Critical thinking approach to answering Science open-ended questions (OEQ)

Workshop for Parents
24 Mar 2023 (Fri)

Mindset Change

- From key words… to concept words
- From topics… to thinking tasks
- From information… to inquiry

Curriculum and Assessment Objectives

I. Knowledge with Understanding

II. Application of Knowledge and Process Skills

I. Knowledge with Understanding

- Students should be able to demonstrate knowledge and understanding of scientific facts, concepts and principles.

Curriculum and Assessment Objectives

I. Knowledge with Understanding

II. Application of Knowledge and Process Skills

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Students should be able to:

a. **apply scientific facts, concepts and principles to new situations.**

b. interpret information (including pictorial, tabular and graphical) and investigate using one or a combination of the following process skills:

- Inferring
- Predicting
- Analysing
- Evaluating
- Generating possibilities
- Formulating hypothesis
- Communicating

II. Application of Knowledge and Process Skills

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- Predicting
- Analysing
- Evaluating
- Generating possibilities
- Formulating hypothesis
- **Communicating**

II. Application of Knowledge and Process Skills

Communicating

- This is the skill of transmitting and receiving information presented in various forms – written, verbal, pictorial, tabular or graphical.

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b. interpret information (including pictorial, tabular and graphical) and **investigate using one or a combination of the following process skills:**

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- **Predicting**
- **Analysing**
- **Evaluating**
- **Generating possibilities**
- **Formulating hypothesis**
- Communicating

II. Application of Knowledge and Process Skills

Inferring

- This is the skill of interpreting or explaining observations or pieces of data or information.

II. Application of Knowledge and Process Skills

Predicting

- This is the skill of assessing the likelihood of an outcome based on prior knowledge of how things usually turn out.

II. Application of Knowledge and Process Skills

Analysing

- This is the skill of identifying the parts of objects, information or processes, and the patterns and relationships between these parts.

II. Application of Knowledge and Process Skills

Evaluating

- This is the skill of assessing the reasonableness, accuracy and quality of information, processes or ideas. This is also the skill of assessing the quality and feasibility of objects.

II. Application of Knowledge and Process Skills

Generating possibilities

- This is the skill of exploring all the alternatives, possibilities and choices beyond the obvious or preferred one.

II. Application of Knowledge and Process Skills

Formulating hypothesis

- This is the skill of making a general explanation for a related set of observations or events. It is an extension of inferring.

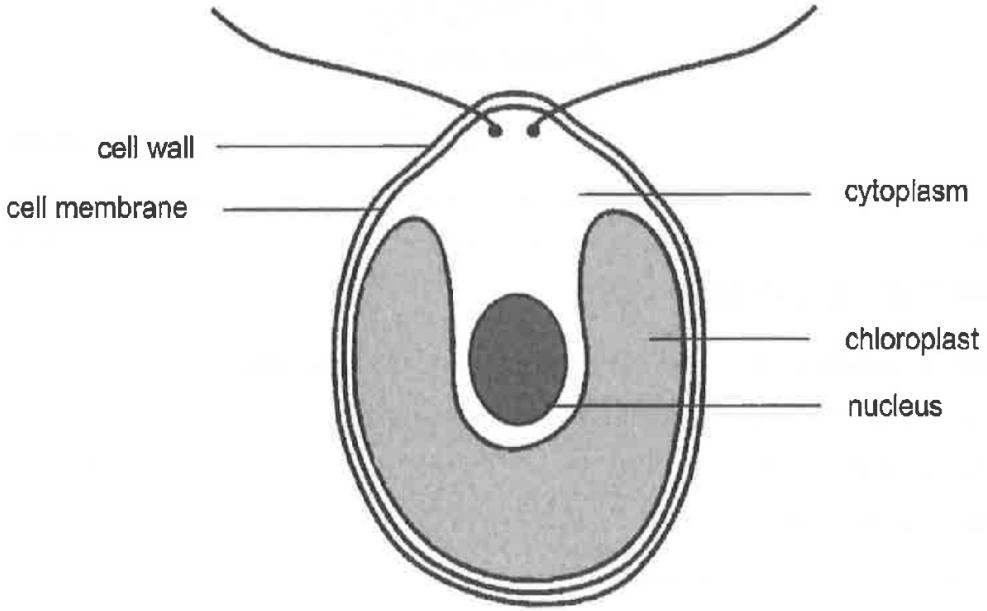
Thinking Tasks

- State
- Describe
- Compare
- Relate
- Explain
- Infer

State

- To give a concise answer with little or no supporting argument

The diagram below shows a single-celled organism which lives in a pond.



