

Electrochemistry



تم تحميل هذا الملف من موقع المناهج الإماراتية

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

تاريخ إضافة الملف على موقع المناهج: 20:20:40 2026-06-09

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

المزيد من مادة
كيمياء:

إعداد: Sarayrah Yousef

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

تحليل مراجعة تدريبات وأسئلة في دروس المنهج

1

ملزمة هيكل 2026

2

ملزمة الهيكل لمادة الكيمياء

3

سلسلة أسئلة الامتحانات السابقة: الهيدروكربونات

4

مراجعة المنهج خطة تغطية أسئلة الامتحان النهائي 2026م النسخة الانجليزية

5



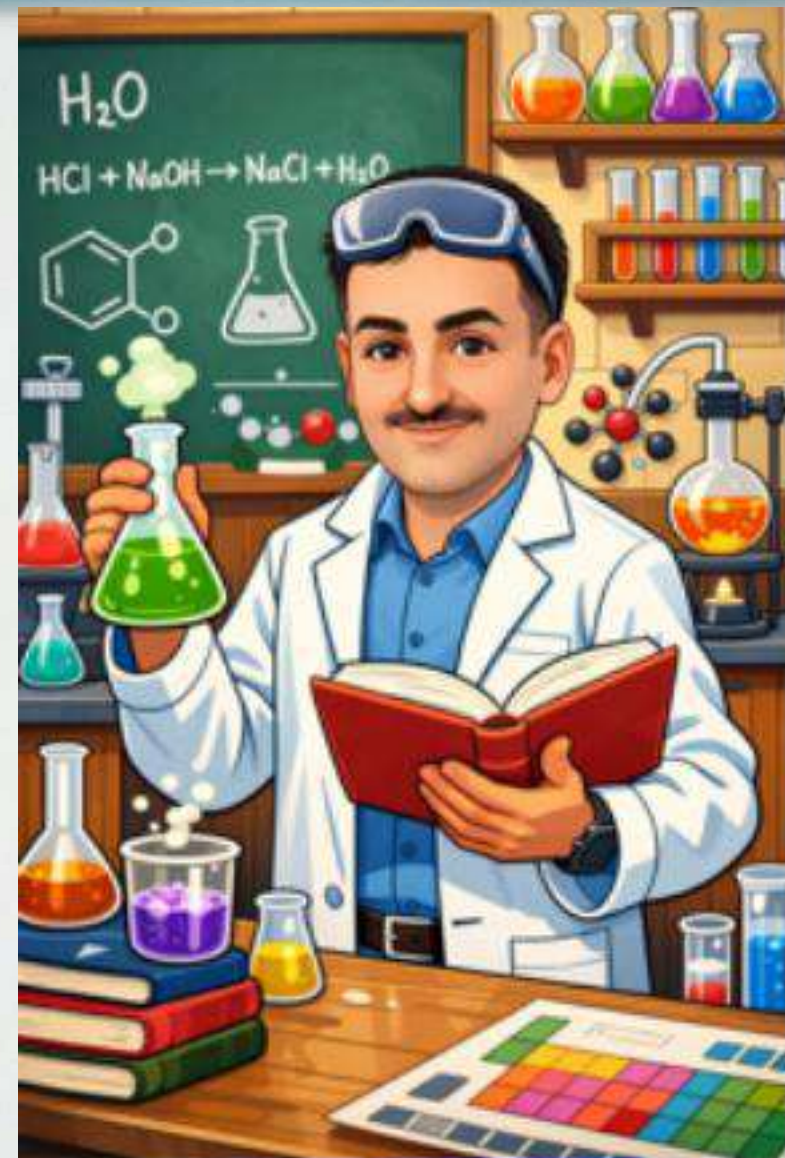
Electrochemistry

QHYDROCARBONES

substituted of hydrocarbons

EOT3 -12ADV C101

- Inspire26-25 -





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

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

Example/Exercise

Page

مثال/تمرين

الصفحة

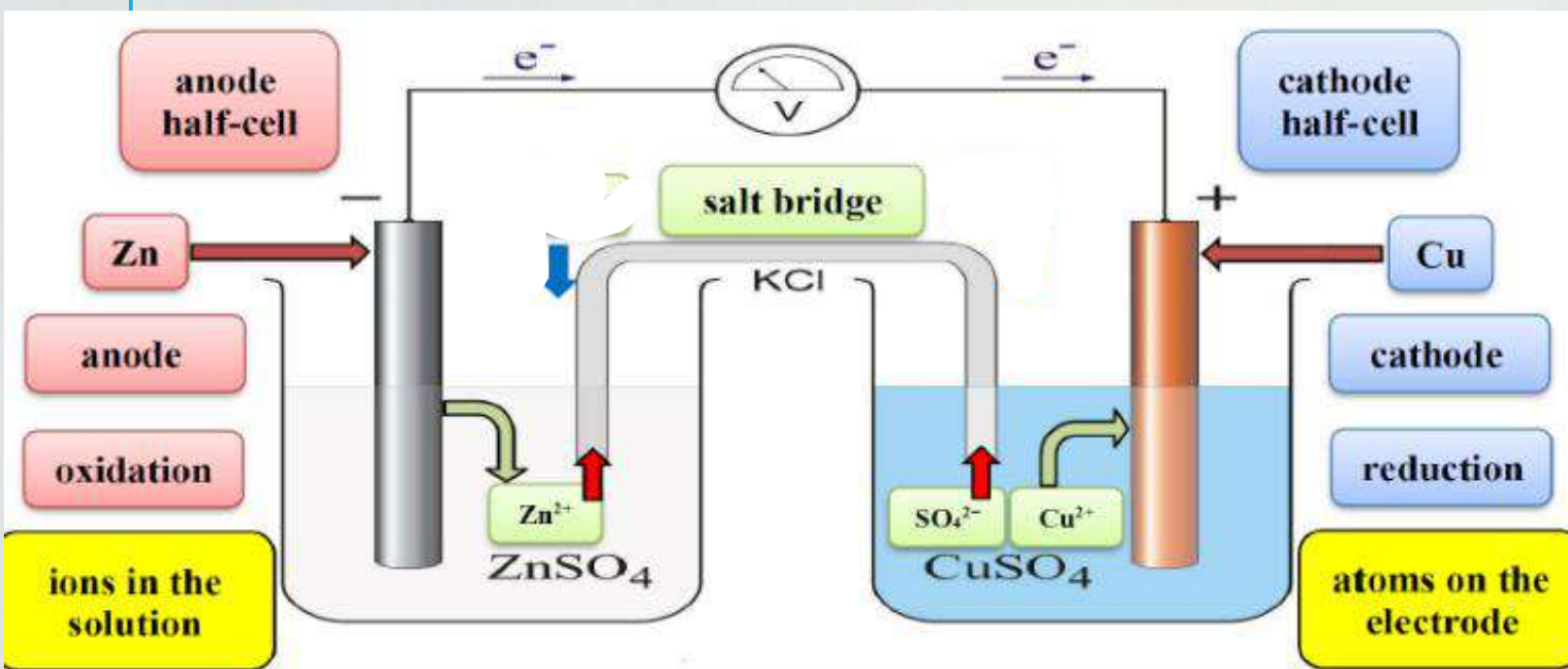
Textbook + figures 1 , 2

25 , 26

Textbook + figure 2

26 ,

Electrochemistry



Electrode: a material that conducts electricity.

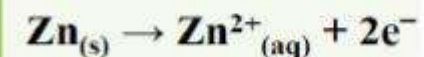
The electrode is a metallic strip or graphite stem that conducts electrons in and out of solution in the half-cell.

Anode: the electrode at which the oxidation reaction takes place.

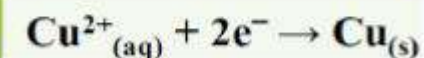
Cathode: the electrode at which the reduction reaction takes place.



oxidation (lose electrons)



reduction (gain electrons)



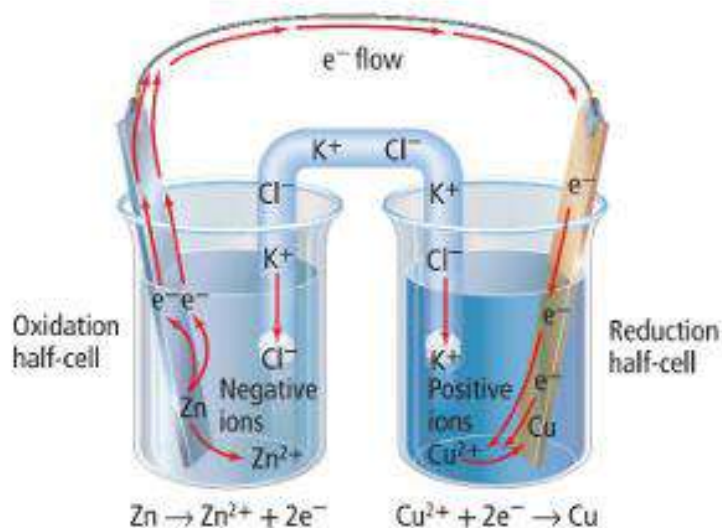
$2e^{-}$ transfers from Zn to Cu^{2+}

the products:
 Zn^{2+} and Cu

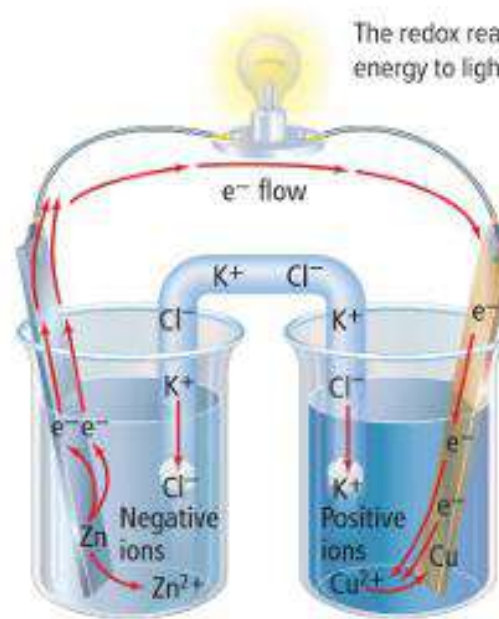


A **salt bridge** is a pathway to maintain solution neutrality by allowing the passage of ions from one side to another, as shown in the figure below.

The salt bridge and the wire provide an unbroken pathway for electrical charge to flow.



The redox reaction provides energy to light the bulb.



the spontaneous redox reaction begins.

1- **Electrons** flow through the **wire** from the oxidation half-reaction to the reduction half-reaction, . A flow of charged particles is called an **electric current**

2- while **ions** move through the **salt bridge**. In the figure above, the flow of electrons through the wire and the flow of ions through the salt bridge make up the electric current.

The energy of the flowing electrons can be used to light a bulb, as shown above.



In the voltaic cell shown below, where are the ions move from one side to another?

في الخلية الفولتية الموضحة أدناه، أين تتحرك الأيونات من جهة إلى أخرى؟



Through the silver strip

خلال قطب الفضة



Through the salt bridge

خلال القنطرة الملح



Through the copper wire

خلال سلك النحاس



Through the zinc strip

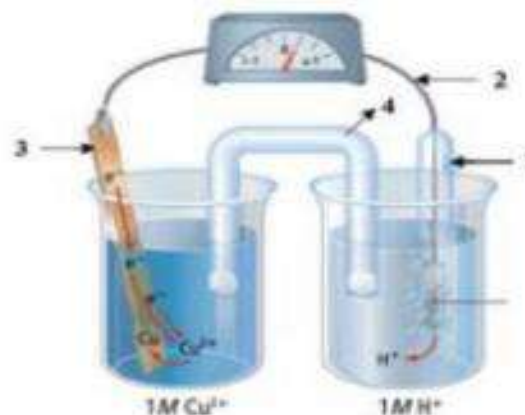
خلال قطب الخارصين





What number represents the part that prevents ions build up around the electrodes in the voltaic cell shown below?

ما الرقم الذي يُمثل الجزء الذي يمنع تراكم الأيونات حول القطبين في الخلية الفولتية الموضحة أدناه؟



1

☐

2

☐

3

☐

4

☐

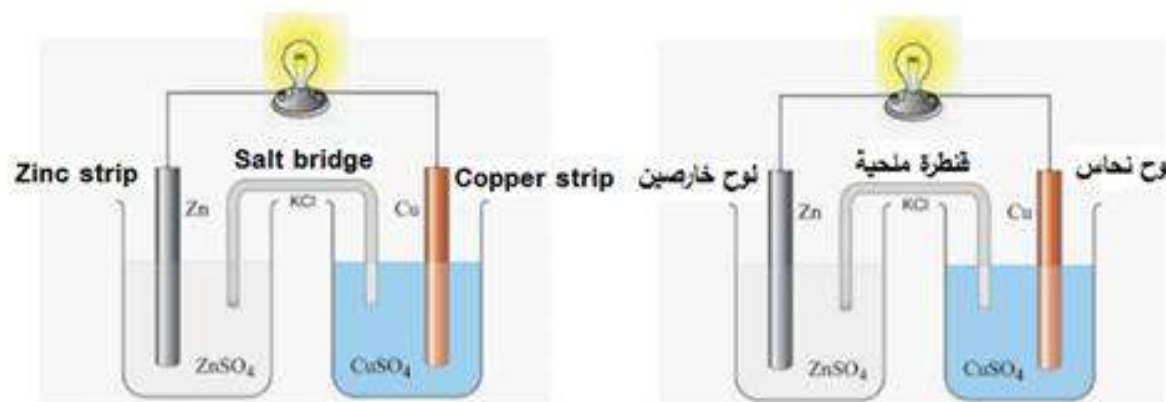


Regarding the cell in the figure below. Which of

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

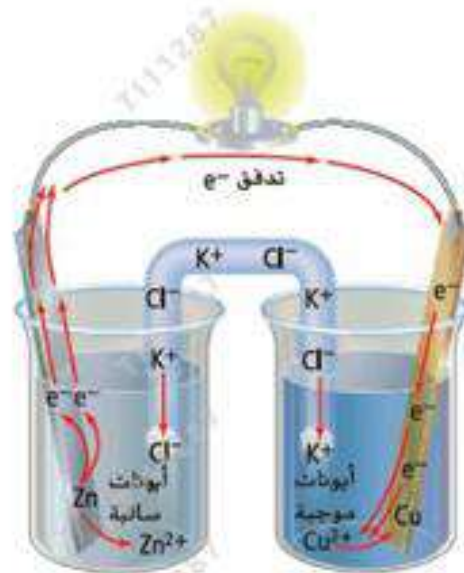
تحدث عمليات أكسدة واختزال تلقائية



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

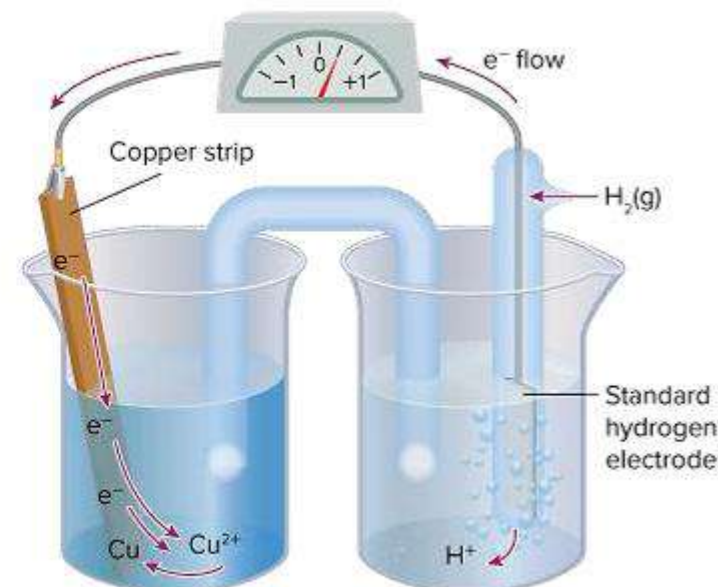
Allows the passage of electrons from one side to another

☐ تسمح بمرور الإلكترونات من جهة إلى أخرى



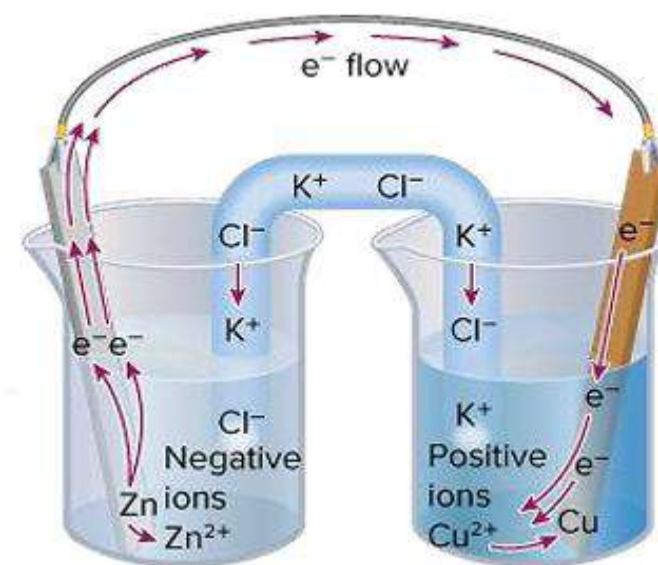
12) When a $\text{Cu}|\text{Cu}^{2+}$ electrode is connected to a standard hydrogen electrode as shown in the figure below, which of the following represents the half-reduction reaction?

- (A) $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
- (B) $\text{Cu}(\text{s}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$
- (C) $\text{H}_2(\text{g}) \rightarrow 2\text{H}^+(\text{aq}) + 2\text{e}^-$
- (D) $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$



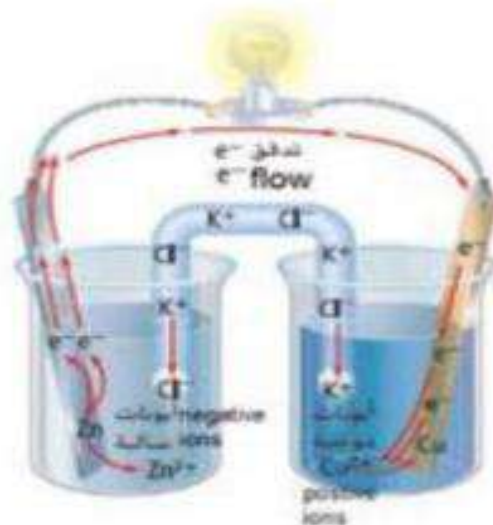
13) Which of the following is the anode in the voltaic cell shown below?

- (A) Cu
- (B) Zn
- (C) Cu^{2+}
- (D) Zn^{2+}



In the voltaic cell shown below, where are electrons loosed?

في الخلية الفولتية الموضحة أدناه، أين تُفقد الإلكترونات؟



At zinc strip

عند قطب الزنك



At salt bridge

عند الفتحة الملحية



At both strips

عند كلا القطبين



At copper strip

عند قطب النحاس





The following reaction takes place in a voltaic cell:

يحدث التفاعل التالي في خلية فولتية:



Which of the following takes place at **the anode**?

أي مما يلي يحدث **عند الأنود**؟

Reduction of Cu^{2+}

اختزال Cu^{2+}

☐

Reduction of Zn^{2+}

اختزال Zn^{2+}

☐

Oxidation of Cu

أكسدة Cu

☐

Oxidation of Zn

أكسدة Zn

☐



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

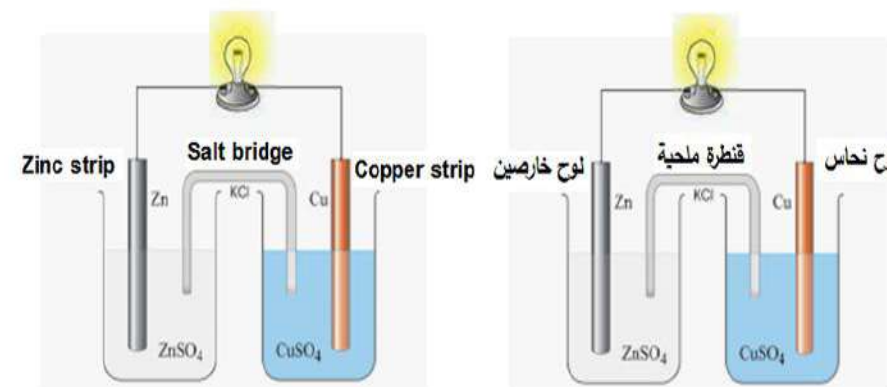
تتراكم أيونات الزنك الموجبة حول القطب الكهربائي للزنك

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 الزنك إلى لوح النحاس

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؟





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 يُمكنك 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 لوحى الخارصين والنحاس بسلك نحاسي لتوفير مسار لنقل الإلكترونات

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

فقط قنطرة ملحية لتوفير مسار لنقل الأيونات

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
A salt bridge and a metal wire to provide an unbroken

قنطرة ملحية لنقل الإلكترونات وسلك نحاسي لنقل الأيونات
قنطرة ملحية وسلك نحاسي معًا لتوفير مسار غير منقطع

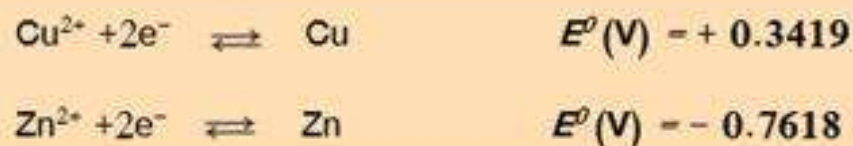
pathway for electrical charge to flow

لانتقال الشحنات الكهربائية



Regarding the standard hydrogen electrode in the figure

below. Which of the following is **correct**?



