similar in size. What explains the lower melting and boiling points of methane compared to the melting and boiling points of water?

الكتلة الجزيئية للميثان قريبة من الكتلة الجزيئية للماء كما يظهر في الجدول أدناه، ويتشابه المركبان في الحجم. ما الذي يفسر انخفاض درجات انصهار وغليان الميثان مقارنة مع درجات انصهار وغليان الماء؟

الميثان (CH ₄) Methane (CH ₄)	الماء (H ₂ O) Water (H ₂ O)	المادة والصيغة Substance and formula
16 amu	18 amu	الكتلة الجزيئية Molecular mass
غاز Gas	سائل Liquid	الحالة عند درجة حرارة الغرفة State at room temperature
-162 C°	100°C	درجة الغليان Boiling point
-182 C°	0°C	درجة الانصهار Melting point

Methane molecules are nonpolar and do not form hydrogen bonds with each other

جزيئات الميثان غير قطبية ولا تُشكل بحدّة روابط هيدروجينية بعضها مع بعض

Methane molecules are polar and form hydrogen bonds with each other

جزيئات الميثان قطبية وتُشكل بحدّة روابط هيدروجينية بعضها مع بعض

Methane molecules have a very high intermolecular attraction compared to water molecules

جزيئات الميثان تتميز بقدرة عالية جدًا لجذب الجزيئات مقارنة بجزيئات الماء

Methane is organic compound, while water is inorganic compound

الميثان مركب عضوي بينما الماء غير عضوي



Why do the melting and boiling points of methane differ from the melting and boiling points of water as shown in the table below?

Methane (CH ₄) الميثان	Water (H ₂ O) الماء	Substance and formula المادة والصيغة
16 amu	18 amu	Molecular mass الكتلة الجزيئية
-162 °C	100 °C	Boiling point درجة الغليان
-182 °C	0 °C	Melting point درجة الانصهار

Because methane molecules are nonpolar and do not form hydrogen bonds with each other, whereas water molecules are polar and freely form hydrogen bonds

Because methane molecules are polar and form hydrogen bonds with each other, whereas water molecules are nonpolar and do not form hydrogen bonds

Because C-H bonds in methane molecule have a very large electronegativity difference, whereas O-H bonds in water molecules have a very small electronegativity difference

Because methane molecule has a bent geometry, whereas water molecule has a regular geometry

ما سبب اختلاف درجات الانصهار والغليان للميثان عن درجات الانصهار والغليان للماء كما هو موضح بالجدول أدناه؟

لأن جزيئات الميثان غير قطبية ولا تُشكل روابط هيدروجينية بعضها مع بعض بينما جزيئات الماء قطبية وتُشكل روابط هيدروجينية

لأن جزيئات الميثان قطبية وتُشكل روابط هيدروجينية بعضها مع بعض بينما جزيئات الماء غير قطبية ولا تُشكل روابط هيدروجينية

لأن روابط C-H في جزيء الميثان فيها اختلاف كبير جدًا في السالبية الكهربائية بينما روابط O-H في جزيء الماء فيها اختلاف بسيط جدًا

لأن شكل جزيء الميثان الهندسي منحني بينما شكل جزيء الماء هندسي منتظم

Water and methane molecules are similar in size, and have molecular masses close to each other. What explains the low boiling and melting points of methane compared to water?

يشابه جزيء الماء مع جزيء الميثان في الحجم، كما أن كتليهما الجزيئية متقاربتان. ما الذي يُفسر انخفاض درجتي الغليان والانصهار للميثان مقارنة مع الماء؟

جزيئات الميثان قطبية وتُشكل روابط هيدروجينية بعضها مع بعض Methane molecules are polar and form hydrogen bonds with each other	I
جزيئات الميثان غير قطبية ولا تُشكل روابط هيدروجينية بعضها مع بعض Methane molecules are nonpolar and do not form hydrogen bonds with each other	II
تتميز جزيئات الميثان بقدرة منخفضة جدًا لجذب بعضها البعض مقارنة بجزيئات الماء Methane molecules have little intermolecular attraction compared to water molecules	III

II, III

II و III

II only

II فقط

I only

I فقط

I, III

I و III



Uses of Alkanes:

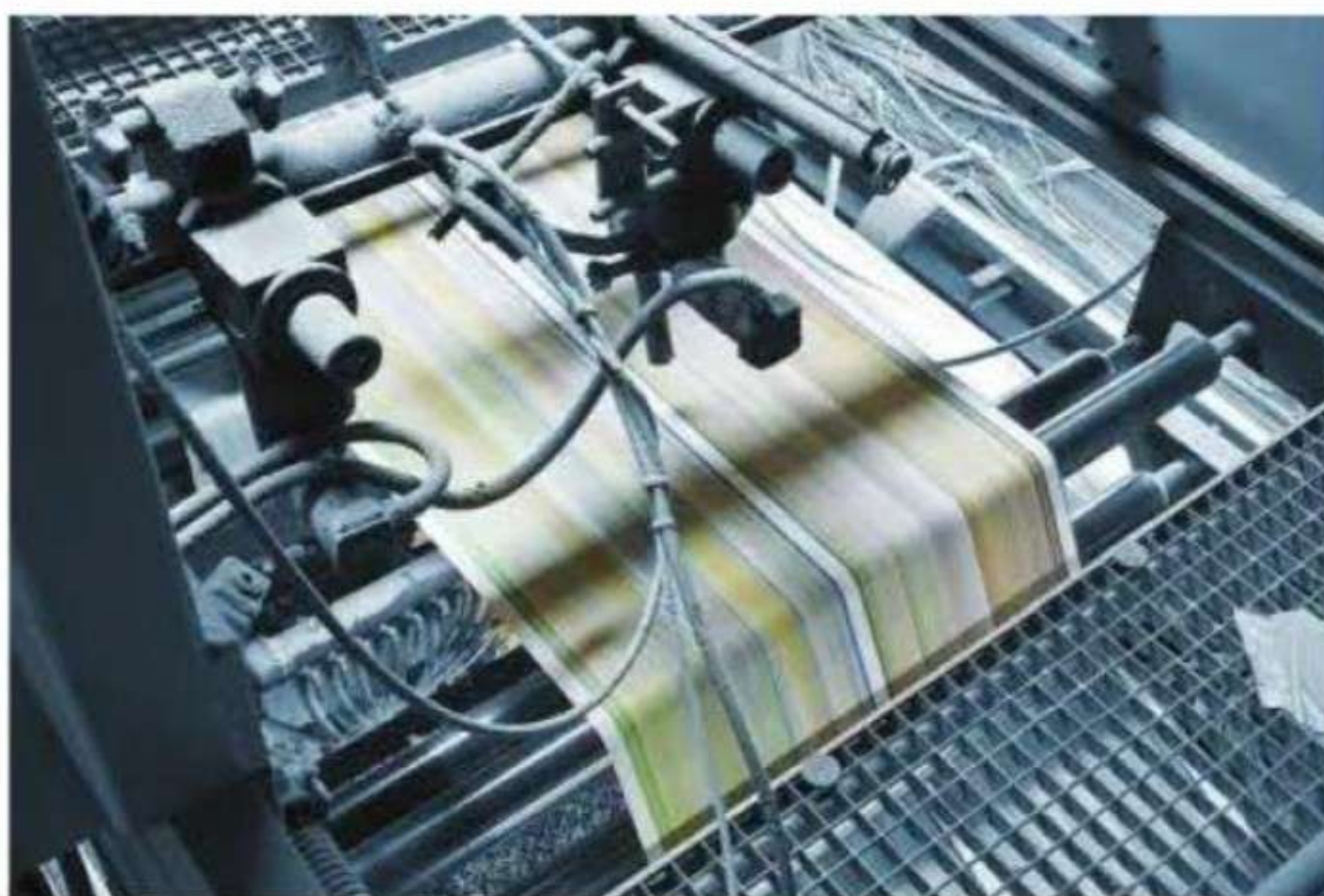


Figure 11 Many solvents—used as thinners for paint, coatings, waxes, photocopier toners, adhesives, and printer press inks—contain alkanes and cycloalkanes.

THE
GARDEN
ACADEMY
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14	CHM.5.6.01.013.08 Draw the structure of an alkene given its IUPAC name	Textbook + table 5	76
15	CHM.5.6.01.013.06 Use IUPAC system to name alkenes (straight chain, branched, non-substituted and substituted)	Textbook + figures 12, 13 + Example problem 3 + Practice problems	77, 78, 79

Alkenes

Unsaturated hydrocarbons that contain one or more double covalent bonds between carbon atoms in a chain are called **alkenes**.

An alkene must have a double bond, so the simplest alkene has two carbon atoms double bonded to each other (C_2H_4).

Alkenes with only one double bond constitute a **homologous series**. The general formula for the series is C_nH_{2n} .

Each alkene has two fewer hydrogen atoms than the corresponding alkane because two electrons now form the second covalent bond and are no longer available for bonding to hydrogen atoms.

Table 5 Examples of Alkenes

Name	Ethene	Propene	1-Butene	2-Butene
Molecular formula	C_2H_4	C_3H_6	C_4H_8	C_4H_8
Structural formula				
Condensed structural formula	$CH_2 = CH_2$	$CH_3CH = CH_2$	$CH_3CH_2CH = CH_2$	$CH_3CH = CHCH_3$

Final Exam Questions

Which of the following is true about alkenes?

أي مما يأتي صحيح فيما يتعلق بالأكينات؟

contain one or more triple bonds between carbon atoms

تحتوي على رابطة ثلاثية أو أكثر بين ذرات الكربون

The simplest alkene has one carbon atom

يحتوي أبسط ألكين على ذرة كربون واحدة

Its general formula is C_nH_{2n+2}

صيغتها العامة C_nH_{2n+2}

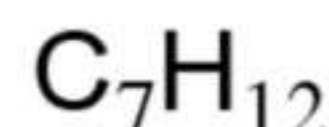
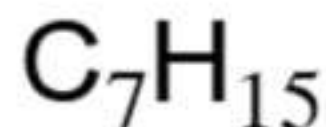
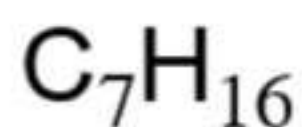
Its general formula is C_nH_{2n}

صيغتها العامة C_nH_{2n}



What is the molecular formula for alkene (**straight series**) has **7** carbon atoms and contains **two** double bonds?

ما الصيغة الجزيئية لألكين (**سلسلة مستقيمة**) يتكون من **7** ذرات كربون ويحتوي على **رابطتين** ثنائيتين؟



How many hydrogen atoms are in **an alkene** with **nine** carbon atoms and **one double bond**?

كم عدد ذرات الهيدروجين الموجودة في جزيء الألكين الذي له تسع ذرات كربون ورابطة ثنائية واحدة؟

18

20

16

17

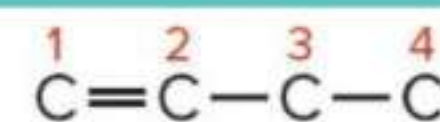
Naming alkenes

- Alkenes are named in much the same way as alkanes.
- Their names are formed by changing the -ane ending of the corresponding alkane to **-ene**.
- To name alkenes with four or more carbons in the chain, it is necessary to specify the location of the double bond.
- This is done by numbering the carbons in the parent chain, starting at the end of the chain that will give the **first carbon in the double bond the lowest number**.
- It is important to recognize that 1-butene and 2-butene are two different substances, each with its own properties.

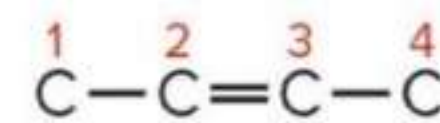
Question: We can't name a compound 3-butene. Why?

- Cyclic alkenes are named in much the same way as cyclic alkanes; however, carbon number 1 must be one of the carbons connected by the double bond.

- Question:** Name that cyclic alkene in the figure.



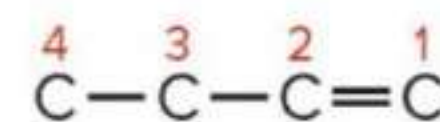
1-Butene



2-Butene

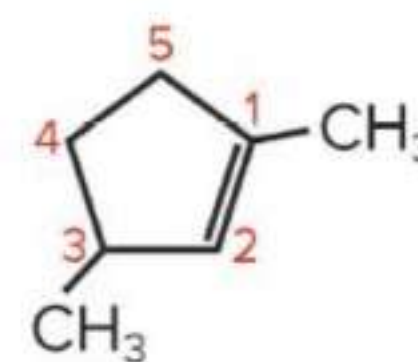


3-Butene



1-Butene

a. Straight-chain alkenes

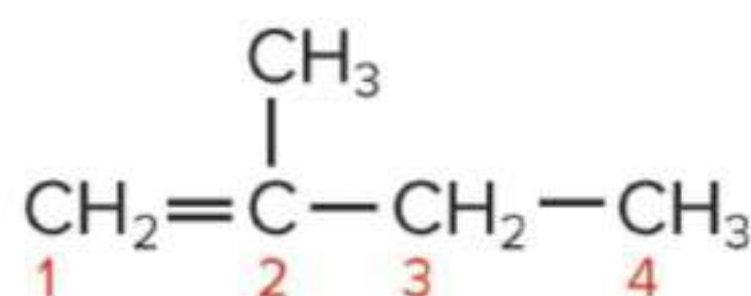


b. Cyclic alkenes

Figure 12 When naming either branched or straight alkenes, they must be numbered using IUPAC rules.

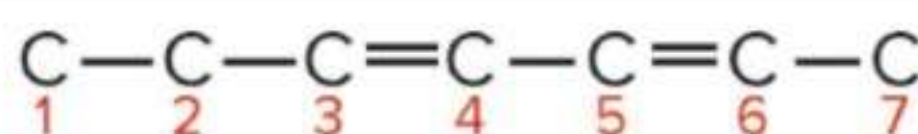
**Naming branched-chain alkenes**

- The parent chain is always the longest chain that contains the double bond.
- The position of the double bond, not the branches, determines how the chain is numbered.
- Some unsaturated hydrocarbons contain more than one double (or triple) bond. The number of double bonds in such molecules is shown by using a prefix (di-, tri-, tetra-, and so on) before the suffix -ene.

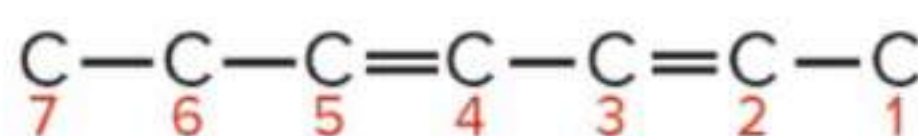


2-methyl-1-butene

a. Single double bond



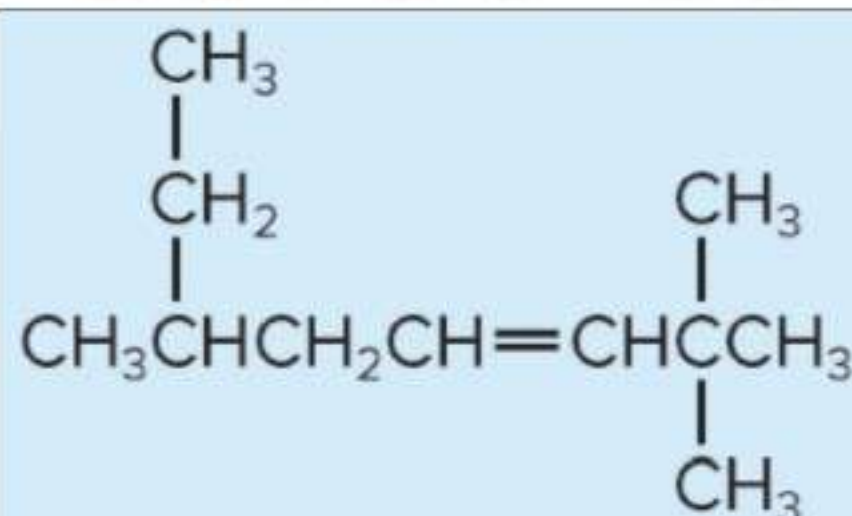
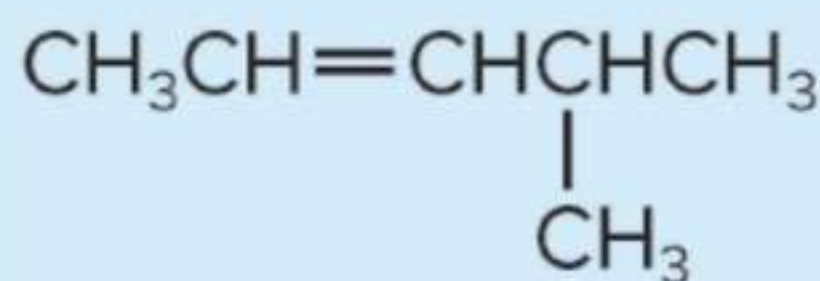
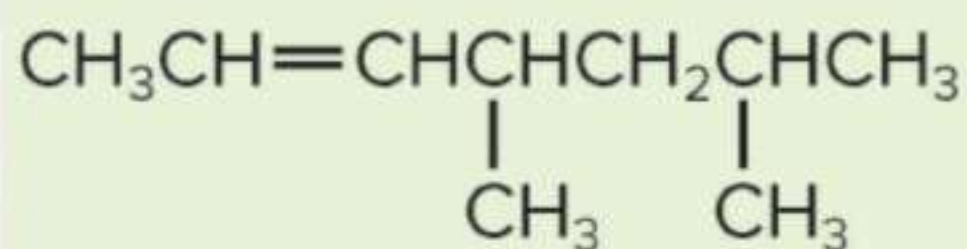
or



2,4-heptadiene

b. Two double bonds

Figure 13 The positions of the double bonds in alkenes are numbered in such a way that gives the lowest set of numbers. This is true in both branched and straight-chain alkenes.