(a) Name two parts in the organism which show that it is more likely to be a plant cell than an animal cell. [1]

(b) State the function of the cell membrane. [1]

Describe

- To state in words (using diagrams where appropriate) the main points

Diagram 2 shows part of a crane that uses an electromagnet to collect metal pieces for recycling.

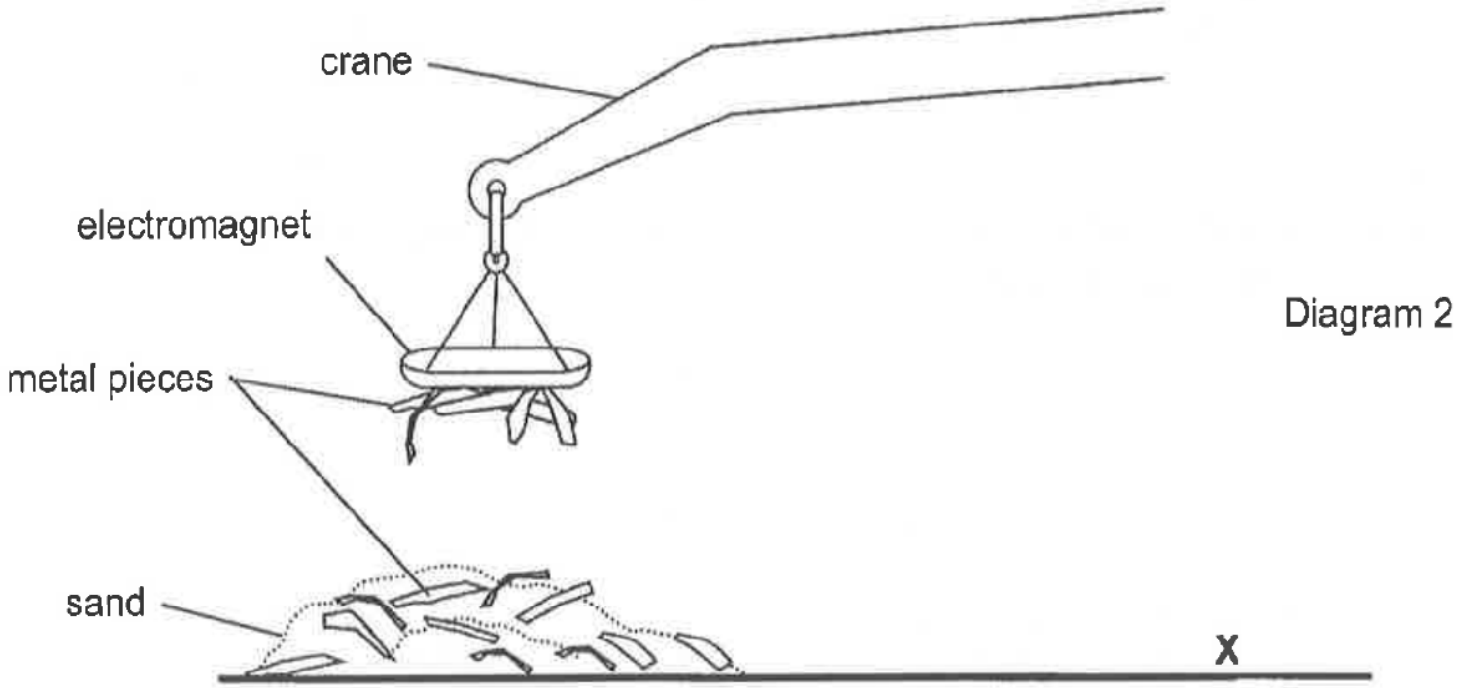


Diagram 2

(b) Based on Diagram 1, describe the **two** steps of how the electromagnet is used to move the metal pieces to the collection point **X** in Diagram 2. [2]

Compare

- To identify similarities and differences between objects, concepts or processes

<u>Similarities</u>

"**Both** birds and insects lay eggs."

