

Total Marks = 48 Marks

Name: \_\_\_\_\_

**PRACTICE SAC 3\_2 BIOLOGY – STRUCTURE & REGULATION OF BIOCHEMICAL PATHWAYS**

Students in a VCE biology class conducted three experiments to investigate factors that affect the rate of photosynthesis and cellular respiration. The research questions for the three experiments are as follows:

**Experiment 1:** How does colour of light affect the rate of photosynthesis?

**Experiment 2:** Does temperature increase the rate of photosynthesis?

**Experiment 3:** Does glucose concentration change the rate at which organisms undergo cellular respiration?

**Question 1** (3 marks)

For each of the experiments, identify the independent variable\*, the dependent variable, and the control group, where appropriate, in the table below. \*Include range & increments as appropriate.

Experiment	Independent variable	Dependent variable	Control group
1 Photosynthesis: Colour of light	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____
2 Photosynthesis: Temperature	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____
3 Cellular Respiration: Glucose concentration	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

**Question 2** (6 marks)

The results from one group of students who conducted experiment 1 are shown in the table below:

Light colour	Rate of p/s (1/ET50) Trial number			Average Rate of P/S
	1	2	3	
Blue	0.25	0.33	0.25	0.28
Green	0.07	0.07	0.08	0.07
Yellow	0.33	0.08	0.08	0.16
Red	0.14	0.14	0.17	0.15
White	25.0	17.0	20.0	21.0
No	0.00	0.00	0.00	0.00

- a. Identify two variables that must be controlled for in experiment 1 for it to be a valid experiment.

**2 marks**

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- b. Analyse and explain the results of this experiment, referring to the data.

**4 marks**

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**Question 3** (14 marks)

Experiment 2 set out to determine whether temperature could impact the rate of photosynthesis in C3 plants. A pair of students conducted the experiment together, and their results are shown below:

	Time taken for each leaf disc to rise (minutes)										Average	
	Disc 1	Disc 2	Disc 3	Disc 4	Disc 5	Disc 6	Disc 7	Disc 8	Disc 9	Disc 10		
<b>1 Ice slurry (3°C)</b>	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+
<b>2 Room temperature (17°C)</b>	17	20	20	21	25	26	29	30	30+	30+	24.8	
<b>3 25°C water bath</b>	9	10	10	14	14	20	21	23	25	25	17.1	
<b>4 50°C water bath</b>	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+	

30+ = the disc had not risen at the 30min mark.

- a. With reference to the enzyme Rubisco, explain why the leaf discs failed to rise within 30 minutes **2 marks**
- i) at 3°C
- ii) at 50°C.

i)

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ii)

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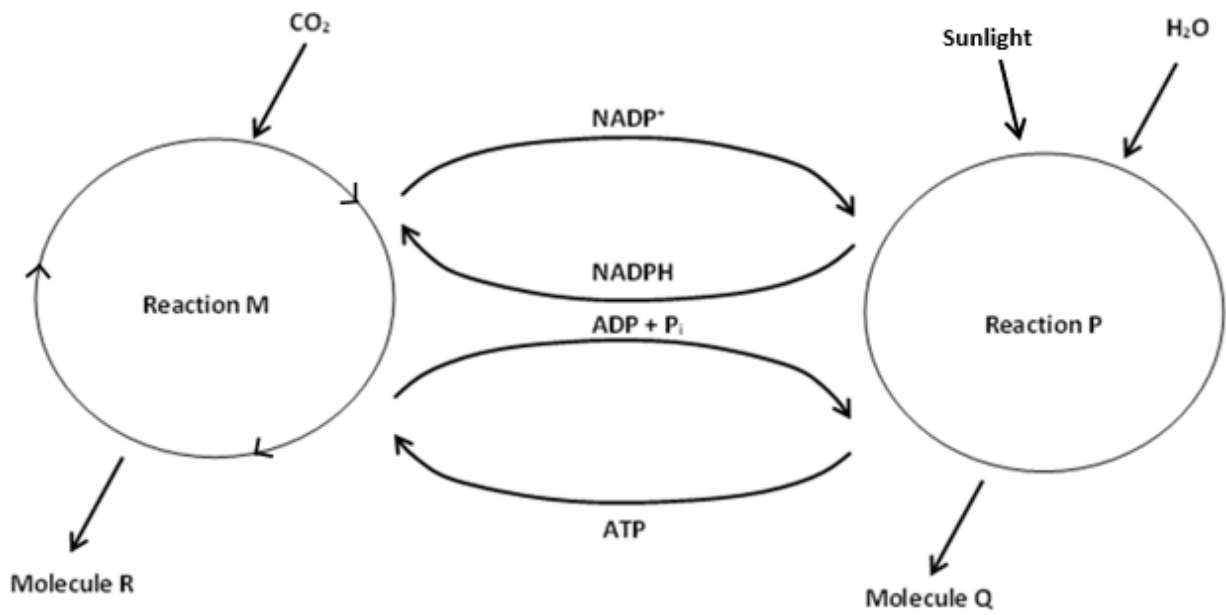


