S.5 BIOLOGY HOLIDAY WORK
TERM 3- 2025

Mukisa Agro-Tech, a biotechnology start-up in Mukono, is working with local farmers whose crops are being severely affected by stem borers (in maize), slow-growing bean varieties, and repeated bacterial wilt in tomatoes. To solve these agricultural challenges, Mukisa Agro-Tech establishes a molecular biology lab and uses modern genetic technologies:

- Recombinant DNA technology to insert pest-resistance and disease-resistance genes into crops.
- Gene cloning to mass-produce desired genes such as the *Bt* toxin gene from *Bacillus thuringiensis*.
- Polymerase Chain Reaction (PCR**)** to verify successful gene insertion.

After several trials, the company develops GMO maize with the Bt gene and GMO tomatoes resistant to bacterial wilt. These GMO varieties are given to selected farmers for field trials to monitor yield, storage life, and resistance to pests and diseases.

TASK (30 Marks)

1. Explain in detail the steps involved in using recombinant DNA technology to create Bt-maize or disease-resistant tomatoes. Include processes such as gene isolation, vector preparation, gene insertion, and transformation of plant cells. (8 marks)
2. Describe the full process of gene cloning and explain why gene cloning is important in crop genetic engineering. Refer to host cells, selectable markers, and gene expression. (6 marks)

3. Explain how PCR is used to confirm that the inserted gene is present in the newly modified plants. Include principles such as denaturation, annealing, extension, and use of specific primers. (6 marks)
4. Discuss three major applications of recombinant DNA technology, gene cloning, and PCR in the development of GMOs**.** Each application must relate to crop improvement relevant to Ugandan agriculture. (6 marks**)**
5. Evaluate two potential benefits and two concerns (or risks) associated with the use of GMOs in Uganda's agricultural sector. (4 marks)

Merry Christmas and happy New Year.