Practice_Naming Branched Chain Alkenes

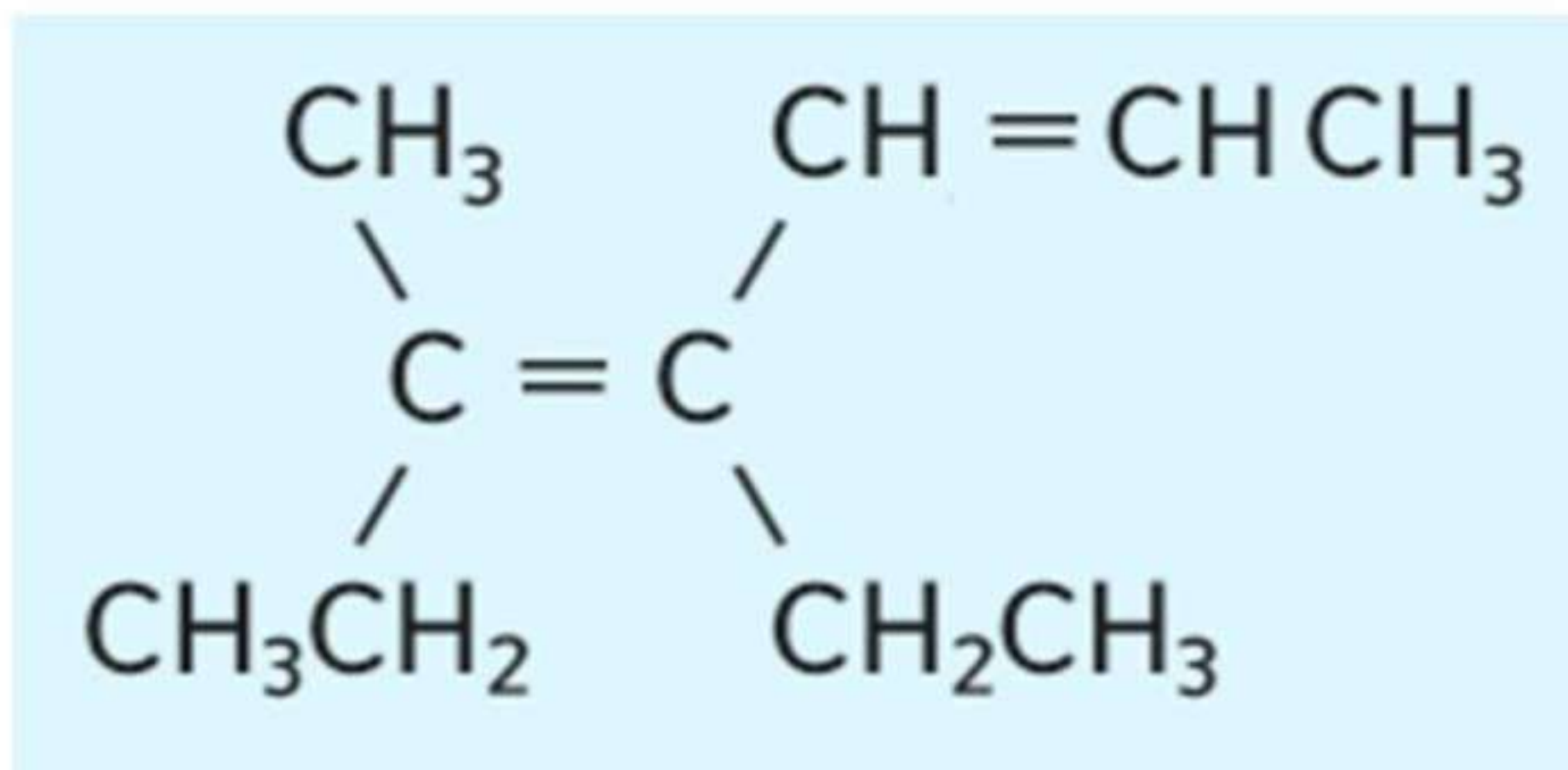
Draw the structure of 1,3-pentadiene.



Final Exam Questions

What is the correct name for the following alkene?
(Using IUPAC rules)

ما الاسم الصحيح للألكين التالي؟
(مُستخدماً قواعد IUPAC)



4 - ethyl - 3 - methyl - 3,5 - heptadiene

4 - إيثيل - 3 - ميثيل - 3 و 5 - هبتاديين

3 - methyl - 4 - ethyl - 3,5 - heptadiene

3 - ميثيل - 4 - إيثيل - 3 و 5 - هبتاديين

4 - ethyl - 5 - methyl - 2,4 - heptadiene

4 - إيثيل - 5 - ميثيل - 2 و 4 - هبتاديين

5 - methyl - 4 - ethyl - 2,4 - heptadiene

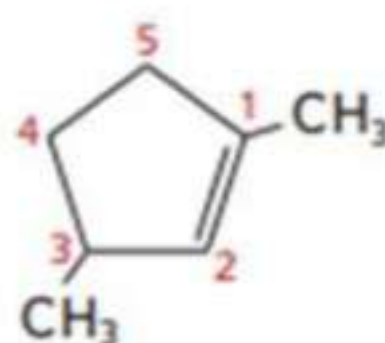
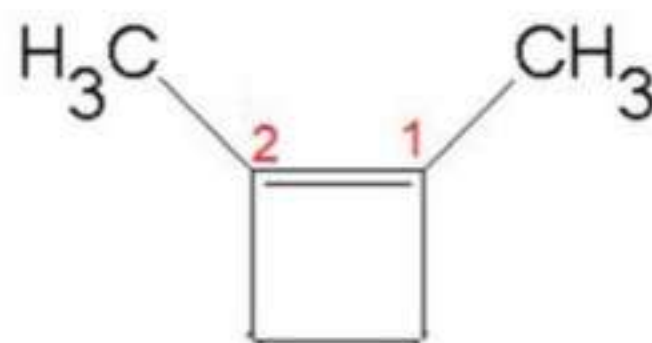
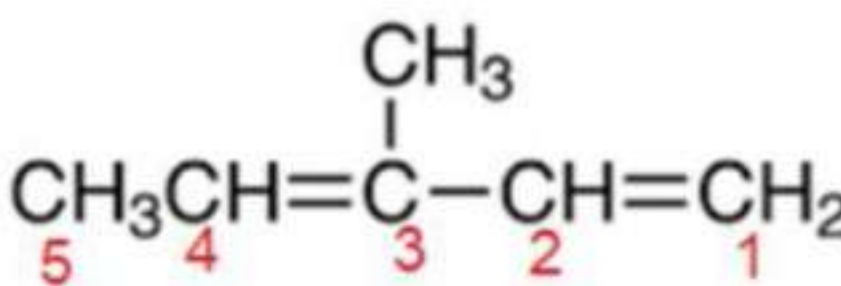
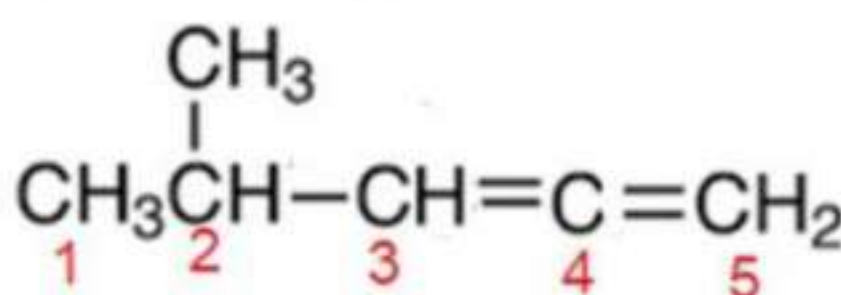
5 - ميثيل - 4 - إيثيل - 2 و 4 - هبتاديين

Which the following structural formulas shows the incorrect

أي الصيغ البنائية التالية تظهر فيها طريقة الترقيم غير الصحيحة

numbering way according to IUPAC rules?

تبعاً لقواعد (IUPAC) ؟



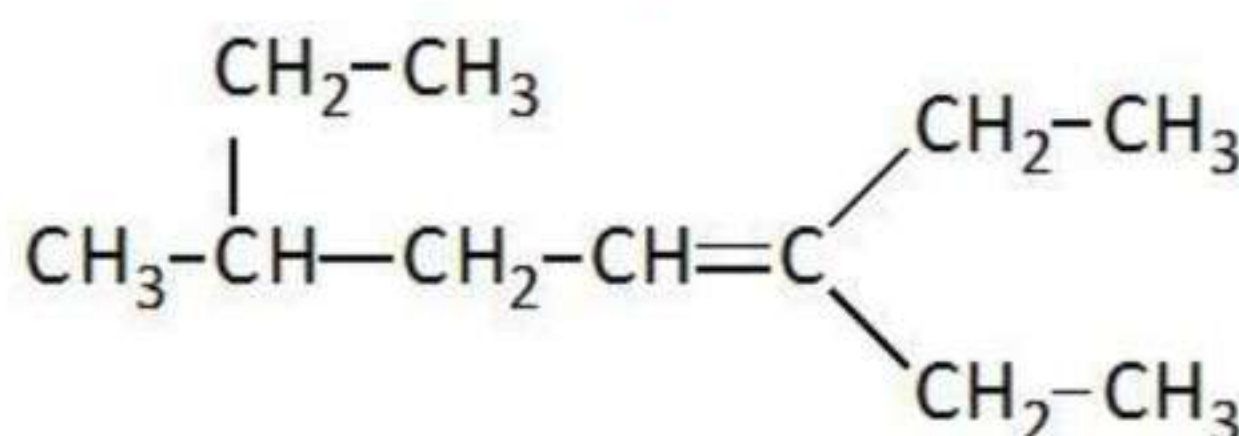


What is the correct name of the alkene with the following structural formula?

- A - 3 - methyl - 6 - ethyl - 5 - octene
B - 6 - ethyl - 3 - methyl - 5 - octene
C - 3 - ethyl - 6 - methyl - 3 - octene
D - 6 - methyl - 3 - ethyl - 3 - octene

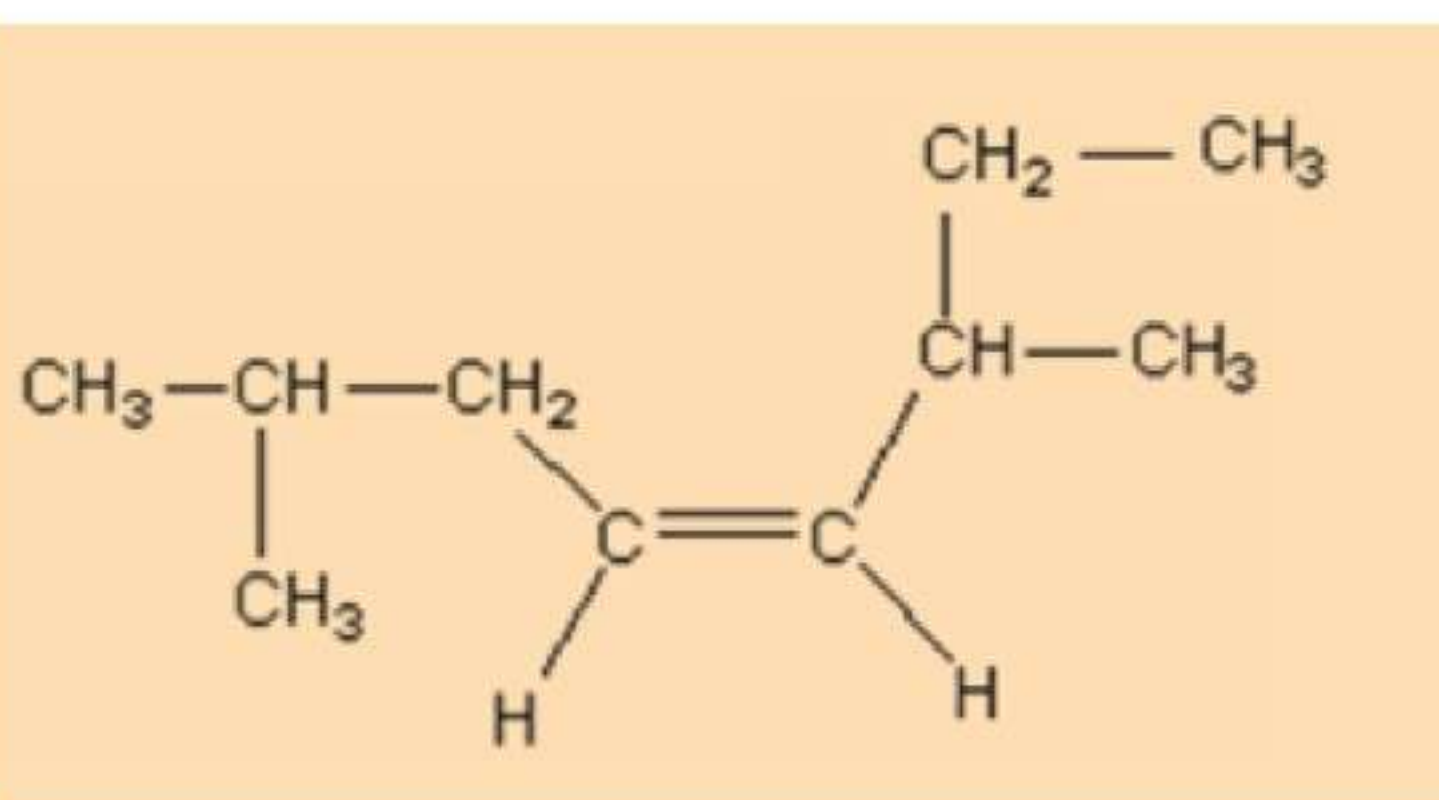
ما الاسم الصحيح للألكين ذو الصيغة البنائية التالية؟

- A - 3 - ميثيل - 6 - إيثيل - 5 - أوكتين
B - 6 - إيثيل - 3 - ميثيل - 5 - أوكتين
C - 3 - إيثيل - 6 - ميثيل - 3 - أوكتين
D - 6 - ميثيل - 3 - إيثيل - 3 - أوكتين



What is the name of the following hydrocarbon according to the (IUPAC) system?

ما اسم الهيدروكربون التالي تبعًا لنظام (IUPAC)؟



6- methyl - 2 - ethyl - 3 - heptyne

6 - ميثيل - 2 - إيثيل - 3 - هبتاين

3, 7 - dimethyl - 4 - octene

3 ، 7 - ثنائي ميثيل - 4 - أوكتين

2 - ethyl - 6 - methyl - 3 - heptene

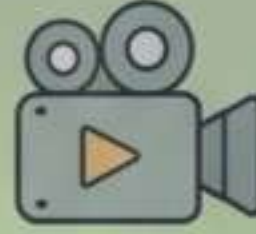
2 - إيثيل - 6 - ميثيل - 3 - هبتين

3, 7 - dimethyl - 4 - octyne

3 ، 7 - ثنائي ميثيل - 4 - أوكتاين

بطاقة الكيمياء صف 12 متقدم

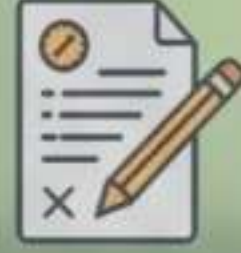
شرح أ. طارق محمد



فيديوهات



ملخصات شرح



أوراق عمل



اختبارات

مراجعة تفصيلية شاملة للهيكـل



جاهز للنجاح وإطلاق إبداعاتك



للاشتراك واتساب الدعم الفني
للكاديمية: 0569174493





Alkynes

- Alkynes are unsaturated hydrocarbons that contain one or more **triple** bonds between carbon atoms in a chain.
- The simplest and most used alkyne is ethyne (C_2H_2), which is widely known by its common name acetylene.



Models of ethyne (acetylene)

Figure 15 These three molecular models represent ethyne.

Naming alkynes:

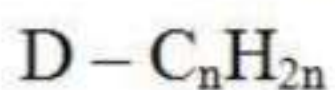
- Straight-chain alkynes and branched-chain alkynes are named in the same way as alkenes.
- The only difference is that the name of the parent chain ends in -yne rather than -ene.
- Alkynes with one triple covalent bond form a homologous series with the general formula C_nH_{2n-2} .

Table 6 Examples of Alkynes

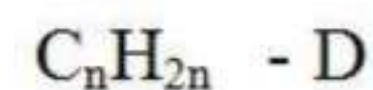
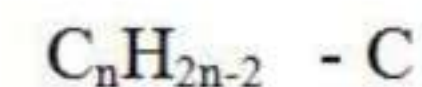
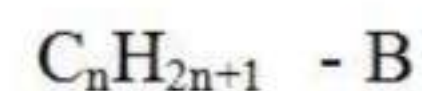
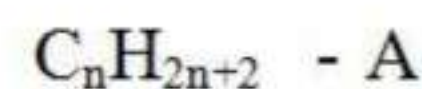
Name	Molecular Formula	Structural Formula	Condensed Structural Formula
Ethyne	C_2H_2	$H-C \equiv C-H$	$CH \equiv CH$
Propyne	C_3H_4	$ \begin{array}{c} H \\ \\ H-C \equiv C-C-H \\ \\ H \end{array} $	$CH \equiv CCH_3$
1-Butyne	C_4H_6	$ \begin{array}{c} H \quad H \\ \quad \\ H-C \equiv C-C-C-H \\ \quad \\ H \quad H \end{array} $	$CH \equiv CCH_2CH_3$
2-Butyne	C_4H_6	$ \begin{array}{c} H \quad \quad H \\ \quad \quad \\ H-C-C \equiv C-C-H \\ \quad \quad \\ H \quad \quad H \end{array} $	$CH_3C \equiv CCH_3$

Final Exam Questions

What is the general formula of **alkynes**?



ما هي الصيغة العامة للألكينات؟





What is the correct structural formula for the following compound?

4-ethyl-5-methyl-2-hexyne

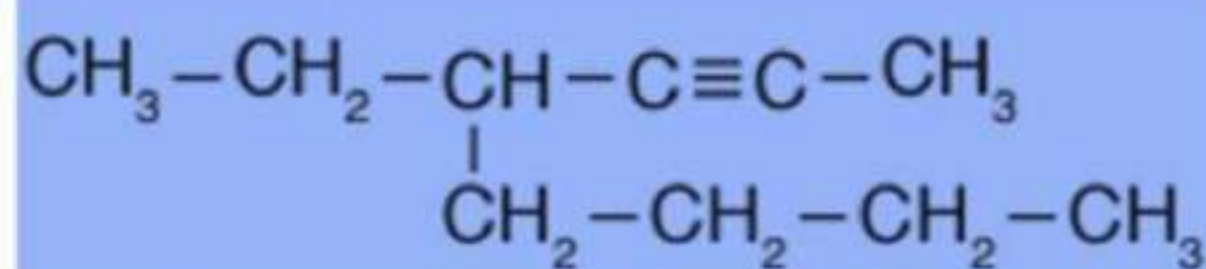
ما الصيغة البنائية الصحيحة للمركب التالي؟

4-إيثيل-5-ميثيل-2-هكساين

A	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{C}\equiv\text{CCHCHCH}_3 \\ \\ \text{CH}_3 \end{array}$	C	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{C}\equiv\text{CCHCHCH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$
B	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{CHCHCH}_2\text{C} \\ \quad \quad \quad \\ \text{CH}_3 \quad \quad \quad \text{CH} \end{array}$	D	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{CHC}\equiv\text{CCH} \\ \quad \quad \quad \\ \text{CH}_3 \quad \quad \quad \text{CH}_3 \end{array}$

Using IUPAC rules, what is the **correct** name of the following structure?

