2023 MCAS Sample Student Work and Scoring Guide

High School Biology
Question 42: Constructed-Response

Reporting Category: Molecules to Organisms
Practice Category: Mathematics and Data
Standard: HS.LS.1.5 - Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates.
Item Description: Determine that photosynthesis is a process performed only by plants and that cellular respiration is a process performed by both plants and animals; analyze data to determine whether flasks in an experiment contain plants, animals, or both and explain the reasoning.

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Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
4A	The response demonstrates a thorough understanding of photosynthesis and cellular respiration. The response correctly identifies the cellular process only the flowering plants perform and also correctly identifies the cellular process that both the flowering plants and insects perform. The response correctly identifies the contents of each flask and clearly explains the reasoning.
4B	
3	The response demonstrates a general understanding of photosynthesis and cellular respiration.
2	The response demonstrates a limited understanding of photosynthesis and cellular respiration.
1	The response demonstrates a minimal understanding of photosynthesis and cellular respiration.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

*Letters are used to distinguish between sample student responses that earned the same score (e.g., 4A and 4B).

Score Point 4A

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

B I U 1443

Photosynthesis is performed only by the flowering plants.

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

B I U 1421

Cellular respiration is performed by both the flowering plants and the insects.

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

Row	Flask Contents	Initial O_2 Concentration (%)	Final O_2 Concentration (%)	Initial CO_2 Concentration (ppm)*	Final CO_2 Concentration (ppm)*
1	?	20.8	20.8	373	375
2	?	20.9	19.6	371	454
3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of **each** flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

728

The flask in row 1 has no organisms because its O2 and CO2 concentrations changed by very little, if at all, after 12 hours. The flask in row 2 has one insect because its oxygen concentration decreased by 1.3% while its carbon dioxide concentration increased by 83 ppm. These changes indicate that only cellular respiration occurred, as oxygen was converted to carbon dioxide, and therefore, this flask had to only have contained one insect. However, the O2 concentration increased and the CO2 concentration decreased in the flask in row 3; photosynthesis must have occurred at a higher rate than cellular respiration. This suggests that the flask in row 3 contained two plants and one insect because photosynthesis converts CO2 into O2 and is performed only by the plants.

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Score Point 4B

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

1416

The flowering plants use photosynthesis which affects the CO2 and O2 concentrations

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

1435

Cellular respiration affects the CO2 and O2 concentration levels

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

Row	Flask Contents	Initial O_2 Concentration (%)	Final O_2 Concentration (%)	Initial CO_2 Concentration (ppm)*	Final CO_2 Concentration (ppm)*
1	?	20.8	20.8	373	375
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3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of **each** flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

B I U 1120

Row 1 had no organisms in the flask because the O2 and CO2 levels had little change in concentration. Row 2 had one insect because the oxygen levels decreased but the CO2 levels increased due to cellular respiration. Row 3 had 2 plants and one insect because the O2 levels increased as there was more oxygen being made than used and the CO2 levels decreased due to photosynthesis.

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Score Point 3

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

1398

The process of the flowering plant that affects the levels of O2 and CO2 in the air is photosynthesis.

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

1359

The process performed by both the flowering plant and insect that affects the concentration of O2 and CO2 in the air is cellular respiration.

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

Row	Flask Contents	Initial O_2 Concentration (%)	Final O_2 Concentration (%)	Initial CO_2 Concentration (ppm)*	Final CO_2 Concentration (ppm)*
1	?	20.8	20.8	373	375
2	?	20.9	19.6	371	454
3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of each flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

B I U 1123

The contents of flask one was no organisms because the oxygen levels did not change at all. The contents of flask two was one insects because the oxygen levels went down and the carbon dioxide levels went up considerably. The contents of flask three was two plants and one insect because the oxygen levels went up slightly and the carbon dioxide levels went down significantly.

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Score Point 2

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

B I U 1362

The cellular process performed only by flowering plants that affects the concentrations of O2 and CO2 in the air is called photosynthesis.

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

B I U 1393

The cellular process performed by both the flowering plants and the insects is called cellular respiration.

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

Row	Flask Contents	Initial O_2 Concentration (%)	Final O_2 Concentration (%)	Initial CO_2 Concentration (ppm)*	Final CO_2 Concentration (ppm)*
1	?	20.8	20.8	373	375
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3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of **each** flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

B I U 1192

There were two plants and one insect in each flask. The data table shows that there is oxygen and carbon dioxide being produced. The plants produce the oxygen and the insect produces carbon dioxide. If there was one insect or no organisms in each then there would be little to none carbon dioxide and oxygen.

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Score Point 1

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

B I U 1445

The cellular process performed would be photosynthesis

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

B I U 1440

The cellular process performed would also be photosynthesis.

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

Row	Flask Contents	Initial O_2 Concentration (%)	Final O_2 Concentration (%)	Initial CO_2 Concentration (ppm)*	Final CO_2 Concentration (ppm)*
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3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of each flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

B I U 1263

Row one = one insect because the final concentration is not the highest
Row two = two plants and one insect because the final concentration is the highest on the chart
Row three = no organisms because it has the lowest final concentration.

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Score Point 0

This question has three parts.

A student is studying how flowering plants and insects affect oxygen (O_2) and carbon dioxide (CO_2) concentrations in the air.

Part A

Identify the cellular process performed **only** by the flowering plants that affects the concentrations of O_2 and CO_2 in the air.

1480

Cellular respiration

Part B

Identify the cellular process performed by both the flowering plants and the insects that affects the concentrations of O_2 and CO_2 in the air.

1486

Photosynthesis

Part C

During an experiment, the student measured the initial concentrations of O_2 and CO_2 in three flasks, added organisms to some of the flasks, sealed the flasks, and placed them under a light. After 12 hours, the student measured the concentrations of O_2 and CO_2 in the flasks. The results for each flask are shown in the table.

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3	?	20.7	22.1	374	267

*parts per million

During the experiment, the student had forgotten to identify the contents of each flask. Each of the three flasks contained one of the following: two plants and one insect; one insect; or no organisms.

Identify the contents of each flask based on the data in rows 1, 2, and 3. Explain your reasoning using data from the table and the processes you identified in Parts A and B. Include the row numbers in your response.

B I U 1435

Row 1 – one insect
Row 2 – 2 plants & 1 insect
Row 3 – no organisms

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