

الاسم:
الرقم:

مسابقة في مادة الكيمياء
المدة: ساعة

**This Exam Is Composed of Three Exercises. It Is Inscribed on Two Pages, Numbered 1 and 2.
Answer the Three Following Exercises:**

**First Exercise (6 points)
Ionic Compounds and Molecular Compounds**

In nature, ionic compounds are solids. They are characterized by their rigid structure. They have higher boiling and melting point temperatures than those of molecular compounds. This is due to the strong electrostatic force of attraction between the ions in ionic compound.

- The table below represents the boiling and the melting point temperatures for some ionic and molecular compounds at a given pressure.

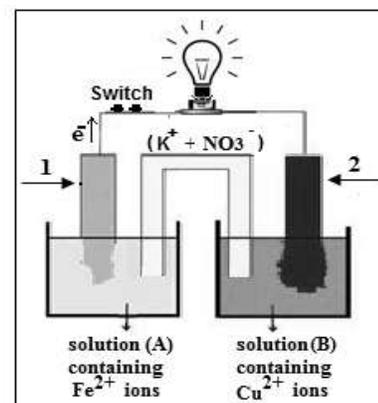
Compound	Melting point temperature(°C)	Boiling point temperature (°C)
Methane	-182	-161
Sodium chloride	801	1413
Water	0	100
Magnesium oxide	2852	3600

- The Lewis electron dot structure of hydrogen sulfide molecule H_2S is given as: $H - \overset{\cdot\cdot}{\underset{\cdot\cdot}{S}} - H$
- Refer to the above table and text:
 - Pick out the reason why ionic compounds have high melting points.
 - List the ionic compounds.
 - Refer to the Lewis electron dot structure of hydrogen sulfide molecule:
 - Indicate the type of bond between the sulfur atom and each of the hydrogen atoms in H_2S molecule. Justify.
 - Verify that the element sulfur belongs to group VI (column 16) in the periodic table.
 - The electron configuration of potassium atom is: $K^2 L^8 M^8 N^1$. Potassium reacts with sulfur to produce the compound potassium sulfide K_2S .
 - Explain the bond formation in the compound potassium sulfide.
 - The boiling point temperature of the compound hydrogen sulfide is $(- 66^\circ C)$.
 - Choose, among the propositions given below, the one that corresponds to the boiling point temperature t of potassium sulfide:
 - a- t equals to $(- 66^\circ C)$
 - b- t less than $(- 66^\circ C)$
 - c- t greater than $(- 66^\circ C)$

**Second Exercise (7 points)
Functioning of Galvanic Cell**

A galvanic cell is a device that converts chemical energy into electrical energy due to a spontaneous redox reaction. The adjacent schema represents a functioning galvanic cell.

- Label the numbered parts 1 and 2 of the galvanic cell.



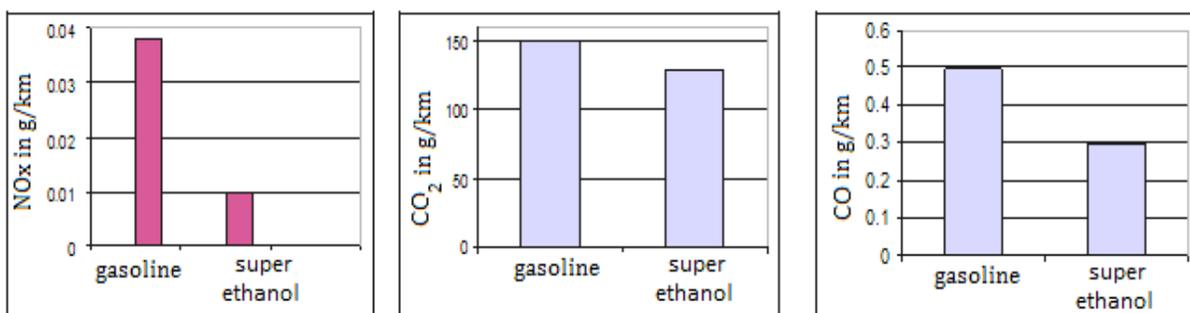
- Indicate the anode of the above galvanic cell. Justify.
- Write the half-reaction that takes place at the anode.
- The equation of the overall redox reaction of the functioning galvanic cell is:



- Deduce the half-reaction that takes place at the cathode.
- During the functioning of this cell, the quantity of Fe^{2+} ions varies in solution (**A**).
 - Compare the amount of Fe^{2+} ions in solution (**A**) before and after the functioning of the galvanic cell.
 - Specify the ions that migrate from the salt bridge toward solution (**A**) to maintain its electroneutrality.

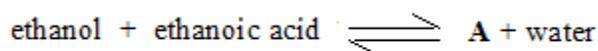
Third Exercise (7 points) A New Fuel: Super-Ethanol

Super ethanol is a fuel composed mainly of ethanol. The combustion of super ethanol in the engines of cars emits the same type of polluting gases as those produced by the combustion of gasoline. The bar graphs given below show the quantities of polluting gases (NO_x , CO_2 and CO) emitted in g/km during the combustion of gasoline and super ethanol in the engines of cars.



