SAMPLE QUESTIONS FOR THE QUIZ COMPETITION FOR PRIVATE SENIOR HIGH SCHOOLS

ROUND 1: STEM SPRINT (SHS/OLYMPIAD – HIGH PRECISION MODE)

FORMAT

- 4 Teams: A, B, C, D
- Rotational questioning
- 10 seconds per question
- Focus: Deep concept recognition under pressure

SET 1: PHYSICS (HIGH-LEVEL CONCEPT TRAPS)

1. A body moves with constant speed in a circular path. What is the net force acting?
   Answer: Centripetal force

2. Increasing voltage while keeping resistance constant affects current how?
   Answer: Increases

3. Work done is zero when force is perpendicular to displacement. Why?
   Answer: No displacement in direction of force

4. A conductor offers resistance due to what fundamental cause?
   Answer: Collision of electrons

5. A system has 100% efficiency. What does this imply?
   Answer: No energy loss

SET 2: MATHEMATICS (PRECISION & LOGIC TRAPS)

1. If $x^2 = 9$, what is x?
   Answer: ±3

2. A function is linear if its graph is?
   Answer: Straight line

3. The sum of interior angles of a triangle is always what?
   Answer: 180°

4. If two ratios are equal, what is the relationship?
   Answer: Proportion

5. If probability of event is 0, what does it mean?
   Answer: Impossible event

SET 3: CHEMISTRY (MISCONCEPTION-BASED TRAPS)

1. A catalyst affects reaction rate by changing what?
   Answer: Activation energy

2. A strong acid differs from a weak acid in what way?
   Answer: Degree of ionization

3. Neutralization always produces what?
   Answer: Salt and water

4. Increase in temperature affects particles how?
   Answer: Increases kinetic energy

5. An exothermic reaction releases what?
   Answer: Heat energy

SET 4: BIOLOGY (FUNCTIONAL MISCONCEPTIONS)

1. Oxygen transport in blood is mainly by what?
   Answer: Haemoglobin

2. Photosynthesis occurs in which organelle?
   Answer: Chloroplast

3. Diffusion occurs due to what driving factor?
   Answer: Concentration gradient

4. Enzymes are affected most by what factor?
   Answer: Temperature and pH

5. The main function of xylem is what?
   Answer: Transport of water

SET 5: AGRICULTURAL SCIENCE (APPLICATION TRAPS)

1. Continuous cropping leads primarily to what?
   Answer: Nutrient depletion

2. Organic manure improves soil by what main property?
   Answer: Structure

3. Irrigation is most effective in which condition?
   Answer: Low rainfall

4. Crop rotation mainly controls what?
   Answer: Soil fertility and pests

5. Loamy soil is preferred because it has what property?
   Answer: Balanced drainage and retention

ROUND 2: THINK & EXPLAIN (SCENARIO & CASE STUDY – SET 1: PHYSICS (Energy System Failure Analysis)

Case Study:
A solar lighting system works well during the day but fails to provide sufficient light throughout the night, despite receiving full sunlight exposure.

1. Identify the system limitation responsible for the failure.
   Answer: Insufficient energy storage
2. Determine the component that must be upgraded to extend lighting duration.
   Answer: Battery
3. Predict what will happen if resistance in the wiring increases.
   Answer: Current decreases
4. Identify the energy conversion that is not adequately sustained at night.
   Answer: Chemical to electrical energy
5. Select the most effective improvement to ensure continuous lighting.
   Answer: Increase battery capacity

SET 2: MATHEMATICS (Applied Cost & Optimization Analysis)

Case Study:
A farmer wants to fence a rectangular plot of land measuring 30 m by 20 m using a limited budget.

1. Calculate the minimum fencing length required.
   Answer: 100 m
2. Determine the total cost if fencing is GH₵4 per metre.
   Answer: GH₵400
3. Identify the mathematical concept used in determining fencing length.
   Answer: Perimeter

4. Predict the effect on cost if the length is doubled and width unchanged.
   Answer: Cost increases
5. Select the best strategy to reduce cost while maintaining area.
   Answer: Use a square shape

SET 3: CHEMISTRY (Soil Treatment Decision-Making)

Case Study:

A soil sample with pH 4 is used for farming, resulting in poor crop yield despite adequate watering.