مستخدمًا قواعد IUPAC، ما الاسم الصحيح للصيغة البنائية التالية؟



4-ethyl-2-octyne

4-إيثيل-2-أوكتاين

5-ethyl-6-octyne

5-إيثيل-6-أوكتاين

4-butyl-2-hexyne

4-بيوتيل-2-هكساين

3-butyl-4-hexyne

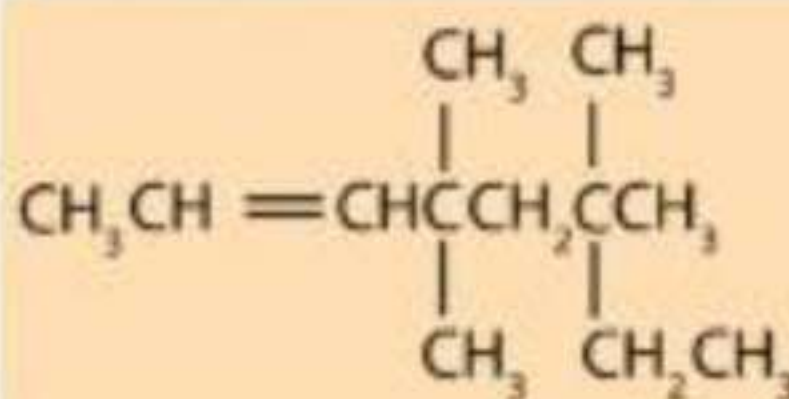
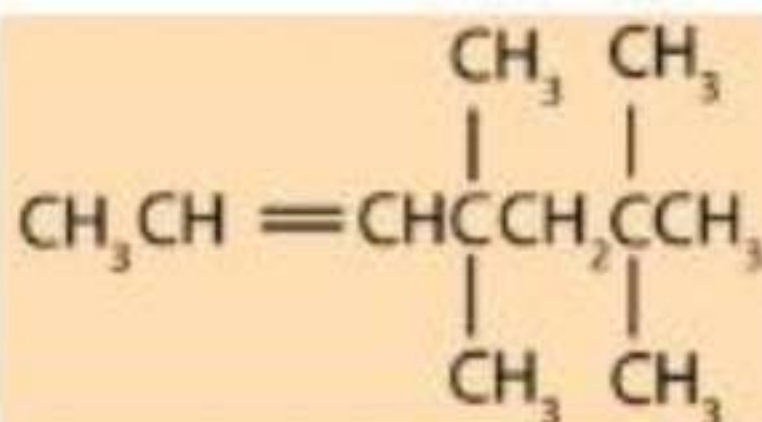
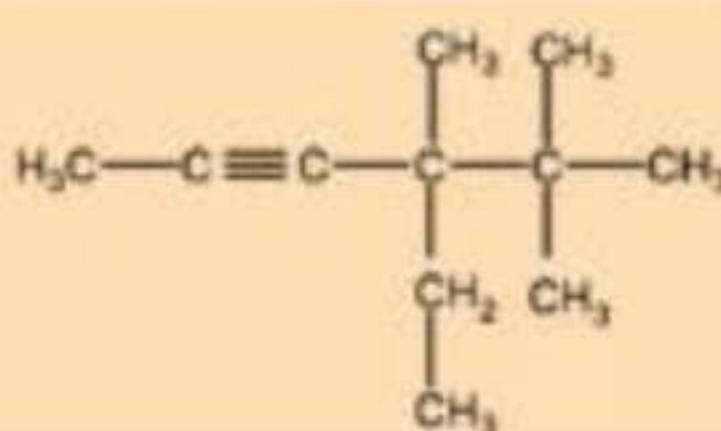
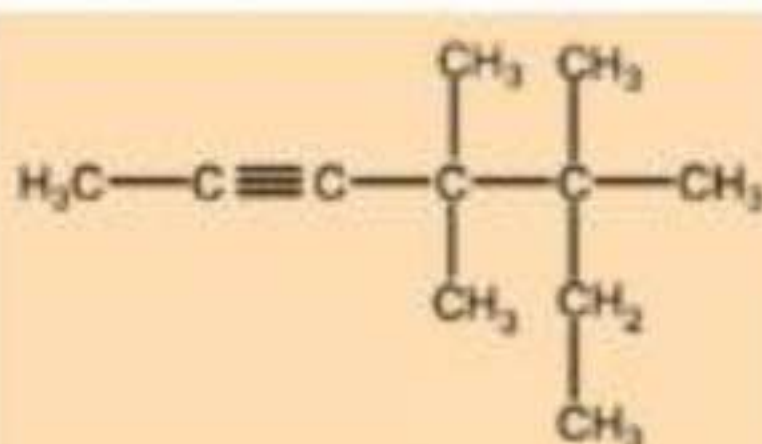
3-بيوتيل-4-هكساين



What is the correct structural formula for the compound:

ما الصيغة البنائية الصحيحة للمركب:
4 - إيثيل - 4 ، 5 ، 5 - ثلاثي ميثيل - 2 - هكسين؟

4-ethyl-4,5,5-trimethyl-2-hexyne?



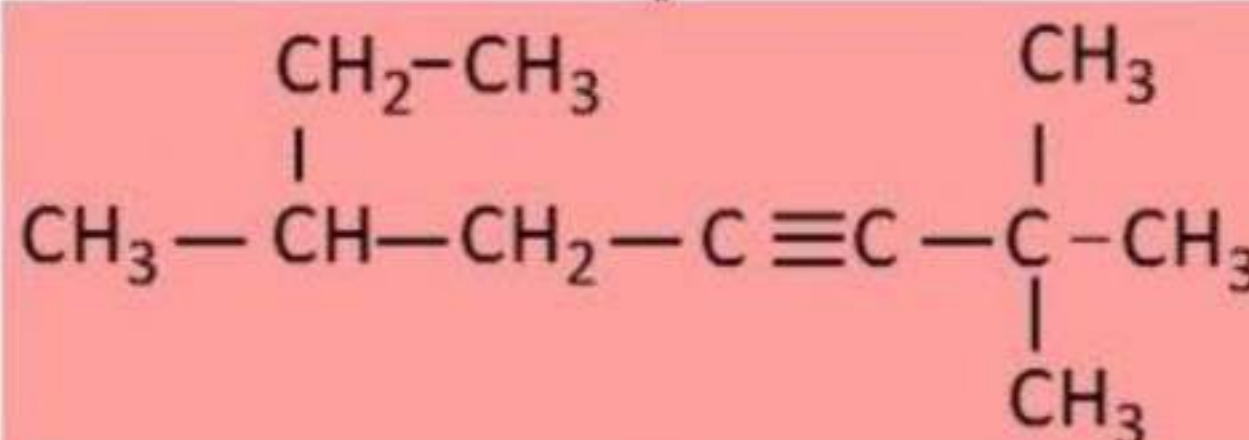
What is the name the compound with the following structural formula using **IUPAC** rules?

- A - 6-ethyl-2,2-dimethyl-3-heptyne
B - 2,2,6-trimethyl-3-octyne
C - 3,7,7-trimethyl-5-octyne
D - 2-ethyl-6,6-dimethyl-4-heptyne

ما اسم المركب ذو الصيغة البنائية التالية باستخدام

قواعد **IUPAC**؟

- A - 6-إيثيل - 2 ، 2 - ثنائي ميثيل - 3 - هبتاين
B - 6 ، 2 ، 2 - ثلاثي ميثيل - 3 - أوكتاين
C - 7 ، 7 ، 3 - ثلاثي ميثيل - 5 - أوكتاين
D - 2 - إيثيل - 6 ، 6 - ثنائي ميثيل - 4 - هبتاين





What is the correct structural formula of the compound (5-methyl-2-hexyne)?

ما الصيغة البنائية الصحيحة للمركب (5 - ميثيل - 2 - هكساين) ؟

Structural Formula	الصيغة البنائية	الرمز Symbol
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} \equiv \text{C} - \text{CH} - \text{CH}_2 - \text{CH}_3 \end{array}$		A
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array}$		B
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{CH} - \text{CH} - \text{CH}_2 - \text{CH}_3 \end{array}$		C
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH} - \text{CH}_3 \end{array}$		D

What is the correct structural formula of the compound (4-methyl-2-hexene)?

ما الصيغة البنائية الصحيحة للمركب (4 - ميثيل - 2 - هكسين) ؟

Structural Formula	الصيغة البنائية	الرمز Symbol
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} \equiv \text{C} - \text{CH} - \text{CH}_2 - \text{CH}_3 \end{array}$		A
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array}$		B
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{CH} - \text{CH} - \text{CH}_2 - \text{CH}_3 \end{array}$		C
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH} - \text{CH}_3 \end{array}$		D



Isomers

Isomers are two or more compounds that have the same molecular formula but different molecular structures.

Question: cyclopentane and pentane are not isomers. Why?

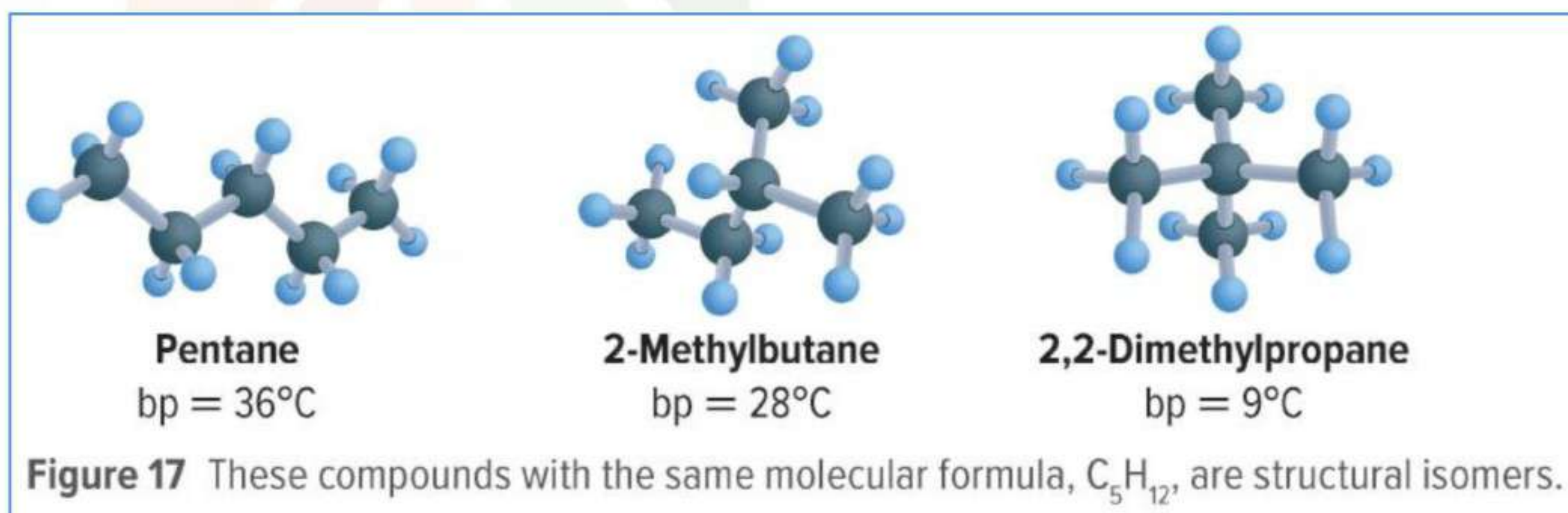
There are two main classes of isomers, **structural isomers** and **stereoisomers**

1) Structural isomers

Structural isomers have the same chemical formula, but their atoms are bonded in different arrangements.

Structural isomers have different chemical and physical properties despite having the same formula.

As the number of carbons in a hydrocarbon increases, the number of possible structural isomers increases.



Question: How does the trend in boiling points of isomers relate to their molecular structures?

Question: Draw some structural isomers of the hydrocarbon with the formula C_7H_{16}



Final Exam Questions

Three of the structural formulas shown in the table below are structural isomers to each other. Which formula does not represent a structural isomer for the other compounds?

ثلاثة من الصيغ البنائية الواردة في الجدول أدناه هي أيزومرات بنائية لبعضها البعض ، ما الصيغة التي لا تمثل أيزومرًا بنائيًا للمركبات الأخرى؟

$\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3$	A
$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	B
$\begin{array}{c} \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	C
$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{CH}_3 - \text{CH} - \text{CH} - \text{CH}_2 \\ \\ \text{CH}_3 \end{array}$	D

Three of the structural formulas in the table below are structural isomers to each other. **Which formula does not represent a structural isomer for the other compounds?**

ثلاث من الصيغ البنائية الواردة في الجدول أدناه هي أيزومرات بنائية لبعضها البعض، ما الصيغة التي لا تمثل أيزومرًا بنائيًا للمركبات الأخرى؟

- A – Formula 1
B - Formula 2
C – Formula 3
D - Formula 4

- A – الصيغة 1
B - الصيغة 2
C - الصيغة 3
D – الصيغة 4

$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	3	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CCH}_3 \\ \\ \text{CH}_3 \end{array}$	1
$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	4	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	2

Which of the following is **NOT** a structural isomer of other three compounds?

أي مما يلي **ليس** أيزومر بنائي للمركبات الثلاثة الأخرى؟

2,3-Dimethylbutane 3,2-ثنائي ميثيل بيوتان	2-methylbutane 2-ميثيل بيوتان	2,2-Dimethylpropane 2,2-ثنائي ميثيل البروبان	Pentane بنتان
A	B	C	D



Which of the following formulas **does not** represent
a structural isomer of the compound:

أي من الصيغ التالية **لا** تمثل أيزومراً بنائياً للمركب:

3 - إيثيل - 2 - ميثيل هكسان؟

3- Ethyl-2-methyl hexane?

A	$ \begin{array}{c} \text{CH}_3 \quad \text{CH}_2\text{CH}_3 \\ \quad \\ \text{CH}_3\text{CHCH}_2\text{CHCH}_2\text{CH}_3 \end{array} $	B	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_2 \\ \\ \text{CH}_3\text{CH}_2\text{CCH}_2\text{CH}_3 \\ \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array} $
C	$ \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{CH}_3\text{CH}_2\text{CHCH}_2\text{CCH}_3 \\ \\ \text{CH}_3 \end{array} $	D	$ \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{CH}_3\text{CH}_2\text{CCH}_2\text{CHCH}_3 \\ \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array} $

Which of the following compounds is **not** a structural
isomer of the other three compounds?

أي المركبات التالية **ليس** أيزومراً بنائياً للمركبات الثلاثة الأخرى؟

$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	1
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CHCHCH}_2\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	2
$ \begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{CHCH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array} $	3
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CHCHCH}_2\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array} $	4



Stereoisomers are isomers in which all atoms are bonded in the same order but are arranged differently in space.

Geometric isomers: Isomers resulting from different arrangements of groups around a double bond.

■ **Figure 18** The single-bonded carbons in ethane are free to rotate around the bond. The double-bonded carbons in ethene resist being rotated.

Explain How do you think this difference in ability to rotate would affect atoms or groups of atoms bonded to single-bonded and double-bonded carbon atoms?

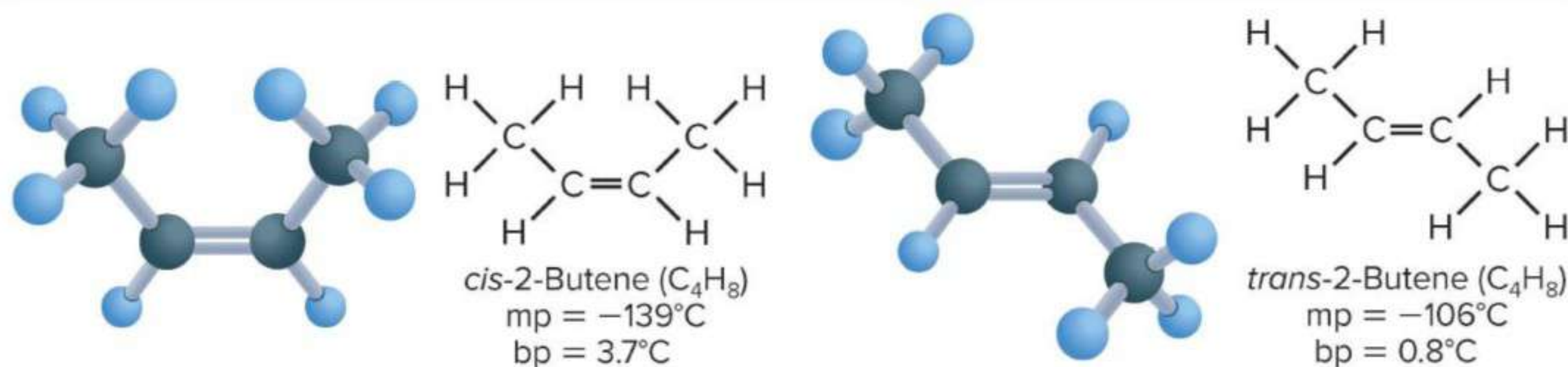
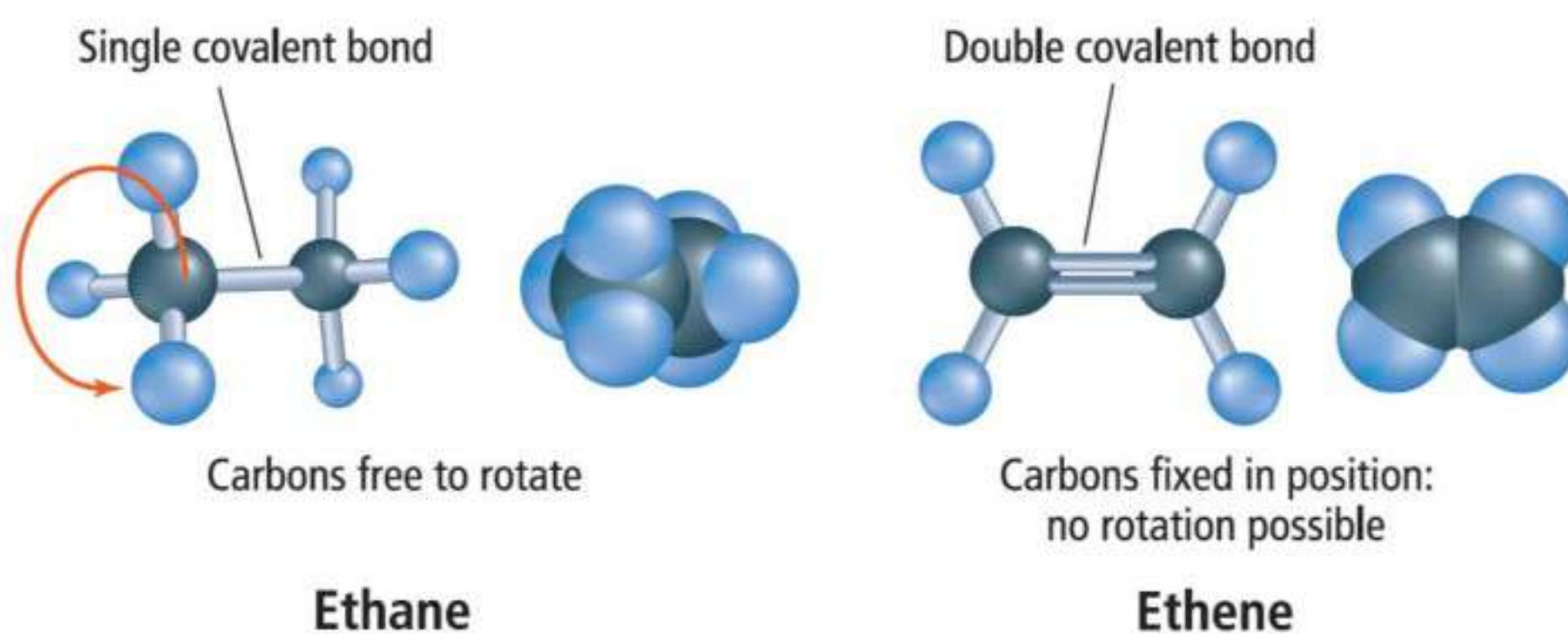


Figure 19 These isomers of 2-butene differ in the arrangement in the space of the two methyl groups at the ends. The double-bonded carbon atoms cannot rotate with respect to each other, so the methyl groups are fixed in one of these two arrangements.

- The arrangement in which the two methyl groups are on the **same side** of the molecule, we use the prefix **cis**-.
- The arrangement in which the two methyl groups are on **opposite sides** of the molecule, we use the prefix **trans**-.

