Answer the four following exercises:

Exercise 1 (5 points)
Transmission of an autosomal hereditary characteristic

First cross : We cross a male guinea pig of pure race having short tail with a female guinea pig of pure race having long tail. We obtain, in the first generation (F_1), 100% guinea pigs with short tail.

Second cross : We cross a male and a female guinea pig with short tail from F_1 generation. We obtain, in the second generation (F_2), 75% guinea pigs with short tail and 25% guinea pigs with long tail.

1- Indicate the dominant allele. Justify the answer.
2- Designate by symbols the corresponding alleles.
3- Write the genotypes of the parents in the first cross.
4- Make a factorial analysis that permits to verify the phenotypic percentages obtained in the second cross.

Exercise 2 (5 points)
Preparatory stage for cell division: Interphase

The opposite **document** shows the variation in the quantity of chromosomal material, as a function of time, in a human skin cell during interphase.

Time (in hours)	0	4	6	8	12
Quantity of chromosomal material in a cell (in a.u.)	6.5	6.5	8	13	13

1- Draw a graph showing the variation in the quantity of chromosomal material, in a skin cell, as a function of time.
2- How does the quantity of chromosomal material vary in the human skin cell between the 4th and the 8th hour of interphase?
3- Indicate the number of chromosomes and that of chromatids in the human skin cell at :
    a- t = 4 hrs
    b- t = 12 hrs.

Exercise 3 (5 points)
Spallanzani's experiment on digestion

Spallanzani, an Italian biologist, realized the first experiments on in vitro digestion.
After extracting gastric juice from the stomach of a hen, Spallanzani realized the experiment schematized in **document 1.**
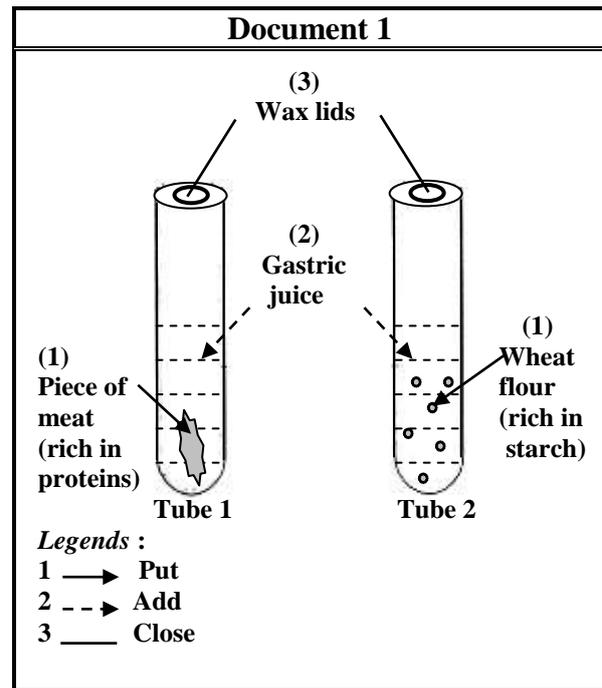
1- Describe this experiment using the legends (**document 1**).

Spallanzani, who did not have a water-bath, placed the two tubes under his armpits for three days (**document 2**).
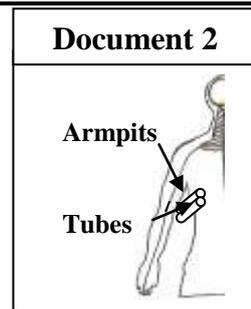
2- Explain why Spallanzani placed the two tubes under his armpits.

The obtained results were the following :
▪Meat disappeared in tube **1**.
▪Wheat flour did not disappear in tube **2**.

3- Analyze these results. What do you conclude ?

Document 1

(3)
Wax lids

(2)
Gastric juice

(1)
Piece of meat (rich in proteins)

(1)
Wheat flour (rich in starch)

Tube 1   **Tube 2**

Legends :
1 ⟶ **Put**
2 --▸ **Add**
3 ── **Close**

Document 2

Armpits

Tubes

Exercise 4 (5 points)
Anemia and the transport of respiratory gases

The table below represents the partial pressures of oxygen gas (O_2 gas) and carbon dioxide (CO_2) in the blood leaving the lungs, in a healthy person and in another anemic person suffering from respiratory difficulty.

	Partial pressure of oxygen gas (in kPa)	Partial pressure of carbon dioxide (in kPa)
Healthy person	13.2	5.2
Anemic person	5.5	6.4

1-a- Compare, in the two individuals, the partial pressures of :
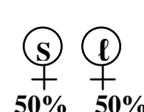- oxygen gas
- carbon dioxide.

b- Derive from this comparison the cause of the respiratory difficulty in the anemic person.