1. Identify the chemical condition affecting the soil.
   Answer: High acidity
2. Determine the most suitable substance to correct the condition.
   Answer: Lime
3. Identify the chemical process involved in treatment.
   Answer: Neutralization
4. Predict the effect of leaving the soil untreated.
   Answer: Reduced crop yield
5. Select the outcome expected after proper treatment.
   Answer: Increased soil fertility

SET 4: BIOLOGY (Health Risk Analysis)

Case Study:

In a densely populated area, poor ventilation leads to increased respiratory infections.

1. Identify the environmental factor contributing to disease spread.
   Answer: Poor ventilation
2. Determine the body system primarily affected.
   Answer: Respiratory system
3. Predict the effect of reduced oxygen supply to the body.
   Answer: Reduced respiration efficiency

4. Identify the structure where gas exchange occurs.
   Answer: Alveoli
5. Select the most effective preventive measure.
   Answer: Improve ventilation

SET 5: AGRICULTURAL SCIENCE (Sustainable Farming Analysis)

Case Study:

A farmer repeatedly grows maize on the same land without applying fertilizers, leading to declining yields.

1. Identify the long-term effect on the soil.
   Answer: Soil nutrient depletion
2. Determine the farming practice responsible.
   Answer: Continuous cropping
3. Predict the effect on crop production over time.
   Answer: Decrease in yield
4. Select the most sustainable farming practice to correct the issue.
   Answer: Crop rotation
5. Identify the key benefit of applying the solution.
   Answer: Improved soil fertility

ROUND 3: STEM IN CONTEXT GOOGLE FORM SETUP PICTURE IDENTIFICATION)

FORMAT

- 4 Teams: A, B, C, D
- Same questions for all teams
- Respond using Google Forms
- Time: **5 minutes total**
- Includes: **Data + Context + Picture Identification**

SECTION: QUESTIONS

Q1 A device operates at 12 V and 3 A.

If resistance doubles, calculate the new current.

Answer: 1.5

Q2

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Identify the device shown that converts sunlight into electrical energy.

Answer: Solar panel

Q3 A solar system fails at night. What is the best improvement?

A. Increase sunlight

B. Add battery storage

C. Reduce voltage

D. Remove load

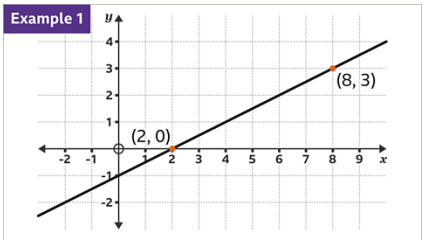
Answer: B

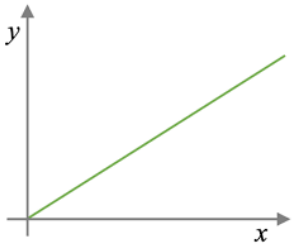
Q4 A rectangular field has area 120 m².

If length doubles and width halves, find the new area.

Answer: 120

Q5





The graph shown represents what type of relationship?

A. Inverse

B. Direct

C. Quadratic

D. Exponential

Answer: B

Q6 A farmer adds lime to acidic soil. What is the result?

A. Soil becomes more acidic

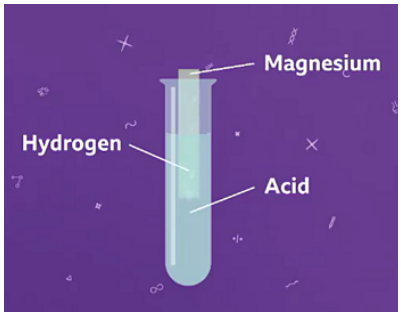
B. Soil becomes neutral

C. Soil becomes saline

D. No change

Answer: B

Q7



The image shows bubbles forming during a reaction.

Identify the gas produced.

Answer: Hydrogen

Q8 A person breathes faster at high altitude. Why?