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The diagram below shows a summary of photosynthesis.



Adapted from: [https://commons.wikimedia.org/wiki/index.php/File:Anoxygenic\\_Photosynthesis\\_in\\_Green\\_Sulfur\\_Bacteria.png&oldid=46284693](https://commons.wikimedia.org/wiki/index.php/File:Anoxygenic_Photosynthesis_in_Green_Sulfur_Bacteria.png&oldid=46284693).

- b.** At which point in photosynthesis does Rubisco catalyse a reaction? Indicate on the diagram **1 mark** with an 'X'.
- c.** In the table below, identify the locations of reactions M and P and list molecules Q and R. **2 marks**

<b>Location of Reaction M</b>	
<b>Location of Reaction P</b>	
<b>Molecule Q</b>	
<b>Molecule R</b>	

- d. The pair of students investigating the effect of temperature on the rate of photosynthesis in C3 plants had differing hypotheses. **3 marks**

**Hypothesis 1 from student 1:** If temperature increases, then the rate of photosynthesis will continue to increase then plateau as other limiting factors prevent it from increasing further.

**Hypothesis 2 from student 2:** If temperature increases, then the rate of photosynthesis will increase until an optimum temperature is reached, then the rate will quickly decline.

Which hypothesis is supported by the data collected for this experiment? Justify your response with reference to the results.

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**2 marks**

e. In addition to C3 plants, Student 2 has also learnt about C4 and CAM plants in class.

Describe one adaptation and one advantage of that adaptation for both C4 and CAM plants.

	Adaptation	Advantage
<b>C4 plant</b>	<hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/>
<b>CAM plant</b>	<hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/>

f. Student 2 conducted another experiment to determine how hot, dry conditions affected the rate of photosynthesis in C4 and CAM plants, compared to C3 plants. Predict the outcome of this experiment.

**1 mark**

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g. Name some possible plants that Student 2 used during the experiment from Q3f (one for each type).

