

Student's Name:.....

Signature.....

Random No.						Personal No.		

P530/1
BIOLOGY
PAPER 1
(Theory)
SET FOUR
2 Hours 30 minutes



SELF-STUDY: BIOCLASS UG
Uganda Advanced Certificate of Education
BIOLOGY
Paper 1
(Theory)
2 HOURS 30 Minutes

INSTRUCTIONS TO CANDIDATES:

*This paper consists of **two** sections: **A** and **B**. It has **seven** examination items.*

*Section **A** has **Two Compulsory** items.*

*Section **B** has **two ITEMS**: Answer **one ITEM**.*

*Answers to section **A** must be written in the spaces provided while answers to **Section B** must be written in the answer booklet(s) provided.*

*Answer **three** items in all.*

*Any additional item(s) answered will **not** be scored*

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(b) The student's microscope has a 10x eyepiece and a 40x objective lens. The field of view under low power (100x total magnification) is 1600 μm . Calculate the size of one rectangular onion cell if 5 cells fit across the diameter of the field of view under high power (400x total magnification). Show your working.

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ITEM 2

A gardener notices that their basil plants wilt dramatically on hot, sunny afternoons but often recover by the next morning. Curious, they measure environmental conditions and leaf responses throughout a typical summer day.

TABLE 4: DIURNAL CHANGES IN BASIL PLANT PHYSIOLOGY

Time of Day	Light Intensity ($\mu\text{mol}/\text{m}^2/\text{s}$)	Temperature ($^{\circ}\text{C}$)	Leaf Water tendency to move (MPa)	Stomatal Conductance ($\text{mmol}/\text{m}^2/\text{s}$)	Net Photosynthesis ($\mu\text{mol CO}_2/\text{m}^2/\text{s}$)
6:00 AM	100	20	-0.5	250	2
12:00 PM	2000	35	-1.8	50	15
3:00 PM	2000	38	-2.5	10	5
7:00 PM	50	25	-1.0	200	1

TASK:

(a) Analyse the data, explaining the relationship between light intensity, temperature, water potential, and stomatal conductance. Account for the sharp drop in photosynthesis at 3:00 PM despite high light intensity.

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SECTION B: Attempt a total of ONE item from this section

ITEM 4

A group of mountaineers is attempting to summit Mount Rwenzori. At base camp (4,000m), their blood oxygen saturation (SpO_2) is measured at 85%. Upon reaching 5,000m, one climber, John, experiences severe headaches, nausea, and confusion. His SpO_2 drops to 70%. Another climber, Sarah, feels only mild shortness of breath and maintains a SpO_2 of 88%. John is given supplemental oxygen, and his SpO_2 rises to 92%, alleviating his symptoms.

TABLE 1: BLOOD PARAMETERS AT 5,000M

Climber	SpO_2 (%)	[Hb] (g/dL)	Arterial PCO_2 (kPa)	Blood pH	2,3-DPG concentration
John (Symptomatic)	70	14.0	4.0	7.50	High
Sarah (Asymptomatic)	88	18.5	5.3	7.38	Slightly High

TASK:

- (a) (i) Explain the role of 2,3-DPG and how John's high levels affect oxygen dissociation from haemoglobin.
 (ii) Analyse how John's low arterial PCO_2 and high blood pH (alkalosis) further impair oxygen delivery to his tissues, causing his symptoms.
- (b) Explain why Sarah's higher haemoglobin concentration ([Hb]) is a beneficial adaptation for high altitude.
- (c) Propose a physiological reason why simply giving John supplemental oxygen was an effective treatment.

ITEM 5

A newborn baby (Baby K) develops severe jaundice (yellowing of the skin) 24 hours after birth. The mother is Rh-negative, and this is her second pregnancy. Blood tests are ordered for both mother and baby.

TABLE 2: HAEMOLYTIC DISEASE OF THE NEWBORN (HDN) BLOOD TEST RESULTS

Parameter	Mother's Blood	Baby K's Blood	Normal Range
Blood Group	O Rh-negative	A Rh-positive	-----
Anti-Rh Antibody Titre	High	Not Applicable	None detected
Erythrocyte (RBC) Count	Normal	Very Low	$4.0\text{-}5.5 \times 10^{12}/\text{L}$
Bilirubin Level	Normal	Very High	$< 5.0 \text{ mg/dL}$

Tasks-:

- (a) (i) Explain the immunological mechanism that caused the mother to develop a high anti-Rh antibody titre.
 (ii) Describe how these antibodies then cause the very low RBC count and very high bilirubin level in Baby K.
- (b) This condition is preventable. Propose a medical treatment that should have been administered to the mother after the birth of her first child and explain how it works.

END

Follow the like for scoring guide: <https://www.youtube.com/@bioclassug/videos>