

**Answer the following four exercises.**

**Exercise 1 (5 points) Cell Division and Formation of Gametes**

A karyotype represents the set of chromosomes in a cell, arranged according to well defined criteria. It permits us to determine the sex (gender) of the fetus and to detect the chromosomal abnormalities.

- 1- Pick out, the aims of performing a karyotype.
- 2- Indicate one criterion to arrange the chromosomes in a karyotype.

The gametes originate from reproductive mother cells. Two karyotypes 1 and 2 are performed to two cells extracted from the same person:

- A gamete G
- A mother cell M of the gametes.

Karyotype 1, shows 22 pairs of homologous autosomes and 1 pair of gonosomes XX.

Karyotype 2, shows 22 autosomes and 1 gonosome X.

3- Identify the karyotype which corresponds to:

3-1- The mother cell M.

3-2- The gamete G.

4- Specify if the gamete G is male or female.

5-1- Indicate if the cell division at the origin of the formation of gamete G from the mother cell M, is mitosis or meiosis.

5-2- Justify the answer.

**Exercise 2 (5 points) Transmission of a Hereditary Characteristic**

The ear lobe can be either free or adherent. This hereditary trait is due to a gene located on an autosome.

This gene exists in two alleles:

- An allele responsible for the phenotype “free lobe”
- An allele responsible for the phenotype “adherent lobe”

The document below represents of a family whose certain members have adherent lobes:

- In generation I, Samia is a female with free lobe is married to Jack (male) with adherent lobe. They gave birth to Carole with adherent lobe and Layla with free lobe.
- Layla who is the daughter of Samia and Jack has free lobe. She is married to Walid having also free lobe, they gave birth in generation III, to Hani a male with adherent lobe and to another child with free lobe.

1-1. Show that the allele responsible for the phenotype “adherent lobe” is recessive.

1-2. Designate by symbols the corresponding alleles.

3. Indicate the genotype of Samia and that of Hani. Justify the answer.

4. Make the necessary factorial analysis to verify the phenotypes of the descendants of Layla & Walid according to the following steps:

- a- Indicate the phenotype of the parents.
- b- Indicate the genotype of the parents.
- c- Indicate the gametes of each of the parents.
- d- Indicate the different genotypes resulting from the random fusion of male and female gametes.
- e- Give the resulting phenotypes of descendants.

**Exercise 3 (4.5 points)                      Characteristics of Blood Capillaries**

Blood circulates in the body through different types of blood vessels: arteries, veins and blood capillaries...; However, the capillaries that are very numerous and have very thin walls, permit the exchange of substances between blood and cells.

- 1- Pick out two characteristics of the capillaries which favor this exchange.
- 2- Name four substances which are exchanged between blood and cells.

The below document shows the average diameter of different types of blood vessels as well as the average speed of the blood circulation in each type.

Type of blood vessel	Average diameter (cm)	Speed of blood circulation (cm/sec)
Arteries	2.5	40
Capillaries	0.1	2
Veins	1.3	17

- 3- Show, by referring to above document that the blood circulation slows down in the blood vessels with smaller diameter.
- 4- Explain, based on all what precedes, that the blood capillaries are structures well adapted for exchange between blood and cells.

**Exercise 4 (5.5 points)                      Digestion in Vitro**

In order to study the effect of mechanical digestion on the chemical digestion, the following experiment is performed and presented in document 1.

We put in tube A 5 g of meat in cube and in tube B 5 g of minced meat. Then we put in both tubes the same amount of pancreatic juice, water and NaOH. The PH in each tube is 8. We placed the two tubes in water bath at 37°C temperature.

**Document 1**

The mass of meat is then measured in both tubes at different intervals of time. The results are represented in document 2 as following:

The mass of meat in a tube A was:	The mass of meat in a tube B was:
5g at time 0(hours)	5g at time 0(hours)
3g at time 1(hours)	2g at time 1(hour)
1g at time 2(hours)	0g at time 2 and 3(hour)
0g at time 3(hours)	

**Document 2**

1. Draw out the experimental condition that varied in this experiment.
2. Formulate the hypothesis tested in this experiment.
3. **a.** Analyze the obtained results in document 2.  
**b.** What do you conclude concerning the effect of the mechanical digestion on the chemical digestion?
4. Suggest based on this experiment, a good habit that you can follow while eating your meals.