Question: the cis- form cannot easily change into the trans- form. Why?

A compound can form geometric isomers only if each carbon atom around the double bond bonds with different atoms or groups.

Question : Draw the structures of cis-3-hexene and trans-3-hexene.

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Final Exam Questions

Identify the pair of geometric isomers among the following structures. **Explain your selection**

- A - " 1 " , " 2 " because of the different arrangements of the alkyl groups around the double bond
- B - " 3 " , " 4 " because of the different arrangements of the same alkyl groups around the double bond
- C - " 1 " , " 3 " because of the ability of the double-bonded carbon atoms to rotate
- D - " 2 " , " 4 " because of the difference in the structural formulas of the two compounds

$\begin{array}{c} \text{CH}_3 \quad \text{CH}_2\text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3\text{CH}_2 \quad \text{CH}_3 \end{array}$	3	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3 \quad \text{CH}_2\text{CH}_2\text{CH}_3 \end{array}$	1
$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3\text{CH}_2 \quad \text{CH}_2\text{CH}_3 \end{array}$	4	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_2\text{CH}_2\text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3\text{CH}_2 \quad \text{CH}_2\text{CH}_3 \end{array}$	2

حدد زوج الايزومرات الهندسية من بين مجموعة

الصيغ البنائية التالية ، **فسر اختيارك**

- A - " 1 " و " 2 " بسبب الترتيبات المختلفة لمجموعات الألكيل حول الرابطة الثنائية
- B - " 3 " و " 4 " بسبب الترتيبات المختلفة لنفس مجموعات الألكيل حول الرابطة الثنائية
- C - " 1 " و " 3 " بسبب قدرة ذرات الكربون حول الرابطة الثنائية على الدوران
- D - " 2 " و " 4 " بسبب اختلاف الصيغ البنائية للمركبين

According to the compounds in the table below.

Which of the following opinions is correct?

- A - Compound 1 can form geometric isomers because each carbon atom bonds with different atoms
- B - Compound 2 can form geometric isomers because it has a double bond
- C - Compound 3 can form geometric isomers because it has a double bond and each carbon atom around it bonds with different atoms and groups
- D - The three compounds cannot form geometric isomers

فيما يتعلق بالمركبات الواردة في الجدول أدناه . **أي**

الآراء التالية صحيحة؟

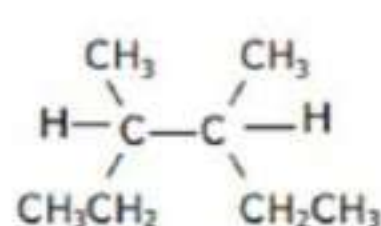
- A - يستطيع المركب 1 تكوين أيزومرات هندسية بسبب ارتباط كل ذرة كربون بذرات مختلفة
- B - يستطيع المركب 2 تكوين أيزومرات هندسية بسبب وجود الرابطة الثنائية
- C - يستطيع المركب 3 تكوين أيزومرات هندسية بسبب وجود الرابطة الثنائية وارتباط كل من ذرتي الكربون حولها بذرات ومجموعات مختلفة
- D - المركبات الثلاثة لا تستطيع تكوين أيزومرات هندسية

3	2	1
$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CH}_2\text{CHCH} = \text{CHCH}_2\text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_2 = \text{C} - \text{CH}_2 - \text{CH}_3 \end{array}$	$\begin{array}{c} \text{H} \quad \text{Br} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{Br} \quad \text{H} \end{array}$

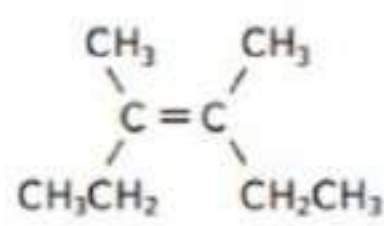


Which of the following is a pair of geometrical isomers?

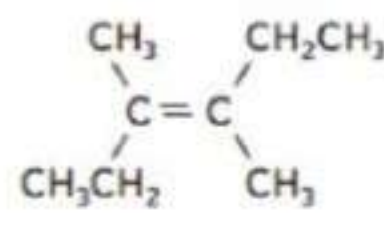
أي مما يلي زوج من الأيزومرات الهندسية؟



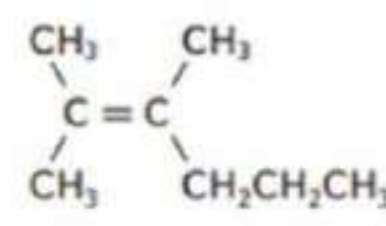
D



C



B



A

B and C

C و B

A and D

D و A

C and A

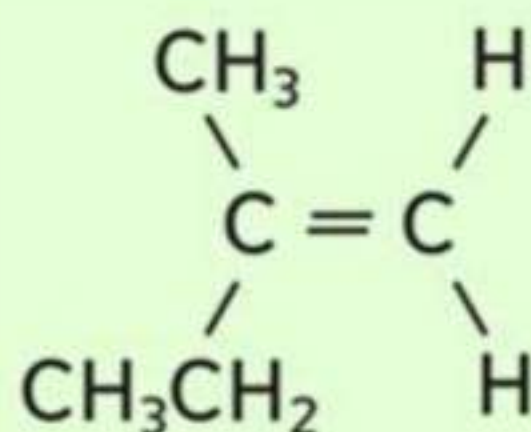
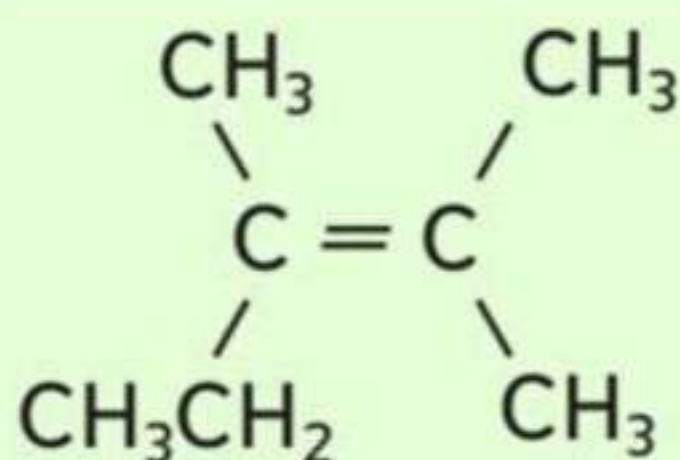
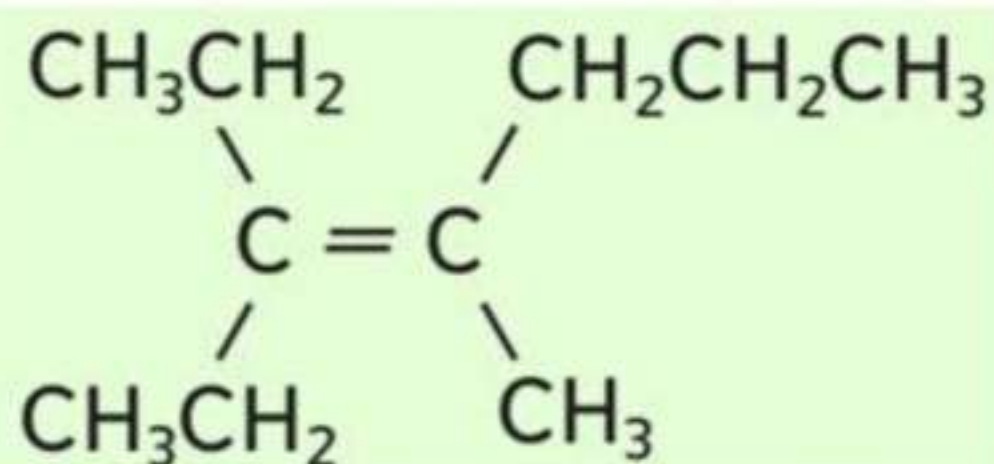
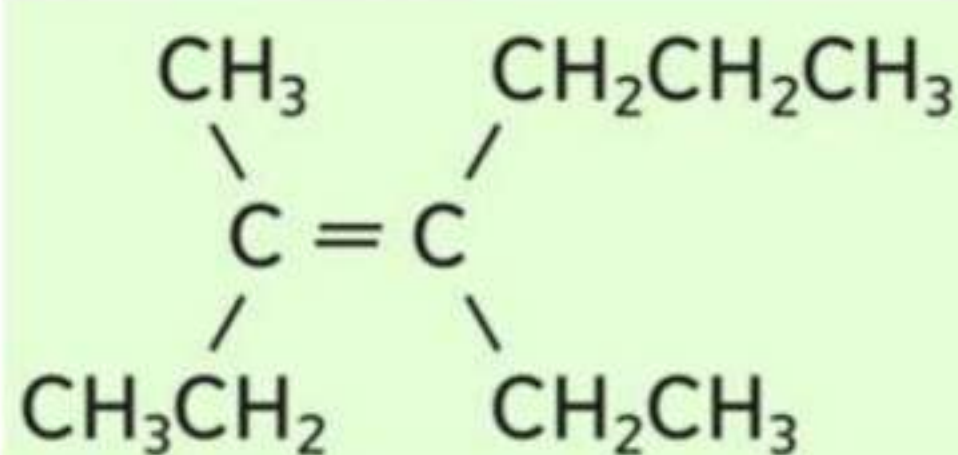
A و C

B and D

D و B

Which of the following compounds can form geometric isomers?

أي المركبات التالية يمكن أن يكون أيزومرات هندسية؟





Which of the hydrocarbons below forms geometric isomers?

أي من الهيدروكربونات أدناه يُكوّن أيزومرات هندسية؟

$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$	1
$\text{CH}_3\text{CH}=\text{CHCH}_3$	2
$\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$	3
$\begin{array}{c} \text{CH}_3\text{C}=\text{CHCH}_2\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	4

I, II only	I و II فقط
II only	II فقط
I only	I فقط
II, III only	II و III فقط

Regarding the two compounds in the table below.

فيما يتعلق بالمركبين في الجدول أدناه. أي مما يأتي صحيح؟

Which of the following is true?

$\begin{array}{c} \text{Cl} \quad \text{Cl} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{Cl} \quad \text{Cl} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array}$
2	1

Rotation is possible in both compounds **1, 2** and they cannot form geometric isomers

الدوران ممكن في كل من المركبين **1 و 2** وكلاهما لا يستطيع تكوين أيزومرات هندسية

Rotation is possible in compound **1** and it cannot form geometric isomers

الدوران ممكن في المركب **1** ولا يستطيع تكوين أيزومرات هندسية

Rotation is impossible in both compounds **1, 2** and they can form geometric isomers

الدوران غير ممكن في كل من المركبين **1 و 2** ويستطيع كل منهما تكوين أيزومرات هندسية

Rotation is possible in compound **2** and it cannot form geometric isomers

الدوران ممكن في المركب **2** ولا يستطيع تكوين أيزومرات هندسية

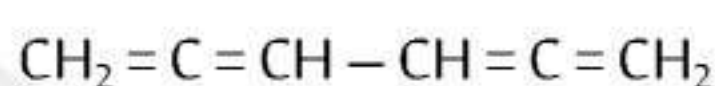




19	CHM.5.6.01.003.26 Describe the structure of benzene and its reactivity	Textbook + figure25	87,88
20	CHM.5.6.01.009.04 Distinguish among aliphatic and aromatic hydrocarbons	Textbook	88

The Structure of Benzene

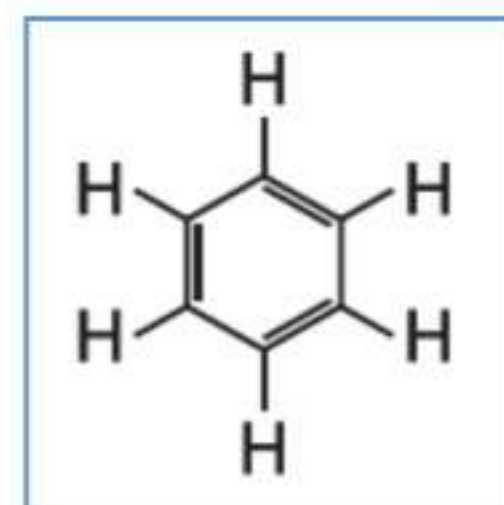
- Benzene's molecular formula is C_6H_6 . It's **unreactive**.
- Because the benzene molecule had so few hydrogen atoms, chemists reasoned that it must be unsaturated; that is, it must have several double or triple bonds, or a combination of both. They proposed many different structures, including this one.



- Such a structure would be unstable and extremely reactive because
- However, benzene was **unreactive**, and it did not react in the ways that alkenes and alkynes usually react.
- For that reason, chemists reasoned that structures such as the one shown above must be incorrect.

Kekulé's dream:

- Benzene's structure is a hexagon of carbon atoms with alternating single and double bonds.
- The flat, hexagonal structure Kekulé proposed explained some of the properties of benzene, but it did not explain the lack of reactivity.



Kekulé's structure should be reactive because

A modern model of benzene:

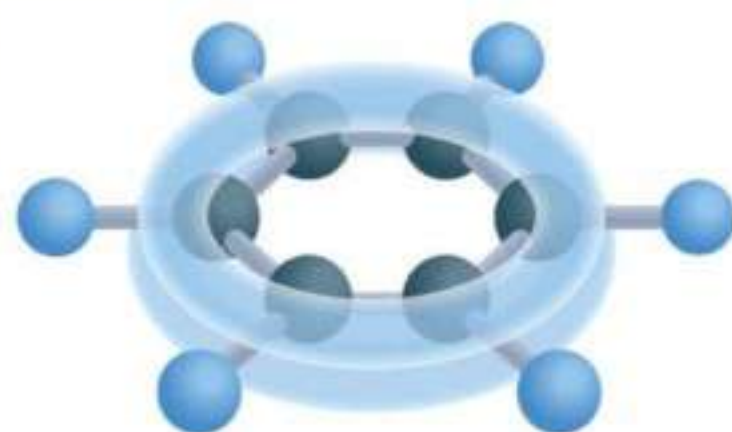


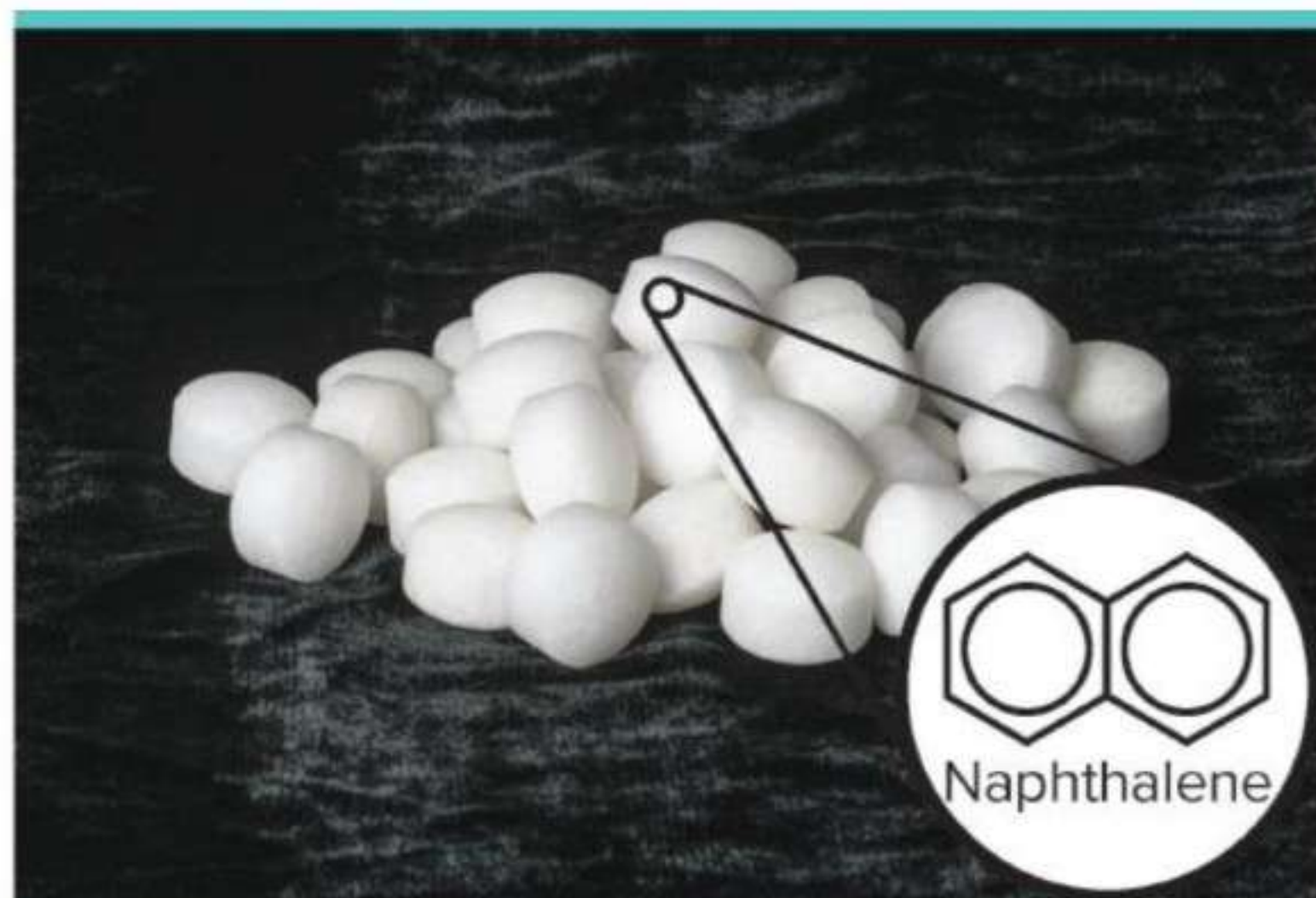
Figure 25 Benzene's bonding electrons spread evenly in a double-donut shape around the ring instead of remaining near individual atoms.

- Benzene's **unreactivity** could not be explained until the theory of hybrid orbitals.
- When applied to benzene, this theory predicts that the **pairs of electrons** that form the second bond of each of benzene's double bonds are **not localized** between only two specific carbon atoms as they are in alkenes.
- Instead, the electron pairs are **delocalized**, which means they are **shared among all six carbons in the ring**.
- This delocalization makes the benzene molecule chemically **stable** because **electrons shared by six carbon nuclei are harder to pull away than electrons held by only two nuclei**.



Aromatic Compounds

- Organic compounds that contain benzene rings as part of their structures are called **aromatic compounds**. The term aromatic was used because of the **pleasant smell** found in spices, fruits, and other plant parts.
- Hydrocarbons such as the alkanes, alkenes, and alkynes are called **aliphatic compounds** to distinguish them from aromatic compounds. Early chemists obtained aliphatic compounds by heating animal fats.