A. More oxygen

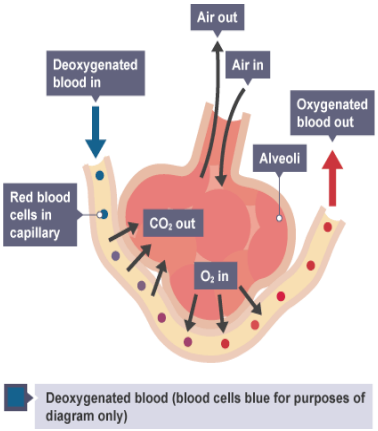
B. Less oxygen

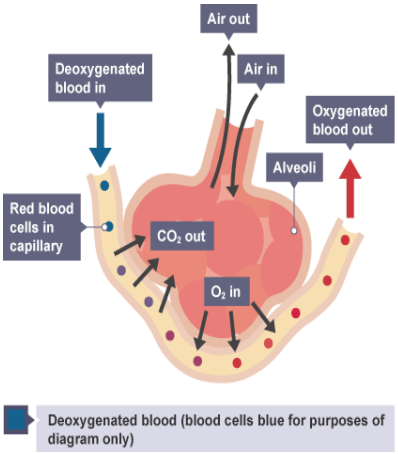
C. More pressure

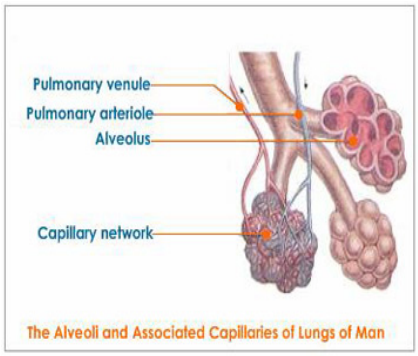
D. Less carbon dioxide

Answer: B

Q9







Identify the structure where gas exchange occurs.

Answer: Alveoli

Q10 (Agriculture – Multiple Choice)

Crop yield increases after fertilizer use. Why?

A. Increased sunlight

B. Increased nutrients

C. Increased rainfall

D. Increased temperature

Answer: B

Q11



Identify the farming practice shown.

Answer: Irrigation

Q12 A machine uses 1000 J of energy with 50% efficiency.
Calculate useful energy output.

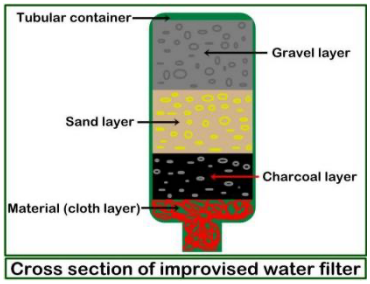
Answer: 500

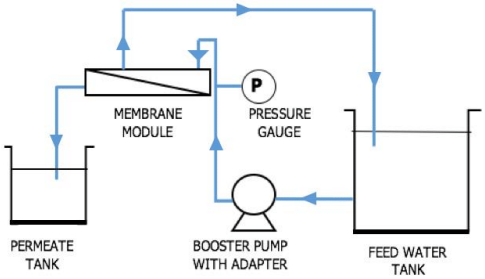
Q13 A water filtration system fails to remove impurities.
What is the likely issue?

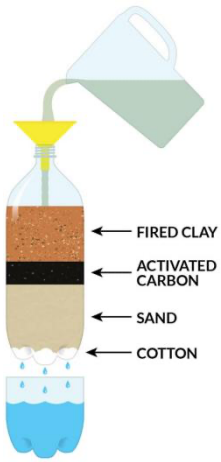
A. Over-filtration
B. Incomplete filtration
C. Too much sunlight
D. High pressure

Answer: B

Q14







Identify the process shown.

Answer: Filtration

Q15 A system improves efficiency using stored energy. What component is required?

A. Switch

B. Battery

C. Wire

D. Resistor

ROUND 4 : DESIGN, EXPERIMENT & INNOVATE, INTEGRATED STEM INVESTIGATION

FORMAT

- 4 Teams: A, B, C, D
- Each set = **1 structured investigation (same for all teams)**
- Teams must: **Observe → Measure → Record → Calculate → Conclude → Improve**
- Time: **10–15 minutes experiment | 3 minutes presentation**

SET 1: PHYSICS (ELECTRIC CIRCUIT INVESTIGATION – WASSCE STYLE)

Apparatus

Battery, bulb, wires, resistor (or long wire), switch

Task

(a) Set up a simple circuit and observe bulb brightness.
(b) Introduce a longer wire/resistor and observe change.
(c) Record observations in a table.
(d) State the relationship between resistance and current.
(e) Explain the effect on brightness using electrical principles.
(f) Suggest one method to improve brightness without changing the battery.