**3 marks**

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C3 -

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C4 -

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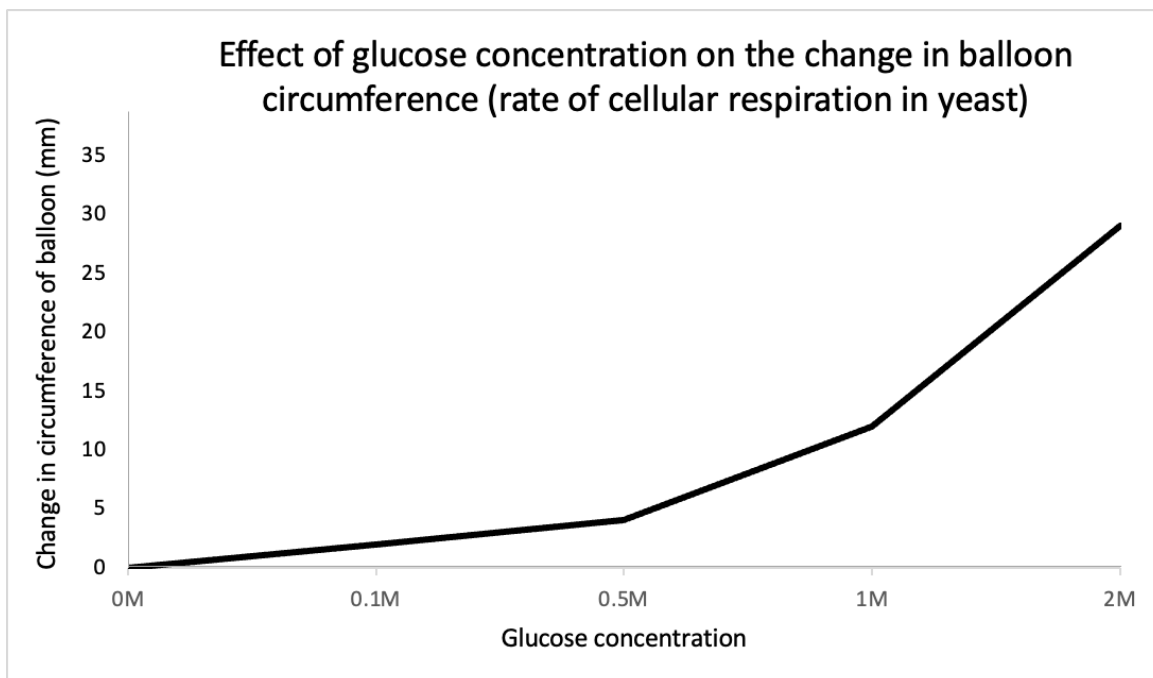
CAM -

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**Question 4** (13 marks)

Finally, the Biology class conducted experiment 3 to determine how glucose concentration affects the rate of cellular respiration in yeast. The results were recorded and graphed, as shown below.

Glucose concentration	Change in circumference of balloon (mm)
0M (distilled water)	0
0.1M	2
0.5M	4
1M	12
2M	29



- a. What would you expect to see on the graph if the concentration of glucose was to continue increasing? Provide a justification for your hypothesis. **2 marks**

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- b.** Outline how anaerobic cellular respiration in yeast differs to aerobic cellular respiration in animals. **2 marks**

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- c.** One of the students in the class suggested to her class mates that they should factor repeatability into the method. How might this be achieved? Would this impact the accuracy or the precision of the data? **2 marks**

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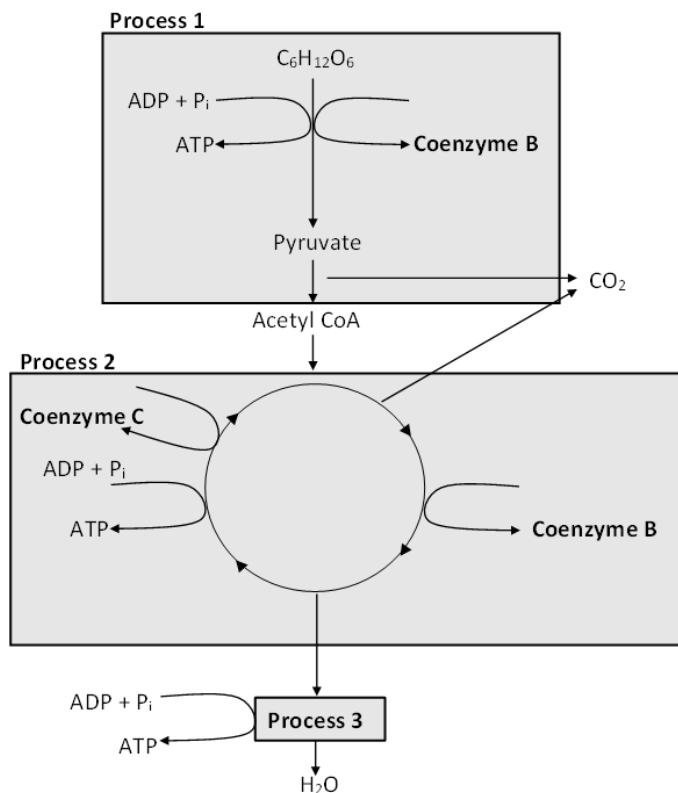
- d.** Name two factors that would need to be controlled in this experiment to ensure that the changes to the dependent variable are due to changes to the independent variable. **2 marks**