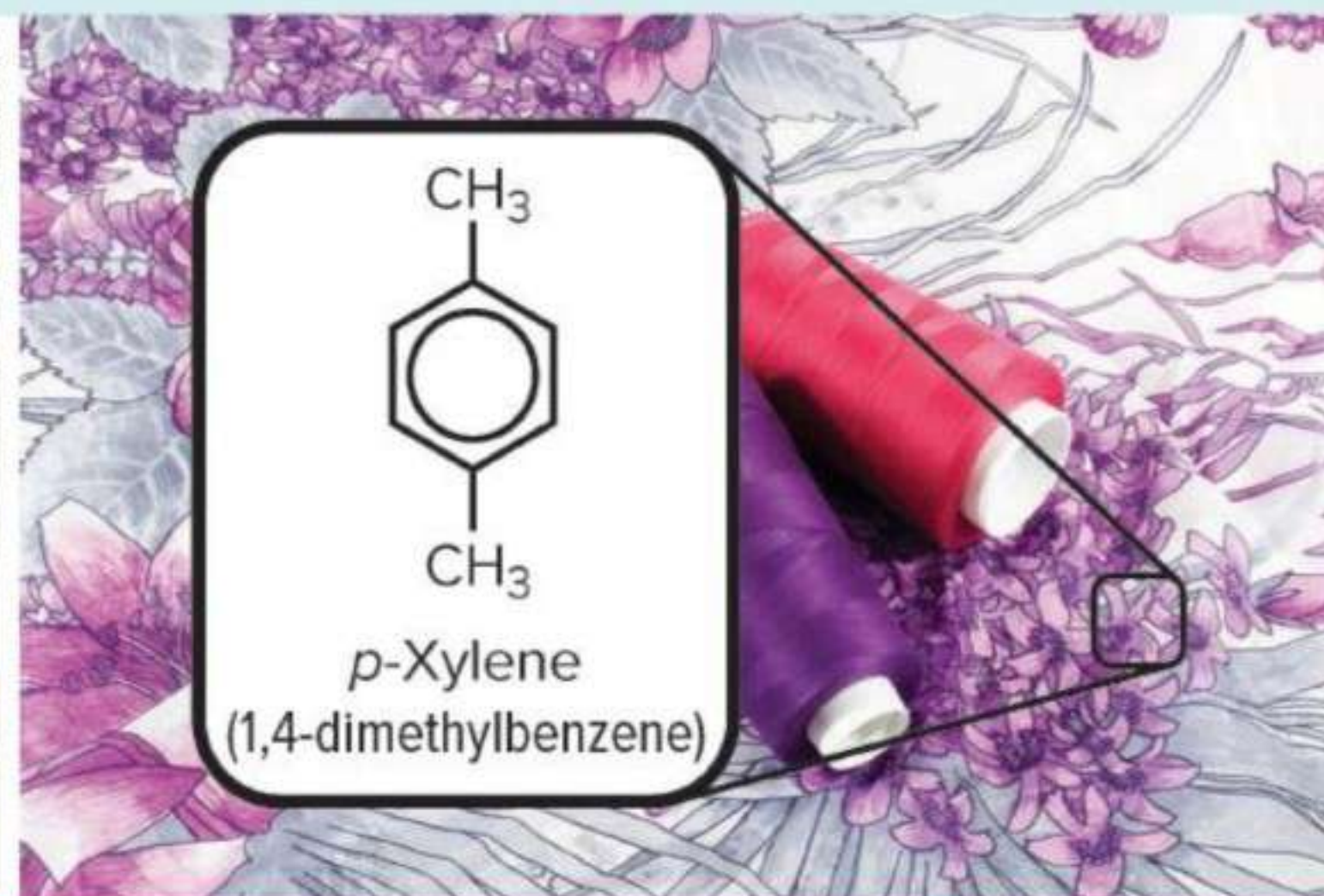
Naphthalene is used to make dyes and as a moth repellent.



Anthracene is used to produce dyes and pigments.



Phenanthrene is present in the atmosphere due to the incomplete combustion of hydrocarbons.



Xylene is used to make polyester fibers and fabrics.

Figure 26 Aromatic hydrocarbons are found in the environment due to the incomplete combustion of hydrocarbons and are used to make a variety of products.

Naphthalene is an example of a **fused ring system**, in which an organic compound has **two or more cyclic structures** with a common side.



Final Exam Questions

In relation to the compounds in the table below.

Which of the following statements is correct?

- A – The compounds **1** , **2** are aliphatic hydrocarbons with low reactivity
- B – The compounds **1** , **2** are aromatic hydrocarbons with low reactivity
- C –Compound **3** is a fairly unreactive aromatic hydrocarbon
- D – Compound **3** is an unstable and extremely reactive aromatic hydrocarbon

3	2	1
	$\text{H}-\text{C} \equiv \text{C}-\text{H}$	$\text{CH}_2=\text{CH}_2$

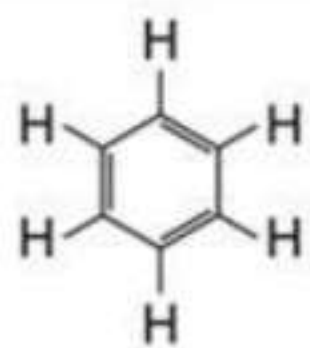
فيما يتعلق بالمركبات الواردة في الجدول أدناه.

أي العبارات التالية صحيحة؟

- A - المركبان **1** و **2** هيدروكربونات أليفاتية منخفضة النشاطية
- B - المركبان **1** و **2** هيدروكربونات أروماتية منخفضة النشاطية
- C - المركب **3** هيدروكربون أروماتي خامل إلى حد ما
- D - المركب **3** هيدروكربون أروماتي غير مستقر ومتفاعل لأقصى درجة

The proposed Benzene's molecular structure has been changed from (**1**) to (**2**) as shown in the figure below according to the theory of hybrid orbitals. **Which of the following is a property of Benzene?**

- A – Unstable and extremely reactive
- B – Stable because the electrons of the double bonds are shared among all six carbons in the ring
- C – More reactive than alkenes
- D –Active in general because the electron pairs of the double bonds are localized between only two specific carbon atoms

2	1
	

تغير شكل التركيب الجزيئي المقترح للبنزين من (**1**) إلى (**2**) كما يظهر بالشكل أدناه بناءً على نظرية الأفلاك المهجنة. **أي مما يأتي من خصائص البنزين؟**

- A - غير مستقر ومتفاعل لأقصى درجة
- B - مستقر لأن إلكترونات الروابط الثنائية مشتركة بين جميع ذرات الكربون الست في الحلقة
- C - أكثر تفاعلاً من الألكينات
- D - نشط عموماً لأن أزواج إلكترونات الرابطة الثنائية تقع بين ذرتي كربون محددتين فقط

Active



Scientists have proposed the structures below to express the benzene compound C_6H_6 . Which of the following is true?

اقترح العلماء التركيب أدناه للتعبير عن مركب البنزين C_6H_6 . أي مما يأتي صحيح؟

$CH_2 = C = CH - CH = C = CH_2$	1
	2

The formula **2** is correct because benzene is chemically stable

الصيغة **2** صحيحة لأن البنزين مستقر كيميائياً

The formula **1** is incorrect because benzene is unstable and extremely reactive

الصيغة **1** غير صحيحة لأن البنزين غير مستقر ومطاط لأكصى درجة

The formula **1** is correct because benzene is unstable and extremely reactive

الصيغة **1** صحيحة لأن البنزين غير مستقر ومطاط لأكصى درجة

The formula **2** is incorrect because benzene is chemically unstable

الصيغة **2** غير صحيحة لأن البنزين غير مستقر كيميائياً

Which of the following is **not** true regarding aromatic compounds?

أي مما يأتي **ليس** صحيحاً فيما يتعلق بالمركبات الأروماتية؟

Benzene is the simplest aromatic hydrocarbon

يُعتبر البنزين أبسط هيدروكربون أروماتي

Some of it take ring shape

بعضها تأخذ شكلاً حلقياً

Were found in pleasant-smelling oils that came from spices, fruits

تم العثور على العديد منها في الزيوت ذات الرائحة الجذابة التي تم استخلاصها من التوابل والفواكه

It may contain one or more benzene ring

يُمكن أن تتكون من حلقة بنزين واحدة أو أكثر



Functional Groups

Functional group is an atom or group of atoms that always reacts in a certain way.

The addition of a functional group to a hydrocarbon structure always produces a substance with physical and chemical properties that differ from those of the parent hydrocarbon.

Functional groups give substances their individual characteristics, such as smell.

Table 1 Organic Compounds and Their Functional Groups

Compound Type	General Formula	Functional Group
Halocarbon	$R-X$ ($X = F, Cl, Br, I$)	Halogen
Alcohol	$R-OH$	Hydroxyl
Ether	$R-O-R'$	Ether
Amine	$R-NH_2$	Amino
Aldehyde	$\begin{array}{c} O \\ \\ * - C - H \end{array}$	Carbonyl
Ketone	$\begin{array}{c} O \\ \\ R - C - R' \end{array}$	Carbonyl
Carboxylic acid	$\begin{array}{c} O \\ \\ * - C - OH \end{array}$	Carboxyl
Ester	$\begin{array}{c} O \\ \\ * - C - O - R \end{array}$	Ester
Amide	$\begin{array}{c} O \\ \\ * - C - N - * \\ \\ * \end{array}$	Amide

- The symbols R and R' represent carbon chains or rings bonded to the functional group.
- * represents a hydrogen atom, carbon chain, or carbon ring.
- Double and triple bonds between two carbon atoms are considered functional groups.
- By learning the properties associated with a given functional group, you can predict the properties of organic compounds.



Final Exam Questions

Which substituted hydrocarbons below agrees with its corresponding general formula in the following table? أي المشتقات الهيدروكربونية أدناه يتفق مع الصيغة العامة المقابلة له في الجدول التالي؟

الصيغة العامة General Formula	نوع المركب Compound Type	
$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{OH} \end{array}$	ألدهيد Aldehyde	1
$\text{R}-\text{O}-\text{R}'$	إيثر Ether	2
$\begin{array}{c} \text{O} \quad \text{H} \\ \parallel \quad \\ *-\text{C}-\text{N}-\text{R} \end{array}$	أميد Amide	3
$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{H} \end{array}$	حمض كربوكسيلي Carboxylic acid	4

1 and 2

2 و 1

2 and 3

3 و 2

3 and 4

4 و 3

1 and 4

4 و 1

Which of the following is **correct** regarding substituted hydrocarbons in the table below?

أي مما يأتي **صحيح** فيما يتعلق بمشتقات الهيدروكربونات في الجدول أدناه؟

الصيغة العامة General Formula	1	2	3	4
$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{OH} \end{array}$	ألدهيد Aldehyde	حمض كربوكسيلي Carboxylic acid	ألدهيد Aldehyde	ألدهيد Aldehyde
$\begin{array}{c} \text{O} \quad \text{H} \\ \parallel \quad \\ *-\text{C}-\text{N}-\text{R} \end{array}$	أميد Amide	ألدهيد Aldehyde	ألدهيد Aldehyde	ألدهيد Aldehyde
$\text{R}-\text{O}-\text{R}'$	إيثر Ether	ألدهيد Aldehyde	ألدهيد Aldehyde	ألدهيد Aldehyde
$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{H} \end{array}$	ألدهيد Aldehyde	ألدهيد Aldehyde	ألدهيد Aldehyde	ألدهيد Aldehyde



What is the functional group that **carboxylic acids** have?

ما المجموعة الوظيفية التي تحتوي عليها **الأحماض الكربوكسيلية**؟

D	C	B	A
- X	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{OH} \end{array}$	- OH	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{H} \end{array}$

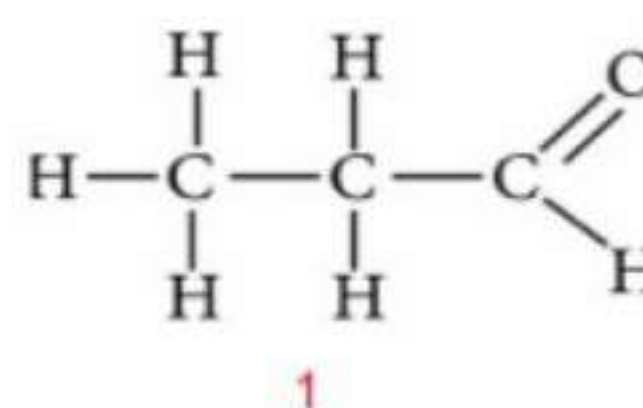
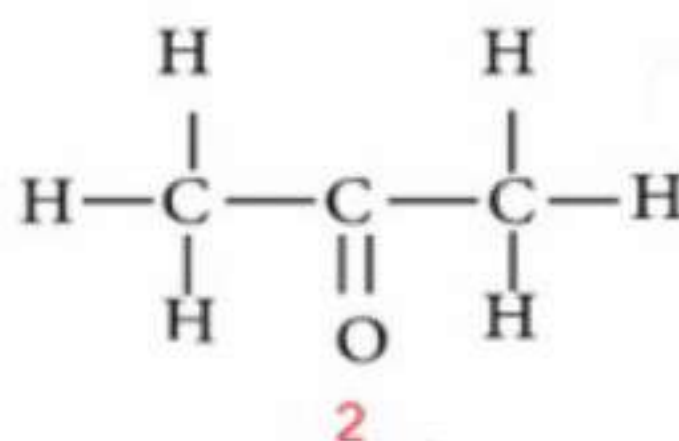
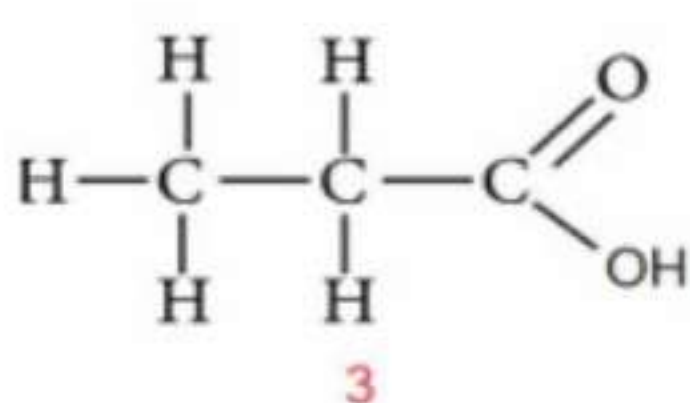
What is the functional group in **alcohols**?

ما المجموعة الوظيفية التي توجد في **الكحولات**؟

D	C	B	A
- X	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{OH} \end{array}$	- OH	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{H} \end{array}$

Which of the following statements is **incorrect** regarding the following three structural formulas?

أي العبارات التالية **غير صحيحة** فيما يتعلق بالصيغ البنائية الثلاث التالية؟



Formula **1** and Formula **2** contain a carbonyl group

الصيغة **1** والصيغة **2** تحتويان على مجموعة الكربونيل

The molecules of the three formulas (**1**, **2**, and **3**) are polar and reactive

جزيئات الصيغ الثلاث (**1**، **2**، و**3**) قطبية ونشطة

The compound with formula **3** has a sour, acidic taste

المركب ذو الصيغة **3** له طعم حمضي لاذع

Formula **1** molecules are less reactive than formula **2** molecules

جزيئات الصيغة **1** أقل نشاطاً من جزيئات الصيغة **2**



22	CHM.5.6.01.013.12 Write the IUPAC name of alkyl halides and aryl halides	Textbook + figures 3 , 4 + practice problems	100 , 101
23	CHM.5.6.01.013.13 Draw the structure if an alkyl halide/aryl halide given its name	Textbook + figure 4 + practice problems	101

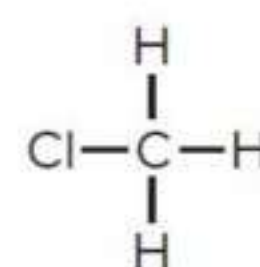
Organic Compounds Containing Halogens (Fluorine_F) (Chlorine_Cl) (Bromine_Br) (Iodine_I)

Any organic compound that contains a halogen substituent is called a **halocarbon**.

If you replace any of the hydrogen atoms in an alkane with a halogen atom, you form an alkyl halide.

An **alkyl halide** is an organic compound containing a halogen atom bonded to an aliphatic carbon atom.

An **aryl halide** is an organic compound containing a halogen atom bonded to a benzene ring or other aromatic group.



Chloromethane

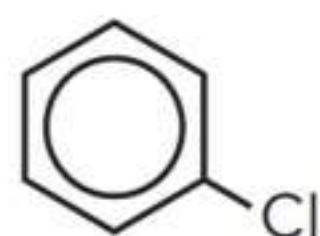
Figure 2 Chloromethane is an alkyl halide that is used in the manufacturing process for silicone products, such as window and door sealants.

Naming halocarbons

A prefix indicates which halogen is present. The prefixes are formed by changing the *-ine* at the end of each halogen name to *-o*. Thus, the prefix for fluorine is **fluoro-**, chlorine is **chloro-**, bromine is **bromo-**, and iodine is **iodo-**.

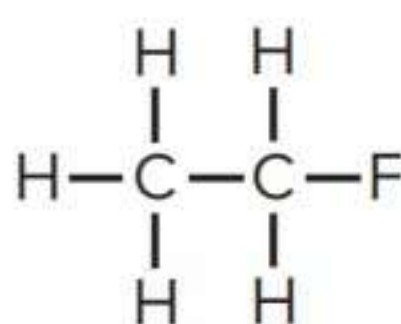
The chain is numbered to give the lowest number.

a

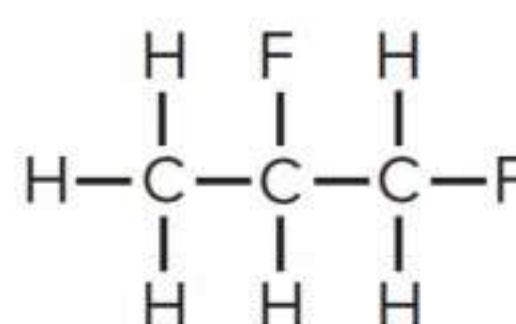


Chlorobenzene

b



Fluoroethane



1,2-Difluoropropane

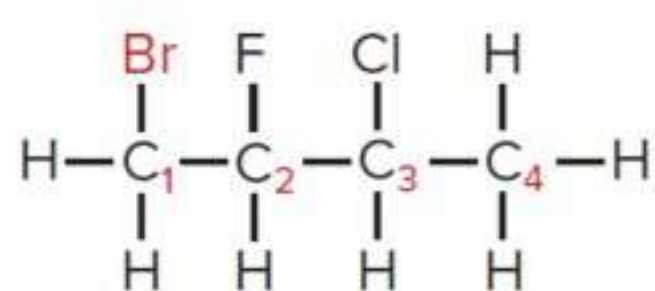
Figure 3 These organic molecules are halides, as indicated by the halogen atoms represented in these structures. The name of an organic halide includes a prefix based on the halogen's name.

If more than one kind of halogen atom is present in the same molecule, the atoms are listed alphabetically in the name.

Similarly, the benzene ring in an aryl halide is numbered to give each substituent the lowest position number possible.