It will be a cathode when connected to $\text{Cu}|\text{Cu}^{2+}$ electrode

It will be an anode when connected to $\text{Zn}|\text{Zn}^{2+}$ electrode

The standard reduction potential (E^0), of the standard hydrogen electrode is defined as 0.000 V

The standard reduction potential (E^0), of the standard hydrogen electrode is defined as 1.104 V

فيما يتعلق بقطب الهيدروجين القياسي في الشكل أدناه.

أي مما يأتي **صحيح**؟



يكون كاثود عند توصيله مع قطب $\text{Cu}|\text{Cu}^{2+}$

يكون أنوداً عند توصيله مع قطب $\text{Zn}|\text{Zn}^{2+}$

جهد الاختزال القياسي (E^0) لقطب الهيدروجين يساوي 0.000 V

جهد الاختزال القياسي (E^0) لقطب الهيدروجين يساوي 1.104 V



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

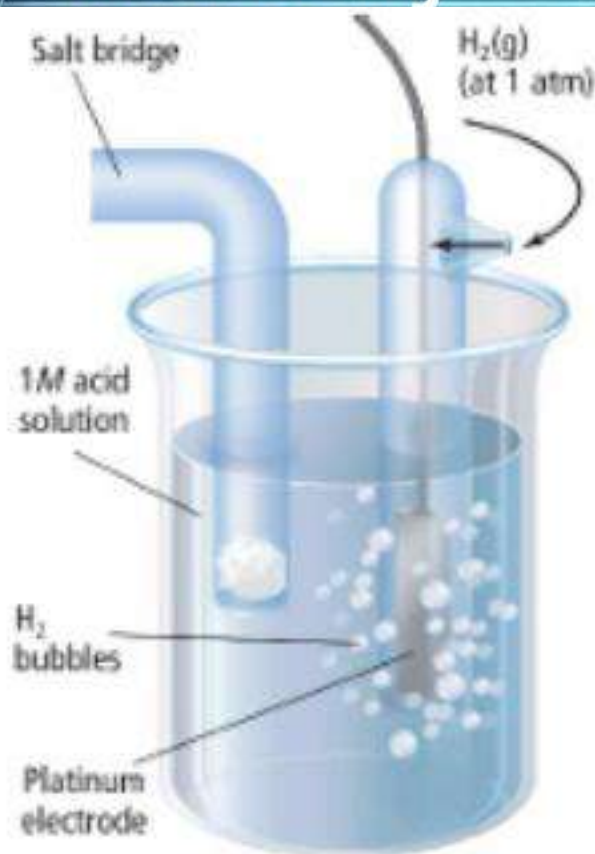
4

CHM.5.3.05.007.04 Write the cell notation and the overall chemical equation for a redox reaction occurring in a voltaic cell

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 + Example problem1 + Practice problems+ check your progress	31 ,32,33 ,34 ,35
Textbook + Example problem1 + Practice problems	31 ,32 ,33
Textbook + figure 6	31



Reduction:



Oxidation:



Calculating Electrochemical Cell Potentials

Recall that **gaining** electrons is called **reduction**. Building on this fact, the tendency of a substance to gain electrons is its **reduction potential**.

The reduction potential of an electrode cannot be determined directly because the reduction half-reaction must be coupled with an oxidation half-reaction. When two half-reactions are coupled, the voltage generated corresponds to the difference in potential between the half-reactions.

A standard hydrogen electrode consists of

- a platinum electrode with
- hydrogen gas at 1 atm pressure bubbling into
- an acidic solution that is 1M in hydrogen ions.

The reduction potential for this configuration is defined as **0.000 V**.

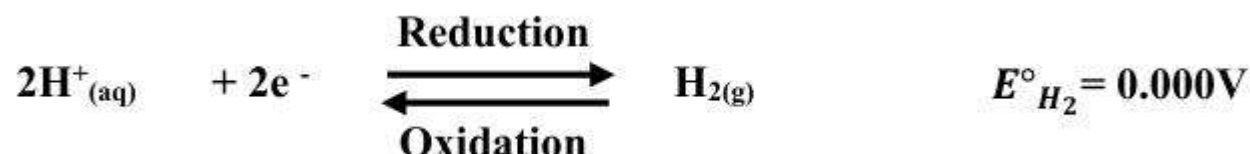


**Table 1 Standard Reduction Potentials**

Half-Reaction	E° (V)	Half-Reaction	E° (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3.0401	$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0.153
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2.868	$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0.3419
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2.71	$\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0.401
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2.372	$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0.5355
$\text{Be}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Be}$	-1.847	$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0.771
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1.662	$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2 + \text{H}_2\text{O}$	+0.775
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1.185	$\text{Hg}_2^{2+} + 2\text{e}^{-} \rightleftharpoons 2\text{Hg}$	+0.7973
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.913	$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0.7996
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2 + 2\text{OH}^{-}$	-0.8277	$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}$	+0.851
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0.7618	$2\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}_2^{2+}$	+0.920
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.744	$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO} + 2\text{H}_2\text{O}$	+0.957
$\text{S} + 2\text{e}^{-} \rightleftharpoons \text{S}^{2-}$	-0.47627	$\text{Br}_2(\text{l}) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1.066
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0.447	$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1.18
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0.4030	$\text{O}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1.229
$\text{PbI}_2 + 2\text{e}^{-} \rightleftharpoons \text{Pb} + 2\text{I}^{-}$	-0.365	$\text{Cl}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1.35827
$\text{PbSO}_4 + 2\text{e}^{-} \rightleftharpoons \text{Pb} + \text{SO}_4^{2-}$	-0.3588	$\text{Au}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Au}$	+1.498
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0.28	$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1.507
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0.257	$\text{Au}^{+} + \text{e}^{-} \rightleftharpoons \text{Au}$	+1.692
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0.1375	$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1.776
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0.1262	$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1.92
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0.037	$\text{S}_2\text{O}_8^{2-} + 2\text{e}^{-} \rightleftharpoons 2\text{SO}_4^{2-}$	+2.010
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2$	0.0000	$\text{F}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2.866



Formula for Cell Potential

E°_{cell} The total standard voltage of the cell

E°_{cathode} Standard potential of the reduction half

E°_{anode} Standard potential of the oxidation half

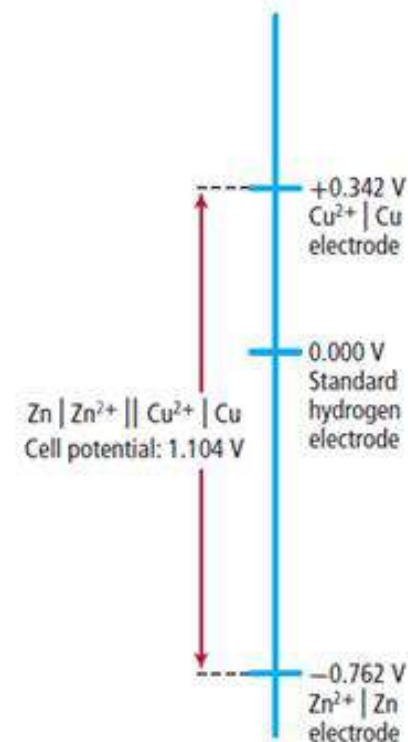
$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$

Example

- 1) Predict, what is the potential difference produced when the two halves of a cell, one for zinc and the other for copper.

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

Example





cell notation

Cell notation is a shorthand way of representing the components and structure of an electrochemical cell without drawing a complex diagram

Anode)**Solid**(| Anode Solution)aq(|| Cathode Solution)aq(| Cathode)Solid(

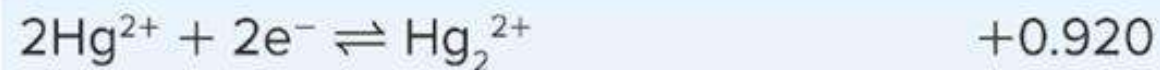
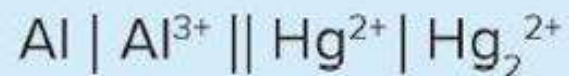
Standard Reduction Potentials (E°):

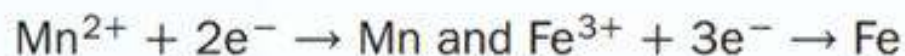
- $\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s}) \quad E^\circ = -1.66 \text{ V}$
- $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s}) \quad E^\circ = +0.34 \text{ V}$





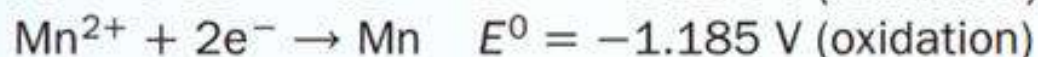
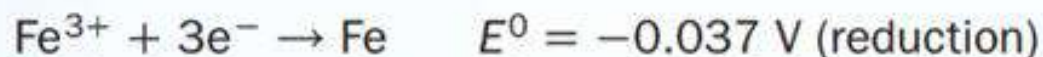
9. CHALLENGE Using **Table 1**, write the equation and determine the cell voltage (E^0) for the following cell. Is the reaction spontaneous?





A table of reduction potentials, such as **Table 1**, is all that is required.

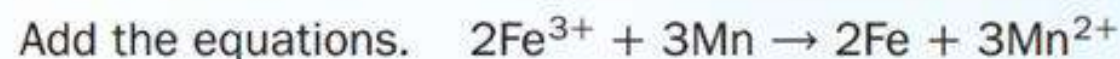
1. Find the two half-reactions on **Table 1**.
2. Compare the two half-cell potentials. The half-cell with the higher reduction potential is the cell in which reduction will occur. Oxidation will occur in the half-cell with the lower reduction potential.



3. Write the equation for the reduction as it is in **Table 1**. Write the equation for the oxidation in the opposite direction.



4. Balance the electrons in the two half-cell equations by multiplying each by a factor. Add the equations.



5. Equalizing the electrons lost and gained does not affect the E° for the overall reaction because E° is an intensive property. Use the formula:

$$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} \quad \text{to obtain the cell potential.}$$

$$\begin{aligned} E_{\text{cell}}^{\circ} &= E_{\text{Fe}^{3+}|\text{Fe}}^{\circ} - E_{\text{Mn}^{2+}|\text{Mn}}^{\circ} = -0.037 \text{ V} - (-1.185 \text{ V}) \\ &= +1.148 \text{ V} \end{aligned}$$



The following reduction half-reactions

تمثل تفاعلات الاختزال النصفية التالية الخلايا النصفية للخلية الفولتية.

represent the half-cells of a voltaic cell.

أي من البيانات في الجدول أدناه **صحيحة**؟

Which data in the table below is **correct**?

Half-Reaction التفاعل النصفية	E^0 (V)
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0.037
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+1.18

تلقائية التفاعل Spontaneity of the reaction	ترميز الخلية Cell notation	التفاعل الكلي للخلية The overall cell reaction	جهد الخلية The cell voltage (E^0)	
تلقائي spontaneous	$\text{Fe} \mid \text{Fe}^{3+} \parallel \text{Pt}^{2+} \mid \text{Pt}$	$2 \text{Fe} + 3 \text{Pt}^{2+} \longrightarrow 2 \text{Fe}^{3+} + 3 \text{Pt}$	+1.217 V	A
غير تلقائي nonspontaneous	$\text{Pt} \mid \text{Pt}^{2+} \parallel \text{Fe}^{3+} \mid \text{Fe}$	$3 \text{Pt} + 2 \text{Fe}^{3+} \longrightarrow 3 \text{Pt}^{2+} + 2 \text{Fe}$	-1.217	B
تلقائي spontaneous	$\text{Pt} \mid \text{Pt}^{2+} \parallel \text{Fe} \mid \text{Fe}^{3+}$	$2 \text{Fe}^{3+} + 3 \text{Pt}^{2+} \longrightarrow 2 \text{Fe} + 3 \text{Pt}$	+1.143 V	C
غير تلقائي nonspontaneous	$\text{Fe} \mid \text{Fe}^{3+} \parallel \text{Pt}^{2+} \mid \text{Pt}$	$2 \text{Fe} + 3 \text{Pt} \longrightarrow 2 \text{Fe}^{3+} + 3 \text{Pt}^{2+}$	-1.143 V	D



A voltaic cell consists of the following half-reduction reactions, which of the following is correct?

تتكون خلية فولتية من تفاعلات الاختزال النصفية التالية، أي مما يأتي صحيح؟

Electrochemical cell potential calculation

$$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$$



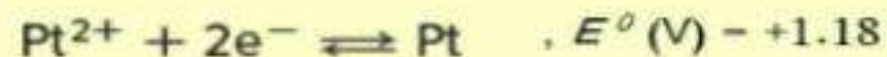
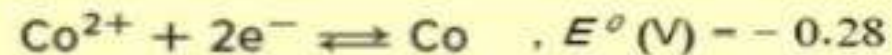
	الأنود Anode	الكاثود Cathode	جهد الخلية (E°) Electrochemical Cell Potential (E°)	نوع التفاعل Reaction Type
A	Cr	Ag	+ 1.54 V	تلقائي Spontaneous
B	Ag	Cr	+ 0.0556 V	تلقائي Spontaneous
C	Cr	Ag	- 1.54 V	غير تلقائي Nonspontaneous
D	Ag	Cr	- 0.0556 V	غير تلقائي Nonspontaneous



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 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؟



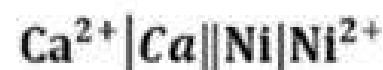
Half reaction نصف التفاعل	$E^{\circ}(\text{V})$
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2.71
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1.185
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0.744
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons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



Which of the following represents the cell notation for the voltaic cell consisting of nickel and calcium electrodes?

أي مما يلي يمثل ترميز الخلية الفولتية التي تتكون من أقطاب النيكل والكالسيوم؟

التفاعل النصفى Half-Reaction	$E^{\circ}(\text{V})$
$\text{Ni}^{2+} + 2\text{e}^{-} \rightarrow \text{Ni}$	- 0.257
$\text{Ca}^{2+} + 2\text{e}^{-} \rightarrow \text{Ca}$	-2.868





Which of the following represents a voltaic cell notation consisting of nickel and silver electrodes?

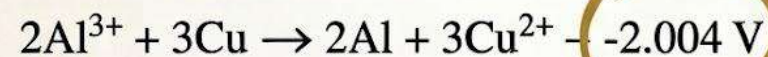
Half-Reaction	$E^\circ(\text{V})$
$\text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}$	- 0.2570
$\text{Ag}^+ + e^- \rightarrow \text{Ag}$	+ 0.7996



WHICH OF THE REACTIONS REPRESENTED IN THE TABLE BELOW IS **NON-SPONTANEOUS** UNDER THE STANDARD CONDITIONS?

Reactions	Standard Cell Potential (E°_{cell} in V)
$2\text{Al}^{3+} + 3\text{Cu} \rightarrow 2\text{Al} + 3\text{Cu}^{2+}$	-2.004 V
$\text{Mg} + \text{Ni}^{2+} \rightarrow \text{Mg}^{2+} + \text{Ni}$	+2.115 V
$\text{Sn} + \text{Pt}^{2+} \rightarrow \text{Sn}^{2+} + \text{Pt}$	+1.32 V
$\text{Sn} + 2\text{Ag}^+ \rightarrow \text{Sn}^{2+} + 2\text{Ag}$	+0.94 V

THE NON-SPONTANEOUS REACTION IS THE ONE WITH A NEGATIVE E°_{cell} :



$E^\circ < 0$
(NEGATIVE)

SOLUTION RATIONALE

- **Key Principle:** A reaction is non-spontaneous if its E°_{cell} is less than zero ($E^\circ_{\text{cell}} < 0$). ($E^\circ_{\text{cell}} < 0$).

SPONTANEOUS ($E^\circ_{\text{cell}} > 0$)

- ✓ Al/Cu (Spontaneous)
- ✓ Mg/Ni (Spontaneous)

NON-SPONTANEOUS ($E^\circ_{\text{cell}} < 0$)

- ✗ Al/Cu (Non-spontaneous)

REMEMBER: Standard cell potential (E°_{cell}) determines spontaneity. Negative value indicates a non-spontaneous reaction.



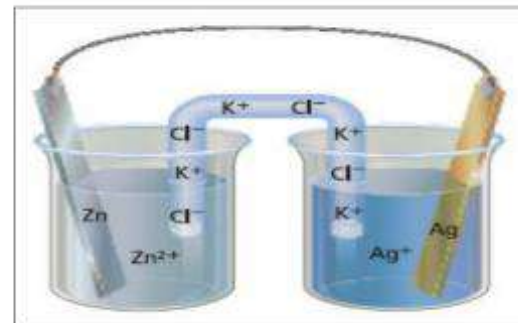
6) Which of the following represents the cell notation for a voltaic cell composed of aluminum and copper electrodes?

- (A) $\text{Al} \mid \text{Al}^{3+} \parallel \text{Cu}^{2+} \mid \text{Cu}$
(B) $\text{Cu} \mid \text{Cu}^{2+} \parallel \text{Al}^{3+} \mid \text{Al}$
(C) $\text{Al}^{3+} \mid \text{Al} \parallel \text{Cu} \mid \text{Cu}^{2+}$
(D) $\text{Cu}^{2+} \mid \text{Cu} \parallel \text{Al} \mid \text{Al}^{3+}$

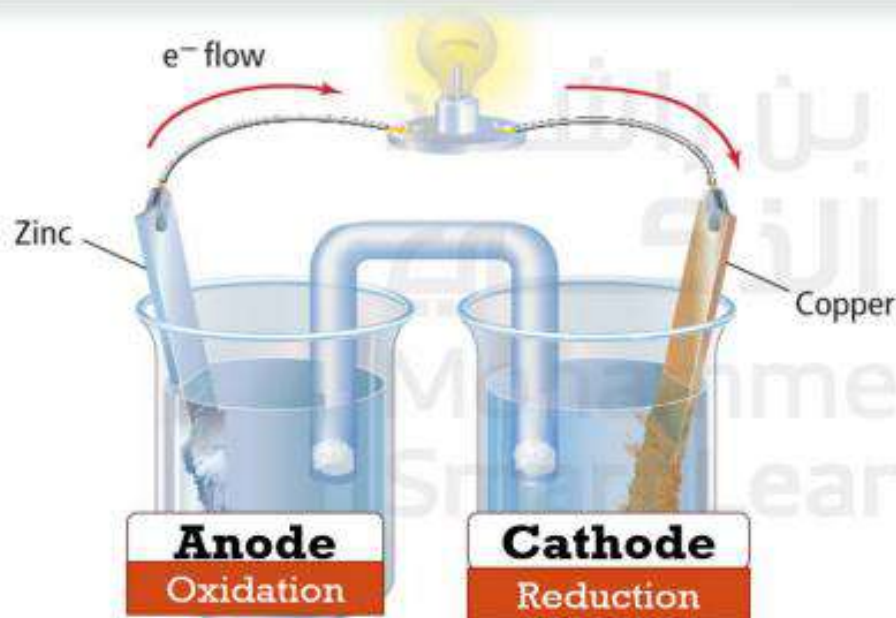
Half-Reaction	E°
(A) $\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s})$	-1.662 V
(C) $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	+0.3419 V

7) Which of the following statements describe what happens in the cell shown in the figure below? ($E^\circ_{\text{Ag}^+/\text{Ag}} = +0.7996 \text{ V}$, $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.761 \text{ V}$)

- a. reaction at the zinc electrode: $\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}$
b. electrons move through the salt bridge to the silver side
c. the ions pass through the wire from the silver stripe to the zinc stripe
d. the positive silver ions are reduced and accumulated on the silver stripe



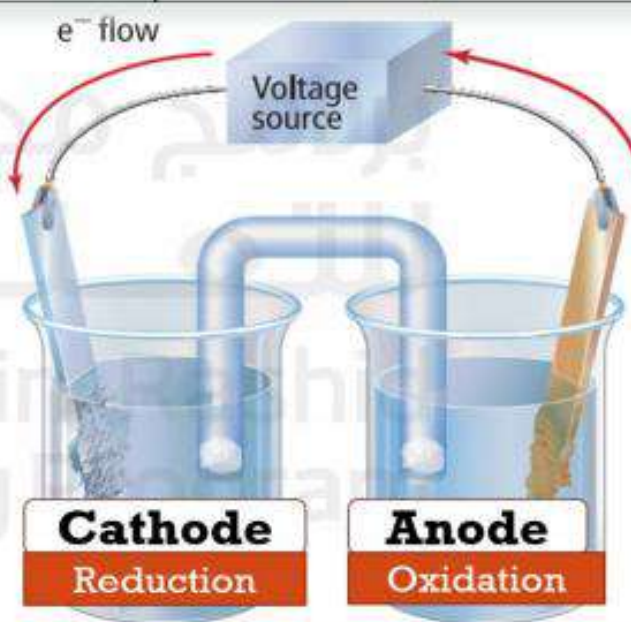
CHM.5.3.05.011.03 Compare between electrolytic cell and voltaic cell in terms of identifying where will reduction and oxidation processes take place, anode, cathode, direction of electron flow and current flow and spontaneity of the reaction occurring



Galvanic Cell

Changes chemical energy into Electrical energy .

1. Anode is -ve
2. Cathode is +ve
3. Spontaneous reaction occurs.
4. Does not require external voltage source.



Electrolytic Cell

Changes electrical energy into chemical energy.

