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VCE Biology  $\frac{3}{4}$   
AOS 2 Revision [2.0]  
Experimental SAC 1

40 Marks. 5 Minutes Reading. 65 Minutes Writing.

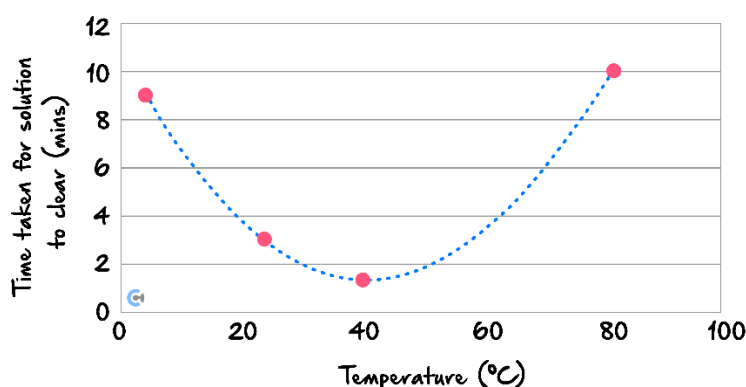
## Section A: SAC Questions (40 Marks)

### Question 1 (6 marks)

Recently you investigated the effect of a change in temperature on the rate of a chemical reaction catalysed by the enzyme Trypsin. The results of this investigation are in the table below.

Temperature (°C)	Time taken for solution to clear (minutes)
4°C	9 mins
24°C	3 mins
40°C	1.2 mins
80°C	> 10 mins
Control (no trypsin added)	> 10 mins

The results of the 4 temperatures are shown in the figure below. (Note: The control has not been included in this graph.)



*The effect of changing temperature on the rate of reaction, as measured by how long it took for the solution to clear.*

- a. Describe the relationship between temperature and the time taken for the solution to clear. (2 marks)

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- b. Explain the results at 4°C, compared to the results at 80°C. Predict what would happen once both tubes returned to room temperature. (3 marks)

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- c. What was the purpose of the control in this experiment? (1 mark)

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**Question 2** (2 marks)

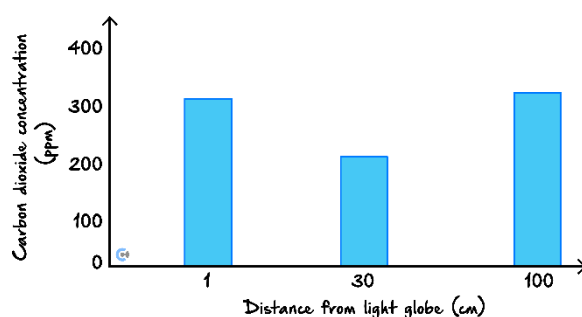
Students performed an experiment to test the effect of light intensity on the rate of photosynthesis in different light intensities. They purchased 15 small Button fern C3 plants (*Pellaea rotundifolia*) from Bunnings and placed each in a small conical flask which was fully sealed so that no gases could enter or leave the flask.

Each flask was placed near a light globe. Five flasks were placed 1 cm from the light globe. Five flasks were placed 30 cm from the light globe. Five flasks were placed 1 m from the light globe.

A carbon dioxide probe was placed inside each flask to measure the concentration of atmospheric carbon dioxide.

The plants were left in the flask for 30 minutes and then the carbon dioxide concentration was measured and averaged. It was noted by the students that the results at each light intensity were very precise.

The results of this experiment are displayed in the figure below.



CO<sub>2</sub> Cone in conical flasks after 30 minutes.

- a. What was the independent variable in this experiment? (1 mark)

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- b. Suggest an explanation for the fact that the CO<sub>2</sub> concentration in the conical flask 1 cm from the light globe was higher than the CO<sub>2</sub> concentration in the flask 30 cm from the light globe. (1 mark)

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**Question 3** (17 marks)

Wheat is the largest grain crop in Australia, with regions in the west of Victoria, including the Wimmera, Central goldfields and Mallee forming part of Australia's wheat belt.

As a C3 plant, wheat does not have any adaptations to overcome changes in photosynthetic rate that can occur at high temperatures.



- a. Photosynthesis can be described as occurring in two stages. These stages are referred to as the light-dependent and light-independent stages.

Fill in the table below by listing **one** of the major chemical inputs and outputs at **each stage** of photosynthesis (use words or appropriate chemical symbols). (2 marks)

<u>Stage of photosynthesis</u>	<u>Input</u>	<u>Output</u>
Light Dependent		
Light Independent		

- b. Briefly explain how the disruption of the light-dependent phase of photosynthesis would cause a plant to die. (1 mark)

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In the Wimmera and Mallee regions, temperatures can reach above 30 degrees Celsius. Wheat ready for harvest can be exposed to these high temperatures.

- c.** Describe, at a molecular level, what is occurring within the chloroplast at high temperatures in the wheat plant. (2 marks)

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Rubisco is an enzyme that plays an important role in photosynthetic organisms. Exposure to high temperatures over time can impact the effectiveness of the enzyme Rubisco in C3 plants.