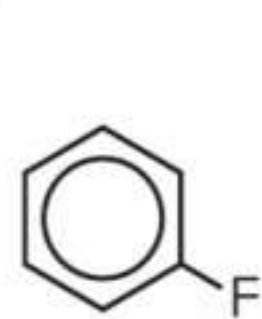
If numbering is identical in two directions, give the lowest position number to the substituent that will be first in the name.

a

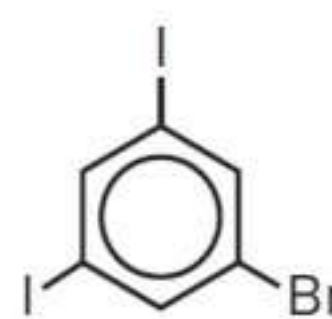


1-Bromo-3-chloro-2-fluorobutane

b



Fluorobenzene



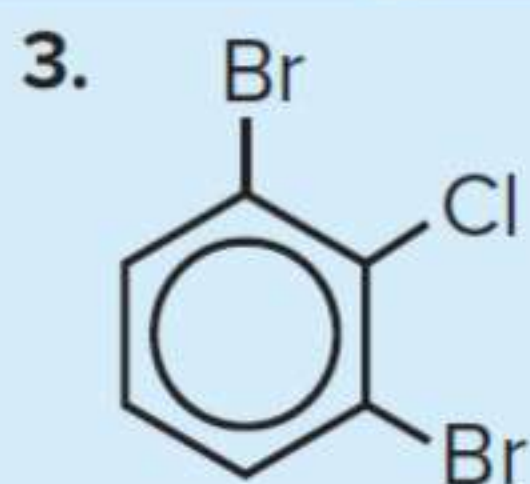
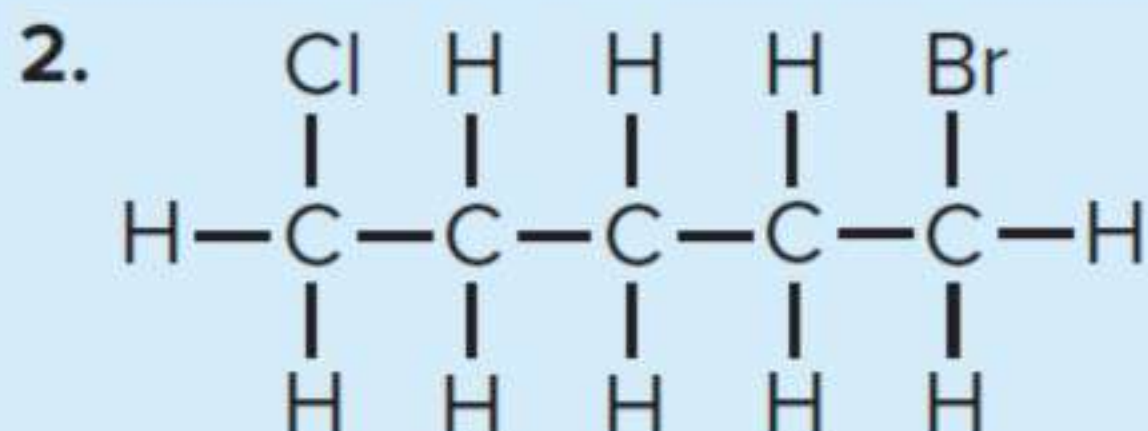
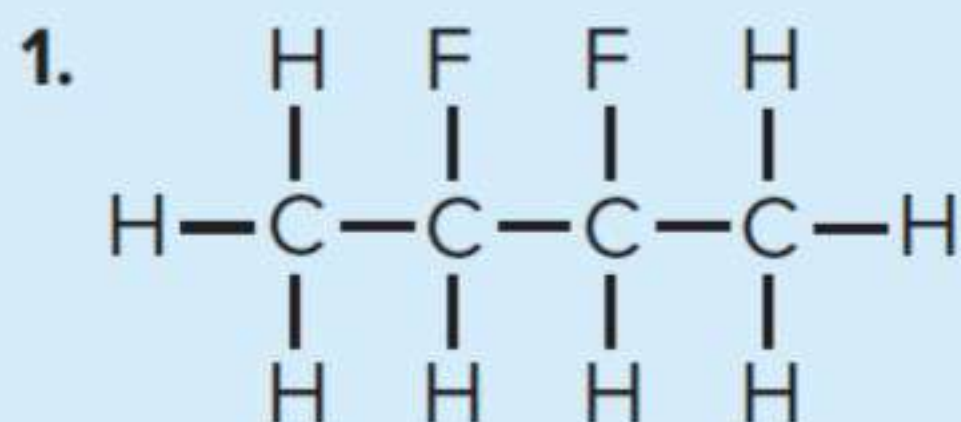
1-Bromo-3,5-diiodobenzene

Figure 4 Organic molecules containing functional groups are named based on their main-chain structure using IUPAC conventions.



Practice problems

Name the alkyl or aryl halide whose structure is shown.

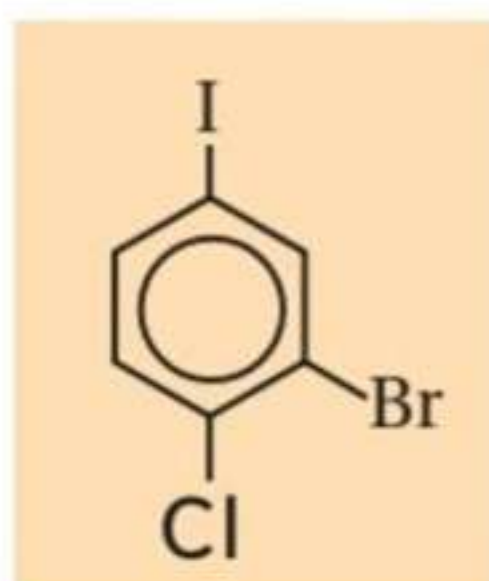


Final Exam Questions

What is the **correct** name of the compound

shown in the figure below?

(Using IUPAC rules)



ما الاسم **الصحيح** للمركب الموضح في الشكل أدناه

(مستخدمًا قواعد IUPAC)

1- Bromo-2 - chloro - 5 - iodobenzene

1- Chloro -2 - bromo - 4 - iodobenzene

2- Bromo -1 - chloro - 4 - iodobenzene

1- Iodo-3 - bromo - 4 - chloro benzene

1 - برومو - 2 - كلورو - 5 - يودوبنزين

1 - كلورو - 2 - برومو - 4 - يودوبنزين

2- برومو - 1 - كلورو - 4 - يودوبنزين

1 - يودو - 3 - برومو - 4 - كلوروبنزين

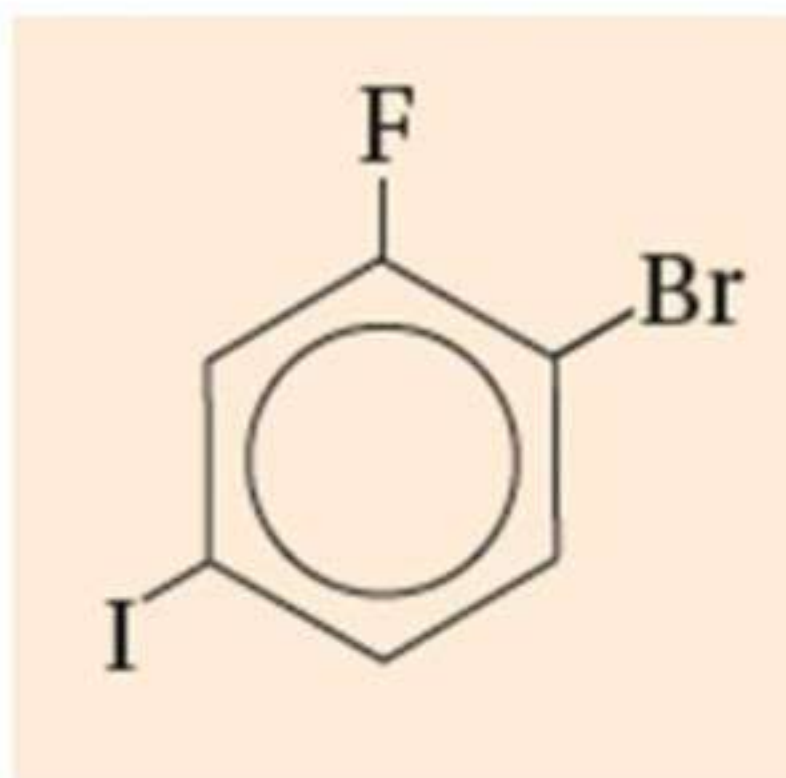


What is the correct name for the aryl halide in the figure below?

(Using IUPAC rules)

ما الاسم الصحيح لهاليد الأريل في الشكل أدناه؟

(مُستخدماً قواعد IUPAC)



1 - Iodo - 3 - fluoro - 4 - bromobenzene

1- يودو - 3 - فلورو - 4 - برومو بنزين

1 - Bromo - 2 - fluoro - 4 - iodobenzene

1 - برومو - 2 - فلورو - 4 - يودو بنزين

1 - Fluoro - 2 - bromo - 5 - iodobenzene

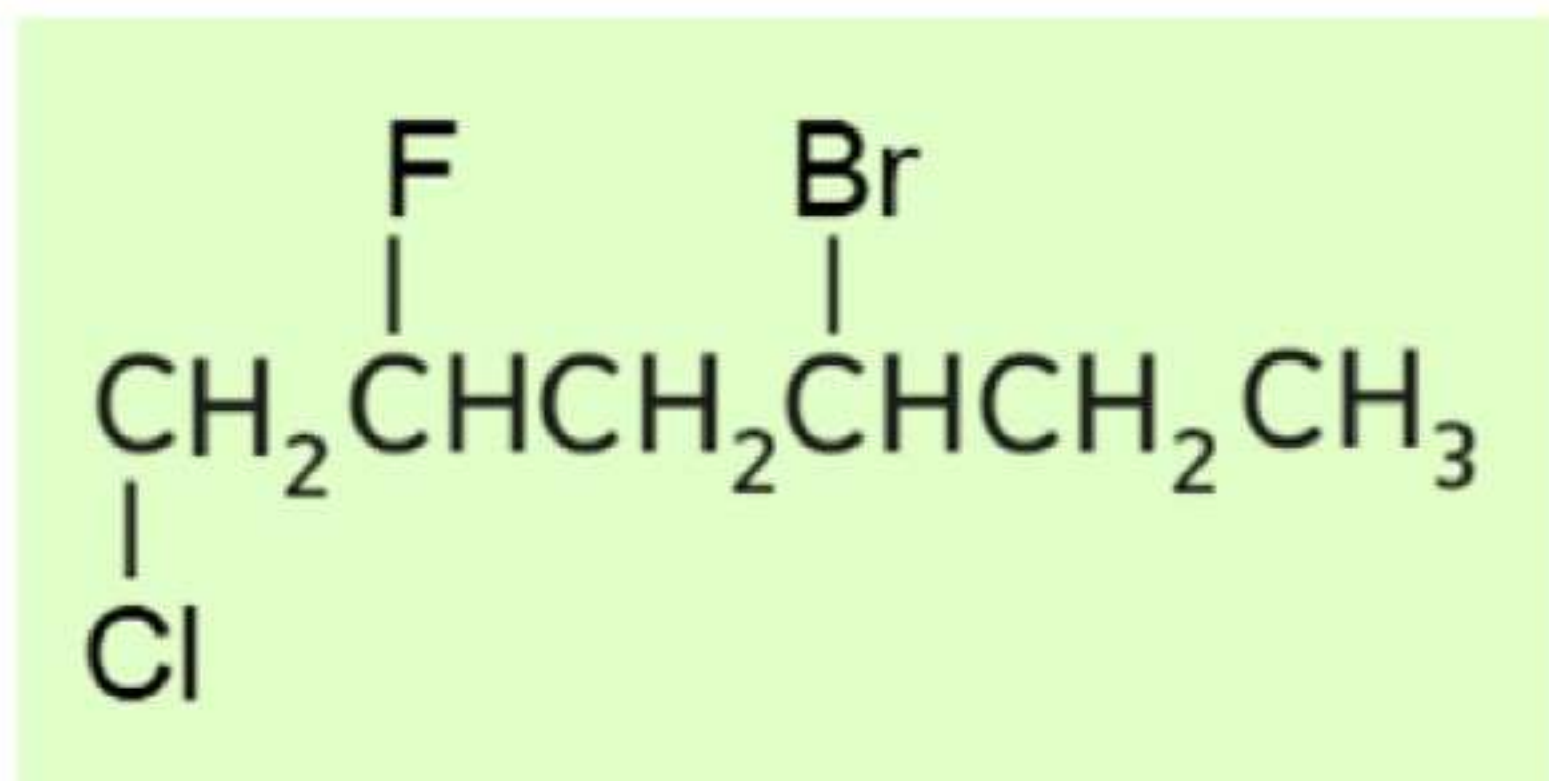
1 - فلورو - 2 - برومو - 5 - يودو بنزين

1 - Iodo - 4 - bromo - 5 - fluorobenzene

1 - يودو - 4 - برومو - 5 - فلورو بنزين

What is the name of the following compound according to the (IUPAC) system?

ما اسم المركب التالي تبعاً لنظام (IUPAC)؟



1 - chloro - 2 - Fluoro - 4 - bromo hexane

1- كلورو - 2 - فلورو - 4 - برومو هكسان

3 - bromo - 6 - chloro - 5 - Fluoro hexane

3 - برومو - 6 - كلورو - 5 - فلورو هكسان

6 - chloro - 3 - bromo - 5 - Fluoro hexane

6 - كلورو - 3 - برومو - 5 - فلورو هكسان

4 - bromo - 1 - chloro - 2 - Fluoro hexane

4 - برومو - 1 - كلورو - 2 - فلورو هكسان



Substitution Reactions:

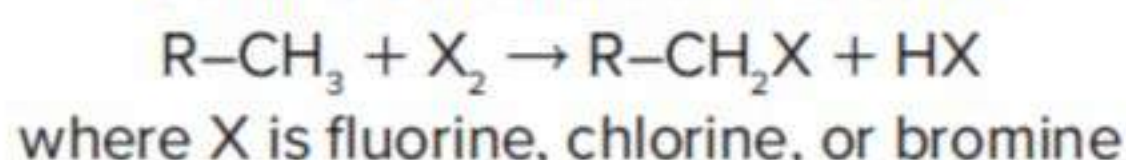
How to convert alkanes into different compounds? One way is to introduce a functional group through substitution.

A **substitution reaction** is one in which one atom or a group of atoms in a molecule is replaced by another atom or group of atoms.

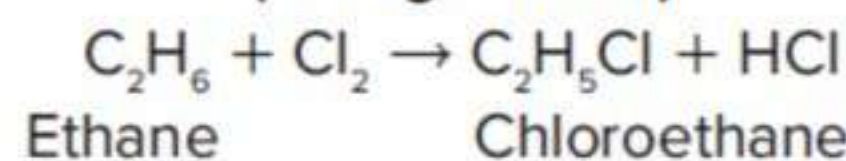
Halogenation

With alkanes, hydrogen atoms can be replaced by atoms of halogens, typically chlorine or bromine.

Generic Substitution Reaction



Example of General Substitution Reaction (Halogenation)



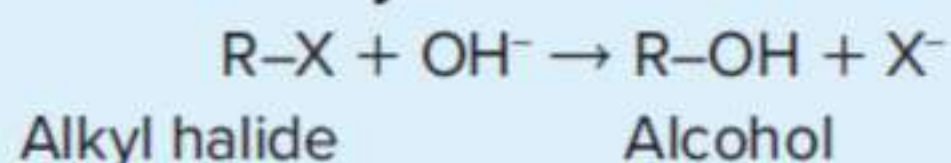
Another halogenated hydrocarbon commonly called halothane (2-bromo-2-chloro-1,1,1-trifluoroethane), which was first used as a general anesthetic.

Draw the structural formula of halothane

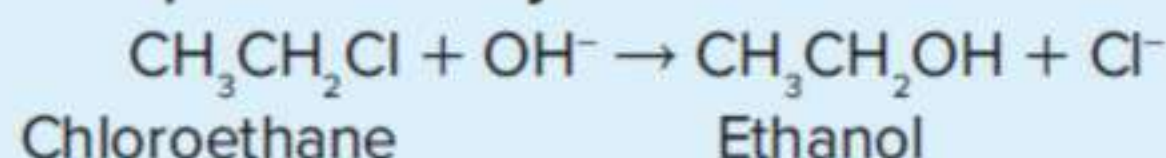
Reacting an alkyl halide with a basic solution

The replacement of the halogen atom by an $-OH$ group, forming an **alcohol**.

General Alkyl Halide-Alcohol Reaction



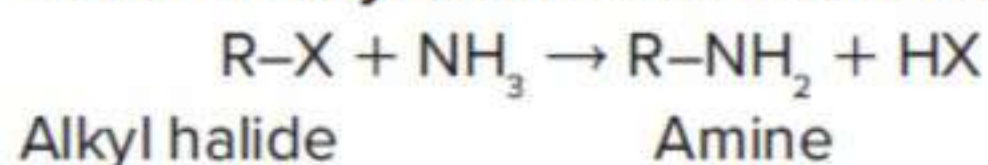
Example of an Alkyl Halide-Alcohol Reaction



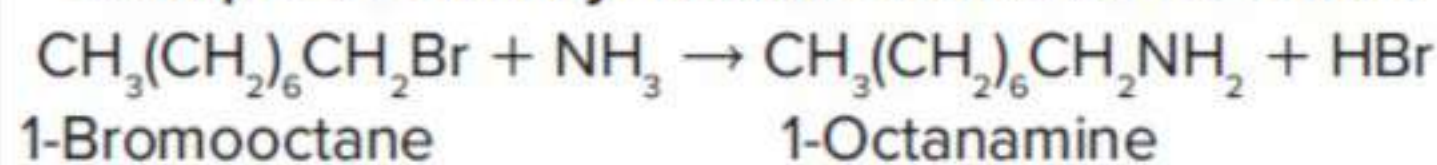
Reacting an alkyl halide with ammonia (NH_3)

The replacement of the halogen atom with an amino group ($-NH_2$), forming an **alkyl amine**

General Alkyl Halide-Ammonia Reaction



Example of an Alkyl Halide-Ammonia Reaction



What results from the reaction of an alkyl halide with a basic solution?

ماذا ينتج عن تفاعل هاليد الألكيل مع محلول قاعدي؟

Alkyl amine

ألكيل أمين

Carboxylic acid

حمض كربوكسيلي

Alcohol

كحول

Ester

إستر





Naming alcohols:

- Name the parent carbon chain or ring first and then change the **-e** at the end of the name to **-ol**.
- In alcohols of three or more carbon atoms, **a number is added to indicate the position**.

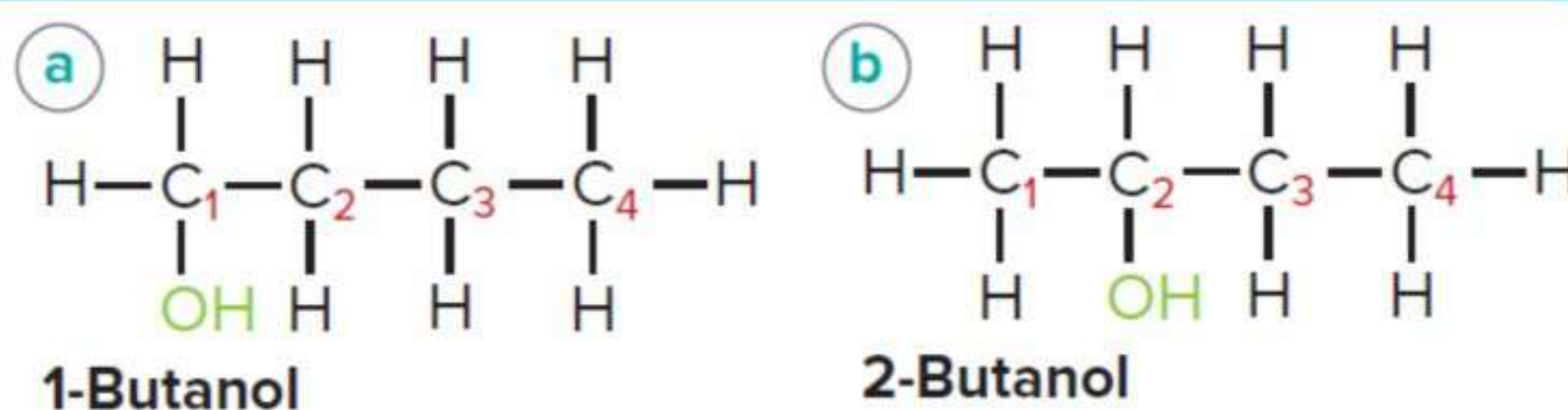


Figure 7 The names of alcohols are based on alkane names.