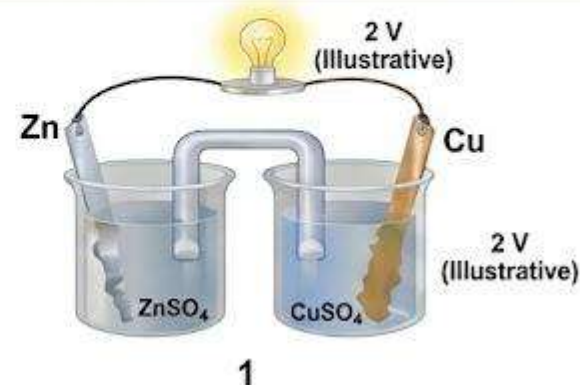
1. Anode is +ve
2. Cathode is -ve
3. Non-Spontaneous reaction occurs.
4. Require external voltage source.

Textbook + figure 18



Which of the following is **true** for the two cells below?

أي مما يلي **صحيح** فيما يتعلق بالخليتين أدناه؟



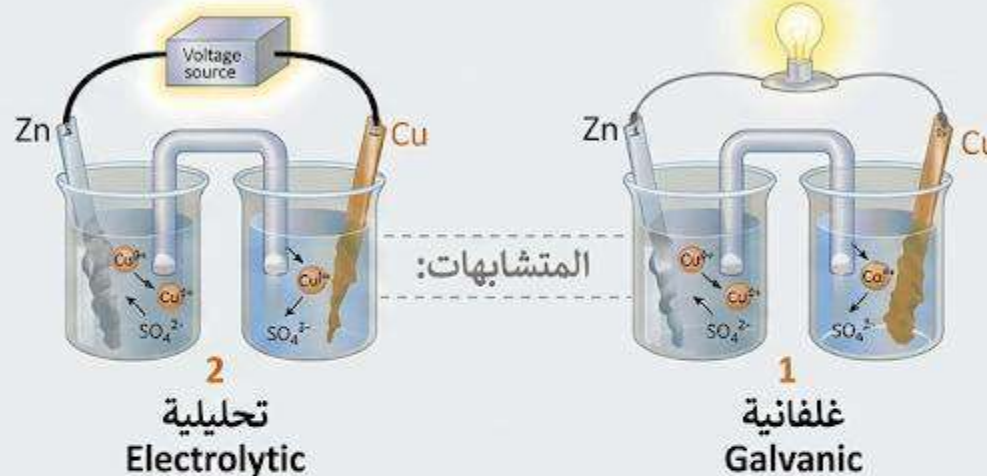
- A- The Cell number **(1)** converts the electrical energy into chemical energy
- B- A spontaneous redox reaction occurs in the cell number **(1)**
- C- The cell number **(2)** converts chemical energy into electrical energy
- D- A spontaneous redox reaction occurs in the cell number **(2)**

- A- تحول الخلية رقم **(1)** الطاقة الكهربائية إلى طاقة كيميائية
- B- يحدث في الخلية رقم **(1)** تفاعل أكسدة واختزال تلقائي
- C- تحول الخلية رقم **(2)** الطاقة الكيميائية إلى طاقة كهربائية
- D- يحدث في الخلية رقم **(2)** تفاعل أكسدة واختزال تلقائي



What is the similarity between the two cells below?

ما وجه الشبه بين الخليتين أدناه؟



A nonspontaneous reaction occurs

حدوث تفاعل غير تلقائي



An oxidation-reduction reaction occurs

حدوث تفاعل أكسدة واختزال



A neutralization reaction occurs

حدوث تفاعل تعادل



A spontaneous reaction occurs

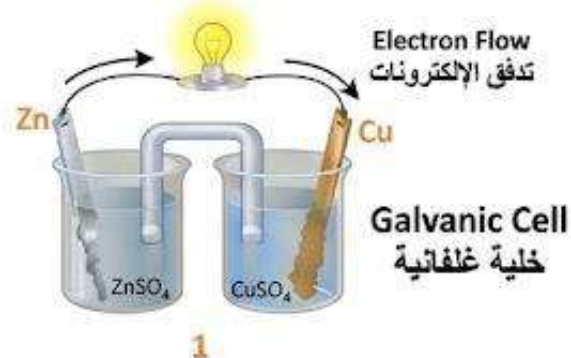
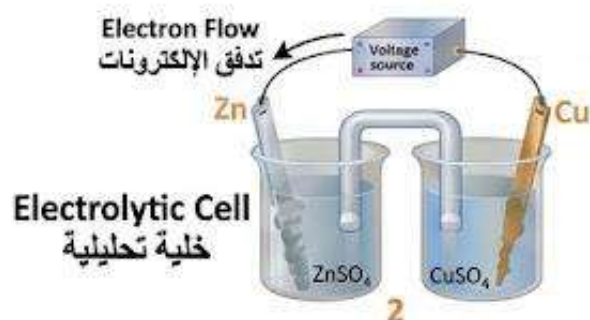
حدوث تفاعل تلقائي





Which of the following is **true** for the two cells below?

أي مما يلي **صحيح** فيما يتعلق بالخليتين أدناه؟



In cell number (1), the electrons flow from Cu to Zn

في الخلية رقم (1) تتدفق الإلكترونات من Cu إلى Zn



In cell number (1), the anode produces electrons from Zn

في الخلية رقم (1) ينتج الأنود الإلكترونات من Zn



In cell number (2), the anode produces electrons from Zn

في الخلية رقم (2) ينتج الأنود الإلكترونات من Zn



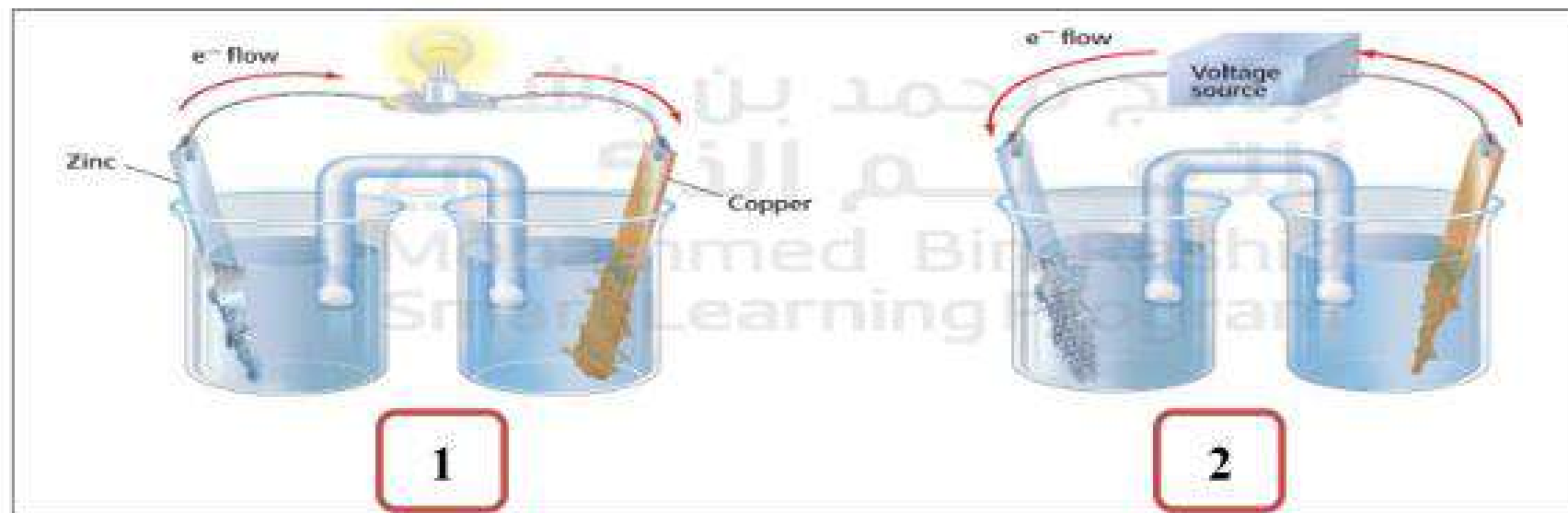
In cell number (2), the electrons flow from Zn to Cu

في الخلية رقم (2) تتدفق الإلكترونات من Zn إلى Cu





Which of the following is **true** about the two cells below?



- a. cell (1), electrical energy converted to chemical energy
- b. cell (1), a spontaneous oxidation-reduction reaction occurs
- c. cell (2), chemical energy converted to electrical energy
- d. cell (2), a spontaneous oxidation-reduction reaction occurs



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

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 تقريباً

Reduction takes place at copper electrode

يحدث اختزال عند قطب النحاس



Regarding the cell in the figure below,
which of the following is **correct**?

فيما يتعلق بالخلية في الشكل أدناه،
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 spontaneous redox
reactions take place

الخلية إلكتروليتيّة وتحدث فيها تفاعلات أكسدة واختزال تلقائية

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

الخلية فولتية وتحدث فيها تفاعلات أكسدة واختزال
غير تلقائية

It is an electrolytic cell and non-spontaneous redox
reactions take place

الخلية إلكتروليتيّة وتحدث فيها تفاعلات أكسدة واختزال
غير تلقائية



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: Applying a thin and uniform layer of metal.

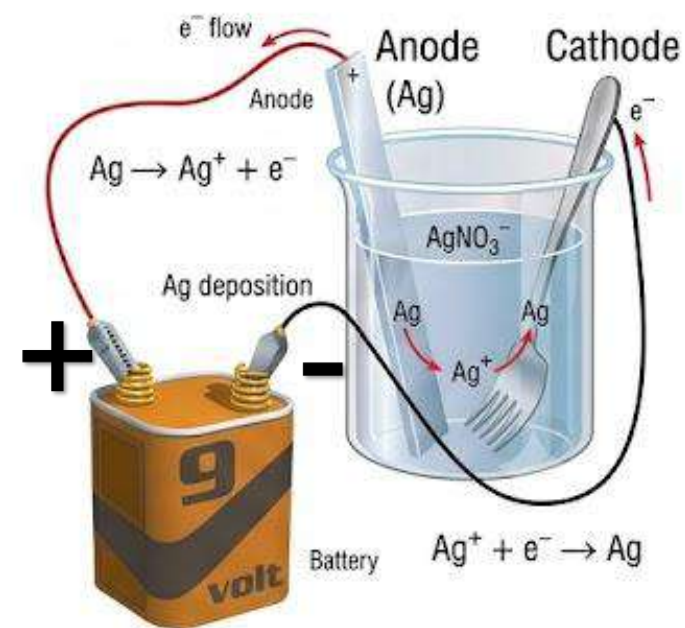
General Principle of Electroplating:

anode	material to be painted with	connect to the positive of the battery
cathode	material to be painted	connect to the negative of the battery
electrolyte	solution of the material to be painted with.	

Electroplating of an item (Fork) with Silver (Ag)

Example: Electroplating with Silver

anode	silver (bar)	silver anode bar
anode reaction	$\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$	<i>Dissolution of silver</i>
cathode	item to be painted (fork)	<i>Silver coating forms on fork</i>
cathode reaction	$\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$	<i>Reduction and deposition</i>
electrolyte	$\text{AgNO}_{3(\text{aq})}$	(silver nitrate solution)





)The figure below shows an electroplating process where a key is coated with a layer of copper in an electrolytic cell. What do the numbers in the figure indicate?

A)

1	2	3
Anode	Cathode	Cu^{2+}

B)

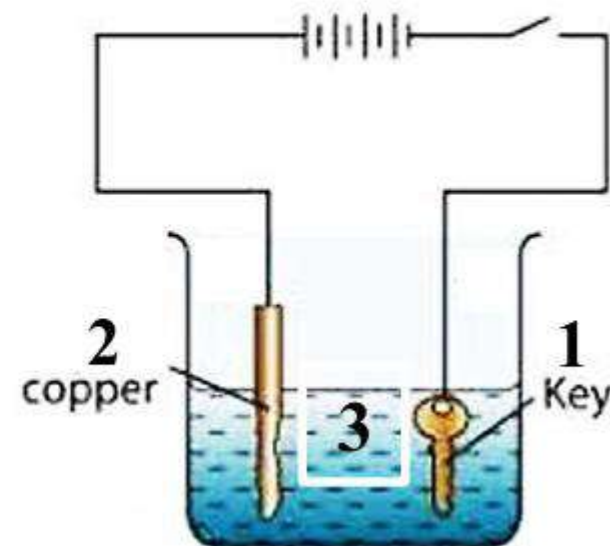
1	2	3
Cathode	Anode	Cu^{2+}

C)

1	2	3
Cathode	Anode	Cu^{2+}

D)

1	2	3
Anode	Cathode	Cu





Khalifah tried to electroplate an iron key with a layer

of copper. He designed the electroplating cell

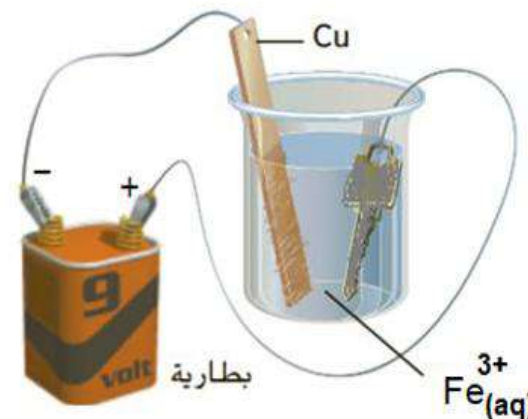
shown in the figure below.

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؟



1 only

3 only

Both 1 and 2

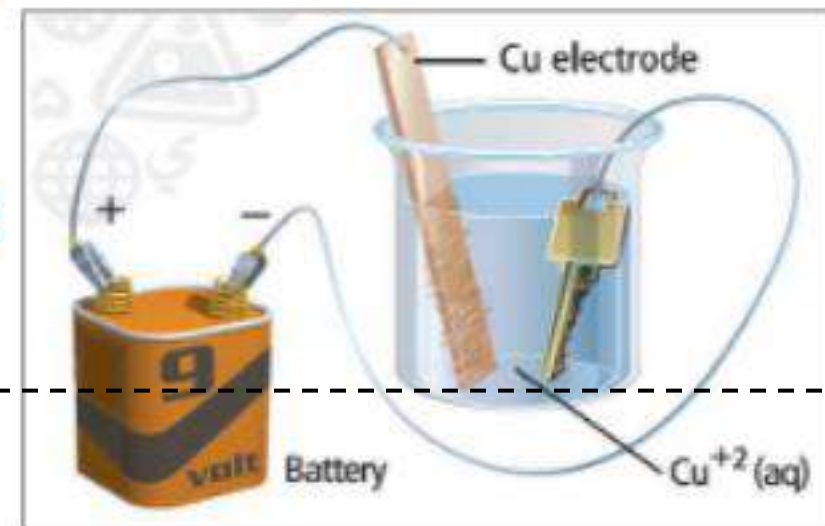
Both 1 and 3

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	



The figure below shows a picture of a key being electroplated with copper in an electrolytic cell. Which of the following statements is **true**?

- a. copper is oxidized to Cu^{2+} ions at the cathode
- b. reduction of copper ions occurs on the anode electrode
- c. the mass of the copper electrode increases
- d. electrical energy is used to cause a redox reaction





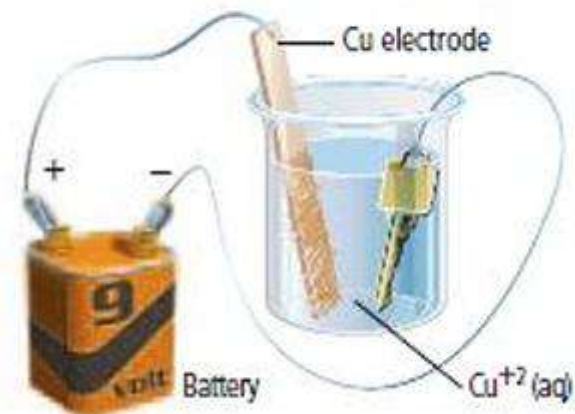
3) Objects are electroplated by depositing a thin and uniform layer to form a protective or decorative coating, as shown in the figure below. Which of the following is correct?

- A) The object to be plated is the anode.
- B) The metal to be plated is the cathode.
- C) Silver is oxidized to silver ions at the cathode.
- D) Silver is oxidized to silver ions at the anode.



4) The figure below shows the electroplating of a key with copper in an electrolytic cell. Which of the following statements is correct?

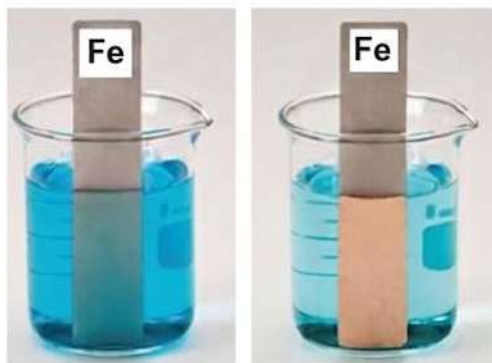
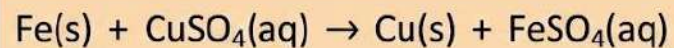
- (A) The key is the anode in the cell.
- (B) Copper is oxidized to Cu^{2+} ions at the anode.
- (C) The mass of the copper plate increases.
- (D) The mass of the key decreases.





An iron plate was placed in a solution of copper(II) sulfate as shown in the figure below. Why did the color of the iron plate change?

تم وضع صفيحة من الحديد في محلول كبريتات النحاس (II) كما هو موضح في الشكل أدناه. لماذا تغير لون صفيحة الحديد؟



Reduction of copper (II) ions and deposition of copper on the iron plate

☐ اختزال أيونات النحاس (II) وترسب النحاس على صفيحة الحديد

Oxidation of copper atoms to copper(II) ions

☐ أكسدة ذرات النحاس إلى أيونات النحاس (II)

Oxidation of iron (III) ions by losing electrons

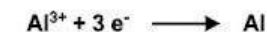
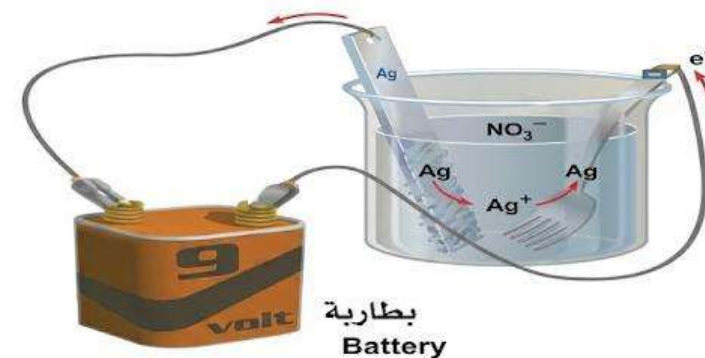
☐ أكسدة أيونات الحديد (III) بفقدانها إلكترونات

Reduction of iron (III) ions by gaining electrons

☐ اختزال أيونات الحديد (III) باكتسابها إلكترونات

An aluminum fork is coated with a thin layer of silver as shown in the figure below. Which of the following reactions occurs at the anode?

يتم طلاء شوكة من الألمنيوم رقيقة رقيقة من القطعة كما في الشكل آتساء. أي التفاعلات التالية يحدث عند الأنود؟





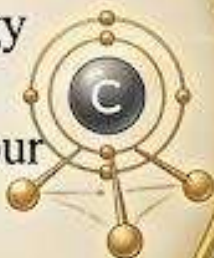
Hydrocarbons



Explain why carbon forms many compounds.

1-

1- Carbon atoms have four electrons in their outer energy level; a carbon atom can form four covalent bonds.



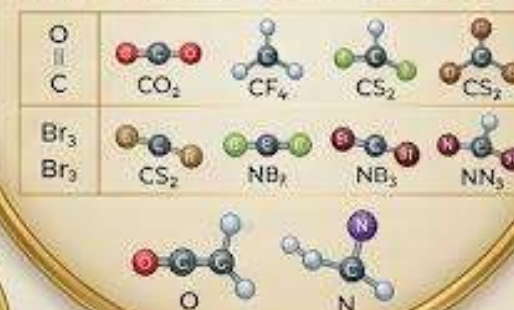
3

2- Carbon can form single, double, or triple covalent bonds.



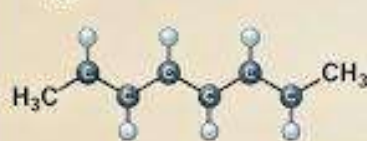
2-

3- Carbon atoms can bond to different atoms, such as Oxygen (O), Fluorine (F), Sulfur (S), Bromine (Br), and Nitrogen (N).

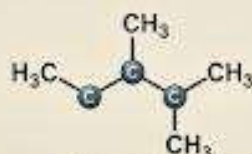


4-

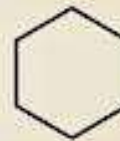
Because carbon forms four bonds with structures like:



chains



branched chains



rings

Fullerene C₆₀
cage like



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

كربون؟

تركيبات مستقيمة Chain structures	1
تركيبات ذات سلاسل متفرعة Branched structures	2
تركيبات حلقية Ring structures	3
تركيبات شبيهة بالاقفاص Cagelike structures	4

- ☐ 3 and 4
- ☐ 1,2 and 3
- ☐ 1 and 2
- ☐ 1,2,3 and 4

Q- When carbon atom forms chemical compounds, it is often

تفقد 4 إلكترونات Loses 4 electrons	I
تكتسب 4 إلكترونات Gains 4 electrons	II
تكون 4 روابط تساهمية Forms 4 covalent bonds	III
تكون روابط أحادية وثنائية وثلاثية Forms single, double, and triple bonds	IV

A. Only I

B. IV and II

C. IV and III

B. Only II



Why carbon can form so many different
organic compounds?