- Refer to the bar graphs given above:
 - Specify which of the two fuels gasoline or super-ethanol is the less pollutant fuel.
- Increased emissions of the gas NO_x contribute to the formation of acid rain.
 - Choose, from the list given below, the harmful effects of acid rain.

a- Global warming	b- Damages in buildings
c- Deterioration of aquatic life	d- Melting of polar caps
- Suggest a method to reduce the emission of NO_x gas from the exhaust pipes of cars.
- In industry, gasoline is obtained in the refining of petroleum, whereas ethanol ($\text{C}_2\text{H}_5\text{OH}$) can be obtained by the hydration reaction of ethene (C_2H_4). One molecule of ethene reacts with one molecule of water to produce one molecule of ethanol.
 - Write, using condensed structural formulas for the organic compounds, the equation of the hydration reaction of ethene.
- Ethanol reacts with ethanoic acid in the presence of sulfuric acid as catalyst to produce an ester **A**, which has a sweet and pleasant odor, and water. The equation of the reaction is represented as follows:

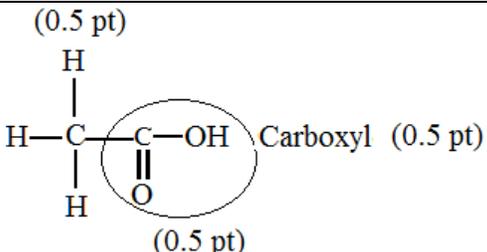


- Write the structural formula of ethanoic acid (CH_3COOH). Circle and name its functional group.
- Give the name of this reaction.
- Indicate one characteristic of ester **A**.

Part of Q	First Exercise (6 points) Answer	Mark
1.1	Ionic compounds have high melting points due to the strong electrostatic force of attraction between the ions of ionic compound.	0.5
1.2	Ionic compounds: Sodium chloride (0.5 pt) and magnesium oxide (0.5 pt).	1
2.1	The type of bond between sulfur atom and each hydrogen atom is single covalent bond (0.5 pt) due to the sharing of one pair of electrons (0.5 pt).	1
2.2	Sulfur atom has six valence electrons (referring to the Lewis electron dot structure of H ₂ S molecule) => Sulfur belongs to group VI (column 16) in periodic table; the number of valence electrons determines the group number in the periodic table.	1
3	Potassium atom K loses the single electron of its outer energy level to become a stable potassium ion K ⁺ (0.5 pt). Sulfur atom S has 6 valence electrons on its outer energy level. It gains two electrons each one from potassium atom to become stable sulfide ion S ²⁻ (0.5 pt). The oppositely charged K ⁺ ion and S ²⁻ ion attract each other mutually by an electrostatic force of attraction forming ionic bond. (0.5 pt)	1.5
4	c- t is greater than (- 66°C).	1

Part of Q	Second Exercise (7 points) Expected Answer	Mark
1	1-Iron strip (0.5 pt); 2- copper strip (0.5 pt)	1
2	Iron strip is the anode (0.75 pt). The electrons move from the anode to the cathode (0.75 pt).	1.5
3	The half-reaction that takes place at the anode: $Fe \rightarrow Fe^{2+} + 2e^{-}$	1
4	Reverse the half-reaction at the anode: $Fe^{2+} + 2e^{-} \rightarrow Fe$; (0.5 pt) add this half-reaction to the equation of the overall reaction: (0.5 pt) $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$ The half-reaction at the cathode is: $Cu^{2+} + 2e^{-} \rightarrow Cu$ (0.5 pt)	1.5

5.1	The amount of Fe^{2+} ions in solution (A) after functioning of the cell is greater than the amount of Fe^{2+} ions in solution (A) before the functioning of the cell	1
5.2	The ions in the salt bridge that migrate toward solution (A) to maintain the electroneutrality of this solution are: nitrate ions (NO_3^-) because the quantity of Fe^{2+} ions, in solution (A), increases during the functioning of the cell.	1

Part of Q	Third Exercise (7 points) Expected Answer	Mark
1	Super-ethanol is less polluting fuel than gasoline because the amount of each of the pollutant gases (NO_x , CO_2 and CO) produced by the combustion of super-ethanol is less than the amount produced by the combustion of gasoline.	1
2	The harmful effects of acid rain: b- damages of buildings (0.5 pt) c- Deterioration of aquatic life (0.5 pt)	1
3	Use of pollution control devices : catalytic converters	1
4	The equation of the hydration of ethene: $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{—CH}_2\text{OH}$	1
5.1	<p>(0.5 pt)</p>  <p>Carboxyl (0.5 pt)</p> <p>(0.5 pt)</p>	1.5
5.2	The name of this reaction is esterification.	0.75
5.3	Ester A has a sweet and pleasant odor	0.75