

EXAM OF CALCULUS

Pharmacy/Biotechnology 1st year

Version B

January 17, 2022

Duration: 1 hour.

- (3.5 pts.) 1. To analyze the hypoxemia tolerance of mammals, in a laboratory some rats are exposed to extreme conditions with variable levels of oxygen. The rats are in a room whose oxygen level (in %) at any position (x, y) is

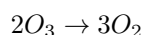
$$O(x, y) = \frac{1}{10}x^2y^2e^{x-y}$$

For the rats to survive, they must reach positions where the oxygen level is above 18%.

- (a) A rat A is at position $(3, 2)$. If the rat stays in that position, will it survive?
- (b) What direction should rat A take in order to increase the oxygen level as quickly as possible? What is the instantaneous rate of change of the oxygen level following that direction?
- (c) Another rat B is at position $(2, 2)$. If it starts to move in such a way that y decreases the double of the increment of x , how will the oxygen level change?

Solution

- (3.5 pts.) 2. The ozone (O_3) in the atmosphere is transformed into oxygen (O_2) through the following chemical reaction:



It was experimentally observed that the speed at which the amount of oxygen varies is inversely proportional to the amount of oxygen present. If there is initially 10 g of oxygen in a place, and after one hour this amount of oxygen doubles,

- (a) What will the amount of oxygen be after 5 hours?
- (b) How long will it take to have 1 kg of oxygen?

Solution

- (3 pts.) 3. Two insects start moving from the same point following perpendicular directions.

- (a) If the first insect moves at a speed of 3 cm/s and the second at a speed of 4 cm/s, at what instantaneous speed does the distance between them change 2 seconds after they start moving? And at 3 seconds?
- (b) If 4 seconds after they start moving the second insect stops and the first continues moving with the same direction and speed, at what instantaneous speed does the distance between the two insects change at that moment?

Remark: The distance between the two insects is the length of the hypotenuse of the right triangle whose sides are the distance traveled by them.

Solution