ما سبب قدرة الكربون على تكوين عدد هائل
من المركبات العضوية المختلفة؟

تحتوي ذرة الكربون على أربعة إلكترونات في مستوى الطاقة الخارجي Carbon atom has four electrons in its outer energy level	1
تستطيع ذرة الكربون تكوين أربع روابط تساهمية مع ذرات كربون أو عناصر أخرى Carbon atom can form four covalent bonds with atoms of carbon or with other elements	2
تستطيع ذرة الكربون تكوين روابط تساهمية أحادية وثنائية وثلاثية Carbon atom can form single, double , and triple covalent bonds	3
تحتوي ذرة الكربون على ثلاثة إلكترونات في مستوى الطاقة الخارجي Carbon atom has three electrons in its outer energy level	4

- A) 1 only.
B) 2 only
C) 2,3, and 4
D) 1,2, and 3



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

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

a.

Carbon atom has three electrons in the outer energy level

تحتوي ذرة الكربون على ثلاثة إلكترونات في مستوى الطاقة الخارجي

b.

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

c.

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

تسمح مواقع الارتباط للكربون بتكوين روابط أحادية وثنائية وثلاثية

d.

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

تستطيع ذرات الكربون أن تكون سلاسل مستقيمة وأخرى متفرعة وحلقات أيضًا

The methane molecule can be represented by the following models

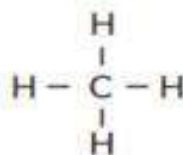
molecular
formula

- It shows the type and number of atoms
- Do not show the geometry of the molecule



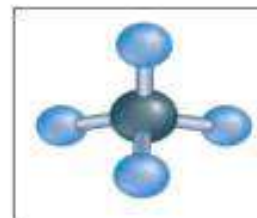
structural
formula

- It shows the general arrangement of atoms in a molecule
- Does not show the 3D figure



ball and stick
model

- It shows the type of atoms in the molecule
- It clearly shows the geometry of the molecule



fill in the blank
form

- It gives a more realistic picture of the molecule if it can be seen in reality
- It is difficult to determine the type of bonds in a molecule





12. Scientists use different models to represent structure, so which of the following models clearly shows the molecular geometry?

12. يستخدم العلماء نماذج مختلفة لتمثيل الهيكل ، أي النماذج التالية يظهر هندسة الجزيئ بشكل واضح؟

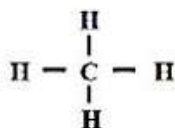
A



B



C



D



A

B

C

D

44. Chemists represent organic molecules in various ways. Which of the following is correct regarding the model shown in the figure below?

- A Shows the general arrangement of molecules, but does not accurately show the three-dimensional shape. Clearly shows the geometry of the molecule.
- B Gives a more realistic picture of what the molecule might look like when viewed.
- C Shows the type of atoms that make up the molecule and the number of each type.

44. يمثل علماء الكيمياء الجزيئات العضوية بأساليب متنوعة أي مما يأتي صحيح فيما يتعلق بالنموذج الموضح بالشكل أدناه؟



يظهر الترتيب العام للجزيئات و لكنه لا يظهر الشكل

ثلاثي الأبعاد بدقة

يظهر هندسة الجزيئ بشكل واضح

يعطي صورة أكثر واقعية لما قد يبدو عليه الجزيئ عند رؤيته

يوضح نوع الذرات التي يتكون منها الجزيئ و عدد كل نوع



32. Which of the following is correct?

32. 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 the structural formula and shows the general arrangement of atoms in the molecule, but it does not show the exact three-dimensional conformation.
- Model 2** is called the space-filling model and clearly shows the geometry of the molecule.
- Model 3** is called the ball-and-stick model and gives a more realistic picture of what the molecule might look like when viewed.
- Model 1** is called the space-filling model and gives a more realistic picture of what the molecule might look like when viewed.

- النموذج 1 يسمى الصيغة البنائية و تظهر التركيب العام للذرات في الجزيء لكنها لا تظهر التشكيل ثلاثي الأبعاد بدقة
- النموذج 2 يسمى النموذج ملء الفراغ و يظهر هندسه الجزيء بشكل واضح
- النموذج 3 يسمى النموذج الكره والعصا و يعطي صورته أكثر واقعيه لما قد يبدو عليه الجزيء عند رؤيته
- النموذج 1 يسمى نموذج ملء الفراغ و يعطي صورته أكثر واقعيه لما قد يبدو عليه الجزيء عند رؤيته

A

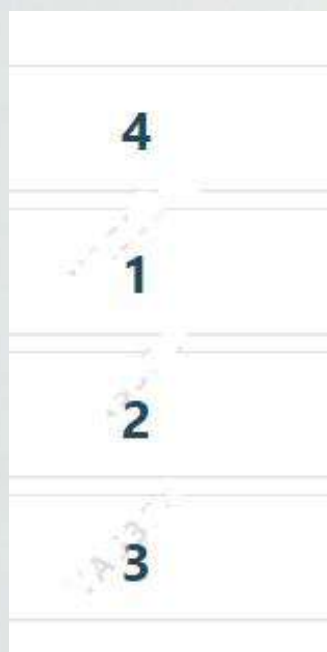
B

C

D



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

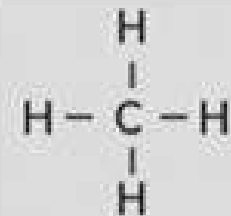


المعلومات التي تُعطيها The information they give	اسم النموذج (الصيغة) Name of model (Formula)	النموذج (الصيغة) Model (Formula)	
يُظهر هندسة الجزيء بشكل واضح Demonstrates the geometry of the molecule clearly	نموذج ملء الفراغ The space-filling model		1
يُظهر هندسة الجزيء بشكل واضح Demonstrates the geometry 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



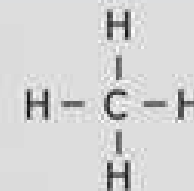
Which of the following methane models (formulas) gives a more realistic picture of what a molecule would look like if you could see it?

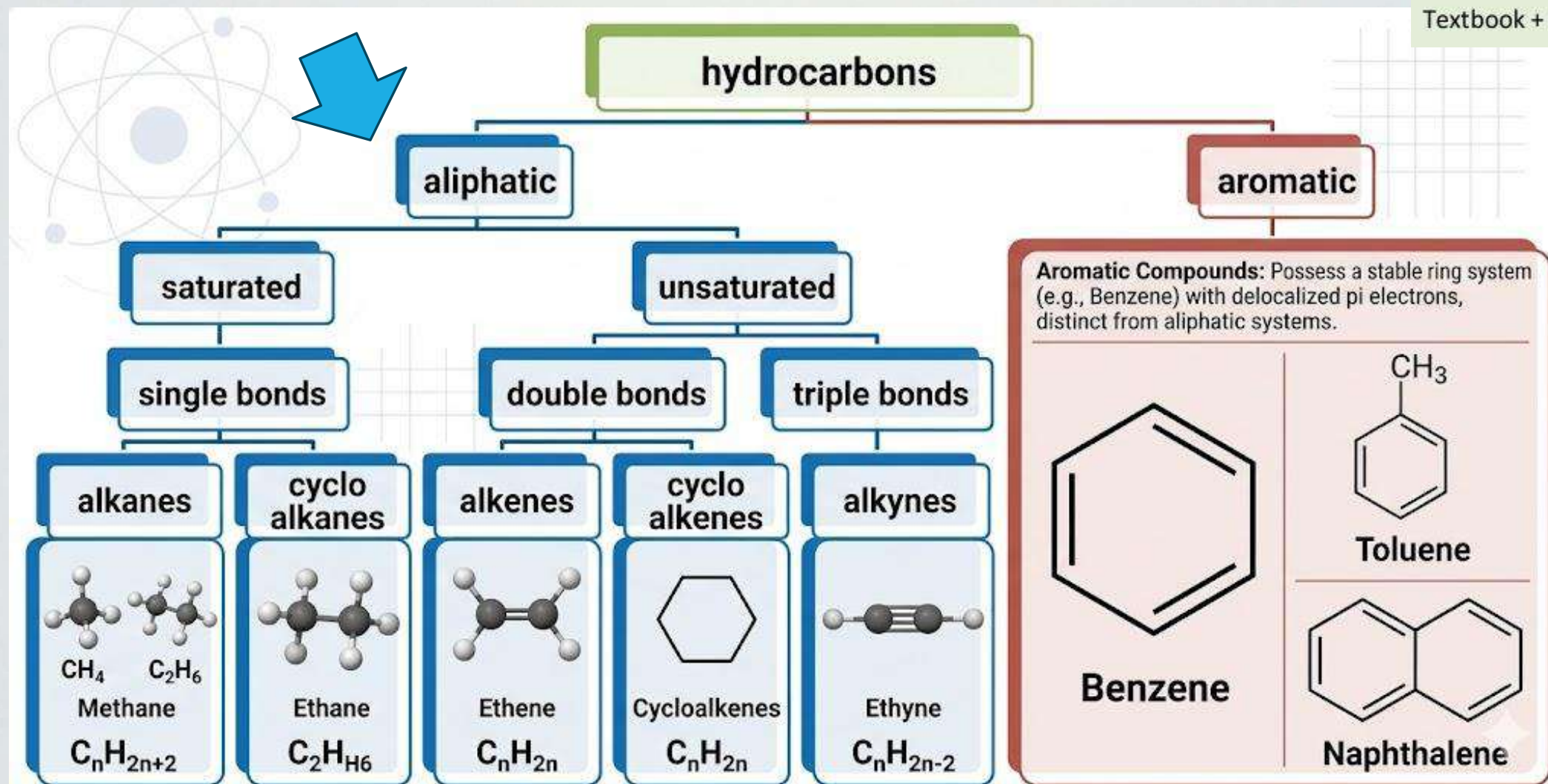
أي من نماذج (صيغ) الميثان التالية يُعطي صورة أكثر واقعية لما قد يبدو عليه الجزيء عند رؤيته؟



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؟







Which of the following correctly describes an **unsaturated** hydrocarbon?

- A Contains only single covalent bonds between carbon atoms and does not react with bromine.
- B Contains only single covalent bonds between carbon atoms and reacts with bromine.
- C Contains double or triple covalent bonds between carbon atoms and reacts with bromine.
- D Contains double or triple covalent bonds between carbon atoms and does not react with bromine.

What are the similarities between alkenes and alkanes?

- A Both contain double bonds
- B Both contain triple bonds
- C Both are **saturated** hydrocarbons
- D Both are **unsaturated** hydrocarbons

Regarding the compounds in the table below, which is **unsaturated** hydrocarbon?

$\text{H} - \text{C} \equiv \text{C} - \text{H}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array}$
3	2	1

The compound **1** only

The compounds **2, 3**

The compound **2** only

The compounds **1, 3**

13. In general, **saturated** hydrocarbons are characterized by:

- A) Containing single bonds between carbon atoms only.
- B) Containing double or triple bonds between carbon atoms.
- C) Having the general formula $\text{C}_n\text{H}_{2n+2}$.
- D) Having the general formula C_nH_{2n} .

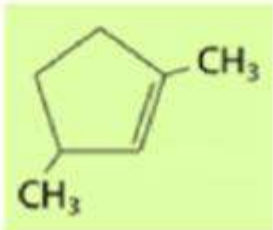
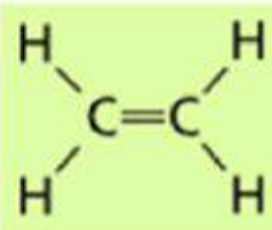
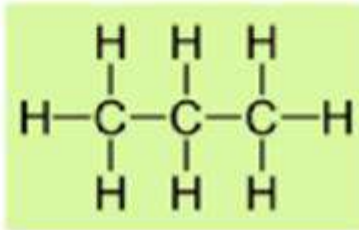


Which of the compounds shown in the table below is **an unsaturated** hydrocarbon?

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

أي من المركبات الواردة في الجدول أدناه يُعتبر هيدروكربون غير مشبع؟

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

3	2	1
		



11

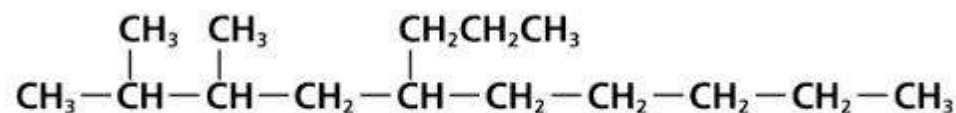
CHM.5.6.01.013.02 Use IUPAC system to name aliphatic alkanes (straight chain, branched, non-substituted and substituted)

12

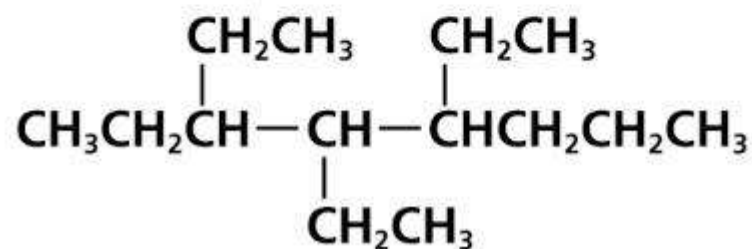
CHM.5.6.01.013.03 Use IUPAC system to name cycloalkanes (non-branched, branched, non-substituted and substituted)

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

a. 2,3-dimethyl-5-propyldecane

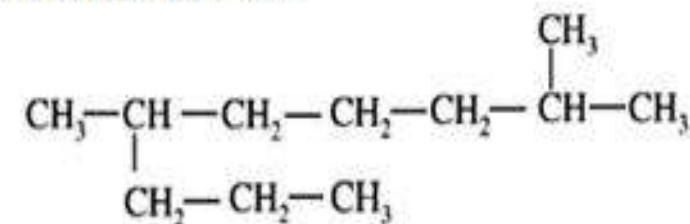


b. 3,4,5-triethyloctane

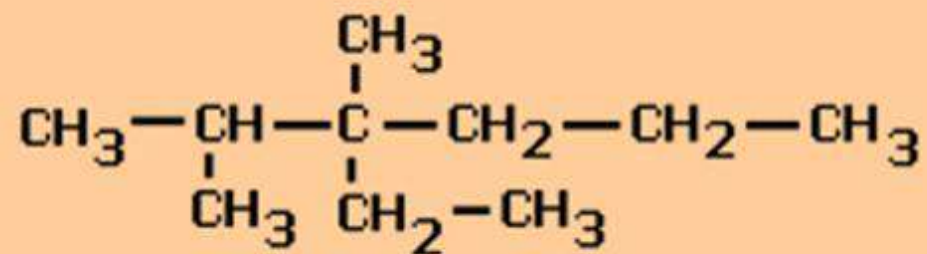


3. Using IUPAC naming rules, what is the correct name for the following alkane?

ما الاسم الصحيح



- A 2-methyl - 6 - propyl heptane
- B 2 - propyl - 6 methyl heptane
- C 2, 6 - dimethyl nonane
- D 4, 8 - dimethyl nonane



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

3 - methyl - 3 - isopropyl heptane

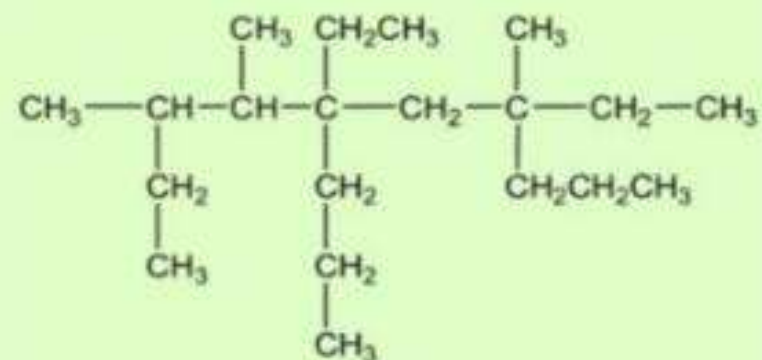
2 ,3 - dimethyl - 3 - ethyl hexane

3 - ethyl - 2 ,3 - dimethyl hexane

3 - isopropyl - 3 - methyl heptane

1. What is the name of the following hydrocarbon according to the IUPAC system?

- a. 5-ethyl-3,4,7-trimethyl-5,7-dipropylnonane
- b. 5,7-diethyl-3,4,7-trimethyl-5-propyldecane
- c. 5-propyl-5,7-diethyl-3,4,7-trimethyldecane
- d. 3,4,7-trimethyl-5-ethyl-5,7-dipropylnonane

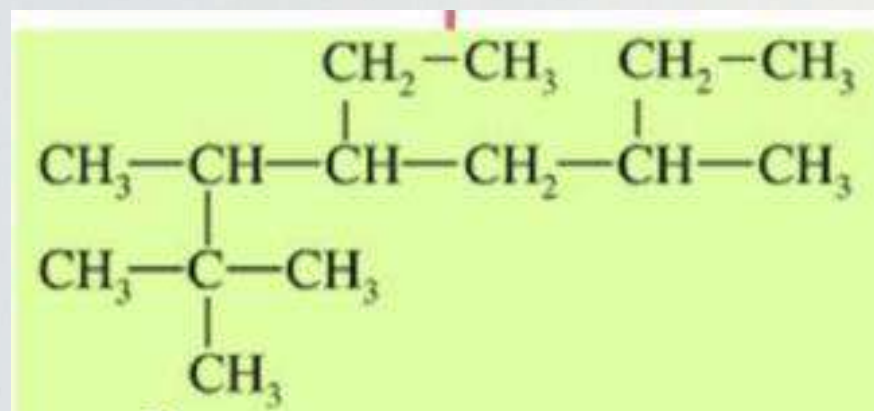




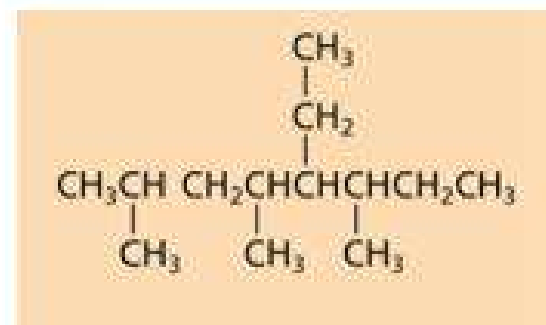
What is the name of the following alkane

Using IUPAC rules?

- A – 2,2,3- trimethyl – 4,6 – diethyl heptane
- B – 4,6- diethyl – 2,2 ,3 – trimethyl heptane
- C – 3,6,7,7- tetramethyl- 5– ethyl octane
- D - 4 – ethyl-2,2,3,6- tetramethyl octane



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



3,5,7 – trimethyl – 4 – ethyl octane

4 – ethyl – 3 ,5,7 – trimethyl octane

5 – ethyl – 2,4,6 – trimethyl octane

2,4,6 – trimethyl – 5 – ethyl octane

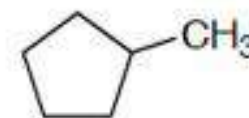


Naming Cycloalkanes

General Formula: $C_nH_{(2n)}$

1. Parent Chain

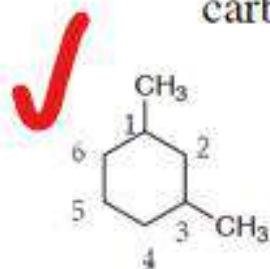
- Use the cycloalkane as the parent chain if it has a greater number of carbons than any alkyl substituent.
- If an alkyl chain off the cycloalkane has a greater number of carbons, then use the alkyl chain as the parent and the cycloalkane as a **cycloalkyl-** substituent.



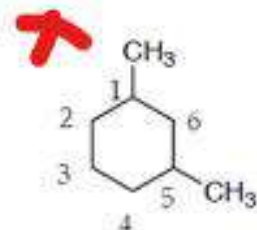
Methylcyclopentane

2. Numbering the Cycloalkane

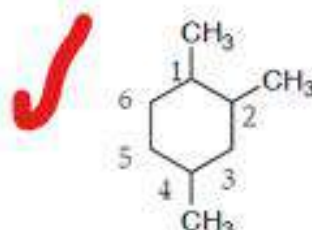
- When numbering the carbons of a cycloalkane, start with a substituted carbon so that the substituted carbons have the lowest numbers (sum).