<u>Differences</u>

"Birds have 2 legs, **but** insects have 6 legs."

Relate

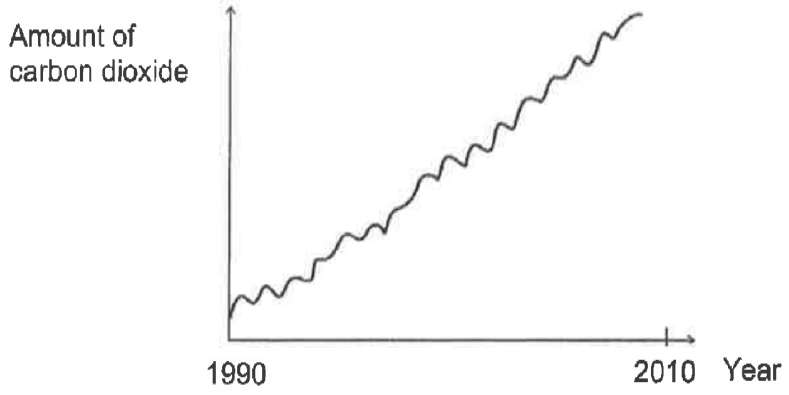
- To identify and explain the relationships between objects, concepts or processes

"**As** the *[changed variable]* **increases**,

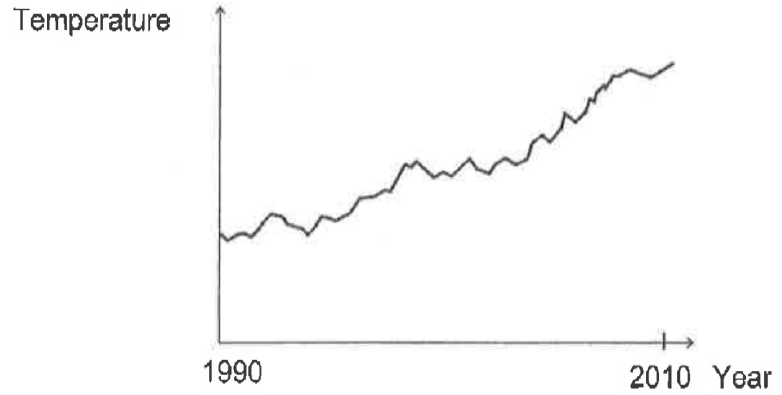
the *[observed variable]*

increases/decreases/remains the same."

Graph 1

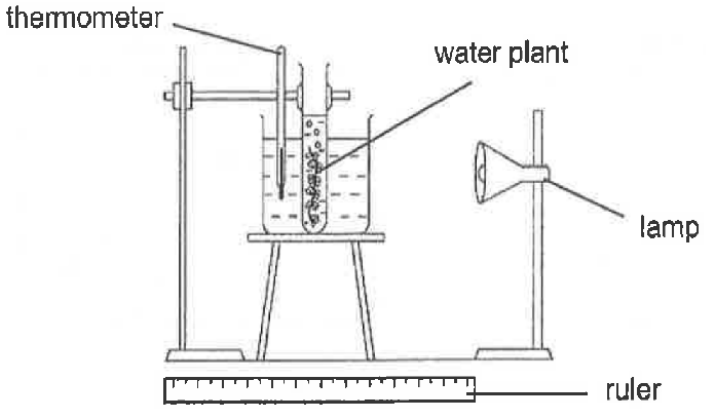


Graph 2



(b) Using Graphs 1 and 2, explain the relationship between the amount of carbon dioxide and the temperature on Earth. [2]

Meifen wanted to find out how temperature affects the number of bubbles produced by a water plant.



