

MENTOR HIGH SCHOOL KITENDE
COMPETENCE BASED ASSESSMENT 2025

SCENARIO ITEMS

S.5 BIOLOGY 1

HOLIDAY PACKAGE

ITEM 1

A research team investigated energy production in two cell cultures: Culture X (muscle cells) and Culture Y (yeast cells). The cultures were grown in identical conditions except for oxygen availability.

After 2 hours, the following data were obtained:

Parameter	Culture X	Culture Y
Oxygen concentration	High	Low
Glucose consumed (mg)	18	40
ATP produced (units)	72	24
End-products detected	CO ₂ + H ₂ O	Ethanol + CO ₂

Task

- a) Explain why Culture Y consumed more glucose than Culture X.

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- (b) What does this suggest about the efficiency of the metabolic pathway used by Culture Y?

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- (c) Using the data, compare ATP yield per mg of glucose in cultures X and Y.

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(d) i Explain the differences in end-products observed in the two cultures.

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(ii) Describe one structural feature of mitochondria that enhances efficiency of the process occurring in Culture X.

Item 2

A farmer planted two varieties of beans, Variety A and Variety B, under the same environmental conditions. After 6 weeks, leaf samples were analysed for stomatal density and chlorophyll content.

Parameter	Variety A	Variety B
Habitat of origin	Arid region	Wet region
Stomatal density (per mm ²)	120	380
Guard cell thickness	Thick	Thin
Chlorophyll content (mg/g)	3.2	5.8
Leaf surface	Waxy	Smooth

Task

(a) Using the data, explain the adaptations of Variety A to survive in its native habitat.

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SECTION B

(Choose one item from each part)

PART 1

ITEM 3

A hospital monitored two patients, Patient P and Patient Q, during a glucose tolerance test. Blood glucose levels (mmol/L) were recorded over time.

Time after glucose intake	0 min	30 min	60 min	120 min	180 min
Patient P	5.2	7.8	6.0	5.4	5.3
Patient Q	5.4	11.0	13.5	12.8	11.5

Task

- Describe the normal homeostatic response in Patient P after glucose intake.
- Using data, explain the abnormal pattern in Patient Q.
- What hormone is likely deficient or malfunctioning in Patient Q? Explain its normal role.
- Propose one long-term complication of Patient Q's condition and explain its physiological basis

Item 4

A study investigated thermoregulation in goats from **Highland Region (H goats)** and **Lowland Region (L goats)** when exposed to increasing environmental temperatures

Temperature (°C)	20	30	35	40
Mean respiration rate (breaths/min) – H goats	18	24	29	34
Mean respiration rate (breaths/min) – L goats	22	33	40	52

Task

- Interpret the data and compare thermal tolerance of the two goat populations.
- Explain why L goats show a sharper increase in respiration rate at higher temperatures.
- Describe two physiological mechanisms goats use to lose heat.
- Suggest how natural selection may have shaped the differences observed between the two populations

PART 11

Item 5

A population of beetles was studied for colour variation. The environment changed when dark volcanic ash covered the ground. Population changes were recorded:

Generation	Light beetles (%)	Dark beetles (%)
1	70	30
5	40	60

10	15	85
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Task

- Describe the evolutionary process responsible for the change in beetle color frequencies.
- Explain how the environmental change exerted selective pressure.
- Predict what would happen if the environment reverted to light-colored soil.
- State one assumption required for natural selection to result in such changes

Item 6

A maize breeder studied two genes:

- Gene A:** kernel texture (dominant = smooth, recessive = wrinkled)
- Gene B:** kernel colour (dominant = purple, recessive = yellow)

A dihybrid cross was performed between two heterozygous plants: **AaBb × AaBb**.

The observed phenotypic ratio among 800 seeds was:

Phenotype	Observed number
Smooth purple	360
Smooth yellow	120
Wrinkled purple	100
Wrinkled yellow	220

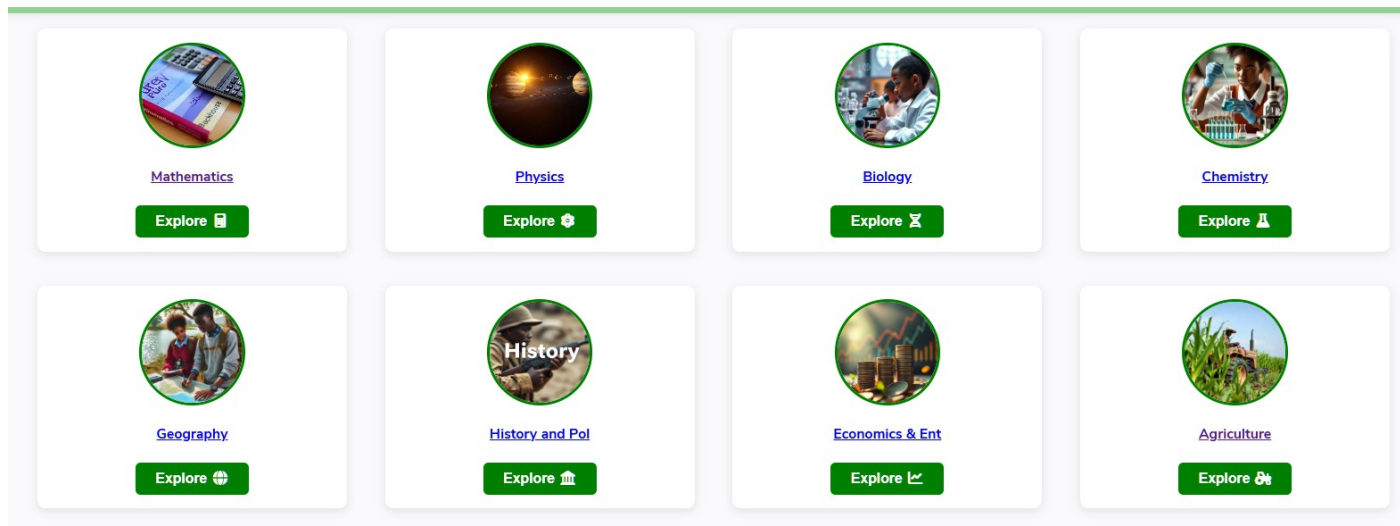
Task

- Calculate the expected Mendelian ratio and expected numbers for each phenotype.
- Using chi-square analysis principles, explain whether the observed results deviate significantly from expectation.
- Suggest a biological reason that could explain the deviation from Mendelian ratios.
- Explain why dihybrid crosses illustrate independent assortment.

END

MERRY X.MAS AND HAPPY NEW YEAR 2026.....

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