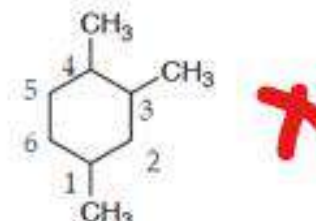
1,3-Dimethylcyclohexane



-not-
1,5-Dimethylcyclohexane



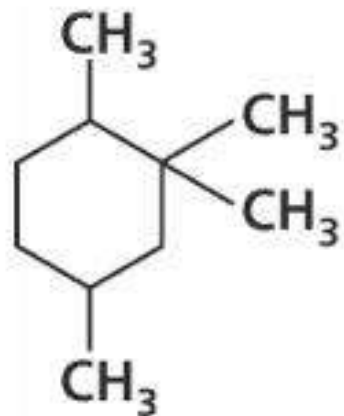
1,2,4-Trimethylcyclohexane
(1 + 2 + 4 = 7)
yousef sarayrah



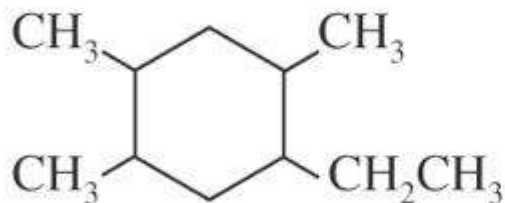
-not-
1,3,4-Trimethylcyclohexane
(1 + 3 + 4 = 8)



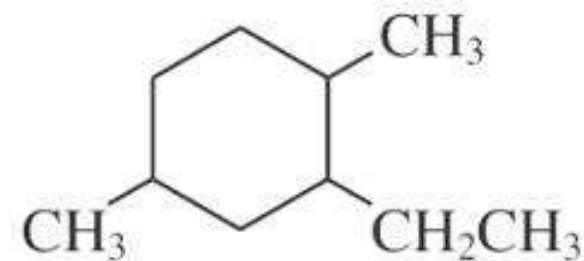
1,2,2,4-tetramethylcyclohexane



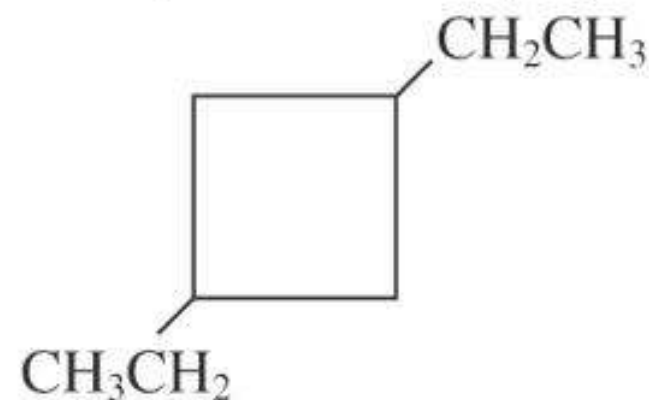
2,2-dimethylpropane



1-ethyl-2,4,5-trimethylcyclohexane



2-ethyl-1,4-dimethylcyclohexane

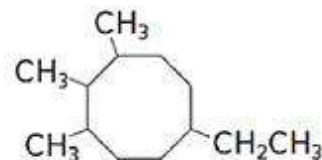


1,3-diethylcyclobutane



8. Using IUPAC naming rules, what is the correct name for the following cyclic compound?

اسم المركب



- A 1 - ethyl - 4, 5, 6 - trimethyl cyclooctane
- B 2 - 1, 3 - trimethyl - 6 - ethyl cyclooctane
- C 6 - ethyl - 1, 2, 3 - trimethyl cyclooctane
- D 4 - ethyl - 1, 7, 8 - trimethyl cyclooctane

حلقي

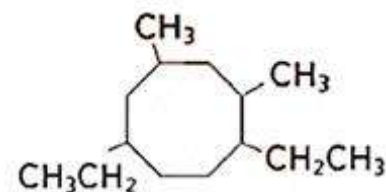
حلقي

حلقي

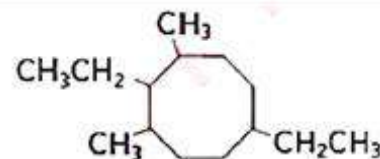
حلقي

75. What is the correct structure for the compound 1,6-dimethyl-2,3-dimethylcyclooctane? (2022)

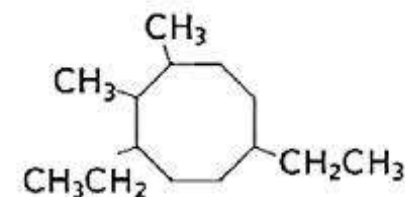
A



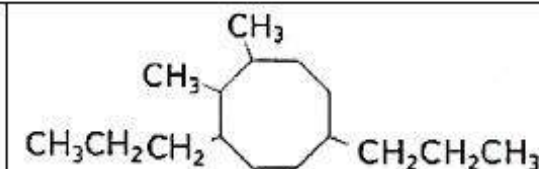
B



C



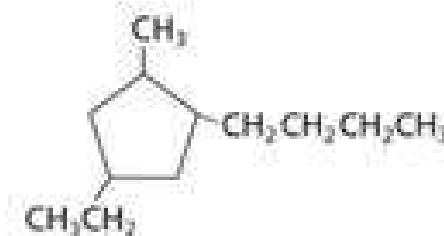
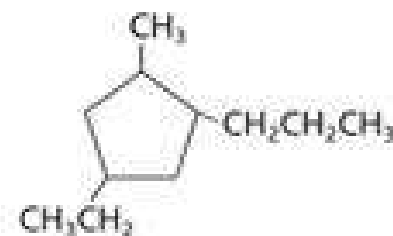
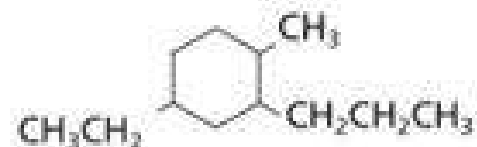
D





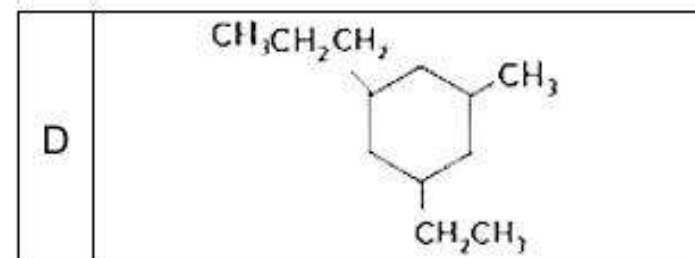
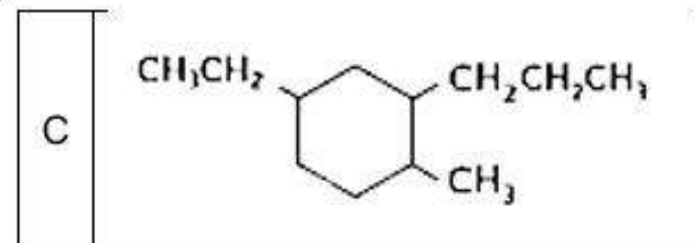
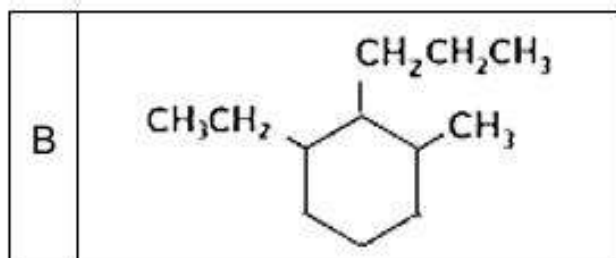
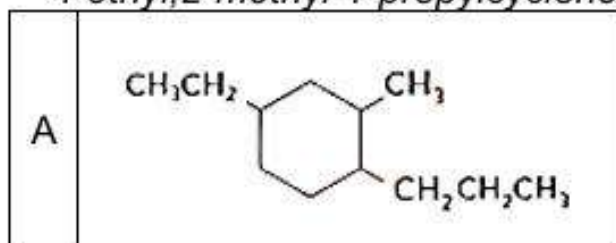
What is the correct structural formula for the compound:

1 - ethyl - 3 - methyl - 4 - propylcyclopentane?



Which of the following structural formulas is the

4-ethyl,2-methyl-1-propylcyclohexane? (2023)





13

State physical properties of alkanes and its uses

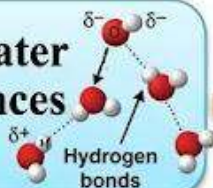
Textbook + figure 11 + table 4

Properties of Alkanes

Why is the water molecule polar?

Because a water molecule has a curved (**bent**) shape and the bond between highly electronegative oxygen and hydrogen is polar.

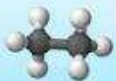
The boiling and melting point of water is much higher than that of substances of similar molecular mass?



Because water molecules are polar and form strong hydrogen bonds with each other, requiring more energy to break.



Why are alkane molecules nonpolar?



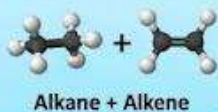
Because carbon-carbon bonds and carbon-hydrogen bonds are *essentially* nonpolar (similar electronegativities), symmetrical structure often cancels any small dipoles.

Alkanes are good solvents for nonpolar materials such as paint solvents, adhesives, and inks?



Because the alkane molecules are nonpolar (like dissolves like).

Why don't alkanes and other hydrocarbons mix with water?



Because the forces of attraction between water molecules (hydrogen bonding) are much *stronger* than the attraction forces between water and nonpolar alkanes. Alkanes interact better with nonpolar molecules.

**Physical properties of Alkanes**

The molecular mass of water is 18 amu and methane is 16 amu. We note that they are close in molecular mass as well as in size. However, we find that:

not required to memorize

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



Why is Water Liquid and Methane Gas?

Water's Boiling Point vs. Methane's

Water's Melting Point vs. Methane's

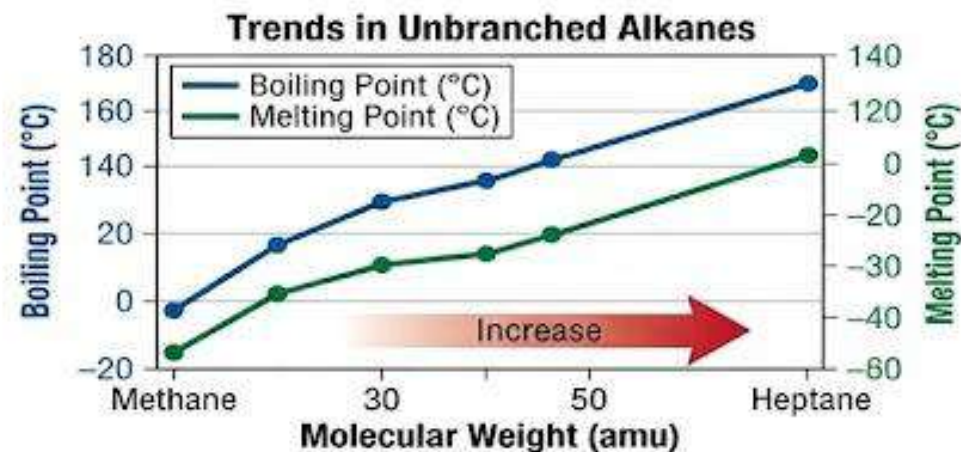
Because methane molecules are nonpolar and do not form hydrogen bonds with each other, water molecules are polar and form hydrogen bonds, so the ability of methane to attract molecules is very low compared to water molecules.



- In general, both boiling and melting points of alkanes increase with increasing molecular weight weak London

Table 11.4 Physical Properties of Some Unbranched Alkanes

Name	Condensed Structural Formula	Molecular Weight (amu)	Melting Point (°C)	Boiling Point (°C)	Density of Liquid (g/mL at 0°C)*
methane	CH ₄	16.0	-182	-164	(a gas)
ethane	CH ₃ CH ₃	30.1	-183	-88	(a gas)
propane	CH ₃ CH ₂ CH ₃	44.1	-190	-42	(a gas)
butane	CH ₃ (CH ₂) ₂ CH ₃	58.1	-138	0	(a gas)
pentane	CH ₃ (CH ₂) ₃ CH ₃	72.2	-130	36	0.626
hexane	CH ₃ (CH ₂) ₄ CH ₃	86.2	-95	69	0.659
heptane	CH ₃ (CH ₂) ₅ CH ₃	100.2	-91	98	0.684



Molecular Structure of Unbranched Alkanes



Methane



Butane



Heptane



27. The molecular mass of methane is close to the molecular mass of water as shown in the table below, and 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

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

	CH ₄	H ₂ O	
Molecular mass	amu 16	amu 18	الكتلة الجزيئية
State at room temperature	Gas غاز	Liquid سائل	الحالة عند درجة حرارة الغرفة
Boiling point	-162°C	100°C	درجة الغليان
Melting point	-182°C	0°C	درجة الانصهار

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

جزيئات الميثان غير قطبية و لا تشكل روابط هيدروجينية بعضها مع بعض

A

B Methane molecules are polar and form hydrogen bonds with each other.

جزيئات الميثان قطبية و تشكل روابط هيدروجينية بعضها مع بعض

B

C Methane molecules have a very high force of attraction between molecules compared to water molecules.

جزيئات الميثان تتميز بقوة عالية جداً لجذب الجزيئات مقارنة بجزيئات الماء

C

D Methane is an organic compound while water is inorganic.

الميثان مركب عضوي بينما الماء غير عضوي

D

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?

Table 1: Molecular Comparison

Substance	Molecular Mass (amu)	Size & Shape Similarity (Ref: Water)
Methane (CH ₄)	16.04	Very Similar
Water (H ₂ O)	18.02	Ref

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

Explanation: Correct answer B. Water's (H₂O) polarity leads to strong hydrogen bonding, resulting in a high boiling point. Methane's (CH₄) nonpolarity results in very weak dispersion forces, hence its low boiling point.



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?

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

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

II, III

I, III

I only

II only

If you try to dissolve alkanes, such as lubricating oils, in water, which of the following is correct?

The two liquids will completely miscible

The attractive forces between alkane molecules are weaker than the attractive forces between the alkane and water molecules

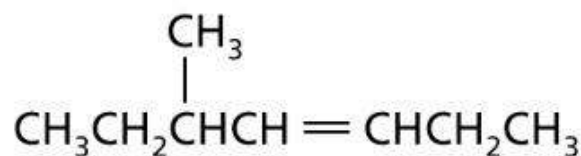
The two liquids separate almost immediately into two phases

Hydrogen bonds are formed between alkane's molecules and water's molecules



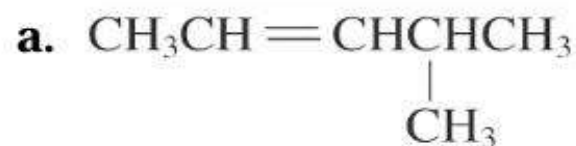
15 | CHM.5.6.01.013.06 Use IUPAC system to name alkenes (straight chain, branched, non-substituted and substituted)

14 | CHM.5.6.01.013.08 Draw the structure of an alkene given its IUPAC name

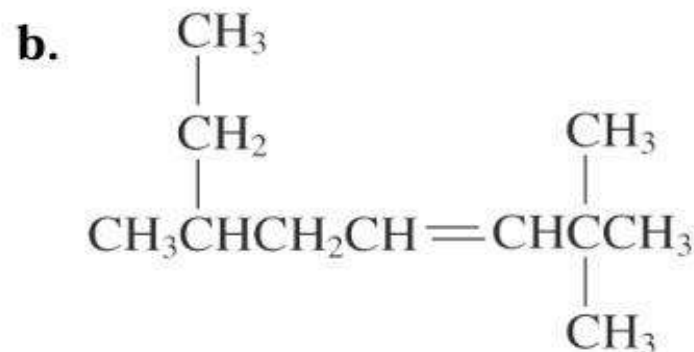


5-methyl-3-heptene

Use IUPAC rules to name the fo



4-methyl-2-pentene



2,2,6-trimethyl-3-octene

Sec. (3) Alkenes and alkynes

Alkenes

Unsaturated hydrocarbons contain double bonds between carbon atoms.

General formula
 C_nH_{2n}

Naming
prefix+ene

- Double bond position should be determined for alkenes with 4 or more carbon atoms in the chain.
- Start from the end of the chain, which gives the smallest number to the first carbon atom in the double bond, then use this number in the name.
- Cyclic alkenes are named in the same way as cyclic alkanes, provided that carbon atom No. 1 is one of the two carbon atoms attached to the double bond, with the lowest number of alternative groups specified.
- Some alkenes contain more than one double bond. The syllable (**di**, **tri**, **tetra**, ...) is written before the syllable (ene) to indicate (**2**, **3**, **4**) double bonds, respectively.



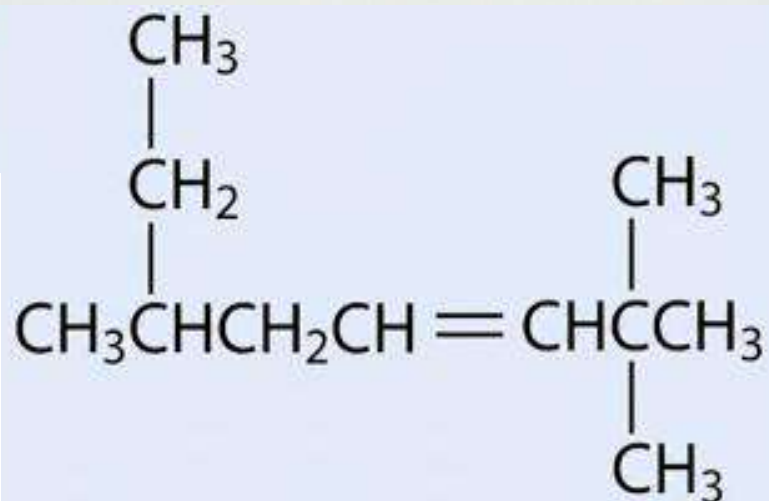
What is the name of the following hydrocarbon according to the (IUPAC) system?

2, 2, 6 – trimethyl – 3 – octene

6 – ethyl – 2 ,2 – dimethyl –3 – heptene

3, 7 ,7 – trimethyl – 5 – octene

2 ,2 – dimethyl –6 – ethyl –3 – heptene

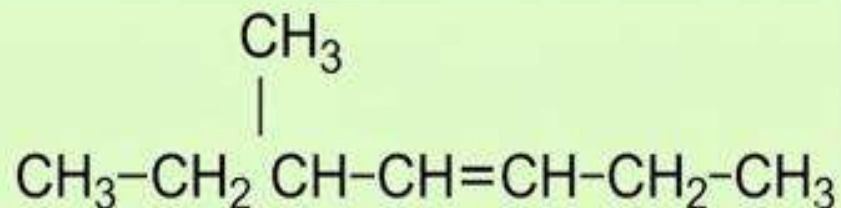


3 – methyl – 4 – heptene

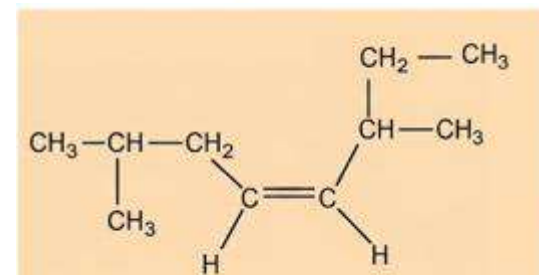
5 – methyl – 3 – heptyne

5 – methyl – 3 – heptene

3 – methyl – 4 heptyne



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



2 – ethyl – 6 – methyl – 3 – heptene

6- methyl – 2 – ethyl – 3 – heptyne

2, 6 – dimethyl – 4 – octene

3, 7 – dimethyl – 4 – octyne



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

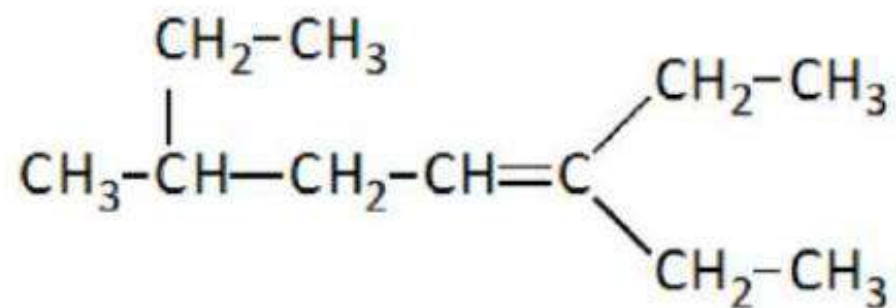
ما الاسم الصحيح للألكين ذو الصيغة البنائية التالية؟

A - 3 - ميثيل - 6 - إيثيل - 5 - أوكتين

B - 6 - إيثيل - 3 - ميثيل - 5 - أوكتين

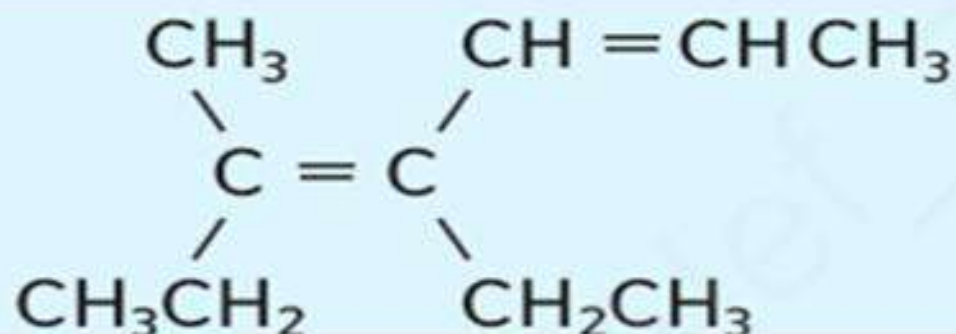
C - 3 - إيثيل - 6 - ميثيل - 3 - أوكتين

D - 6 - ميثيل - 3 - إيثيل - 3 - أوكتين





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



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

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

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

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

What is the correct structural formula of the compound
(3 -ethyl - 4 - methyl 1, 4 - hexadiene)?