She set the temperature of water at 10°C and switched on the lamp. She counted the number of bubbles produced per minute. Next, she repeated the experiment at 20°C and 30°C. Her results are as shown.

Temperature (°C)	Number of bubbles produced per minute
10	4
20	12
30	25

(a) Based on Meifen's results, how does temperature affect the rate of photosynthesis?

[1]

Explain (Cause & Effect)

- To explain new situations using scientific facts, concepts and principles

Cause => Effect

Explain (Cause & Effect)

Wearing slippers

⇒ More exposed surface area to surrounding air

⇒ Sweat evaporate more easily

⇒ Feet stay more dry

⇒ Less moisture for fungus to grow

Yiwen has a medical condition in which fungus grows on his feet.

The doctor advised Yiwen to wear slippers instead of covered shoes.

Explain how wearing slippers helps reduce the growth of fungus on the feet. [2]

Infer (CER)

- To draw a conclusion based on observations

Claim – conclusion

Evidence – observations in pictures, tables, graphs

Reasoning – scientific concept

Infer (CER)

- Claim

Box R

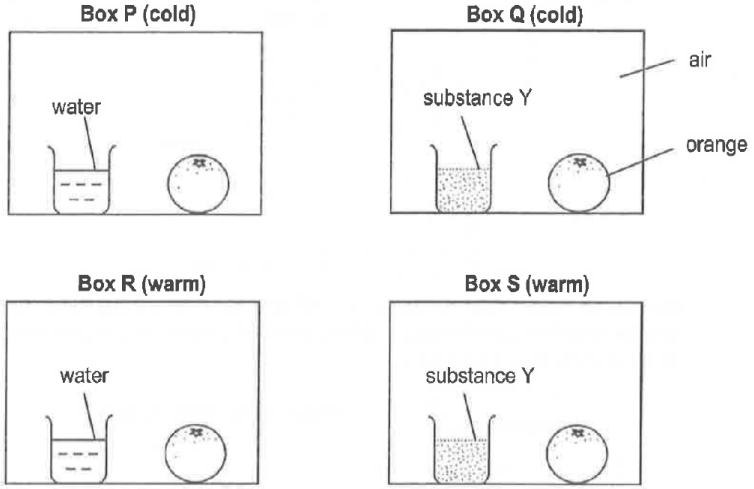
- Evidence

“Box R is warm and has water.”

- Reasoning

“Fungus needs warmth and water to grow.”

Yiwen placed four similar oranges in four identical sealed boxes. He placed boxes P and Q in a cold place and boxes R and S in a warm place. Substance Y absorbs water from the surrounding.

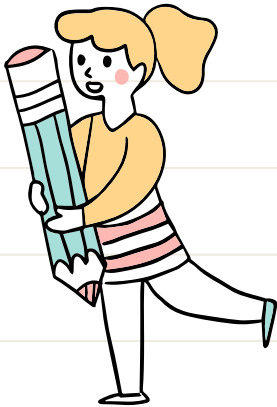


(a) In which box, P, Q, R or S, would fungus first appear on the orange? Give a reason for your answer. [2]

Cue- Prompt- Close Learning Gap Approach

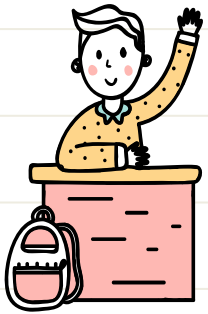
When ‘providing feedback’ we need to ensure that

Lesson objectives for their students are clarified (Cue)	Students’ metacognition is part of the learning process (Prompt)	Opportunities for students to show that the feedback has enabled them to close their learning gaps (Close)
What area should I work on? →	What is missing? →	My improved answer is…



CRITICAL THINKING Rubric (CUE)

- **Clarity (Language)**
  - Answer is understandable and the meaning can be grasped; Answer is free from confusion or ambiguity (open to other interpretation)
- **Accuracy**
  - Answer is free from errors in content, misconceptions, mistakes or distortions
- **Relevance**
  - Answer is related to the correct theme and topic and is important to the scenario presented in the question
- **Precision**
  - Answer has the necessary level of detail



CRITICAL THINKING Rubric (CUE)

CRITICAL THINKING IN SCIENCE

Clarity Will my answer be understood?

