مسابقة في مادة علوم الحياة والارض
المدة ساعة واحدة

الاسم:
الرقم:

Answer the following four exercises.

Exercise 1 (5 points) Cellular Metabolism

Indicate the true statements and correct the false ones.

1. Cellular metabolism includes a set of chemical reactions of synthesis and degradation.

2. Cells use nutrients and carbon dioxide to produce energy.

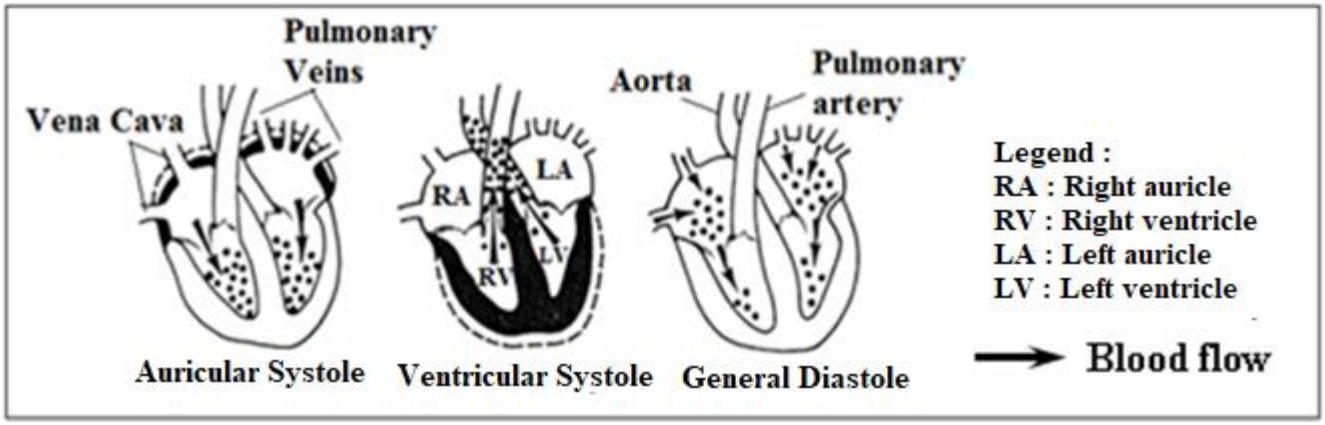
3. Oxidation of nutrients produces only energy and water.

4. Cells use nutrients and energy to synthesize new matter during assimilation.

5. Energy produced by the cells is entirely used for the production of heat.

Exercise 2 (5 points) Cardiac Activity

The heart contracts regularly according to a succession of cardiac cycles. Each cardiac cycle consists of three phases. Document 1 represents the three phases of a cardiac cycle.



Document 1

1. Describe, by referring to document 1, the path of the blood in the heart during each phase of the cardiac cycle.

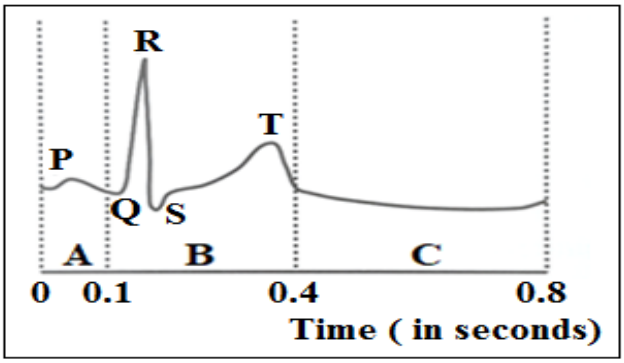
2. Indicate the behavior of the valves during the two systoles.

Document 2 represents the recording of the electrical activity of the heart during a cardiac cycle.

3. Name this recording.

4. Match each of the three parts A, B and C of the recording of document 2 with the corresponding phase of the cardiac cycle of document 1.

5. Calculate, by referring to document 2, the duration of each of the phases of a cardiac cycle.



Document 2

Exercise 3 (5 points) pH and Pepsin Activity

In the framework of studying the convenient pH for pepsin activity, we perform an experiment on in vitro digestion of ovalbumin, a protein extracted from egg white. Three test tubes, placed for one hour at a temperature of 37˚C, contain respectively:

Tube A: 3g of coagulated and chopped ovalbumin + Water + Pepsin; pH = 2
Tube B: 3g of coagulated and chopped ovalbumin + Water + Pepsin; pH = 7
Tube C: 3g of coagulated and chopped ovalbumin + Water + Pepsin; pH = 12

1. Construct a table showing the different conditions of the experiment.
2. Pose the problem at the origin of this experiment.

The opposite document represents the aspect of each of the three test tubes at the beginning of the experiment and after one hour.

Tube	Aspect of the tube at the beginning of the experiment	Aspect of the tube after one hour
A	Turbid	Clear
B	Turbid	Turbid
C	Turbid	Turbid

3. **3-1.** Interpret the obtained results.
3-2. What do you conclude concerning the convenient pH for the pepsin activity?
4. Name the product resulting from the digestion of ovalbumin by pepsin.

Exercise 4 (5 points) Chronic Bronchitis

Chronic bronchitis, a respiratory disease, is a chronic inflammation of the bronchi and bronchioles. In affected individuals, this inflammation is manifested by hypersecretion of mucus leading to narrowing of the respiratory airways, shortness of breath and coughing. Smoking is responsible for 90% of chronic bronchitis. This disease, if left untreated, leads to respiratory failure.