Structural Formula	الصيغة البنائية	الرمز Symbol
$\text{CH}_3 - \text{C} \equiv \text{C} - \overset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_2 - \text{CH}_3$		A
$\text{CH}_3 - \text{CH} = \overset{\text{CH}_3}{\underset{\text{CH}_3}{ \text{C}}} - \underset{ }{\text{CH}} - \text{CH} = \text{CH}_2$		B
$\text{CH}_3 - \text{CH} = \overset{\text{CH}_3}{\underset{\text{CH}_3 - \text{CH}_2}{ \text{C}}} - \underset{ }{\text{CH}} - \text{CH} = \text{CH}_2$		C
$\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_3$		D



16

CHM.5.6.01.013.07 Use IUPAC system to name alkynes (straight chain and branched)

Textbook + table 6 + check your progress

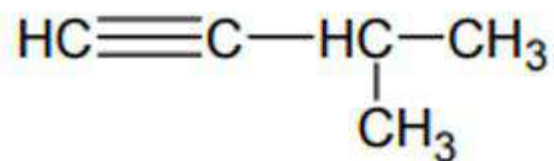
80 , 81

Alkynes

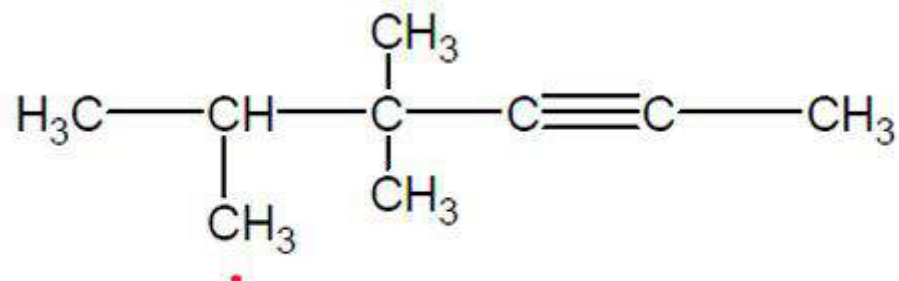
Unsaturated hydrocarbons contain a triple bond between carbon atoms.

General formula**Naming**
prefix+yne

- Alkynes are named in the same way as alkenes, with the exception that the name of the parent chain ends in **-yne**



3-methyl-1-butyne



4,4,5-trimethyl-2-hexyne

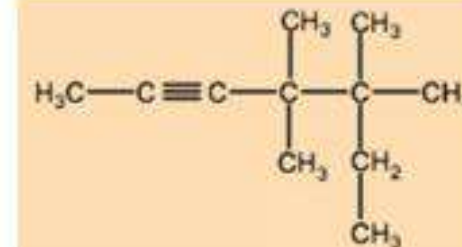
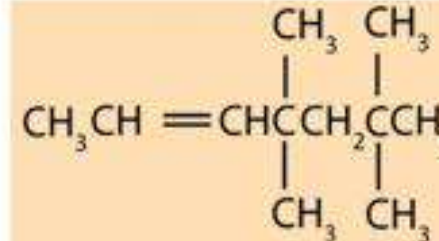
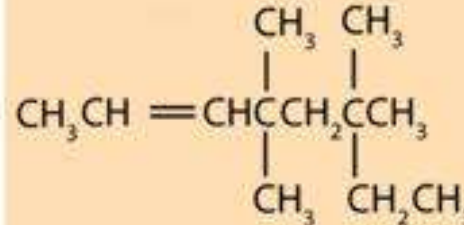
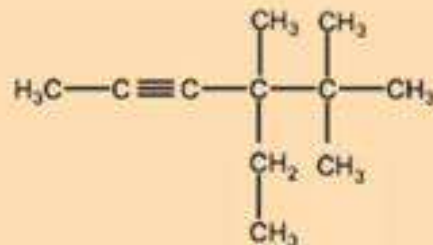


What is the correct structural formula for the compound:

4,4,5,5 – tetramethyl –2–heptyne?

ما الصيغة البنائية الصحيحة للمركب:

4 ، 4 ، 5 ، 5 – رباعي ميثيل – 2 – هبتاين؟

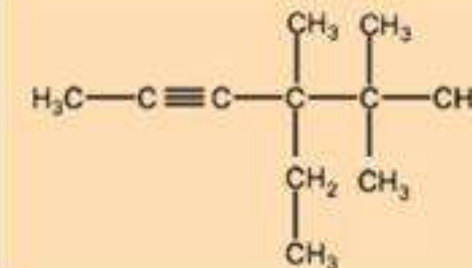
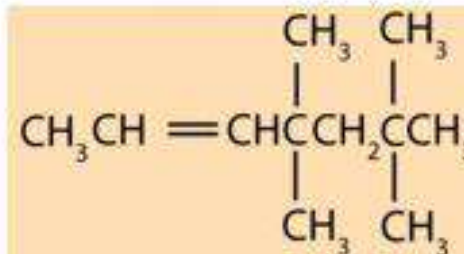
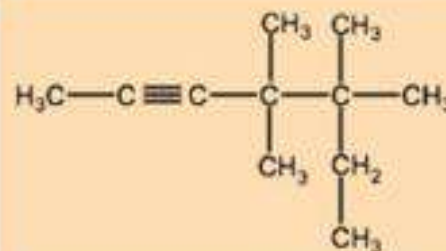
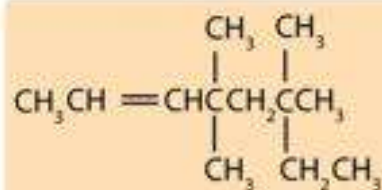


What is the correct structural formula for the compound:

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

ما الصيغة البنائية الصحيحة للمركب:

4 – إيثيل – 4 ، 5 ، 5 – ثلاثي ميثيل – 2 – هكساين؟

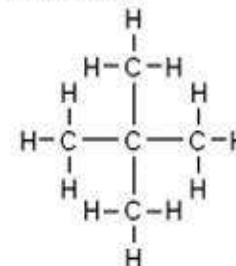
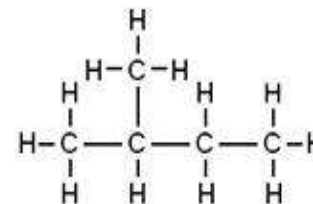
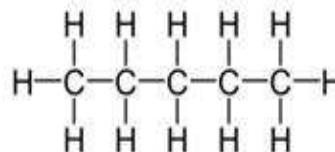




17 CHM.5.6.01.004.01 Define the term structural isomers (and illustrate their similarities and differences)

	Structural isomers
Molecular formula	similar
Structural formula	different
Physical and chemical properties	different
Naming	different names
Conditions	they have the same molecular formula and differ in structural formula and name

Regarding the isomers in the table below, which of the following is correct?



- A) All of them are isomers and differ in physical properties.
 B) All of them are isomers and are similar in physical properties.
 C) Compounds 1 and 2 are isomers and differ in physical properties.
 D) Compounds 2 and 3 are isomers and differ in physical properties.

What are the similarities between the three compounds?

22. ما أوجه الشبه بين المركبات الثلاث؟

2-ميثيل بيوتان	2,2 - ثنائي ميثيل البروبان	بنتان
2-methylbutane	2,2-Dimethylpropane	Pentane

- A All have the same structural formula
 جميعها لها نفس الصيغة البنائية
- B All have the same number of carbon atoms and hydrogen atoms
 جميعها لها نفس عدد ذرات الكربون و عدد ذرات الهيدروجين
- C All are geometric isomers
 جميعها أيزومرات هندسية
- D All have the same chemical and physical properties
 جميعها لها نفس الخصائص الكيميائية و الفيزيائية



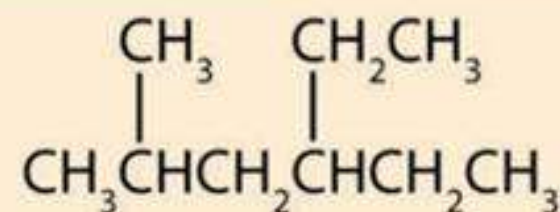
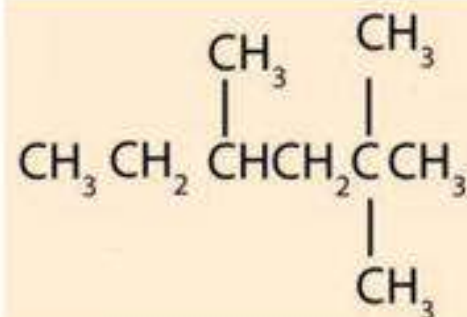
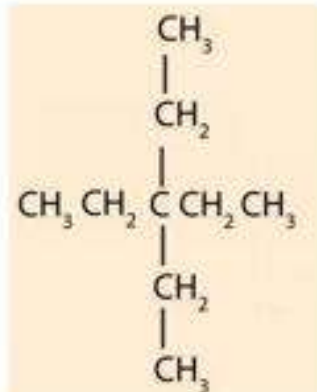
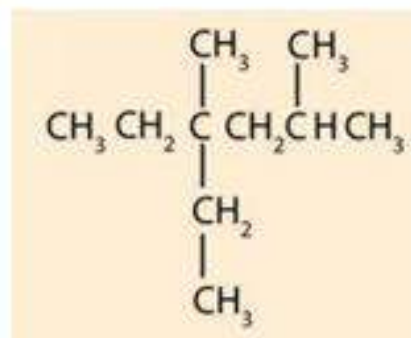
Which of the following formulas **does not** represent

أي من الصيغ التالية **لا** تمثل أيزومرا بنائيا للمركب:

a structural isomer of the compound:

3 - إيثيل - 2 - ميثيل هكسان؟

3- Ethyl-2-methyl hexane?



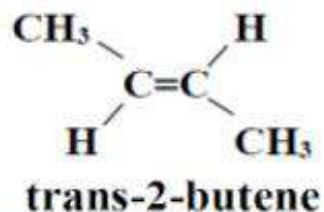
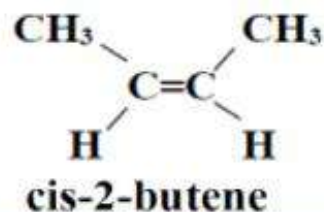
Which of the following compounds is **not** a structural isomer for the other three compounds?

2, 3 - ثنائي ميثيل بنتان 2,3 - dimethyl pentane	1
2 - ميثيل هكسان 2 - methyl hexane	2
2, 2 - ثنائي ميثيل بيوتان 2,2 - dimethyl butane	3
3 - ميثيل هكسان 3 - methyl hexane	4

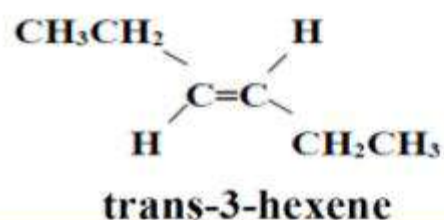
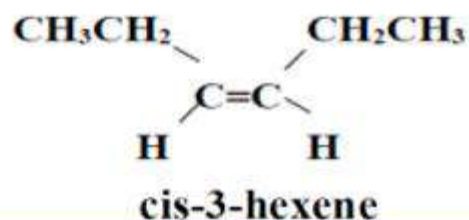


18

CHM.5.6.01.011.02 Describe the difference between cis- and trans- isomers in terms of geometrical arrangements



They have the same molecular and structural formula and differ in the arrangement and orientation of groups around the double bond, so they form geometric isomers.



They have the same molecular and structural formula and differ in the arrangement and orientation of groups around the double bond, so they form geometric isomers.



Which of the hydrocarbons below forms geometric

$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$	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

II only

II, III only

I only

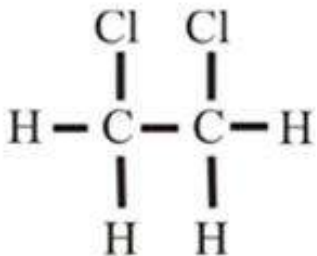
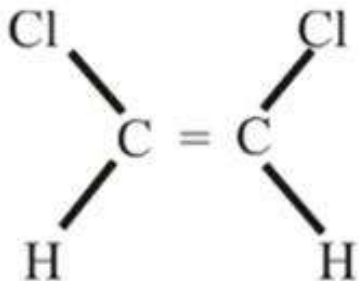
Which of the hydrocarbons below forms geometric isomers?

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



Regarding the two compounds in the table below.

Which of the following is true?

	
2	1

- a. rotation is possible in compound 1 and it cannot form geometric isomers
- b. rotation is impossible in both compounds 1, 2 and they can form geometric isomers
- c. rotation is possible in both compounds 1,2 and they cannot form geometric isomers
- d. rotation is possible in compound 2 and it cannot form geometric isomers



Regarding the two compounds in the table below.

Which of the following is true?

$\text{CH}_3\text{CH}=\text{CHCH}_3$	$\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$
2	1

Both compounds can form geometric isomers

Only compound **1** can form geometric isomers

Both compounds cannot form geometric isomers

Only compound **2** can form geometric isomers

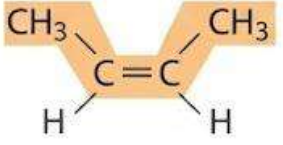
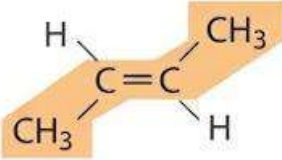
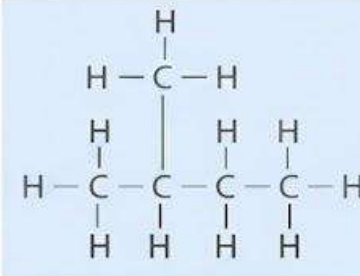
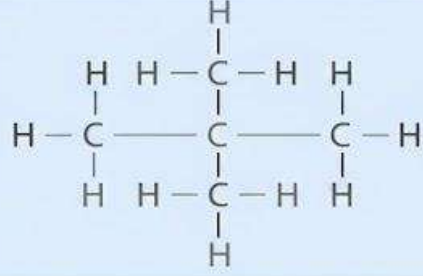
Which of the hydrocarbons below forms geometric isomers?

$\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$	C	$\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)=\text{CH}_2$	A
$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	D	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}\equiv\text{C}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	B



Regarding the isomers in the table below, which of the following is correct?

فيما يتعلق بالأيزومرات في الجدول أدناه، أي مما يأتي صحيح؟

			
4	3	2	1

The isomers **1** and **2** differ in their geometric shapes

يختلف الأيزومران **1** و **2** في أشكالهما الهندسية ☐

The isomers **1** and **2** are similar in their boiling points and melting points

يتشابه الأيزومران **1** و **2** في درجات الغليان والانصهار ☐

The isomers **3** and **4** differ in their geometric shapes

يختلف الأيزومران **3** و **4** في أشكالهما الهندسية ☐

The isomers **2** and **3** have the same structural formula

يتشابه الأيزومران **2** و **3** في الصيغة البنائية ☐



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

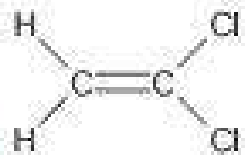
فيما يتعلق بالمركبات الواردة في الجدول أدناه . أي

الآراء التالية صحيحة؟

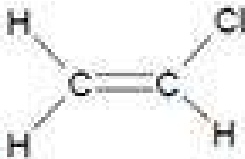
- A - يستطيع المركب **1** تكوين أيزومرات هندسية بسبب ارتباط كل ذرة كربون بذرات مختلفة
- B - يستطيع المركب **2** تكوين أيزومرات هندسية بسبب وجود الرابطة الثنائية
- C - يستطيع المركب **3** تكوين أيزومرات هندسية بسبب وجود الرابطة الثنائية وارتباط كل من ذرتي الكربون حولها بذرات ومجموعات مختلفة
- D - المركبات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

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



48) Why: The following compound  does not form geometric isomers?

Because the substituents are on one side of the bond

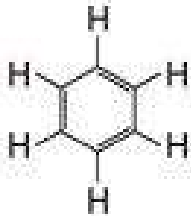
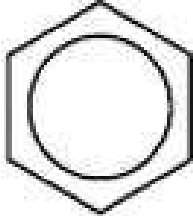
49) Why: The following compound  does not form geometric isomers?

Because there are no two different groups attached to the two carbon atoms, there is one substituent (one chlorine atom).

50) Why: The following compound $H-C\equiv C-H$ does not form geometric isomers?

Because the arrangement of atoms in space will not form any position (cis nor trans)



The first stage	The second stage	The last
$\text{CH}_2 = \text{C} = \text{CH} - \text{CH} = \text{C} = \text{CH}_2$		
This hydrocarbon is unstable and extremely reactive because it has multiple bonds. Benzene is unreactive, so this formula is not correct.	Friedrich August Kekulé proposed this structure for benzene. A hexagon of carbon atoms with alternating single and double bonds.	After proposing Linus Pauling theory of hybrid orbitals, the electron pairs are suggested to be delocalized, which means they are shared among all six carbons in the ring.

Explain benzene's structure and how it makes the molecule unusually stable.

The electron pairs in benzene are delocalized and shared by all six carbon atoms in the ring. Benzene is relatively unreactive because the electrons are harder to pull away from six carbon atoms.

Describe the properties of benzene that made chemists think it was not an alkene with several double bonds.

Benzene is much less reactive than alkenes with multiple double bonds, which usually are very unstable. When benzene did react, the reactions were not similar to those of alkenes.



Kekulé had proposed the flat, hexagonal structure of benzene shown in figure 1. While the theory of hybrid orbitals helped to propose the figure 2.

Which of the following is true?

اقترح كيكوليه التركيب المُسطح والسداسي للبنزين الموضح في

الشكل 1، بينما ساعدت نظرية الأفلاك المهجنة على اقتراح

لشكل 2 . أي مما يأتي صحيح؟

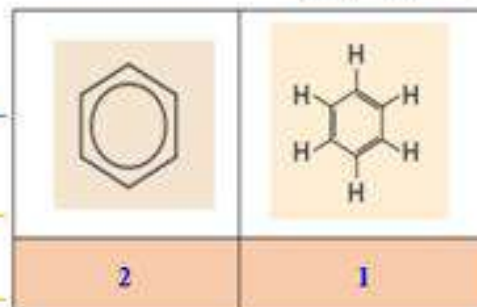


Figure 2 helped explain the stability of benzene

ساعد الشكل 2 على تفسير استقرار البنزين

In The figure 2 the pairs of electrons that form the second bonds are localized between only two specific carbon atoms

في الشكل 2 تقع أزواج الإلكترونات التي تُشكل الروابط الثنائية بين اثنين فقط من ذرات الكربون

Figure 1 helped explain the benzene's unreactivity

ساعد الشكل 1 على تفسير عدم تفاعلية البنزين

In The figure 1 the pairs of electrons that form the second bonds are shared among all six carbons in the ring

في الشكل 1 تكون أزواج الإلكترونات التي تُشكل الروابط الثنائية مشتركة بين ذرات الكربون الست



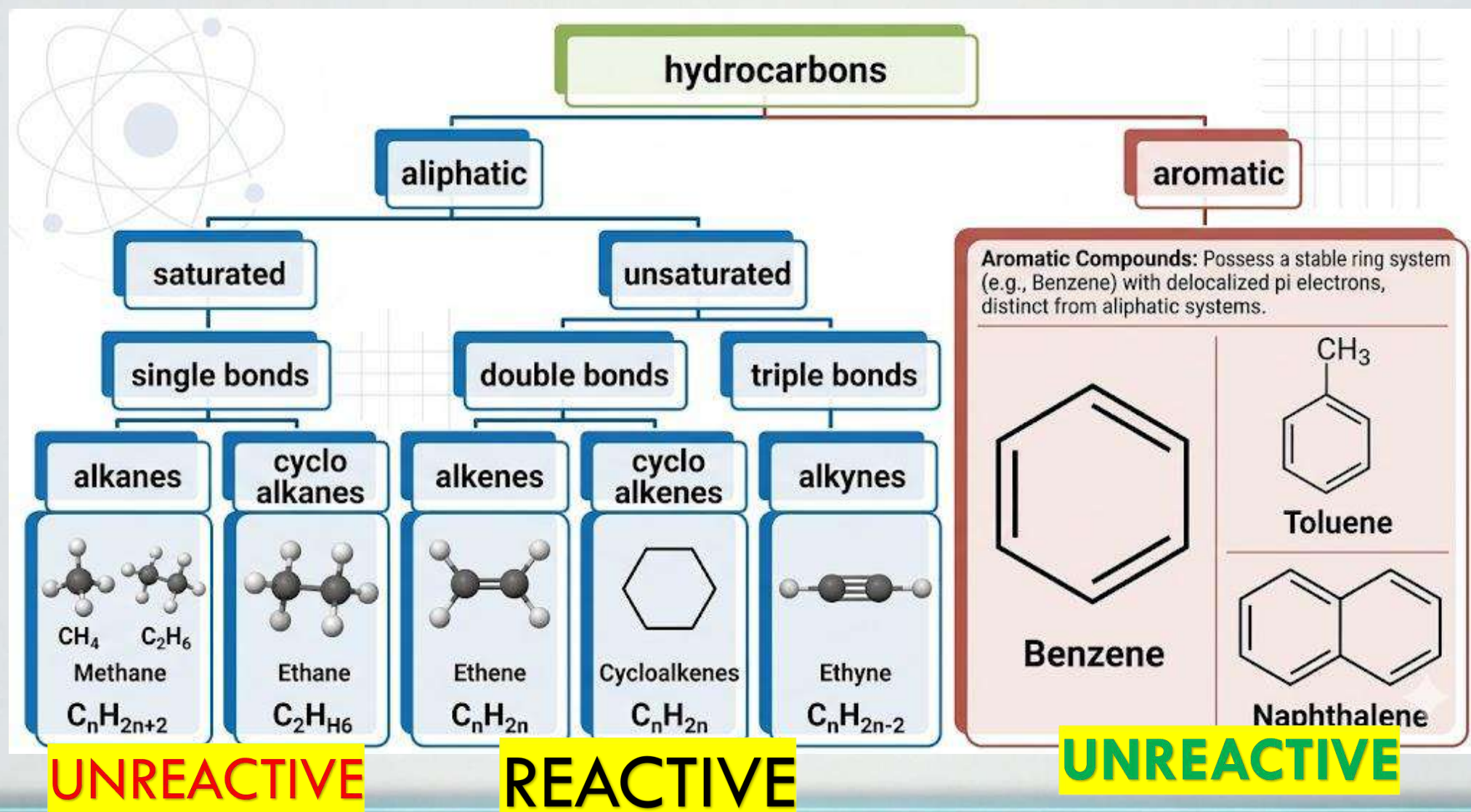
10. The simplest example of aromatic hydrocarbons is benzene C_6H_6 , and chemists proposed several molecular formulas for benzene. Which of the following is correct?