- If the parent hydrocarbon is **cyclohexane**. The alcohol is called **cyclohexanol**.
- Cyclohexanol** is a **poisonous** compound used as a **solvent for certain plastics** and in the manufacture of **insecticides**.
- A carbon chain can have **more than one hydroxyl group**. To name these compounds, prefixes such as **di-, tri-, and tetra-** are used **before the -ol** to indicate the number of hydroxyl groups present.
- The molecule 1,2,3-propanetriol, commonly called glycerol. It is an alcohol containing more than one hydroxyl group.
- Glycerol** is often used as an **antifreeze** and as an **airplane deicing fluid**.

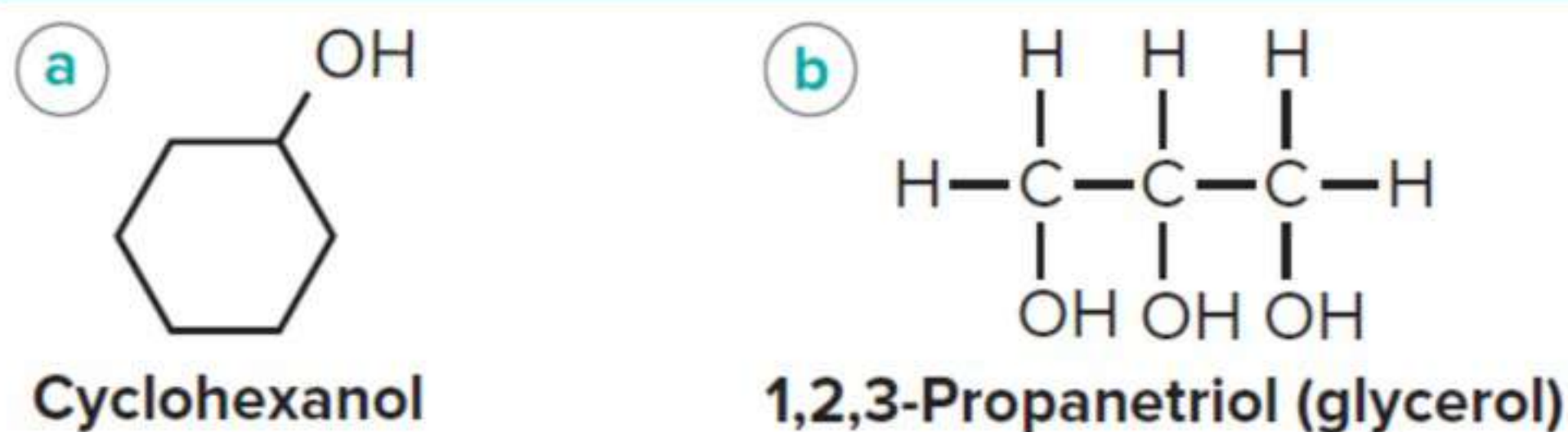


Figure 8 Alcohols can include one or more hydroxyl groups.

Draw the structure for each molecule.

1-propanol

1,3-cyclopentanediol



Draw structures for the following alcohols.

1,2-butanediol	
2-methyl-1-butanol	
cyclopentanol	

Regarding the compounds in the table below.

فيما يتعلق بالمركبات في الجدول أدناه.

Which of the following is **correct**?

أي مما يأتي **صحيح**؟

(Using IUPAC rules)

(مُستخدماً قواعد IUPAC)

1	2	3	4
$\text{CH}_3\text{CH}_2-\text{O}-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$			

Compound **1** is called ethyl butyl ether

المركب **1** يُسمى إيثيل بيوتيل إيثر

Compound **2** is called cyclopentanol

المركب **2** يُسمى بنتانول حلقي

Compound **3** is called 1,2,3 -Propanetriol

المركب **3** يُسمى 1 و 2 و 3 -بروبان تريول

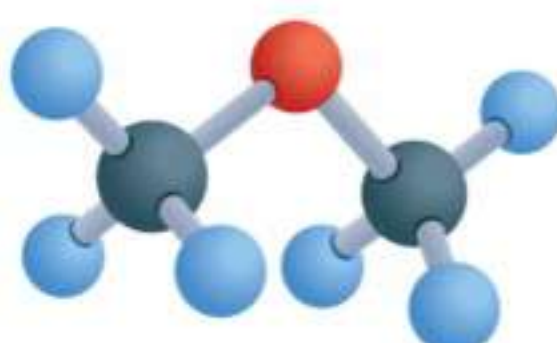
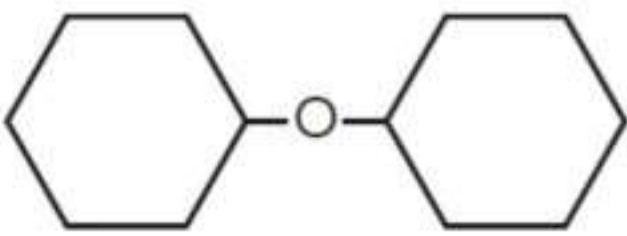
Compound **4** is called cyclopentyl ether

المركب **4** يُسمى ثنائي بنتيل حلقي إيثر



Ethers:

Table 4 Ethers

General Formula	Methanol and Methyl Ether	
ROR' where R and R' represent carbon chains or rings bonded to functional groups	 Methanol bp = 65°C	 Methyl ether bp = -25°C
Examples of Ethers		
 Cyclohexyl ether	$CH_3CH_2CH_2 - O - CH_2CH_2CH_3$ Propyl ether	
$CH_3CH_2 - O - CH_2CH_2CH_2CH_3$ Butyl ethyl ether	$CH_3CH_2 - O - CH_3$ Ethyl methyl ether	

- An **ether** is an organic compound containing an oxygen atom bonded to two carbon atoms.
- The simplest ether is one in which oxygen is bonded to two methyl groups.
- The term *ether* was first used in chemistry as a name for **ethyl ether**, the **volatile, highly flammable** substance that was commonly used as an **anesthetic** in surgery.
- Because **ethers have no hydrogen atoms bonded to the oxygen atom**, their molecules **cannot form hydrogen bonds with each other**.
- Ethers are generally **more volatile** and have much **lower boiling points** than alcohols of similar size and mass.
- Because of the lack of hydrogen atoms bonded to the oxygen atom, ethers are much **less soluble in water** than alcohols.
- Ethers have no hydrogen to donate to a hydrogen bond with a water molecule. However, **the oxygen atom of the ether can act as a hydrogen bond receptor for the hydrogen atoms of water molecules**.

Naming ethers:

When naming ethers that have two identical alkyl chains bonded to oxygen, first name the alkyl group and then add the word ether.

If the two alkyl groups are different, the groups are listed in alphabetical order then followed by the word ether.

Draw the structure for propyl ether.



Final exam questions

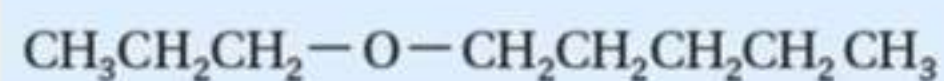
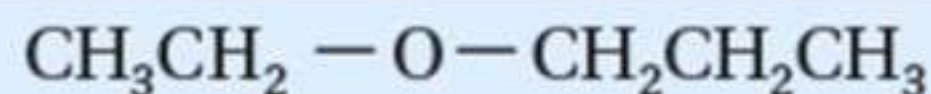
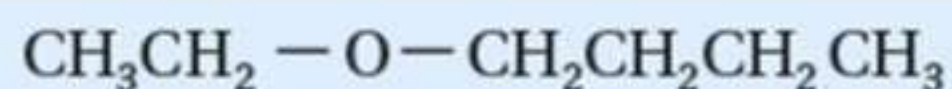
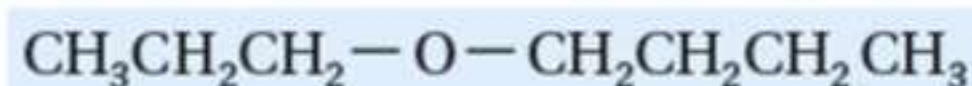
Which of the following structural formulas represents the compound **Butyl methyl ether**?

أي من الصيغ البنائية التالية تمثل المركب
بيوتيل ميثيل إيثر؟

$\text{CH}_3-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$	C	$\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$	A
$\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3$	D	$\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_3$	B

Which of the following formulas represents the compound **butyl propyl ether**?

أي من الصيغ التالية تمثل المركب
بيوتيل بروبيل إيثر؟



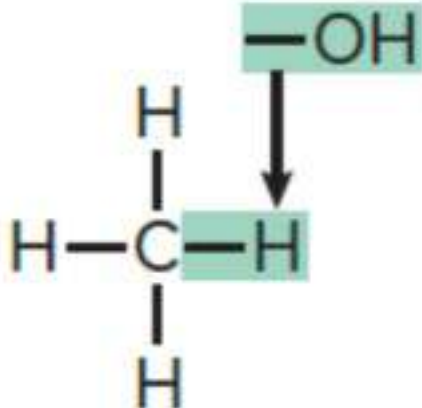
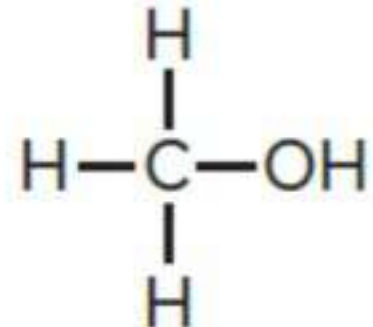
Which of the following formulas of ethers does **not** agree with its corresponding name in the table below?

أي من صيغ الإيثرات التالية لا يتفق مع الاسم المقابل لها في الجدول أدناه؟

$\text{CH}_3\text{CH}_2-\text{O}-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	بيوتيل إيثيل إيثر Butyl ethyl ether	A
$\text{CH}_3\text{CH}_2-\text{O}-\text{CH}_3$	إيثيل ميثيل إيثر Ethyl methyl ether	B
$\text{CH}_3\text{CH}_2\text{CH}_2-\text{O}-\text{CH}_3$	ميثيل بروبيل إيثر Methyl propyl ether	C
 -O-CH ₂ CH ₂ CH ₂ CH ₃	هكسيل حلقي بيوتيل إيثر Cyclohexyl butyl ether	D

Alcohols:

Table 3 Alcohols

General Formula	Simple Alcohol and Simple Hydrocarbon
ROH R represents carbon chains or rings bonded to the functional group	 Methane (CH_4) Alkane  Methanol (CH_3OH) Alcohol

An oxygen-hydrogen group covalently bonded to a carbon atom is called a **hydroxyl group** ($-OH$).

An organic compound in which a hydroxyl group replaces a hydrogen atom of a hydrocarbon is called an **alcohol**.

Ethanol	It's produced by yeasts when they ferment sugars, such as those in grapes. It is found in medicinal products. It is an effective antiseptic; it can be used to swab skin before an injection is given. It is a gasoline additive and an important starting material for the synthesis of more complex organic compounds.
----------------	--

- The hydroxyl groups of alcohol molecules are moderately **polar**, as with water, and are able to form **hydrogen bonds** with the hydroxyl groups of other alcohol molecules.
- Alcohols have much **higher boiling points** than hydrocarbons of similar shape and size.
- Ethanol is completely **miscible with water**. In fact, once they are mixed, it is difficult to separate water and ethanol completely.
- Distillation** is used to remove ethanol from water, but even after that process is complete, about 5% water remains in the ethanol-water mixture.
- Because of their polar hydroxyl groups, alcohols make **good solvents for other polar organic substances**.
- Methanol**, the smallest alcohol, is a common industrial **solvent** found in some **paint strippers**.
- 2-butanol** is found in some **stains and varnishes**.

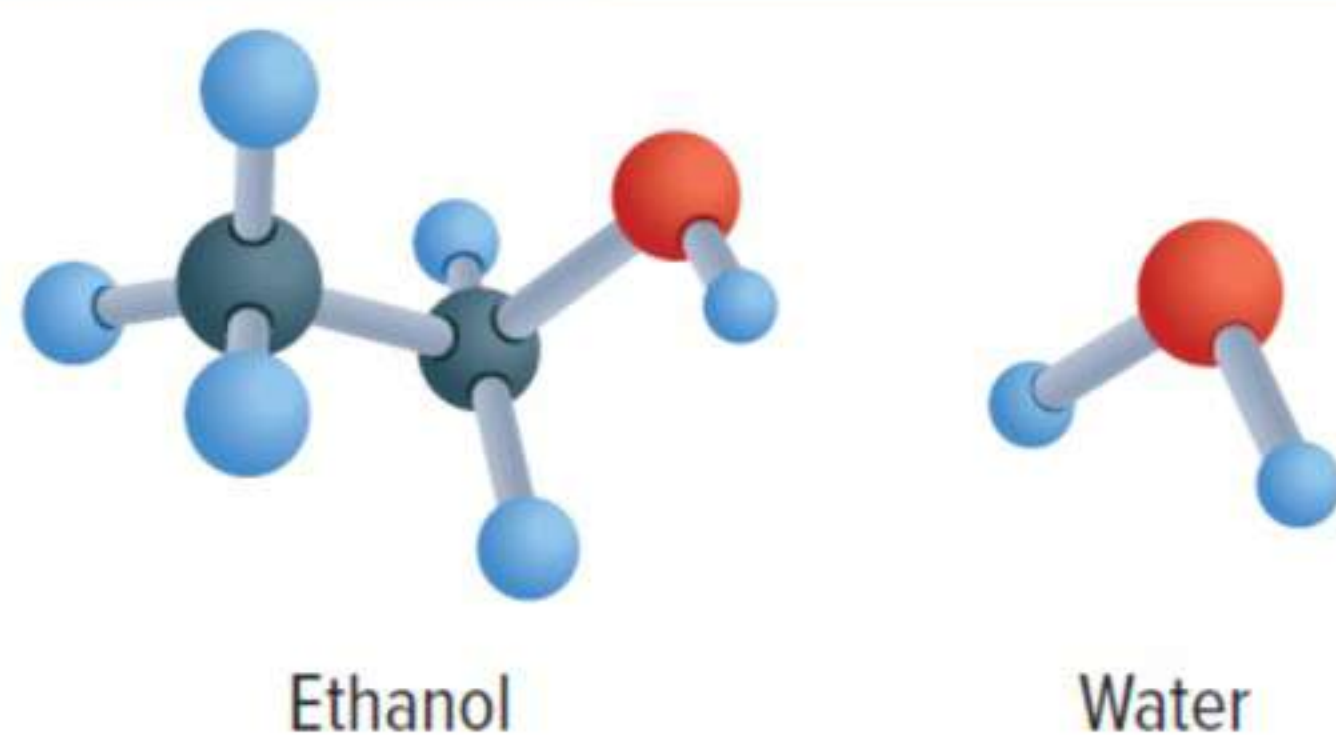


Figure 6 The covalent bonds from oxygen have approximately the same bonding angle in ethanol and water.



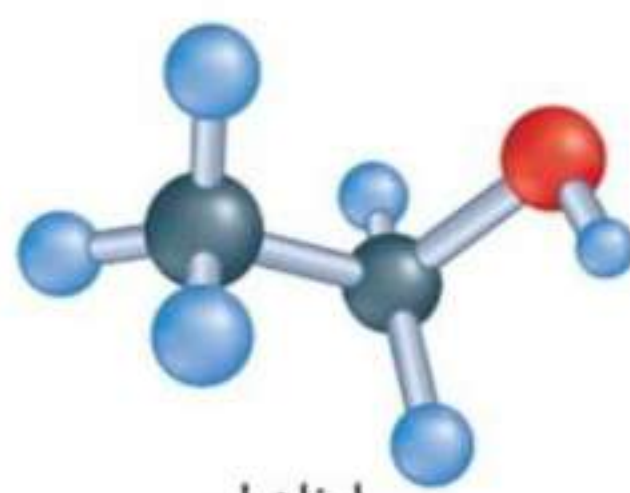
Final exam questions

The hydroxyl group in ethanol molecules are moderately polar, as in water molecules, and the angle between covalent bonds of oxygen is almost the same in both ethanol and water.

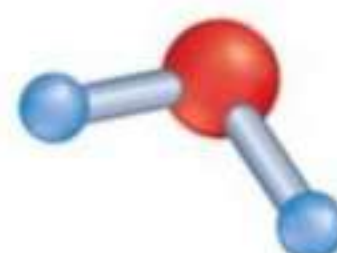
What is the effect of this on ethanol properties?

تكون مجموعة الهيدروكسيل في جزيئات الإيثانول متوسطة القطبية كما في جزيئات الماء، كما أن الزاوية بين الروابط التساهمية للأكسجين تقريبًا هي نفسها في كل من الإيثانول والماء.

ما أثر ذلك على خصائص الإيثانول؟



إيثانول
Ethanol



ماء
Water

Ethanol is not a good solvent for other polar organic compounds

الإيثانول ليس مذيبًا جيدًا للمركبات العضوية القطبية الأخرى

Ethanol is completely immiscible with water

الإيثانول لا يمتزج مع الماء كليًا

Ethanol have much lower boiling point than hydrocarbons of similar shape and size

درجة غليان الإيثانول أقل من درجة غليان الهيدروكربونات المماثلة له في الشكل والحجم

Ethanol molecules can form hydrogen bonds with the hydroxyl groups of other alcohol molecules

يُمكن أن تكون جزيئات الإيثانول روابط هيدروجينية مع مجموعات هيدروكسيل في جزيئات كحولات أخرى

Why do alcohols have much higher boiling points than hydrocarbons of similar shape and size?