Post-Experiment Questions

1. What observation confirms that current changed in your circuit?
   Answer: Change in brightness of bulb
2. Using Ohm's Law, explain why the bulb became dimmer.
   Answer: Increase in resistance reduces current

3. Suggest one modification to reduce energy loss in the circuit.
   Answer: Use shorter/thicker wire

SET 2: CHEMISTRY (REACTION RATE INVESTIGATION – WASSCE STYLE)

Apparatus

Effervescent tablets (whole & crushed), water, stopwatch

Task

(a) Place a whole tablet in water and record time taken to dissolve.
(b) Repeat with crushed tablet.
(c) Tabulate results.
(d) Compare reaction rates.
(e) Explain the difference using particle theory.
(f) State one factor controlled in the experiment.
(g) Suggest one industrial application of this principle.

Post-Experiment Questions

1. Which form of the tablet reacted faster based on your data?
   Answer: Crushed tablet
2. Explain the observed difference using collision theory.
   Answer: Larger surface area increases collision rate
3. Suggest one way to further increase the reaction rate.
   Answer: Increase temperature

SET 3: BIOLOGY (RESPIRATION INVESTIGATION – WASSCE STYLE)

Apparatus

Stopwatch, student

Task

(a) Measure breathing rate at rest for 1 minute.
(b) Perform light exercise and measure again.
(c) Record results in a table.
(d) Compare the two values.
(e) Explain the difference using respiration concepts.
(f) State one limitation of the method.
(g) Suggest one improvement.

Post-Experiment Questions

1. What change did you observe after exercise?
   Answer: Increased breathing rate
2. Explain why this change occurs in terms of energy demand.
   Answer: Increased oxygen demand for respiration
3. Suggest one method to improve accuracy of your measurement.
   Answer: Repeat measurements and average

SET 4: MATHEMATICS (DATA MODELING INVESTIGATION – WASSCE STYLE)

Task

A student records the following pattern:
2, 4, 6, 8, 10

(a) Construct a table showing term number and value.
(b) Determine the rule governing the pattern.
(c) Express the rule algebraically.
(d) Calculate the 15th term.
(e) Verify your answer using substitution.
(f) State one real-life application of this pattern.

Post-Experiment Questions

1. What type of relationship exists in the pattern?
   Answer: Linear
2. How does the algebraic rule confirm your pattern?
   Answer: It generates all terms correctly
3. Suggest one real-life system that follows this pattern.
   Answer: Equal spacing/fence posts

SET 5: AGRICULTURAL SCIENCE (SOIL INVESTIGATION – WASSCE STYLE)

Apparatus

Sandy soil, clay soil, water, containers

Task

(a) Add equal water to both soil samples.
(b) Observe and record drainage rate.
(c) Tabulate observations.
(d) Identify which soil drains faster.
(e) Explain results based on soil structure.
(f) State one agricultural implication.
(g) Suggest a method to improve water retention in sandy soil.

Post-Experiment Questions

1. Which soil showed faster drainage based on your results?
   Answer: Sandy soil
2. Explain the difference using particle size and structure.
   Answer: Larger particles create bigger pores
3. Suggest one method to improve water retention in sandy soil.
   Answer: Add organic matter

ROUND 5: GRAND CHALLENGE (FINALS – VARIED STYLE, INTEGRATED STEM)

FORMAT

i. 4 Teams: A, B, C, D
ii. Same questions for all teams
iii. Each question is independent
iv. Teams must give:

- Final Answer
- Reason (must be part of response)

QUESTION 1: WATER SYSTEMS (CONSTRAINT + SELECTION)

A community uses two water sources:

- Borehole supplies 1000 L/day at GH₵50 with 90% reliability
- Rainwater tank supplies 400 L/day at GH₵10 with 60% reliability

Daily demand is 1200 L, and the system must maintain at least 80% reliability.

Task:
Select the best combination of sources and state your reason based on supply, cost, and reliability.