- A Formula 1 represents the modern model of the benzene molecule and explains the chemical instability of benzene.
- B Formula 2 represents the modern model of the benzene molecule and explains the chemical instability of benzene.
- C Formula 3 illustrates the chemical stability of benzene.
- D Formula 3 is an unstable and extremely reactive aromatic hydrocarbon.

10. أبسط مثال على الهيدروكربونات الأروماتية هو البنزين C_6H_6 ، واقترح الكيميائيون عدة صيغ جزيئية للبنزين، أي مما يلي صحيح ؟

- A الصيغة 1 تمثل النموذج الحديث لجزيء البنزين و هي تفسر عدم الاستقرار الكيميائي للبنزين
- B الصيغة 2 تمثل النموذج الحديث لجزيء البنزين و هي تفسر عدم الاستقرار الكيميائي للبنزين
- C الصيغة 3 توضح الاستقرار الكيميائي للبنزين
- D الصيغة 3 هيدروكربون أروماتي غير مستقر ومتفاعل لأقصى درجة

CHM.5.6.01.009.04 Distinguish among aliphatic and aromatic hydrocarbons





74. Which of the following statements correctly describes aromatic compounds? (Advanced - 2022)

- (A) Some of them have a branched chain.
- (B) **Benzene** is considered the simplest aromatic hydrocarbon.
- (C) Many of them are found in essential oils extracted from flowers and fruits.
- (D) They can consist of one **benzene** ring or more.

Explain how aromatic hydrocarbons differ from aliphatic hydrocarbons.

Aromatic compounds contain benzene rings in their structures and aliphatic hydrocarbons are straight-chain or branched-chain structures.

In relation to the compounds in the table below.

Which of the following statements is correct?

- A – The compounds 1 , 2 are aliphatic hydrocarbons
- B – The compounds 1 , 2 are aromatic hydrocarbons
- C – The compounds 1 , 2 are aromatic hydrocarbons
- D – Compound 3 is an reactive aromatic

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

نمما يتعلق بالمركبات الواردة في الجدول أدناه.

ي العبارات التالية صحيحة ؟

- أ - المركبان 1 و 2 هيدروكربونات أليفاتية منخفضة النشاطية
- ب - المركبان 1 و 2 هيدروكربونات أروماتية منخفضة النشاطية
- ج - المركب 3 هيدروكربون أروماتي خامل إلى حد ما
- د - المركب 3 هيدروكربون أروماتي غير مستقر ومتفاعل لأقصى درجة



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



21

CHM.5.6.01.003.18 Define functional group and give examples

Which substituted hydrocarbons below agrees with its corresponding general formula in the following table?

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 and 3

3 and 4

1 and 4

	Compound type	General formula	Functional group	
1	Halocarbon	$\text{R}-\text{X}$ (X= F, Cl, Br, I)	halogen	F, Cl, Br, I
2	Alcohol	$\text{R}-\text{OH}$	hydroxyl	$-\text{OH}$
3	Ether	$\text{R}-\text{O}-\text{R}'$	ether	$-\text{O}-$
4	Amine	$\text{R}-\text{NH}_2$	amino	$-\text{NH}_2$
5	Aldehyde	$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{H} \end{array}$	carbonyl	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}- \end{array}$
6	Ketone	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{R}' \end{array}$		
7	Carboxylic Acid	$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{OH} \end{array}$	carboxyl	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{OH} \end{array}$
8	Ester	$\begin{array}{c} \text{O} \\ \parallel \\ *-\text{C}-\text{O}-\text{R} \end{array}$	ester	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{O}- \end{array}$
9	Amide	$\begin{array}{c} \text{O} \quad \text{H} \\ \parallel \quad \\ *-\text{C}-\text{N}-\text{R} \end{array}$	amide	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{NH}- \end{array}$

What are the organic compounds that contain one or more nitrogen atoms bonded to carbon atoms in aliphatic chains or aromatic rings?

ما المركبات العضوية التي تحتوي على ذرة نيتروجين واحدة أو أكثر مرتبطة مع ذرات كربون في سلاسل أليفاتية أو حلقات أروماتية؟

Alcohols

Amines

Ethers

Aldehydes

What is the general formula of amines?

ما الصيغة العامة للأمينات؟





What is The functional group that **aldehydes** have?

جموعة الوظيفية التي تحتوي عليها **الألدهيدات**؟

D	C	B	A
- X	$\text{—}\overset{\text{O}}{\parallel}\text{C—OH}$	- OH	$\text{—}\overset{\text{O}}{\parallel}\text{C—H}$

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

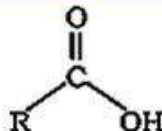
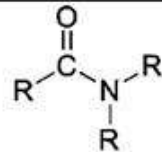
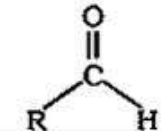
ما المجموعة الوظيفية التي توجد في **الكحولات**؟

D	C	B	A
- X	$\text{—}\overset{\text{O}}{\parallel}\text{C—OH}$	- OH	$\text{—}\overset{\text{O}}{\parallel}\text{C—H}$



1) Which of the carbon derivatives below agrees with its corresponding general formulas in the following table? (2024)

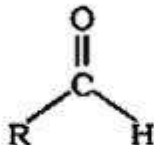
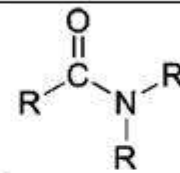
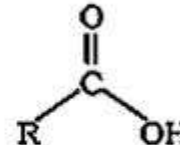
- A) 1 and 2
B) 2 and 3
C) 1 and 4
D) 3 and 4

	Compound	General formula
1	Aldehyde	
2	Ether	$R-O-R'$
3	Amide	
4	Carboxylic Acid	

24) Which of the following is correct regarding the hydrocarbon derivatives in the table below?

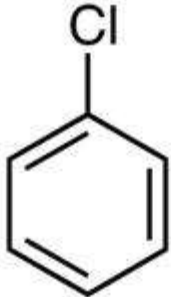
(2023)

- A) 1
B) 2
C) 3
D) 4

General formula		$R-O-R'$		
1	Carboxylic acid	Ether	Amide	Aldehyde
2	Aldehyde	Ether	Amide	Carboxylic acid
3	Ether	Aldehyde	Amide	Carboxylic acid
4	Amide	Aldehyde	Carboxylic acid	Ether



94) Which of the following is an example of an organic compound containing a halogen covalently bonded to an alkyl group?

$\text{CH}_3\text{—O—CH}_2\text{CH}_3$		$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHBr}_2$	$\text{CH}_3\text{CH}_2\text{CHO}$
A	B	C	D

3. The general formula for a carboxylic acid is:

- A. R—OH
- B. R—NH_2
- C. R—COOH
- D. R—CO—R'

4. Which compound is an ester?

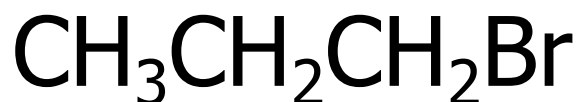
- A. $\text{CH}_3\text{CH}_2\text{OH}$
- B. CH_3COOH
- C. $\text{CH}_3\text{COOCH}_3$
- D. $\text{CH}_3\text{CH}_2\text{NH}_2$



22 CHM.5.6.01.013.12 Write the IUPAC name of alkyl halides and aryl halides

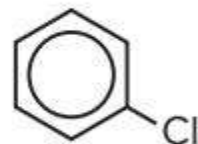
23 CHM.5.6.01.013.13 Draw the structure if an alkyl halide/aryl halide given its name

- **Alkyl Halides** name of the **parent alkane** with a prefix indicating the halogen substituents, preceded by number indicating
- The prefixes are X (F fluoro Cl chloro Br bromo I iodo)
- If there is more than a single halogen, they are listed alphabetically.
- And use Di or Tri for same halogen
- IUPAC Name Format : **locator number + halo prefix + parent alkane**.
- Similarly , the benzene ring in an aryl halide is numbered to give each substituent the lowest possible number possible.



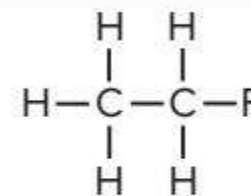
1-bromopropane.

a

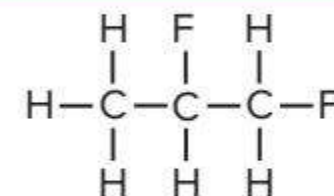


Chlorobenzene

b



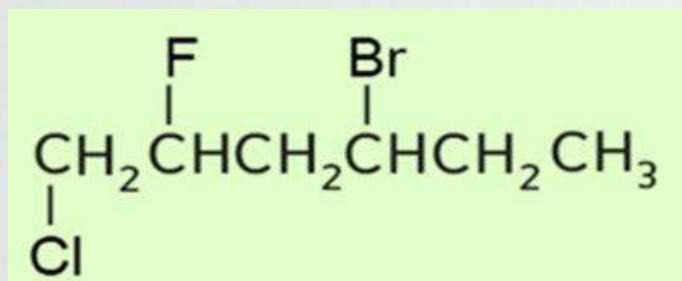
Fluoroethane



1,2-Difluoropropane

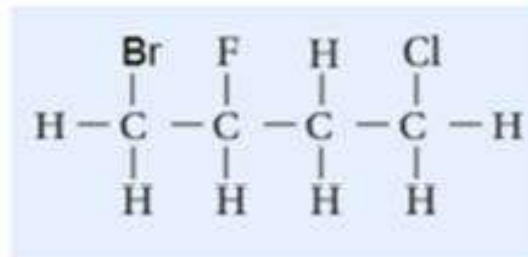


What is the name of the following compound according to the (IUPAC) system?



- 1 – chloro – 2 – fluoro – 4 – **b**romo hexane
- 3 – **b**romo – 6 – chloro – 5 – fluoro hexane
- 6 – chloro – 3 – **b**romo – 5 – fluoro hexane
- 4 – **b**romo – 1 – chloro – 2 – fluoro hexane

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



4 – bromo – 1 – chloro – 3 – Fluoro butane

1 – chloro – 4 – bromo – 3 – Fluoro butane

1 – bromo – 4 – chloro – 2 – Fluoro butane

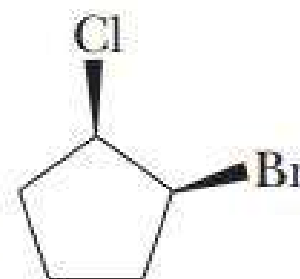
1 – chloro – 3 – Fluoro – 4 – bromo butane



Name Cyclic Haloalkanes

- (a) First, determine the root name of the cycloalkane.

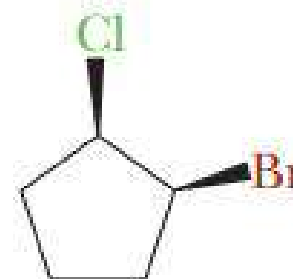
the root name of
a 5-carbon ring is
"cyclopentane"



Cyclopentane

- (b) Name and number the halogen substituents.

in rings, multiple halogens are listed
alphabetically and numbered in
alphabetical order



1 -Bromo-2-chlorocyclopentane



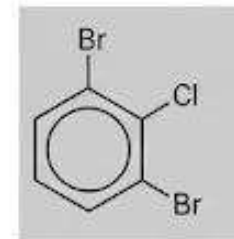
What is the correct name of the compound shown in the figure below?

(using IUPAC rules)

- a. 1-iodo-2,4-difluoro-3-bromobenzene
- b. 2-bromo-1,3-difluoro-4-iodobenzene
- c. 2,4-difluoro-3-bromo-1-iodobenzene
- d. 1,3-difluoro-2-bromo-4-iodobenzene



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



1,3 – dibromo – 2 – chloro cyclohexane

2 – chloro – 1,3 – dibromo benzene

2 – chloro – 1,3 – dibromo cyclohexane

1,3 – dibromo – 2 – chloro benzene



CHM.5.6.02.005.04 Define substitution reaction while writing the equation for the substitution reaction including halogenation of alkanes, alkyl halide-alcohol reaction and alkyl halide-ammonia reaction

Table 6 Substitution Reactions

Generic Substitution Reaction $\text{R-CH}_3 + \text{X}_2 \rightarrow \text{R-CH}_2\text{X} + \text{HX}$ where X is fluorine, chlorine, or bromine	Example of General Substitution Reaction (Halogenation) $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$ Ethane Chloroethane
General Alkyl Halide-Alcohol Reaction $\text{R-X} + \text{OH}^- \rightarrow \text{R-OH} + \text{X}^-$ Alkyl halide Alcohol	Example of an Alkyl Halide-Alcohol Reaction $\text{CH}_3\text{CH}_2\text{Cl} + \text{OH}^- \rightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{Cl}^-$ Chloroethane Ethanol
General Alkyl Halide-Ammonia Reaction $\text{R-X} + \text{NH}_3 \rightarrow \text{R-NH}_2 + \text{HX}$ Alkyl halide Amine	Example of an Alkyl Halide-Ammonia Reaction $\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{Br} + \text{NH}_3 \rightarrow \text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{NH}_2 + \text{HBr}$ 1-Bromooctane 1-Octanamine



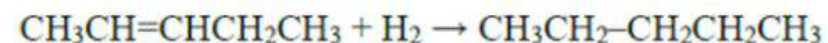
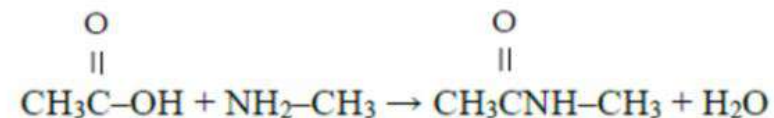
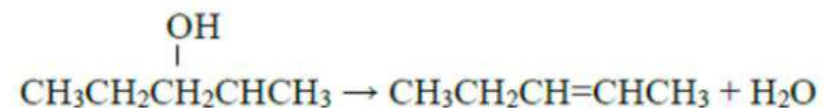
Which reaction of these is halogenation reaction ?

لتالية يعتبر تفاعل هالجنة ؟

$\text{RCOOH} + \text{R}'\text{OH} \rightarrow \text{RCOOR}' + \text{H}_2\text{O}$	1
$\text{R}-\text{CH}_3 + \text{X}_2 \rightarrow \text{R}-\text{CH}_2\text{X} + \text{HX}$	2
$\text{R}-\text{CH}_2-\text{CH}_2-\text{X} \rightarrow \text{R}-\text{CH}=\text{CH}_2 + \text{HX}$	3
$\text{R}-\text{C}\equiv\text{C}-\text{H} + \text{H}_2 \rightarrow \text{R}-\text{CH}=\text{CH}_2$	4

Which reaction of these represent a substitution reaction?

أي من التفاعلات التالية يمثل تفاعل استبدال





1. What are the products of this reaction?



- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2\text{Br}$ and H_2
- B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_3$ and Br_2
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ and HBr
- D. $\text{CH}_3\text{CH}_2\text{CH}_3$ and NH_2Br

What results from the reaction of an alkyl halide with ammonia?

Carboxylic acid

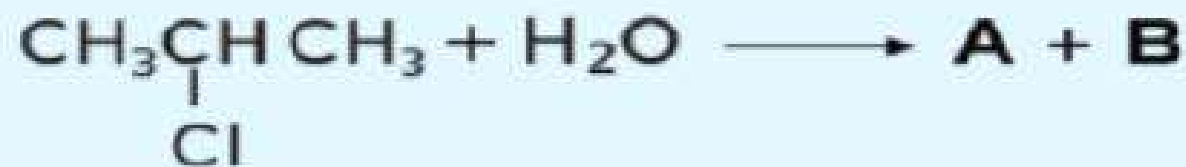
Alkyl amine

Ester

Alcohol



Which of the following are the **correct** products (A, B) for the reaction below?



a. 1

b. 2

c. 3

d. 4

A	B	
$\text{CH}_3\underset{\text{OH}}{\text{CH}}\text{CH}_3$	HCl	1
$\text{CH}_3\text{CH}_2\underset{\text{OH}}{\text{CH}}$	HCl	2
$\text{CH}_3\underset{\text{OH}}{\text{CH}}\text{CH}_2\text{OH}$	HCl	3
$\underset{\text{OH}}{\text{CH}_2}\underset{\text{OH}}{\text{CH}}\underset{\text{OH}}{\text{CH}_2}$	HCl	4



26

CHM.5.6.01.013.18 Draw the structure of an ether given its name

107

■ Ethers are compounds with the general formula:

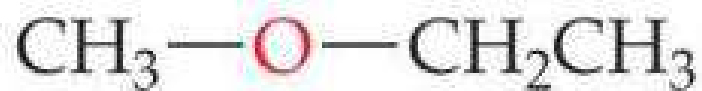


■ symmetrical ethers: $R = R'$

■ unsymmetrical ethers: $R \neq R'$



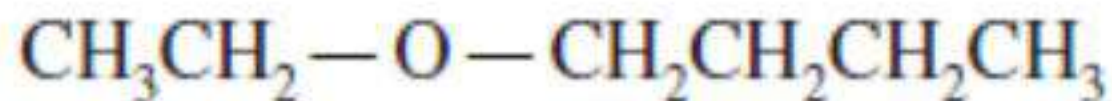
Dimethyl ether



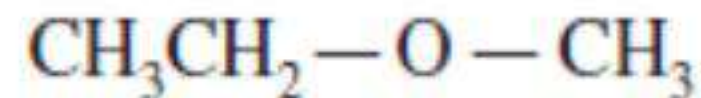
Ethyl methyl ether



Diethyl ether



Butylethyl ether



Ethylmethyl ether



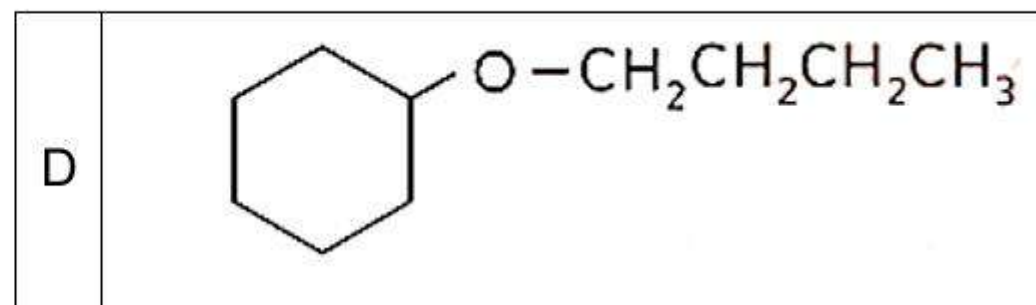
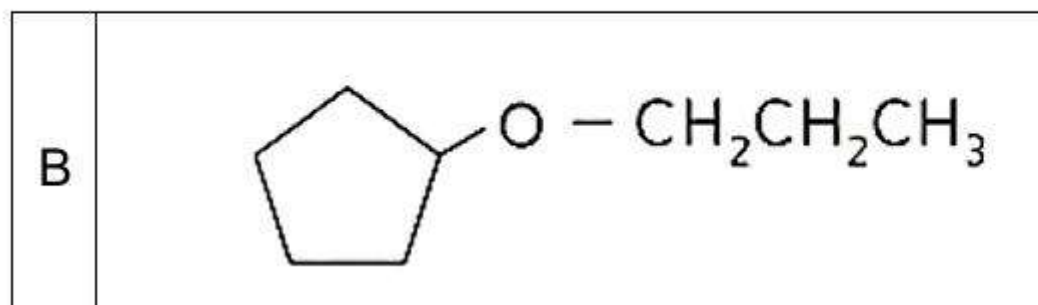
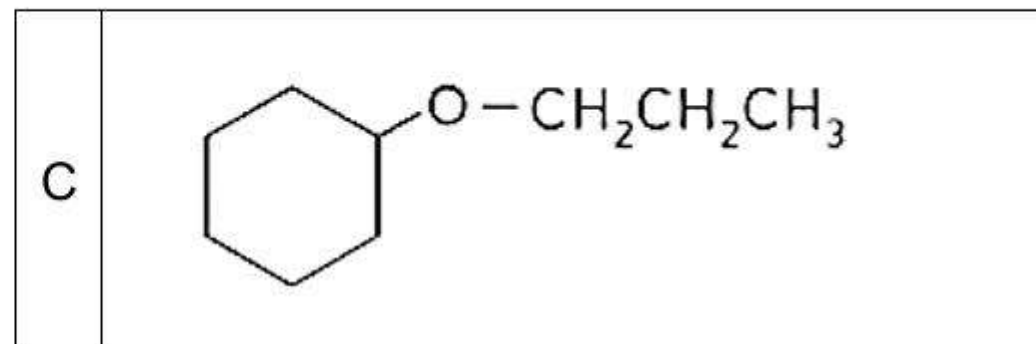
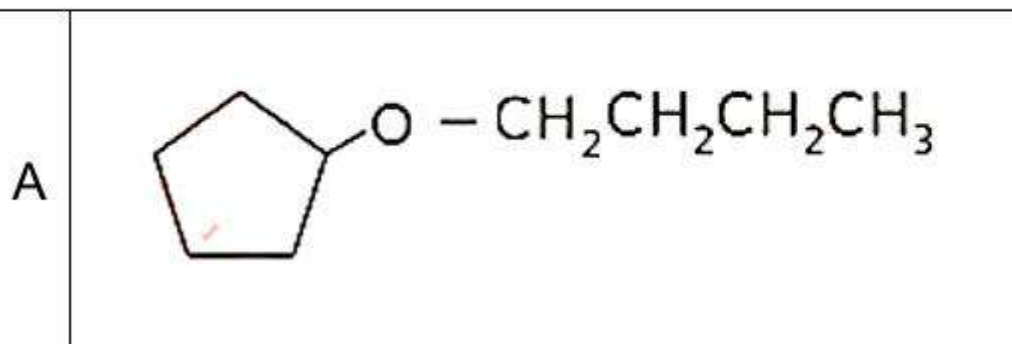
Which of the following formulas of ethers does **not** agree with its corresponding name in the table below?