- A- The alcohol molecules can form hydrogen bonds with each other
- B- Alcohols are non-polar organic compounds
- C- The attraction forces between the alcohol molecules are weaker than the attraction forces between the hydrocarbon molecules
- D- The polarity of alcohols is weaker than the polarity of hydrocarbons

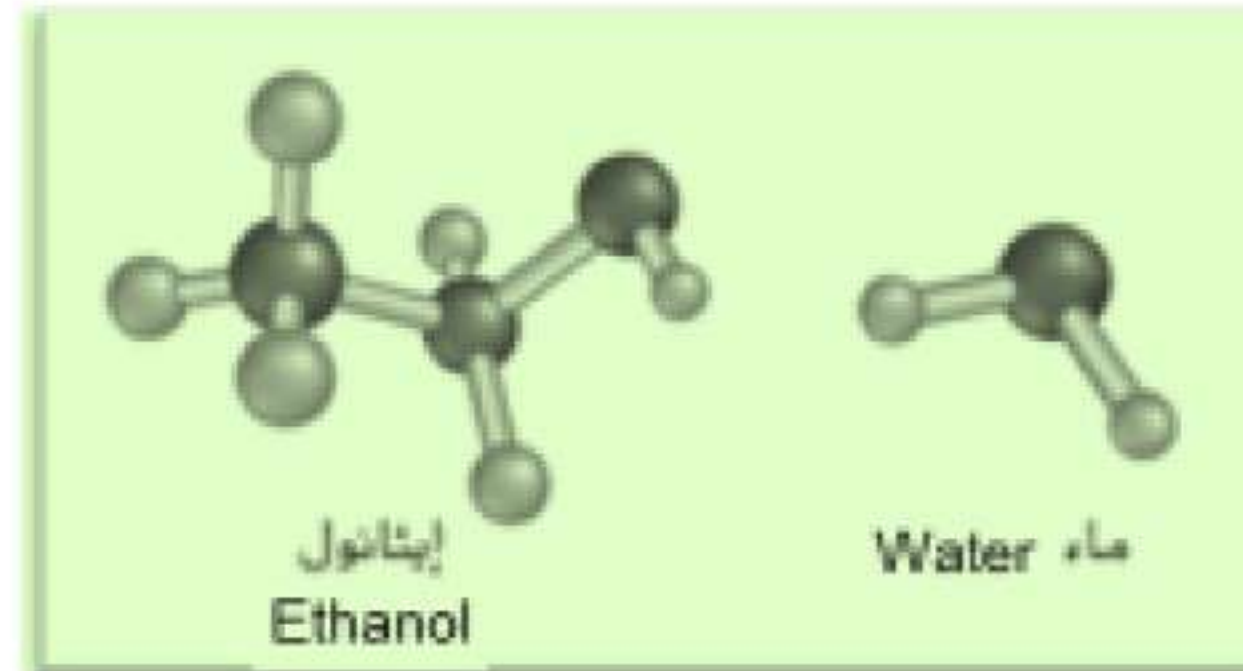
لماذا تكون درجات غليان الكحولات أعلى من درجات غليان الهيدروكربونات المماثلة لها بالشكل والحجم؟

- A- يُمكن لجزيئات الكحولات تكوين روابط هيدروجينية بين بعضها البعض
- B- الكحولات مركبات عضوية غير قطبية
- C- قوى التجاذب بين جزيئات الكحولات أضعف من قوى التجاذب بين جزيئات الهيدروكربونات
- D- قطبية الكحولات أضعف من قطبية الهيدروكربونات



From the figure below, the covalent bonds from the oxygen in ethanol are at roughly the same angle as the bonds around the oxygen in the water molecule, which of the following is not a property of alcohols?

من الشكل أدناه، فإن زاوية الرابطة التساهمية من الأكسجين في الإيثانول تساوي تقريبًا زاوية الرابطة التساهمية من الأكسجين في الماء أي مما يأتي **ليس** من خصائص الكحولات؟



Alcohols have much higher boiling points than hydrocarbons of similar shape and size

تكون درجات غليان الكحولات أعلى من درجات غليان الهيدروكربونات المماثلة لها بالشكل والحجم

The hydroxyl groups of alcohol molecules are nonpolar

تكون مجموعة الهيدروكسيل في جزيئات الكحولات غير قطبية

The hydroxyl groups of alcohol molecules are moderately polar

تكون مجموعة الهيدروكسيل في جزيئات الكحولات متوسطة القطبية

Hydrogen bonds are formed between alcohol molecules

تتكون روابط هيدروجينية بين جزيئات الكحول

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



Ethers are generally more volatile and have much lower boiling points than alcohols of similar size and mass. **What explains these properties?**

يكون الإيثر أكثر قابلية للتطاير ودرجة غليانه أقل من الكحولات المساوية له في الكتلة الجزيئية والحجم. **ما الذي يُفسر هذه الخصائص؟**

1	عدم وجود ذرات هيدروجين مرتبطة مع ذرة الأكسجين في الإيثر Ethers have no hydrogen atoms bonded to the oxygen atom
2	لا يُمكن لجزيئات الإيثر تكوين روابط هيدروجينية بين بعضها البعض Ether's molecules cannot form hydrogen bonds with each other
3	يُمكن لذرة الأكسجين في الإيثر أن ترتبط مع ذرات الهيدروجين من جزيئات الماء The oxygen atom in ether can bond with hydrogen atoms of water molecules

1 only

1 فقط

2 only

2 فقط

1 and 2

1 و 2

2 and 3

2 و 3

The Oxygen atom doesn't bond with Hydrogen atom in ether. **What is the effect of that on the Ether's properties?**

A- Its molecules can form hydrogen bonds with each other

B- It becomes less volatile

C- It has a higher boiling point than alcohols of similar size and mass

D- It is less soluble in water than alcohols

لا ترتبط ذرة الأكسجين بذرة هيدروجين في جزيء الإيثر. **ما أثر ذلك على خصائص الإيثر؟**

A- يُمكن لجزيئاته تكوين روابط هيدروجينية بين بعضها البعض

B- يكون أقل قابلية للتطاير

C- تكون درجة غليانه أعلى من الكحولات المساوية له في الكتلة والحجم

D- يكون أقل قابلية للذوبان في الماء من الكحولات



Carboxylic Acids

- A **carboxylic acid** is an organic compound that has a carboxyl group.
- A **carboxyl group** consists of a carbonyl group bonded to a hydroxyl group.

Table 9 Carboxylic Acids

General Formula	Examples of Carboxylic Acids
$\begin{array}{c} \text{O} \\ \parallel \\ * - \text{C} - \text{OH} \end{array}$ where * represents a hydrogen atom, carbon chain, or ring bonded to the functional group	$\begin{array}{c} \text{H} \quad \text{O} \\ \quad \parallel \\ \text{H} - \text{C} - \text{C} - \text{OH} \\ \\ \text{H} \end{array}$ Ethanoic acid (acetic acid) $\begin{array}{c} \text{O} \\ \parallel \\ \text{H} - \text{C} - \text{O} - \text{H} \end{array}$ Methanoic acid (formic acid)

Naming Carboxylic Acids (IUPAC):

The formal name is formed by changing the **-ane** of the parent alkane to **-anoic acid**.

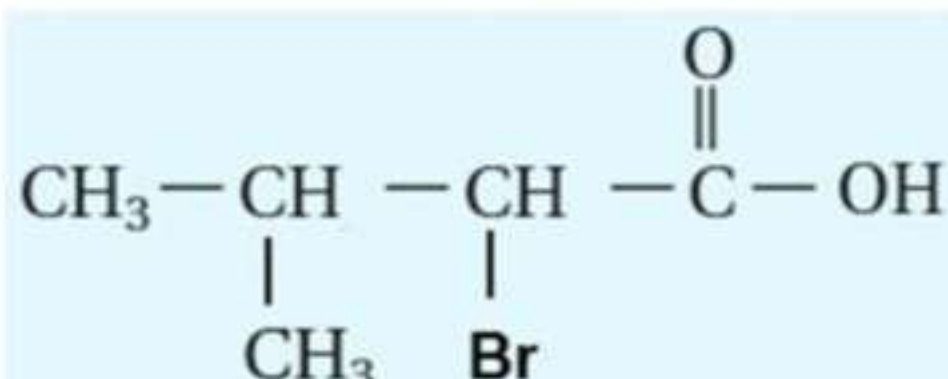
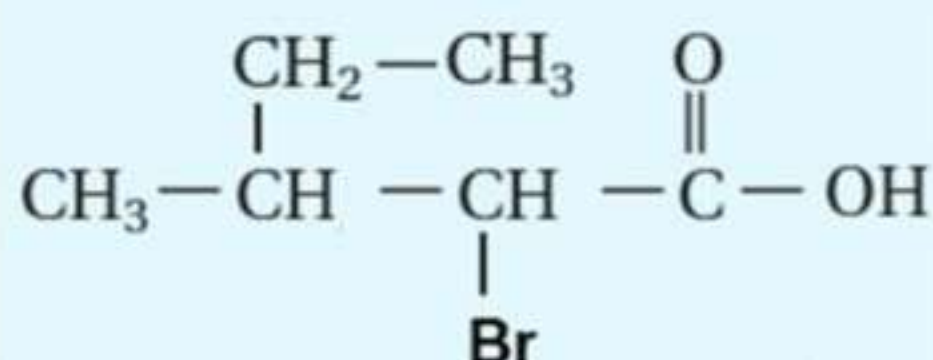
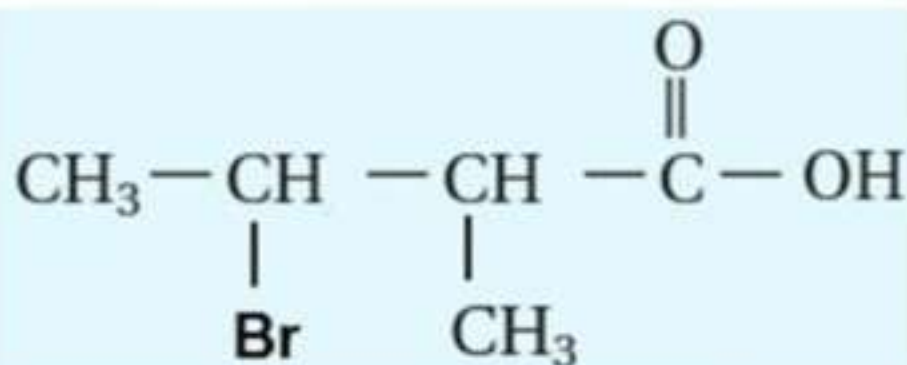
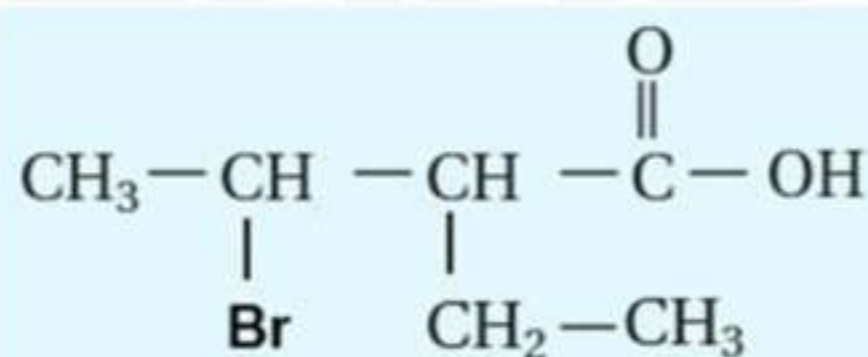
A carboxyl group is usually represented in condensed form by writing **-COOH**.

What is the structural formula of the compound

ما الصيغة البنائية للمركب

(3-bromo-2-ethyl-butanoic acid)?

(3- برومو - 2 - إيثيل حمض البيوتانويك) ؟





Ketones

A **ketone** is an organic compound in which the carbon of the carbonyl group is bonded to two other carbon atoms. (within the chain)

Table 8 Ketones

General Formula	Examples of Ketones
$\text{R}-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{R}'$ where R and R' represent carbon chains or rings bonded to functional groups	$\begin{array}{c} \text{H} & \text{O} & \text{H} \\ & \parallel & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array}$ 2-Propanone (acetone) $\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & \parallel & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & \\ \text{H} & & \text{H} & \text{H} \end{array}$ 2-Butanone (methyl ethyl ketone)

Naming Ketones:

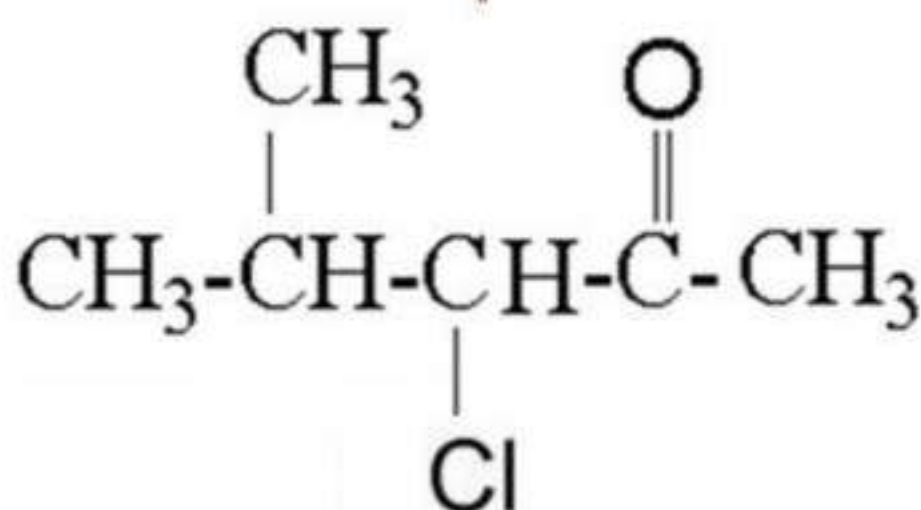
Change the **-e** at the end of the alkane name to **-one**, include a number before the name to indicate the position of the ketone group.

What is the correct name for the compound shown in the figure below?

- A – (4 – ethyl – 3 – chloro – 2 – pentanone)
 B – (3 – chloro – 4 – methyl – 2 – pentanone)
 C – (2 – methyl – 3 – chloro – 4 – pentanone)
 D – (3 – chloro – 2 – methyl – 4 – pentanone)

ما الاسم الصحيح للمركب الموضح بالشكل أدناه؟

- A – (4 – إيثيل – 3 – كلورو – 2 – بنتانون)
 B – (3 – كلورو – 4 – ميثيل – 2 – بنتانون)
 C – (2 – ميثيل – 3 – كلورو – 4 – بنتانون)
 D – (3 – كلورو – 2 – ميثيل – 4 – بنتانون)

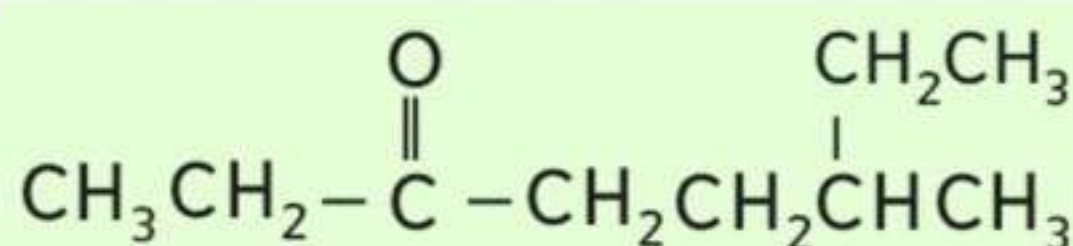


What is the correct name for the following compound?

(Using IUPAC rules)

ما الاسم الصحيح للمركب التالي؟

(مستخدمًا قواعد IUPAC)



2 – ethyl – 5 – heptanone

2 – إيثيل – 5 – هبتانون

6 – ethyl – 3 – heptanone

6 – إيثيل – 3 – هبتانون

6 – methyl – 3 – octanone

6 – ميثيل – 3 – أوكتانون

3 – methyl – 6 – octanone

3 – ميثيل – 6 – أوكتانون



	Aldehydes	Ketones
Functional group	Carbonyl at the end	Carbonyl within the chain
General formula	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{H} \end{array}$	$\begin{array}{c} \text{O} \\ \\ \text{R}-\text{C}-\text{R}' \end{array}$
Polarity	Polar	Polar (Popular solvents for polar substances)
Reactivity	Reactive	less reactive than aldehydes.
Hydrogen bonds	cannot form hydrogen bonds among themselves because the molecules have no hydrogen atoms bonded to an oxygen atom	Similar
Boiling point	Lower than alcohols	Similar
Solubility in water	Water can form hydrogen bonds with the oxygen atom of aldehydes, so aldehydes are more soluble in water than alkanes but not as soluble as alcohols or amines.	Similar

Compared to Aldehydes. Why are Ketones popular solvents for other moderately polar substances, including waxes, plastics?

- A - Ketones are nonpolar organic compounds
- B - Ketones are polar organic compounds with lower reactivity than Aldehydes
- C - Ketones are polar organic compounds with higher reactivity than Aldehydes
- D - Ketones differ in their properties from Aldehydes because their structures are different

مقارنة مع الألدهيدات ، لماذا تُعتبر الكيتونات مذيبات جيدة للمركبات العضوية متوسطة القطبية ومنها الشموع والبلاستيك ؟

- A - الكيتونات مركبات عضوية غير قطبية
- B - الكيتونات مركبات عضوية قطبية ولكنها أقل نشاطاً من الألدهيدات
- C - الكيتونات مركبات عضوية قطبية ولكنها أكثر نشاطاً من الألدهيدات
- D - الكيتونات تختلف اختلافاً كبيراً في خصائصها عن الألدهيدات نتيجة اختلاف بنيتها

Which of the following is incorrect regarding the physical and chemical properties of ketones and aldehydes?

أي مما يلي غير صحيح فيما يخص الخصائص الفيزيائية والكيميائية للكيتونات والألدهيدات؟

Both contain a terminal carbonyl group

كلاهما تحتوي على مجموعة كربونيل طرفية

Ketones are polar molecules and are less reactive than aldehydes

الكيتونات جزيئات قطبية ولكنها أقل نشاطاً من الألدهيدات

Ketones are popular solvents for other moderately polar substances

تعتبر الكيتونات مذيبات جيدة للمركبات العضوية متوسطة القطبية

Both form hydrogen bonds with water molecules

كلاهما تشكل روابط هيدروجينية مع جزيئات الماء



Which of the following statements is not correct

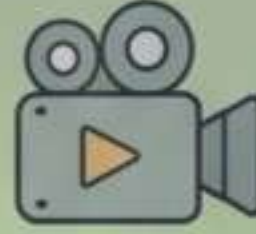
أي من الجمل التالية غير صحيحة

- a In aldehydes, the carbonyl group is located at the end of a carbon chain. في الالدهيدات، توجد مجموعة الكربونيل في نهاية سلسلة الكربون متصلة بذرة هيدروجين
- b In ketones, the carbonyl group is located within a carbon chain. (between two carbon atoms) في الكيتونات، توجد مجموعة الكربونيل ضمن سلسلة الكربون متصلة بذرتي كربون
- c Ketones and aldehydes share many chemical and physical properties because their structures are similar. الالدهيدات والكيتونات لديهما نفس الخصائص الفيزيائية والكيميائية بسبب تشابه تركيبهما
- d Ketones and aldehydes have polar molecules, but ketones are more reactive than aldehydes. الالدهيدات والكيتونات لديهما جزيئات قطبية، ولكن الكيتونات اعلی في النشاط الكيميائي



بطاقة الكيمياء صف 12 متقدم

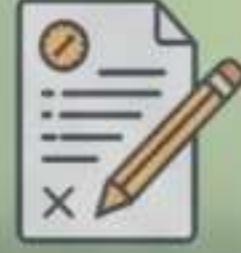
شرح أ. طارق محمد



فيديوهات



ملخصات شرح



أوراق عمل



اختبارات

مراجعة تفصيلية شاملة للهيكل



جاهز للنجاح وإطلاق إبداعاتك



للاشتراك واتساب الدعم الفني
للاكاديمية: 0569174493