1. Read your answer.
2. Check the **SENTENCE STRUCTURE**. Is it clear to to the reader?
3. Use **SHORT SIMPLE SENTENCES** when answering the question.

Accuracy Is my answer free from error in content?

1. Recall what are the **SCIENTIFIC CONCEPTS** you have learnt in the topic.
2. Did I apply the **SCIENTIFIC CONCEPTS CORRECTLY**?
3. Identify the scientic concepts that can be used to answer the question.

Relevance Is my answer related to the correct topic?

1. Read the question **CAREFULLY**.
2. What are the **KEY WORDS** in the question?
3. These key words will give you a **HINT** about the topic the question is based on.

Precision Am I answering the question? Have I given enough details in my answer?

1. Read your answer.
2. Have you given enough **DETAILS** in the answer?
3. If not, **ELABORATE** on the answer and give more details.

Clarity Will my answer be understood?

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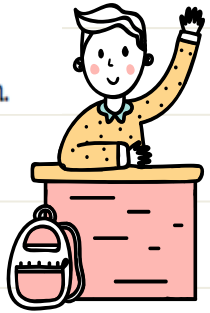
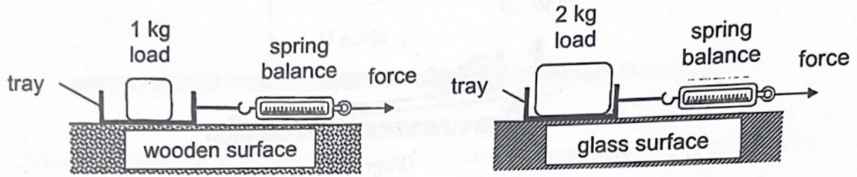


CRITICAL THINKING Rubric (CUE)

9 **LO3** Aisha conducted an experiment to find out how the mass of an object affects the force needed to start moving the object. She used similar trays and spring balances in the set-ups below.

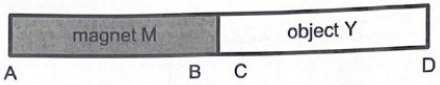
Aim



(b) Aisha found out that the temperature of the tray increased slightly after moving along the wooden surface. Give a reason for this.

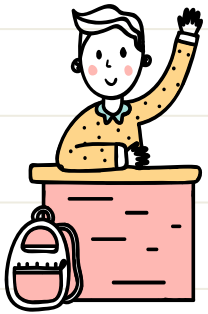
As there was friction between the wooden surface and the tray, when the tray moved along the wooden surface, the friction between them caused the tray's temperature to increase slightly. P M

11 **LO3** Chengyi observed that object Y was attracted and moved towards magnet M as shown below.



(b) Using only magnet M and object Y, what should Chengyi do to conclude whether object Y is a magnet or not? Explain your answer.

Chengyi should try to see if magnet M can attract object Y from the other side of object Y. P As if object Y is a magnet, then only the unlike poles of magnet M and object Y can attract. A



CRITICAL THINKING Rubric (CUE)

(c) Peter placed a wooden block under the track at point H.

Explain why the train moved more slowly as it moved from G to H.

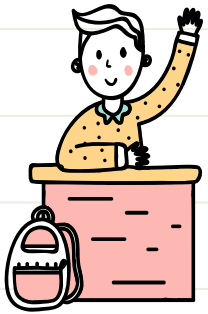
More electrical energy needs to be converted into more gravitional potential energy to allow the train to move from G to H. As the train had lesser electric energy, it could not move as fast.

(b) Without using different apparatus and additional materials, suggest two different ways to help the car reach C in this investigation. Explain your answer.

1. Adjust the joint and make it higher so that there will be more gravitational potential energy, it will then be converted into more kinetic energy so it can reach C.

