مسابقة في مادة:الكيمياء | الاسم:
المدة: ساعة واحدة | الرقم:

This Exam is Composedof Three Exercises. It is inscribed on Two Pages Numbered 1 and 2.
Answer the Three Following Exercises. The Use of a Non- Programmable Calculator is allowed.

First Exercise(6points)

Glass Etching

Glass etching lotion, available from art supply stores, consists of fluoride compounds, such as sodium fluoride (**NaF**) and hydrogen fluoride (**HF**).Glass is composed of about 75% silicon dioxide (**SiO_2**),the rest can be sodium oxide (**Na_2O**), calcium oxide (**CaO**), and several minor additives. Air at high pressure mixed with the lotion permits the etching of the glass.

Given:

The table below shows the placement of three elements in the Periodic Table.

Element	Group *(Column)*	Period (row)
Hydrogen	I; *(1)*	1
Fluorine	VII; *(17)*	2
Carbon	IV;*(14)*	2

1. Write the Lewis electron dot symbol for eachof fluorine (**F**) and hydrogen (**H**) atoms.

2. The element fluorine combines with the element hydrogen to produce the molecular compound, hydrogen fluoride.

-Explain the bond formation in hydrogen fluoride molecule.

3. The element silicon (**Si**)and the element carbon (**C**) are in the same group (column) of the periodic table; but silicon is along the third period(row) of the periodic table**.**

3.1. Choose,among the electron configurations given below, that of silicon atom. **Justify**.

a- K^2, L^8, M^3 **b-** K^2, L^7, M^4 **c-** K^2, L^8, M^4 **d-** K^2, L^4

3.2. Determine the atomic number of the element silicon.

4. Pick out from the text the names of the chemical compounds used for glass etching.

Second Exercise (7points)

Octane Number

The "knock" property of gasoline is evaluated according to a scale known as the octane number. This scale is based on the way gasoline is burned in vehicle's engine.One of the isomersof the hydrocarbon (**C_8H_{18}**), 2,2,4- trimethylpentane, has an octane number equals to 100 whereas that ofoctane is 0.

1. Write the condensed structural formula of 2,2,4-trimethylpentane and that of octane.

2. The cracking of an alkane (**C_xH_y**) produces two hydrocarbons: octane (**C_8H_{18}**)and ethene (**C_2H_4**).The equation of the cracking reaction isgiven below:

$$C_xH_y \longrightarrow C_8H_{18} + C_2H_4$$

-Determine the molecular formula of the alkane (**C_xH_y**).

3. The normal boiling point temperaturesin ˚Cof thethree alkanes**A, B** and **C** are given in the table below:

Alkane		Normal boiling point temperature ˚C
A	$C_{10}H_{22}$ (straight chain)	174
B	C_8H_{18}(straight chain)	125
C	2,2,4-trimethylpentane	99.3

3.1. Compare the normal boiling point temperatures of the alkanes **A**and **B**thenthose of the alkanes **B** and **C**mentioned in the table above.

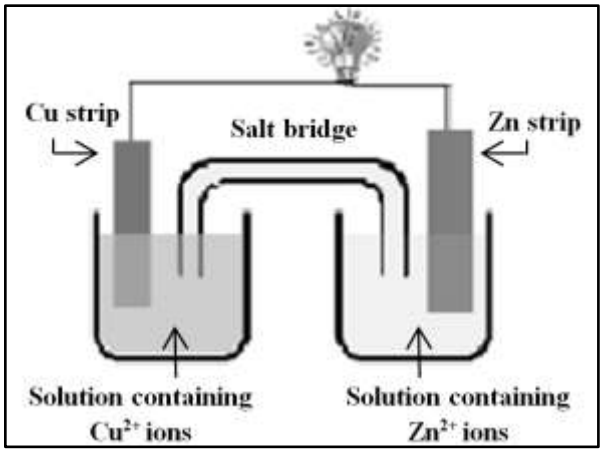
3.2. Draw out two conclusions.

4. Pick out from the text on what scale the "knock" property of gasoline is evaluated.

Third Exercise (7 points)

Galvanic Cell

A galvanic cell constructed by grade 9 student,is represented in the adjacent figure.



1. The overall reaction of the adjacent functioning galvanic cell isrepresented by the equationgiven below:

$$Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$$

1.1. Show, using oxidation numbers, that the overall reaction given above is an oxidation-reductionreaction.

1.2. Identify the reducing agent in this reaction.

1.3. Deduce that the zinc strip is the anode of this galvanic cell.

2. Choose,among the proposed representations given below, the written cell representation of thisgalvanic cell.

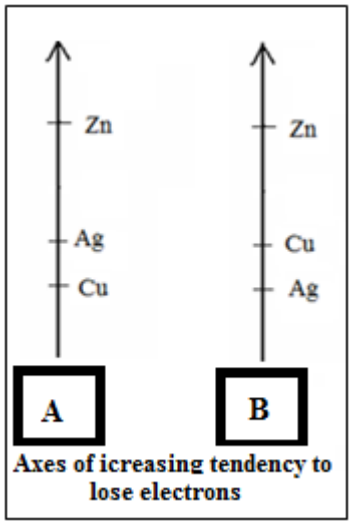
a- Cu/Cu^{2+}-salt bridge-Zn^{2+}/Zn

b- Zn/Zn^{2+}-salt bridge-Cu^{2+}/Cu

c- Zn^{2+}/Zn-salt bridge-Cu/Cu^{2+}

3. The blue color of the Copper (II) sulfate solution ($Cu^{2+} + SO_4^{2-}$)is due to the presence ofCopper (II) ions (Cu^{2+}).The intensity of the blue color depends on the quantity of Copper (II) ions (Cu^{2+}) inthissolution.