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 إيثريل 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
 $\text{O}-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	هكسيل حلقي بيوتيل إيثر Cyclohexyl butyl ether	D



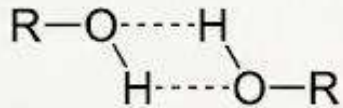
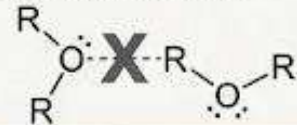
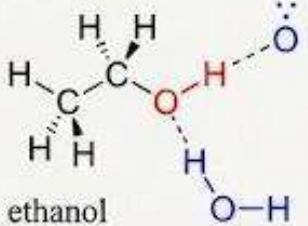
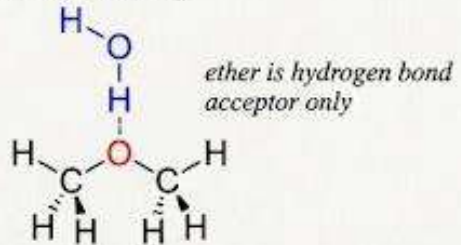
8) Which of the following is the formula for cyclobutyl pentyl ether? (2024)





COMPARATIVE STUDY OF ALCOHOLS & ETHERS

COMPARATIVE STUDY OF ALCOHOLS & ETHERS

PROPERTY	ALCOHOLS	ETHERS
FUNCTIONAL GROUP 	Contain a hydroxyl group (-OH)	Contain an oxygen atom between two carbon chains
GENERAL FORMULA	(R-OH)	(R-O-R)
POLARITY 	More polar	Less polar
HYDROGEN BONDING	Form hydrogen bonds between molecules 	Do not form hydrogen bonds between their molecules 
BOILING POINT 	Higher due to hydrogen bonding	Lower than alcohols
SOLUBILITY IN WATER	Higher, especially for short chains 	Lower solubility 



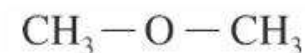
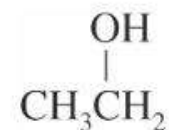
Ethers are more volatile and have lower boiling points than alcohols of similar molecular mass and size. What explains this? (2024)

- A) The presence of hydrogen atoms with the oxygen atom in the ether.
- B) Ether molecules can form hydrogen bonds with each other.
- C) The absence of hydrogen atoms bonded to the oxygen atom in the ether.
- D) The oxygen atom in the ether can act as a hydrogen acceptor from water molecules.

Discuss the properties of alcohols, ethers, and amines, and name one use of each.

alcohols—moderately polar: can form hydrogen bonds with other molecules; higher boiling points than other alkanes of similar shape and size; example—ethanol; ethers—cannot form hydrogen bonds; lower boiling points and volatile; less soluble in water than alcohols; example—methyl ether; amines—some amines have volatile odors

Analyze Based on the molecular structures below, which compound would you expect to be more soluble in water? Explain your reasoning.



Ethanol (on the right) is more soluble than methyl ether. Because of their molecules' greater polarities, alcohols are usually more water-soluble than ethers.



85) Why does ethanol ($\text{CH}_3 - \text{CH}_2 - \text{OH}$) have a much higher boiling point than dimethyl ether ($\text{CH}_3 - \text{O} - \text{CH}_3$), even though their molecular weights are approximately equal?

- A) Because there are hydrogen atoms bonded to oxygen atoms in ethanol.
- B) Because ethanol molecules do not form hydrogen bonds with each other.
- C) Because dimethyl ether is the simplest ether available.
- D) Because ethanol is produced when sugars are broken down, while ether is not.

17) Ethers are more volatile and have lower boiling points than alcohols of similar molecular mass and size. What explains these properties? (2023)

- A) 1 only
- B) 2 only
- C) 1 and 2
- D) 2 and 3

A	Absence of hydrogen atoms bonded to the oxygen atom in ether
B	Ether molecules cannot form hydrogen bonds with each other
C	The oxygen atom in ether can bond with hydrogen atoms from water molecules



Why ethers are generally more volatile and have much lower boiling points than alcohols of similar size and mass?

- A - Reason "1" only
- B - Reason "2" only
- C - Reasons "1" and "2" together
- D - Reasons "3" and "4" together

لماذا تكون الإيثرات أكثر قابلية للتطاير ودرجات غليانها أقل من الكحولات المساوية لها في الكتلة الجزيئية والحجم؟

- A - السبب "1" فقط
- B - السبب "2" فقط
- C - السببان "1" و "2" معًا
- D - السببان "3" و "4" معًا

الرقم Number	التفسير Explanation
1	لوجود ذرات هيدروجين مرتبطة مع ذرة الأكسجين في الإيثر Because ethers have hydrogen atoms bonded to the oxygen atom
2	لأن جزيئات الإيثر يمكنها أن تكون روابط هيدروجينية بين بعضها البعض Because ether molecules can form hydrogen bonds with each other
3	لعدم وجود ذرات هيدروجين مرتبطة مع ذرة الأكسجين في الإيثر Because ethers have no hydrogen atoms bonded to the oxygen atom
4	لأن جزيئات الإيثر لا يمكنها أن تكون روابط هيدروجينية بين بعضها البعض Because ether molecules cannot form hydrogen bonds with each other



28

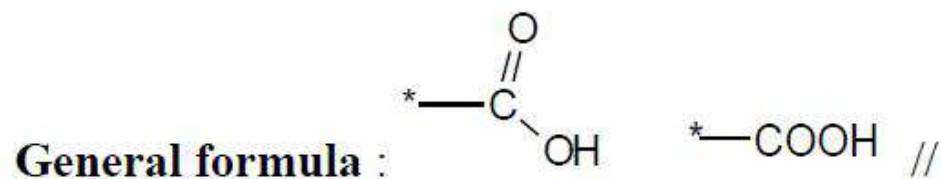
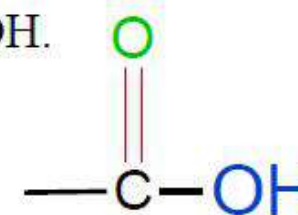
CHM.5.6.01.013.24 Use the IUPAC system to name carboxylic acids

114

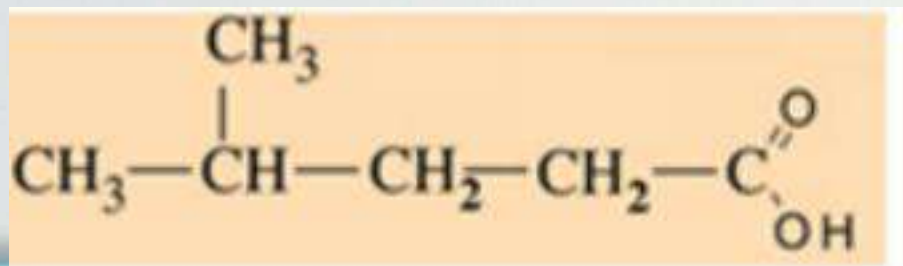
Carboxylic acids

Carboxylic acid: It is an organic compound containing the Carboxyl group -COOH .

Carboxyl group: Consists of a carbonyl group bonded with a hydroxyl group.

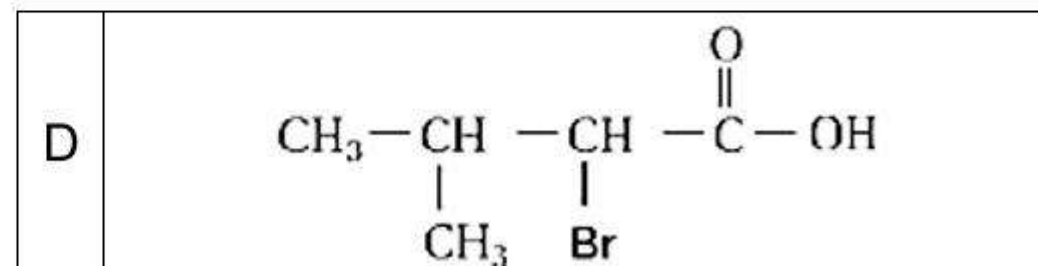
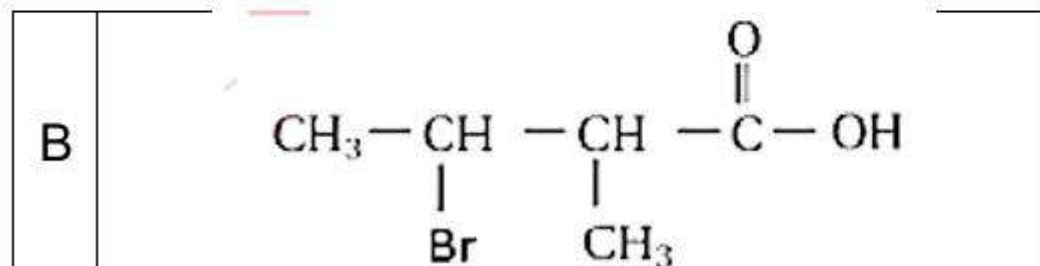
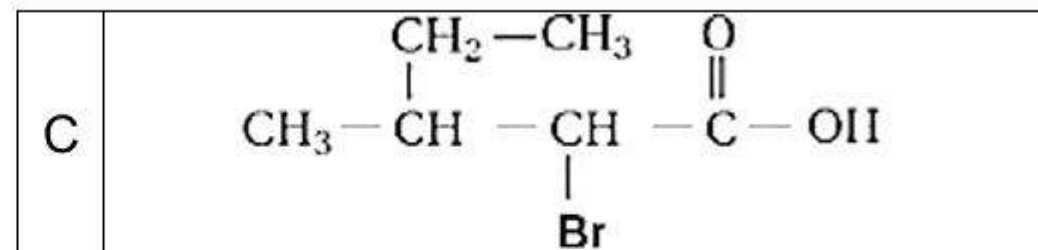
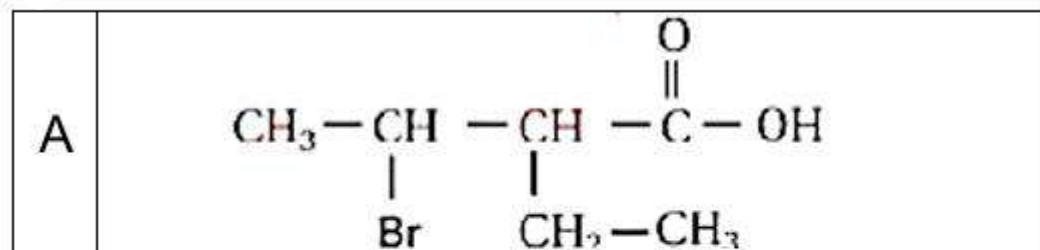


Naming : Add the Suffix (-oic) to the end of the alkene, and the word acid to the beginning of the name. (Alkane + oic+ Acid)



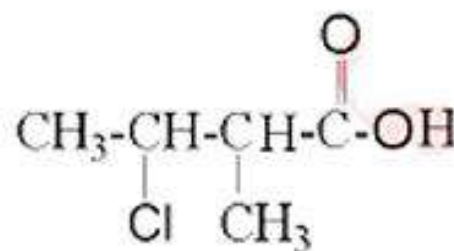


69) What is the structural formula for the compound 3-bromo-2-ethylbutanoic acid? (2023)



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

- A) 2 - chloro - 3 - methyl butanoic acid
- B) 3 - chloro - 2 - methyl butanoic acid
- C) 2 - methyl - 3 - chloro butanoic acid
- D) 3 - methyl - 2 - chloro butanoic acid





) What is the structural formula of the compound: **3-methylbutanoic acid**?



) What is the structural formula of the compound: **3-chloro-2-methyl propanoic acid**?





29

CHM.5.6.01.013.20 Use the IUPAC system to name ketones

113

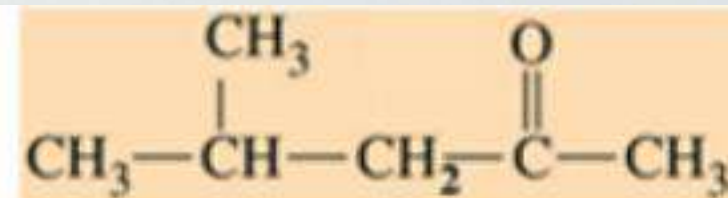
An organic compound in which the carbon atom in the carbonyl group is bonded to two other carbon atoms.

General formula



Naming

(one) is added after the name of alkane ~~name~~

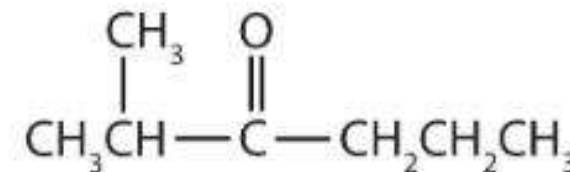


3-methyl-2-pentanone.

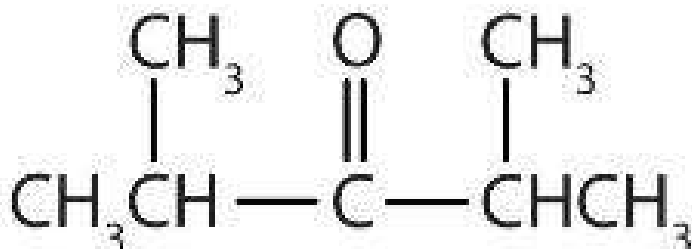
Naming ketones

Ketones are named using the rules of the IUPAC system.

- The name of the corresponding alkane is written based on the number of carbon atoms in the corresponding alkane chain.
- The syllable (one) is added after the name of the alkane ~~name~~, or the names of the alkyl groups are written in the order of the English alphabet and then the word ketone.
- A number is placed before the name of the ketone, to indicate the location of the carbonyl group on the chain.



2-methyl-3-hexanone.



2,4-dimethyl-3-pentanone.

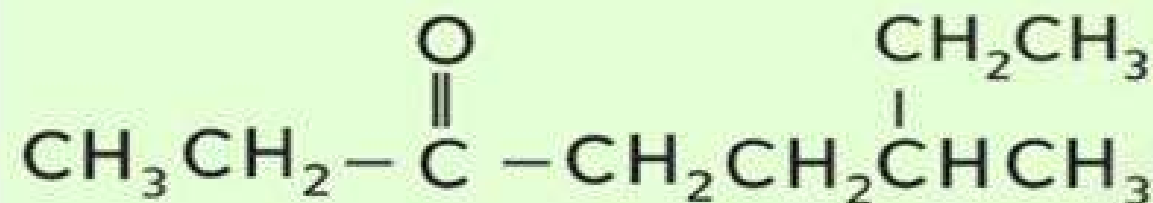


What is the correct name for the following compound?

(Using IUPAC rules)

ما الاسم الصحيح للمركب التالي؟

(مُستخدماً قواعد IUPAC)



2 - ethyl - 5 - heptanone

6 - ethyl - 3 - heptanone

6 - methyl - 3 - octanone

3 - methyl - 6 - octanone

2 - إيثيل - 5 - هبتانون

6 - إيثيل - 3 - هبتانون

6 - ميثيل - 3 - أوكتانون

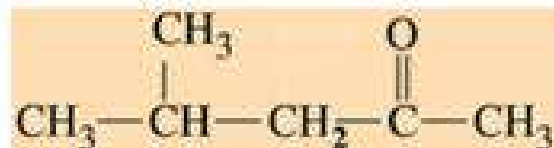
3 - ميثيل - 6 - أوكتانون



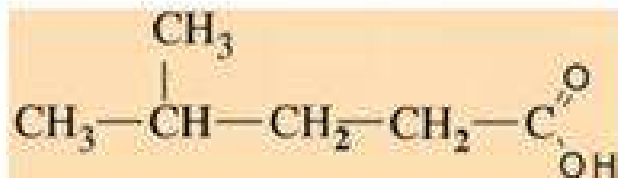
Which of the following is the formula of 4-methyl- 2 - pentanon?



A



B



C



D

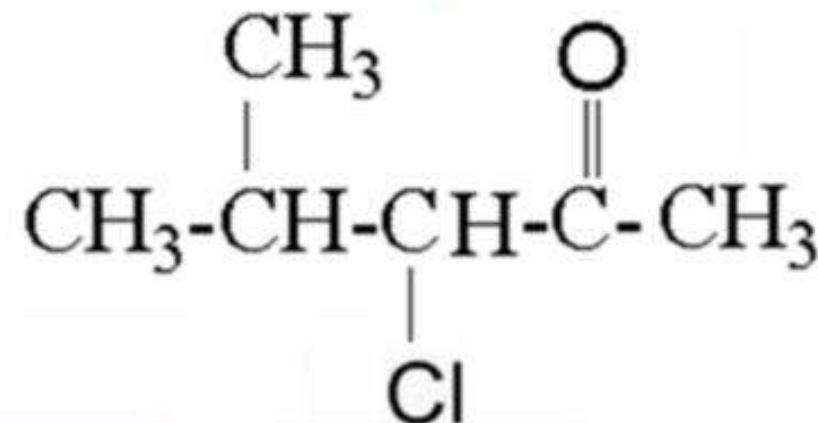
What is the correct name for the compound shown in the figure below?

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)





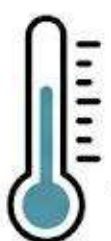
ملخص خواص الألدهيدات الفيزيائية | Summary of Aldehyde Physical Properties

1 Polarity and Reactivity | القطبية والنشاط

- An aldehyde molecule contains a polar, reactive structure. $\text{:R}^{\delta+}\text{H:}$ ⚡
- تحتوي جزيئات الألدهيد على تركيب قطبي ونشط ونشط كيميائيًا. ⚡

3 Boiling Points | درجة الغليان

- Aldehydes have lower boiling points than corresponding alcohols (same C number).



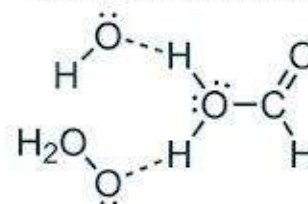
◀ درجات غليان الألدهيدات أقل من الكحولات المناظرة (التي تمتلك نفس عدد ذرات الكربون).



- Aldehydes cannot form hydrogen bonds among themselves (no H bonded to O).
- ◀ لا تستطيع الألدهيدات تكوين روابط هيدروجينية بين جزيئاتها نفسها (لعدم وجود H مرتبط بـ O).

4 الذوبان في الماء | Solubility in Water

- Water molecules can form hydrogen bonds with the aldehyde oxygen atom.



◀ تستطيع جزيئات الماء تكوين روابط هيدروجينية مع ذرة الأكسجين في الألدهيدات.

- More soluble than alkanes.
- Less soluble than alcohols or amines.



Which of the following is **correct** regarding to properties of carbonyl compounds?

أي مما يأتي **صحيح** فيما يتعلق بخصائص مركبات الكربونيل؟

A

Aldehyde molecules are polar, reactive and can form hydrogen bonds among themselves

جزيئات الألكهيدات قطبية ونشطة وتُشكل روابط هيدروجينية بين بعضها البعض

B

Ketones molecules are polar and are more reactive than aldehydes

جزيئات الكيتونات قطبية وهي أكثر نشاطًا من الألكهيدات

C

Carboxylic acids molecules are polar, reactive and ionize completely in water

جزيئات الأحماض الكربوكسيلية قطبية ونشطة، وتتأين في الماء بشكل تام

D

Aldehydes have lower boiling points than alcohols with the same number of carbon atoms

درجات غليان الألكهيدات أقل من الكحولات التي تحتوي على نفس عدد ذرات الكربون



Which of the following is **NOT** a property of aldehydes?

أي مما يأتي **ليست** من خصائص الألكهيدات؟

Aldehydes are less soluble in water than alkanes

الألكهيدات أقل قابلية للذوبان في الماء من الألكانات

A

Aldehyde molecules cannot form hydrogen bonds

لا يمكن لجزيئات الألكهيدات تشكيل روابط هيدروجينية

B

Among themselves

بين بعضها البعض

C

Aldehyde molecule is polar and reactive

يكون جزيء الألكهيد قطبي ونشط

D

Aldehydes have lower boiling points than alcohols with
the same number of carbon atoms

درجات غليان الألكهيدات أقل من الكحولات التي تحتوي
على نفس عدد ذرات الكربون

D

Which of the following is **NOT** a property of aldehydes?

أي مما يأتي **ليست** من خصائص الألكهيدات؟

Aldehyde molecule is polar and reactive

Aldehyde molecules cannot form hydrogen bonds

Among themselves

Aldehydes have lower boiling points than alcohols with
the same number of carbon atoms

Aldehydes are less soluble in water than alkanes



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