- d.** Explain why a decrease in the effectiveness of Rubisco will limit the rate of photosynthesis. (2 marks)

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CRISPR Cas9 technologies can be used to increase crop yield. Altering Rubisco to increase its affinity to carbon dioxide is one such option.

- e. Referring to the use of CRISPR technology on wheat, outline an ethical issue and describe how an ethical concept should be considered before making decisions. (3 marks)

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A farmer decided to grow maize, a C4 plant that is a starchier version of a typical sweet corn, in place of wheat.



- f. Describe how the process of carbon fixation would differ in the wheat, a C3 plant, and the maize plant at high temperatures. (3 marks)

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The Sonoran Cactus use the CAM pathway to carry out photosynthesis.



- g.** What primary advantage does a Sonoran Cactus have in using the CAM pathway compared to C3 plants such as wheat? (1 mark)

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In recent years, Sugar Cane crops have been grown in northern Queensland to explore their potential for bioethanol production. Yeast cells are used to ferment the Sugar Cane biomass to produce bioethanol.

- h.** Explain how yeast cells can produce bioethanol and outline the benefits of producing bioethanol from sugar cane biomass. (3 marks)

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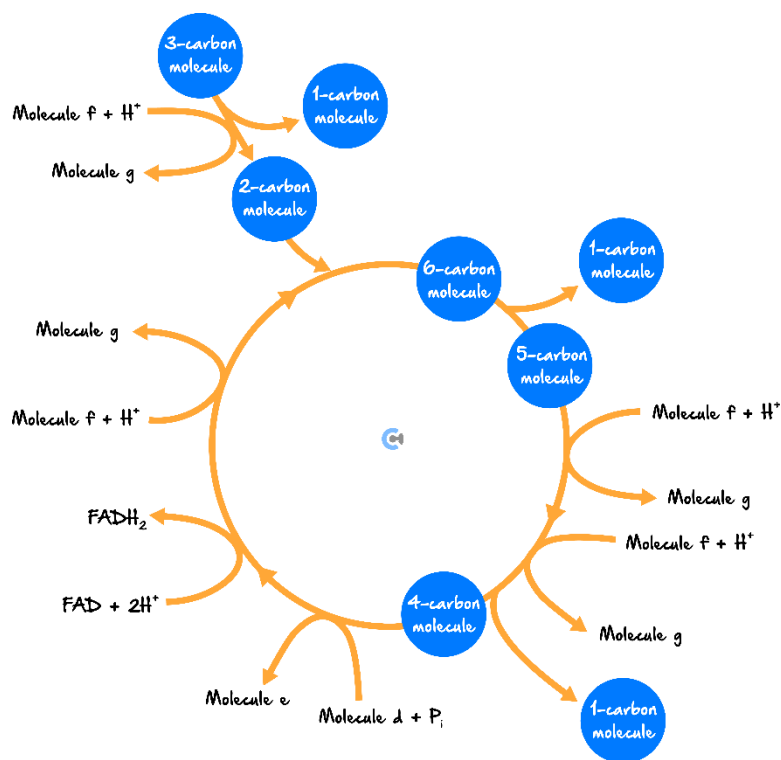
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**Question 4** (15 marks)

The diagram below represents one of three stages of aerobic cellular respiration.



*One of the biochemical processes involved in cellular respiration.*

- a. What name is given to the process above? (1 mark)

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- b. One of the coenzymes involved in the process is FAD and it's charged from FADH<sub>2</sub> which are labelled on the diagram. Two other coenzymes are also involved in the process. Referring to the diagram in the figure above, complete the following table to show the names of these coenzymes. (2 marks)

Label	Molecule name
Molecule <i>d</i>	
Molecule <i>e</i>	
Molecule <i>f</i>	
Molecule <i>g</i>	

c. In the diagram several carbon-containing molecules are shown with the number of carbons they contain indicated. The 2-carbon molecule is acetyl-CoA.

i. What is the name of the 3-carbon molecule? (1 mark)

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ii. What name is given to the 1-carbon molecule? (1 mark)

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d. Where, within a eukaryote cell does the process depicted in the figure above take place? (1 mark)

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e. Explain the purpose of producing  $\text{FADH}_2$  in this stage of cellular respiration. (1 mark)

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Glucose is first broken down in the process of glycolysis in cellular respiration.

f. Describe the process of glycolysis. (2 marks)

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A biochemical pathway is a series of enzyme-mediated reactions where the product of one reaction is used as the substrate in the next.

Aerobic cellular respiration is an example of a common biochemical pathway found within the body:

**g.** Inhibitors can alter the rate of an enzyme-driven chemical reaction. Describe the action of each type of inhibitor listed below and the effect of the rate of reaction if the concentration of substrate increased.

**i.** A competitive inhibitor. (3 marks)

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**ii.** A non-competitive inhibitor. (3 marks)

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