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Cellular respiration in eukaryotes is summarised in the diagram below.



Adapted from: <https://www.tes.com/teaching-resource/complete-respiration-flow-chart-6095662>

e. Name processes 1-3, and list the ATP yield for each stage. 3 marks

	Name	Net ATP yield
Process 1		
Process 2		
Process 3		

f. Name Coenzymes B and C. Describe the general role of these coenzymes in the reaction. 2 marks

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**Question 5** (4 marks)

A student noticed that some plants at her home were not growing as quickly in winter as they did during warmer months.

Referring to data from two of the three experiments, explain this observation.

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**Question 6** (4 marks)

One group of students decided to reproduce experiment 1 using a carbon dioxide sensor to measure the rate of photosynthesis, instead of using the rate of leaf discs rising due to bubbles forming.

- a. Does this improve the validity, accuracy, or precision of this experiment? Explain your response. **2 marks**

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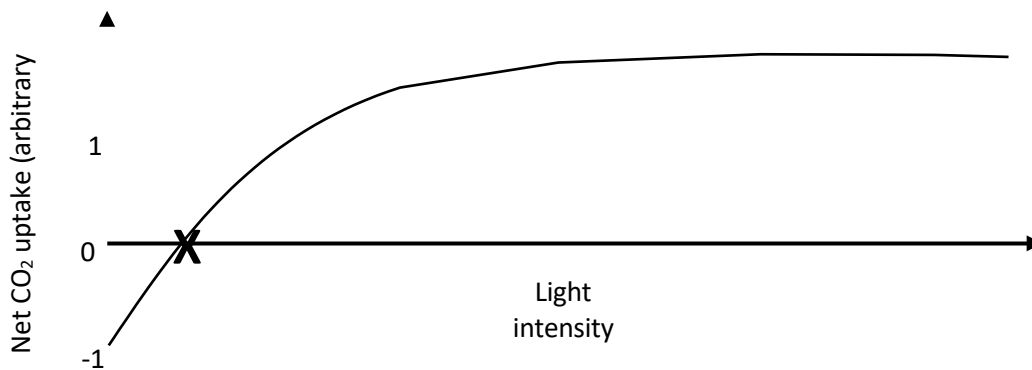


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- b. The results of the group who repeated the experiment were used to calculate the net uptake of carbon dioxide. The graph below shows the net uptake of CO<sub>2</sub> against light intensity. **1 mark**



By referencing both photosynthesis and cellular respiration, describe what is occurring at point X.

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- c. Suggest how these students could check the reliability of their data. **1 mark**

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**Question 7** (4 marks)

- a.** All enzymes are susceptible to inhibition, both by competitive inhibition and non-competitive inhibition.
- i.** Sketch a graph to show the effect of competitive inhibition on enzyme activity as the substrate concentration increases. You should include a line of comparison to show the effect of substrate concentration on enzyme activity without enzyme inhibition. **2 marks**

- ii.** Explain why substrate concentration has no effect on non-competitive inhibition. **2 marks**

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**END OF QUESTION AND ANSWER BOOK**