- Explain why the intensity of the blue color of copper(II) sulfate solution decreases with time, when the cell is set to function.



4. Two galvanic cells, (Zn-Ag) and (Zn-Cu) are constructed at standard conditions.

For (Zn- Ag) galvanic cell,the anode is the zinc strip and the voltageof the cell is 1.56 V.

For (Zn- Cu) galvanic cell, the anode is the zinc strip and the voltage of the cell is 1.1 V.

The greater the difference between the tendencies of the metals to lose electrons, the greater is the voltage of the galvanic cell.

- Specify, based on the preceding information,which of the two axes (**A**) or (**B**) shows the correct order of increasing tendencies of the metals to lose electrons.

أسس التصحيح

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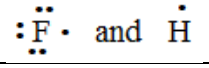
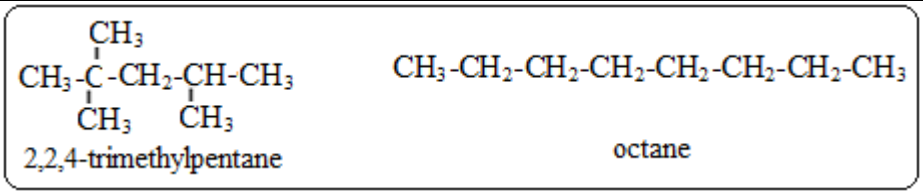
	First Exercise (6points) Expected Answer	Mark
1	 **(2x 0.5pt)**	**1**
2	Fluorine atom has 7 valence electrons. It needs one electron to achieveits octet and become stable.**(0.5pt).** Hydrogen atom has one valence electron. It needs one electron to achieveitsduet and become stable.**(0.5pt).** Each atom shares one pair of electrons with the other atom forming a single covalent bond.**(0.5pt).**	**1.5**
3.1	The electron configuration of silicon atom is: c- K^2, L^8, M^4. **(0.5pt).** Carbon belongs to group IV; carbon atom has four electrons on its outer energy level.**(0.25pt)** Silicon and carbon belong to the same group => silicon has 4 electrons on its valence shell.**(0.25pt)** Silicon is along the third period(row), it has 3 energy levels. K and L must be fully occupied before filling the third energy level M by the 4 valence electrons.**(0.5pt)**	**1.5**
3.2	According to the electron configuration, the total number of electrons: 2 + 8 + 4 = $14e^-$. **(0.5pt)** Since the atom is electrically neutral, therefore the number of electrons is equal to the number of protons = 14.**(0.25pt)** Z=Atomic number =Number of protons = 14. **(0.25pt)**	**1**
4.	Sodium fluoride and hydrogen fluoride. **(2x 0.5pt)**	**1**

	Second Exercise (7 points) Expected Answer	Mark
1	 2,2,4-trimethylpentane octane **(2x 1pt)**	**2**
2	According to the law of conservation of mass (atoms): in a chemical reaction, the number of atoms of an element is conserved.**(0.25pt)** For Carbon: x = 8 + 2 = 10 **(0.5pt)** For Hydrogen: y = 18 + 4 = 22 **(0.5pt)** Then themolecular formula is **$C_{10}H_{22}$(0.25pt)**	**1.5**
3.1	The normal boiling point of **A:**174°C is greater than that of **B:** 125°C.**(0.5pt)** The normal boiling point of **B:**125°C is greater than that of **C:** 99.3°C. **(0.5pt)**	**1**

3.2	$174^oC > 125^oC$, the normal boiling point temperature of straight chain $C_{10}H_{22}$ is greater than that of straight chain octane C_8H_{18}, then the normal boiling point temperature of straight chain alkanes increases as the number of carbon atoms increases in the molecules of straight chain alkanes.**(1pt)** $125^oC > 99.3^oC$, the normal boiling point of the straight chain octane C_8H_{18} is greater than that of the branched alkane. 2,2,4-trimethylpentaneand octane C_8H_{18}have the same number of carbon and hydrogen atoms. Therefore, the normal boiling point of isomers decreases as the number of branching increases in the structure of the molecule. **(1pt)**	**2**
4	The "knock" property of gasoline is evaluated on a scale Known as the octane number.	**0.5**

	Third Exercise (7 points) **Expected Answer**	**Mark**
1.1	$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ 0 +II +II 0 The oxidation number of copper decreases from +II to 0, then (Cu^{2+}) isreduced, the oxidation number of zinc increases from 0 to +II,then (Zn) isoxidized. Therefore, this reaction is anoxidation- reduction reaction.	**1.5**
1.2	Zinc is the reducing agent, because its oxidation number increases during the reaction.	**1**
1.3	Zn is the reducing agent then it undergoes oxidation therefore Zn strip is theanode of this galvanic cell.	**1**
2	**b-** Zn/Zn^{2+} - salt bridge - Cu^{2+} / Cu	**1**
3	When the galvanic cell functions, Cu^{2+} ions in the solution are consumed according to the given overall reaction, thus the quantity of Cu^{2+} ions decreases as time elapses.**(0.75pt)** The intensity of the blue colordepends on the quantity of copper (II) ions (Cu^{2+}) in solution, as a result, the intensity of the blue color of copper (II) sulfate solution decreases.**(0.75pt)**	**1.5**
4	Axis (**B**)shows the correct order of increasing tendencies of the metals to lose electrons becausethe difference in the tendency to lose electrons between Zn and Ag is greater than the difference in the tendency to lose electrons between Zn and Cu,(1.56V > 1.1V), which isnot the case in axis (A).	**1**