The number of red blood cells, in this anemic person, is equal to 3 millions/mm^3 of blood. This number is lower than the normal value of red blood cells : 5 millions/mm^3 of blood.
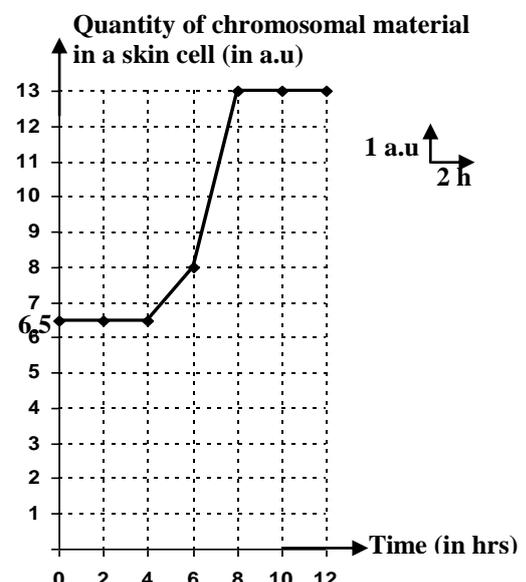
2- Name the constituent of red blood cells that ensures the transport of oxygen gas.

3- Based on the above information and knowledge, explain why the anemic person has low partial pressure of oxygen gas.

2

Exercise 1 (5 points)

Part of the Q	Answer	Mark
1	The allele for the short characteristic is dominant over the allele for long which is recessive, because the cross of two parents of pure race, one having short tail and the other having long tail, gives in **F₁** all guinea pigs with short tails. **Or** the only phenotype expressed in **F₁** is short.	**1.5**
2	Symbol of alleles : **S** : short, dominant allele. **ℓ** : long, recessive allele.	**0.5**
3	The genotype of the male with short tail is : **SS** The genotype of the female with long tail is : **ℓ ℓ**	**0.5**
4	P : ♂ **S ℓ** × ♀ **S ℓ** γP : (S) (ℓ) (S) (ℓ) **50% 50% 50% 50%** Table of cross : | ♂ / ♀	**S** 50%	**ℓ** 50%
S 50%	**SS** 25%	**Sℓ** 25%
ℓ 50%	**Sℓ** 25%	**ℓℓ** 25% | Two phenotypes are obtained : 75 % **[S]** 25% **[ℓ]** Thus, the experimental result is verified.	**2.5**

Exercise 2 (5 points)

Part of the Q	Answer	Mark
1		**2**

	Curve showing the variation in the quantity of chromosomal material in a skin cell in function of time.	
2	The quantity of chromosomal material increases from 6.5 a.u. to 13 a.u. between the 4th hour and the 8th hour in the human skin cell during interphase (it doubles).	**1**
3-a	The number of chromosomes, at the 4th hour, is **46**. The number of chromatids, at the 4th hour, is **46**.	**1**
3-b	The number of chromosomes, at the 8th hour, is **46**. The number of chromatids, at the 8th hour, is **92.**	**1**

Exercise 3(5 points)

Part of the Q	Answer	Mark
1	We put a piece of meat (rich in proteins) in tube **1** and wheat flour (rich in starch) in tube **2**. We add gastric juice to each tube, and then we close each tube with a wax lid.	**1.5**
2	Spallanzani placed the two tubes under his armpits to maintain them at body temperature.	**1**
3	The piece of meat disappeared in tube **1** that contains gastric juice and is placed at body temperature ; on the contrary, wheat flour did not disappear in tube **2** placed in the same conditions of tube **1**. This indicates that the meat has been digested in the presence of gastric juice while wheat flour has not. Thus, gastric juice acts on meat but not on wheat flour.	**2.5**

Exercise 4(5 points)

Part of the Q	Answer	Mark
1-a	- In the healthy person, the partial pressure of oxygen (13.2 kPa) is higher than the partial pressure of oxygen in the anemic person (5.5 kPa). - In the healthy person, the partial pressure of carbon dioxide in the healthy person (5.2kPa) is less than the partial pressure of carbon dioxide in the anemic person (6.4 kPa).	**2**
1-b	The principle cause of the respiratory difficulty in the anemic person is the low pressure of oxygen gas and the increase in the level of CO_2.	**1**
2	The constituent of the red blood cells that ensures the transport of oxygen gas is hemoglobin.	**0.5**
3	Hemoglobin ensures the transport of the most quantity of oxygen gas. The anemic person has a number of red blood cells (3 millions/mm^3 of blood) lower than that of the normal value (5 millions/mm^3 of blood) ; thus as the quantity of hemoglobin decreases, the transport of oxygen gas decreases. This is why the partial pressure of oxygen gas is slow in the anemic person.	**1.5**