Document 1

1. Pick out from document 1 two symptoms of chronic bronchitis.
2. Draw out from document 1 the main cause of chronic bronchitis.

Document 2 represents the partial pressures of carbon dioxide and oxygen gas in the blood leaving the lungs, in a healthy individual and an affected one.

	Partial pressure of CO_2 (KPa)	Partial pressure of O_2 gas (KPa)
Healthy individual	5.2	13.2
Affected individual	7.34	6.5

Document 2

3. **3-1.** Compare, in the two individuals, the partial pressures of**:**
- Carbon dioxide
- Oxygen gas.

3-2. What do you conclude concerning the effect of the disease on the partial pressures of the two gases?
4. Explain, by referring to documents 1 and 2, how mucus hypersecretion in diseased individuals can lead to respiratory failure.

Ex	Part	Exercise1 (5 points) Cellular Metabolism	Mark
1	1	True.	1
	2	False. Cells use nutrients and oxygen gas to produce energy.	1
	3	False. Oxidation of nutrients produces energy, water and carbon dioxide.	1
	4	True.	1
	5	False. Energy produced by the cells is used for the production of heat and cellular activity.	1

Ex	Part	Exercice 2 (5 points) Cardiac Activity	Mark
2	1.	- During auricular systole, blood flows from the right auricle into the right ventricle and from the left auricle into the left ventricle. - During ventricular systole, blood flows from the right ventricle into the pulmonary artery and from the left ventricle into the aorta. - During general diastole, blood returns to the right auricle through the vena cava and to the left auricle through the pulmonary veins and flows into the ventricles.	0.5 0.5 0.5
	2.	- During auricular systole, the tricuspid and mitral valves open and the sigmoid valves close. - During ventricular systole, the tricuspid and mitral valves close and the sigmoid valves open.	0.5 0.5
	3.	The electrocardiogram.	0.5
	4.	**A** corresponds to the auricular systole. **B** corresponds to the ventricular systole. **C** corresponds to the general diastole.	0.25 0.25 0.25
	5.	The duration of the auricular systole (**A**) is 0.1 seconds. The duration of the ventricular systole (**B**) is: 0.4 – 0.1 = 0.3 seconds. The duration of the general diastole (**C**) is: 0.8 – 0.4 = 0.4 seconds.	0.25 0.5 0.5

<table>
<tr><th>Ex</th><th>Part</th><th>Exercise 3 (5 points)
pH and Pepsin Activity</th><th>Mark</th></tr>
<tr><td rowspan="5">3</td><td>1</td><td>
<table>
<tr><th>Conditions of the experiment</th><th>Tube A</th><th>Tube B</th><th>Tube C</th></tr>
<tr><td>3g of coagulated and chopped ovalbumin</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Water</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Pepsin</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>pH</td><td>2</td><td>7</td><td>12</td></tr>
<tr><td>Temperature</td><td>37˚C</td><td>37˚C</td><td>37˚C</td></tr>
<tr><td>Duration</td><td>1 hour</td><td>1 hour</td><td>1 hour</td></tr>
</table>
(+): Presence
Table showing the different conditions of the experiment.
</td><td>1.5</td></tr>
<tr><td>2</td><td>What is the convenient pH for pepsin activity?</td><td>1</td></tr>
<tr><td>3-1</td><td>At the beginning of the experiment, the aspect of the 3 tubes is turbid. After one hour, this aspect remains turbid in tubes B and C where the pH is respectively 7 and 12. On the contrary, in tube A, placed under the same conditions as tubes B and C but where the pH = 2, the aspect becomes clear.
This means that the transformation of ovalbumin takes place only in tube A where the pH = 2.</td><td>1.5</td></tr>
<tr><td>3-2</td><td>Pepsin is only active at a pH equals 2.
Or
pH equals 2 is the convenient pH for pepsin activity.</td><td>0.5</td></tr>
<tr><td>4</td><td>Peptides.</td><td>0.5</td></tr>
</table>

<table>
<tr><th>Ex</th><th>Part</th><th>Exercise 4 (5 points)
Chronic Bronchitis</th><th>Mark</th></tr>
<tr><td rowspan="4">4</td><td>1.</td><td>The two symptoms of chronic bronchitis are: hypersecretion of mucus and shortness of breath Or coughing.</td><td>0.5</td></tr>
<tr><td>2.</td><td>Smoking is the main cause of chronic bronchitis.</td><td>0.75</td></tr>
<tr><td>3-1.</td><td>The partial pressure of CO_2 in the blood of the healthy individual is 5.2 KPa, lower than that in the affected individual, 7.34 KPa.
The partial pressure of O_2 gas in the blood of the healthy individual is 13.2 KPa, greater than that in the affected individual, 6.5KPa.</td><td>0.75
0.75</td></tr>
<tr><td>3-2.</td><td>Chronic bronchitis decreases the pressure of O_2 gas and increases that of carbon dioxide in the blood of the affected individual.</td><td>1</td></tr>
<tr><td>4.</td><td>The hypersecretion of mucus causes the narrowing of the respiratory airways in the affected individual (document 1), which makes it difficult for air to circulate in these airways. Consequently, the diffusion of oxygen gas from the alveolar air into the blood and that of carbon dioxide from the blood into the alveolar air decrease which explains the decrease in the partial pressure of oxygen gas and the increase of that of carbon dioxide in the blood (document 2), thus leading to respiratory failure.</td><td>1.25</td></tr>
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