

**P530/1**  
**BIOLOGY**  
**Paper 1**  
**June 2026**  
**3 hours**



**Uganda Advanced Certificate of Education**  
**Muto Online Mock Examinations**

**BIOLOGY**

**Paper One**  
**(Theory)**

**3 hours**

**INSTRUCTION TO CANDIDATES**

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

*Section **A** has two compulsory items.*

*Section **B** has **two** Parts: **I** and **II**. Respond to **one** item from **each** part.*

*Respond to **four** items in **all**.*

*Any additional item(s) responded to will not be scored*

## SECTION A

Respond to **both** items in this section.

### ITEM 1

Ruthan Logistics deals in the manufacture of synthetic human body structures including hair extensions, synthetic blood vessels and soft tissues to replace damaged ones. During the production process, the company generates synthetic cells made by enclosing maintaining fluid in a synthetic membrane made by an interaction between solution R with a phospholipid extract.

Solution R is a protein produced when the gene sequence 5'-ATG GCT TCT GGA AAA GCT-3' in the bacteria is transcribed and translated. The synthetic tissues also require glucose in the maintaining fluid, which is used to produce ATP for membrane maintenance through the expression of the ATP synthase gene 5'-ATG CGT TTG GCA TTC-3'.

During a routine check, analysis showed that a batch had been exposed to heavy metal residues. The sequence of the keratin gene had changed slightly to 5'-ATG GCT TCT GGA CAA GCT-3' and the sequence of the ATP synthase gene had changed to 5'-ATG CGT TTG GCA CTC-3'. Tissues formed from this batch were abnormal, weak, and broke down easily.

During Investigations made on solution R, several tests were made to find out its validity. Below were observations made when tests were made;

Test	Observation(s)
Hot combing of the twisted hair made from the solution R.	The hair straightens.
Boiling solution R.	The solution solidified.

On carrying out biuret's test on the solution R, a purple coloration was formed; When the same test was carried out on boiled portion of solution R, still purple coloration was formed; However, when about 2cm<sup>3</sup> of an extract from Q obtained from ground stomach wall of a rat, a blue coloration was formed.

To preserve the tissues made, they usually clean them with ethanol. However, whenever ethanol is used, leakage of the maintaining fluid occurs, the tissues weaken and usually breakdown. One of the production team members has proposed use of ethanol together with egg extract solution which has given better

results. The above observations raised need for explanations to the company executives. You have been appointed by the fellow production members.

**Task:**

As a biology learner, analyze the above observations made during the investigations and draw appropriate explanations and recommendations for the use of such molecules of life.

**ITEM 2**

A plant physiologist conducted an experiment to investigate the rate of photosynthesis in Elodea plants under different light intensities and carbon dioxide concentrations. The rate was measured by counting the number of oxygen bubbles released per minute. The data collected is presented in the table below:

<b>Light Intensity (lux)</b>	<b>Bubble count per minute at 0.03% CO<sub>2</sub></b>	<b>Bubble count per minute at 0.1% CO<sub>2</sub></b>
100	5	5
200	12	14
400	22	28
600	25	42
800	26	55
1000	26	58

**Task**

- a) Represent the data graphically on the same axes.
- b) Analyze the curves to explain the concept of limiting factors as demonstrated by the data, and describe the biochemical processes in the light-dependent and light-independent stages of photosynthesis that explain the shapes of the curves at high light intensities.

## SECTION B

### Part I

Respond **one** item from **this** part

#### ITEM 3

Researchers compared two healthy adults exposed to different environmental conditions for 4 hours. One person was in a hot, humid environment at 38°C and 85% humidity. The other was in an extremely cold environment at -5°C with wind exposure. Both were at rest. Data were collected on physiological responses and observed behaviors that contribute to thermoregulation, as follows:

Condition	Core temp (°C)	skin blood flow (mL/100g/min)	Sweat rate (g/min)	Shivering intensity	Behavioral response
Hot, humid	39.8	40	1.5	None	Loosened clothing, fanning
Cold, windy	34.9	8	0.1	High	Put on extra clothing, Curled Posture

Normal resting core temperature: ranges between 36.5 — 37.5°C

#### Task

- Analyze the above data and explain why the body's responses differ between hot-humid and cold environments; what they mean in maintaining a stable internal environment
- Suggest any strategy people can take to reduce risks of poor thermal responses by the body and give justification using the above data.

#### ITEM 4

In a study on kidney function, researchers measured the concentrations of various substances in the blood plasma, glomerular filtrate, and urine of a healthy human volunteer. The results are summarized in the table below:

Substance	Concentration in Plasma (g/100mL)	Concentration in Glomerular Filtrate (g/100mL)	Concentration in Urine (g/100mL)
Proteins	7.00	0.00	0.00
Glucose	0.10	0.10	0.00
Urea	0.03	0.03	2.00
Uric acid	0.004	0.004	0.05
Sodium ions	0.32	0.32	0.35

## Task

- Analyze the data to explain how ultrafiltration and selective reabsorption account for the differences in concentrations of proteins, glucose, and urea across the three fluid compartments.
- Predict and justify what changes would occur in the composition of the urine if the individual suffered from untreated diabetes mellitus or severe dehydration.

## Part II

Respond to **one** item from **this** part.

### ITEM 5

Farmers in Region K report a rapid outbreak of *Agrilus* borer, an invasive insect that feeds on staple grain crops. The pest was absent 3 years ago. Below are field and lab data collected this season.

Table : Pest and crop data from Region K.

Site	Borer Larvae/m <sup>2</sup>	Avg. Crop Yield [kg/ha]	Plant height (cm)	% crop with Pest X resistance gene	Notes
A	8	4200	95	15	Low pesticide use, high natural predators
B	65	1800	62	18	High pesticide use, low predator activity
C	22	3500	88	70	Mixed pesticide use, introduced Pest X crop strain

Normal crop yield is about 4000-5000kg/ha, and normal plant height for healthy crops is between 90-100cm. Pest X resistance gene allows plants to produce a protein toxic to borer larvae. Borer develops from eggs to larva, to pupa and to adult in 28 days at 28°C. With warmer seasons, development speeds up by 15-20%.

Table : summarizes the ecological observation made on the following

Factor	Site A	Site B	Site C
Natural predator abundance	High	Low	Moderate
Soil Nitrogen level	High	Low	Moderate
Recent temp trends	+0.8°C in 5 years	+1.2°C in 5 years	+1.0°C in 5 years

**Task**

- a) Evaluate the genetic, ecological, and developmental factors driving the borer outbreak and crop loss across sites A, B and C. Intergrate inheritance, population growth, plant growth and ecological interactions to explain why the problem differs between sites.
- b) Develop sustainable strategy for Region K that addresses the invasive species and account for the ongoing climate change.

**ITEM 6**

In population of forest mice, coat color is influenced by two genes. One gene controls pigment production, and the other controls where pigment is deposited in the hair. Researchers crossed two mice that both had agouti coats. The agouti coat has bands of pigments and is the wild type in this species. In the  $F_2$  generation, 960 offsprings were recorded.

Table below show coat color data.

Coat color observed	Agouti	Black	White	Total
Number of mice	540	180	240	960

No white mice were used in the original cross, and all white mice had pink eyes.

**Task**

- a) Analyze the  $F_2$  data to determine the inheritance pattern for coat color in these mice. Explain what the ratio suggests about how the two genes interact.
- b) Use the data to support your explanation, and also describe how this type of gene interaction differs from the 9:3:3:1 pattern seen in dihybrid crosses with independent genes.

**END**