Answer: Borehole + Rain Tank
Reason: Meets demand (1400 L) at lowest cost while maintaining acceptable reliability

QUESTION 2: WASTE MANAGEMENT (ERROR ANALYSIS)

A student argues that burning waste is the best method because it uses less energy.
However, burning processes 70% of waste but has high environmental risk, while recycling processes 80% with moderate risk.

Task:
State whether the student's claim is correct or incorrect and justify your answer using the data.

Answer: Incorrect
Reason: Burning has high environmental risk despite lower energy use, while recycling processes more waste with lower risk

QUESTION 3: FOOD SECURITY (RANKING + DECISION)

Three crop varieties have the following characteristics:

- Crop A: high yield but very high water use
- Crop B: moderate yield, low water use, high pest resistance
- Crop C: high yield, moderate water use, low resistance

Task:
Rank the crops from most suitable to least suitable under conditions of water scarcity and high pest infestation, and justify your ranking.

Answer: B → C → A
Reason: Crop B minimizes water use and resists pests best

QUESTION 4: HEALTH & SANITATION (PROCESS DESIGN)

Dirty water is passed through a filter but still causes disease outbreaks due to bacteria.

Task:
State the correct sequence of treatment required and explain why this sequence is necessary.

Answer: Filtration followed by disinfection (chlorination/UV)
Reason: Filtration removes particles, while disinfection kills microorganisms

QUESTION 5: FLOODING & DRAINAGE (CALCULATION + SYSTEM DECISION)

Rainfall of **20 mm** falls on a **30 m² surface**, and only **50% infiltrates the ground**.

Task:
Calculate the runoff volume and **state the most effective surface modification to reduce flooding, giving your reason**.

Answer:

- Runoff = **300 L**
- Solution = Vegetated/permeable surface
  Reason: Increases infiltration and reduces runoff

QUESTION 6: TRANSPORT & INFRASTRUCTURE (TRADE-OFF ANALYSIS)

A district can construct one of the following roads:

- Gravel road (40 km/h, GH₵2 million)
- Asphalt road (70 km/h, GH₵5 million)
- Concrete road (60 km/h, GH₵7 million)

Budget limit is **GH₵5 million**.

Task:
Select the best road option and justify why another option is not suitable.

Answer: Asphalt
Reason: Highest speed within budget; concrete exceeds cost

QUESTION 7: CLIMATE & ENVIRONMENT (OPTIMIZATION)

A school must choose an energy source under a budget of GH₵80/day:

Dataset

Source	Emission	Cost GH₵
Diesel	600	100
Solar	100	80
Grid	300	70

Task:
Select the best option and justify based on both environmental and cost considerations.

Answer: Solar
Reason: Lowest emissions within budget

QUESTION 8: HOUSING & BUILT ENVIRONMENT (TRADE-OFF DECISION)

A housing project cannot afford the most expensive insulation material.
Available options include materials with:

- High heat loss and low cost
- Medium heat loss and moderate cost
- Low heat loss and high cost

Task:
Select the best option and justify your choice based on performance and cost trade-off.

Answer: Medium heat loss (wood-type material)
Reason: Balances thermal efficiency and affordability

QUESTION 9: DIGITAL ACCESS (PERFORMANCE DECISION)

A school must select a network system under a GH₵500 budget:

- Option A: low speed, small coverage
- Option B: high speed, exceeds budget
- Option C: moderate speed, wide coverage

Task:
Select the best option and justify your decision based on performance and constraints.

Answer: Option C
Reason: Best coverage within budget

QUESTION 10: AGRICULTURE SYSTEMS (EFFICIENCY DECISION)

A farmer wants to maximize water use efficiency but cannot afford the most expensive irrigation system.

Dataset

Method	Efficiency (%)	Cost
Flood	40	Low
Sprinkler	65	Medium
Drip	85	High

Task:
Select the most appropriate irrigation method and justify your answer based on efficiency and cost.

Answer: Sprinkler system
Reason: Highest efficiency among affordable options

QUESTION 11: LOCAL INDUSTRY & INNOVATION (SYSTEM EVALUATION)

A factory must choose a machine that avoids high maintenance cost while maintaining high output and efficiency.

Task:
Select the best machine and **justify your decision using all three factors (efficiency, output, maintenance)**.

Answer: Machine C
Reason: High efficiency and output without high maintenance