

**BIOLOGY 100**  
**SOLUTIONS TO PROBLEMS**

**FERMENTATION AND RESPIRATION**

1. If a yeast culture evolved 1.28 ml of CO<sub>2</sub> in 7 minutes, what was the rate of fermentation?

$$\text{Rate of fermentation} = \frac{1.28 \text{ ml CO}_2}{7 \text{ minutes}} = \frac{0.18 \text{ ml CO}_2}{\text{minute}}$$

2. If yeast culture A produced 0.50 ml of CO<sub>2</sub> in 10 minutes and culture B produced 0.20 ml in 2 minutes, which culture had the faster rate of fermentation?

Culture A            rate of fermentation =  $\frac{0.50 \text{ ml CO}_2}{10 \text{ minutes}} = \frac{0.05 \text{ ml CO}_2}{\text{minute}}$

Culture B            rate of fermentation =  $\frac{0.20 \text{ ml CO}_2}{2 \text{ minutes}} = \frac{0.10 \text{ ml CO}_2}{\text{minute}}$

The rate of fermentation for Culture B is twice that of Culture A.

3. Organism A performs only alcoholic fermentation in anaerobic environments. Organism B is capable of only lactic acid fermentation when anaerobic. If these organisms were fed glucose, which would have the greater rate of CO<sub>2</sub> production? In an aerobic environment, which would produce more CO<sub>2</sub>?

Organism A performs alcoholic fermentation:    glucose → pyruvate → ethyl alcohol + CO<sub>2</sub>

Organism B performs lactic acid fermentation:    glucose → pyruvate → lactate (no CO<sub>2</sub> produced)

Since only alcoholic fermentation produces CO<sub>2</sub>, Organism A will have the greater rate of CO<sub>2</sub> production.

In an aerobic environment, both organisms will use aerobic respiration. Both organisms should produce the same amounts of CO<sub>2</sub>.

4. Mystery sugars A and B were used in the Beano/Lactaid exercise as described above. The amount of CO<sub>2</sub> released when each sugar was mixed with 7% yeast with and without enzyme was monitored. Yeast in sugar A without enzyme produced 0.1 ml CO<sub>2</sub>; yeast in sugar A with Lactaid produced 5 ml CO<sub>2</sub>, and yeast in sugar A with Beano yielded 0.1 ml CO<sub>2</sub>. What sugar is sugar A? Yeast in sugar B without enzyme produced 6 ml CO<sub>2</sub>; yeast in sugar B with Lactaid produced 6 ml CO<sub>2</sub>, and yeast in sugar B with Beano yielded 11 ml CO<sub>2</sub>. What sugar is sugar B? (Hint: The sugar could be a combination of different sugars.)

Sugar A and yeast only produce significant amounts of CO<sub>2</sub> when in the presence of Lactaid. This means that the Lactaid helps break down sugar A into simple sugars that can be fermented by the yeast. Lactaid is specific for lactose; so sugar A must be lactose.

Sugar B and yeast produce significant amounts of CO<sub>2</sub> without enzyme, suggesting that sugar B contains a simple sugar like glucose. Levels of CO<sub>2</sub> almost double, however, with the addition of Beano, suggesting that sugar B also contains Beano's substrate, melibiose.