Lower point C as lesser kinetic energy will be needed to be converted back

2. Make the circle smaller by adjusting the flexible plastic tracks to gravitational potential energy so there will be more gravitational potential energy that will be converted into more kinetic energy so the toy car can reach C.



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(b) Seng Huat held the phone by the wire.

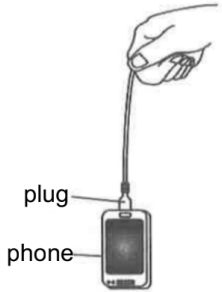


Diagram 2

Diagram 3

(i) The phone did not drop off immediately in Diagram 2.
Explain why the phone did not drop off.

Sample Answers:

Answers	C	A	R	P
The frictional force between the plug and the phone opposes motion, preventing the phone from falling and it is also greater than the gravitational force acting on the phone.	✓	✓	✓	✓
The friction between the phone and the plug is strong thus the phone did not fall.	✓	✓	✓	✗
There was friction in the air temporarily preventing the phone from dropping.	✓	✗	✗	✗

Essential Point(s)

- Friction opposes motion.
- Friction is greater than the gravitational force.

CRITICAL THINKING Rubric (PROMPT)

(b) Seng Huat held the phone by the wire.

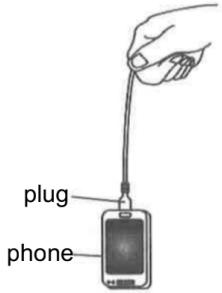


Diagram 2

Diagram 3

(i) The phone did not drop off immediately in Diagram 2. Explain why the phone did not drop off.

(ii) The phone dropped to the ground after a few seconds as shown in Diagram 3. Explain, in terms of forces, why the phone dropped.

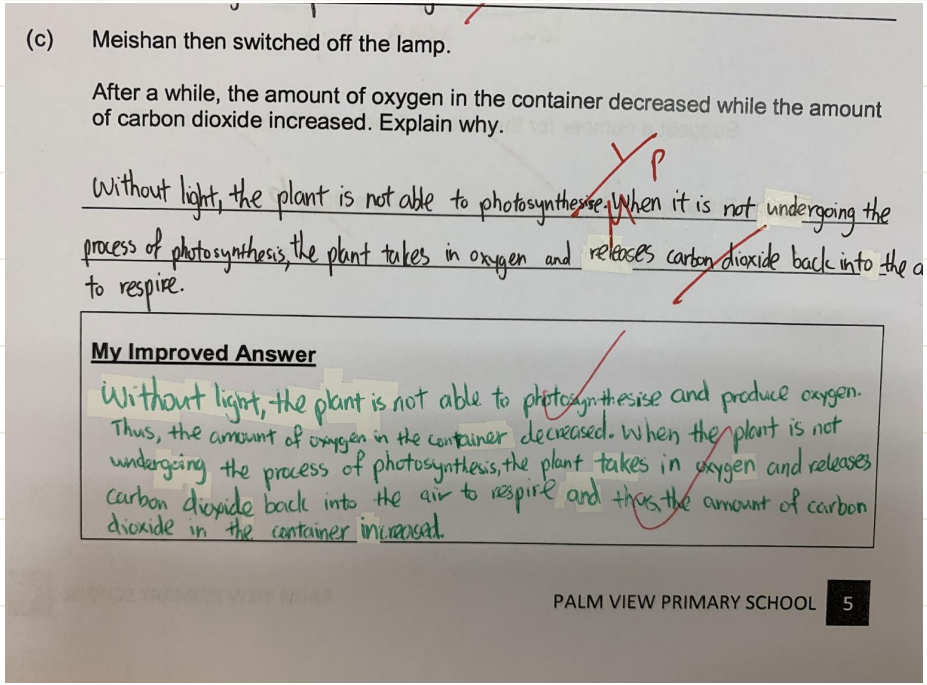
Sample Answers:

Answers	C	A	R	P
The gravitational force was stronger than the frictional force so the gravitational force pulled the phone down.	✓	✓	✓	✗
The gravity acting on the phone is stronger than the friction between the plug and the phone so gravity pulled the phone down.	✓	✓	✓	✓
As there was more gravitational force acting on the phone than frictional force between the plug and the phone, hence, gravitational force pulled the phone to the ground eventually.	✓	✓	✓	✓
The gravitational force increased to pull the phone down and the force acting on the phone was greater than the friction between the tip of the charger and the phone, therefore the phone dropped after a few seconds.	✓	✗	✓	✓

Essential Point(s)

- Gravitational force overcomes the frictional force.
- Friction is between surfaces.

MY IMPROVED ANSWER IS…(CLOSE)



(c) Meishan then switched off the lamp.

After a while, the amount of oxygen in the container decreased while the amount of carbon dioxide increased. Explain why.

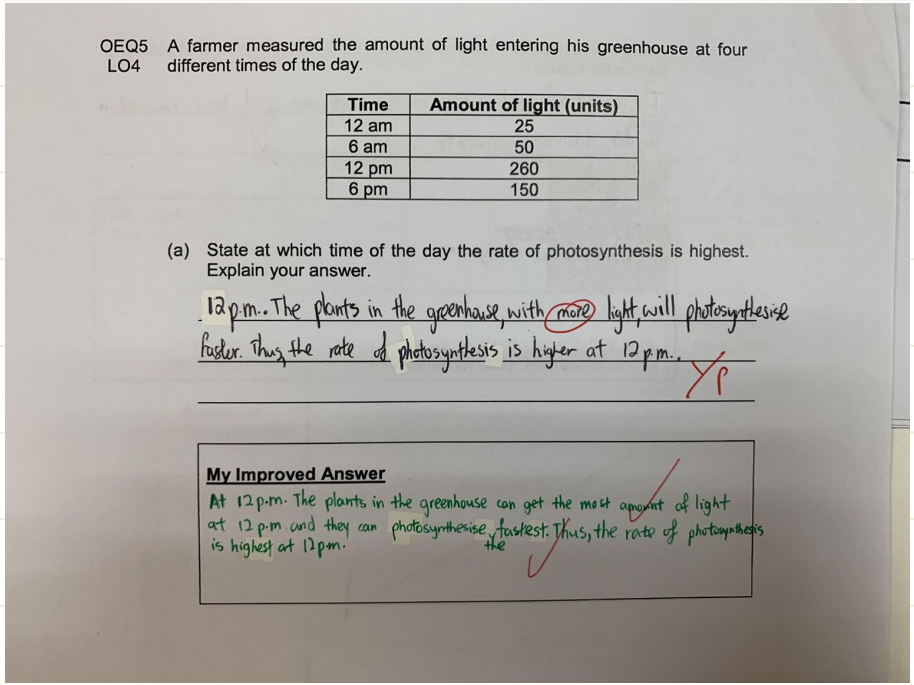
Without light, the plant is not able to photosynthesise. When it is not undergoing the process of photosynthesis, the plant takes in oxygen and releases carbon dioxide back into the a to respire.

YP

My Improved Answer

Without light, the plant is not able to photosynthesise and produce oxygen. Thus, the amount of oxygen in the container decreased. When the plant is not undergoing the process of photosynthesis, the plant takes in oxygen and releases carbon dioxide back into the air to respire and thus, the amount of carbon dioxide in the container increased.

PALM VIEW PRIMARY SCHOOL 5



OEQ5 LO4 A farmer measured the amount of light entering his greenhouse at four different times of the day.

Time	Amount of light (units)
12 am	25
6 am	50
12 pm	260
6 pm	150

(a) State at which time of the day the rate of photosynthesis is highest. Explain your answer.

12 p.m.. The plants in the greenhouse, with more light, will photosynthesise faster. Thus, the rate of photosynthesis is higher at 12 p.m.

YP

My Improved Answer

At 12 p.m. The plants in the greenhouse can get the most amount of light at 12 p.m. and they can photosynthesise the fastest. Thus, the rate of photosynthesis is highest at 12 p.m.


SCAN ME