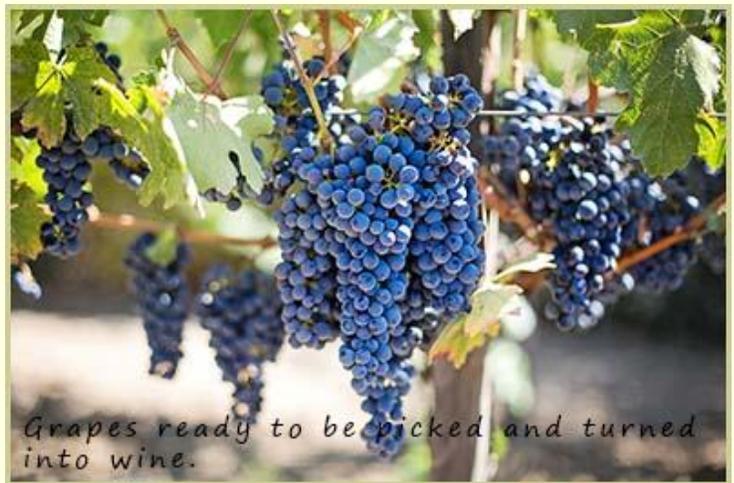


Fermentation

Answers all the questions below then check your answers

1. Wine is made from grapes in a process called fermentation. What is fermentation?

2. Write a word and a balanced symbolic equation to show the fermentation reaction that forms wine from grapes.



a. How could you show that the gas produced during fermentation is carbon dioxide gas?

3. At what temperature is fermentation normally carried out? Give a reason for your answer.

4. What type of organism is yeast?

5. Explain why fermentation is not carried out at 10°C and at 70°C .

6. Fermentation of grapes to make wine is a batch process. What does this mean?

7. Ethene gas is produced in the chemical industry by cracking large hydrocarbon molecules obtained from crude oil. This cracked gas or ethene can be turned into ethanol in a continuous process called direct hydration.

a. Write word and balanced symbolic equations to show the direct hydration of ethene gas.

b. Direct hydration is a continuous process, what does this mean?

c. Direct hydration is more efficient than traditional fermentation; explain why.

d. The ethanol produced by traditional fermentation ends up in alcoholic drinks, what uses are made of the ethanol produced by direct hydration?

d. Give examples of advantages and disadvantages of fermentation and direct hydration.

8. Increasing amounts of crops are being grown to produce biofuels.

a. What are biofuels? Name 3 biofuels.

b. The use of biofuels is often described as being a carbon neutral process. Explain what the term carbon neutral means.

c. Why might biofuels not be carbon neutral after all?

d. Why do many people object to the use of crops to produce biofuels?

Answers

1. Wine is made from grapes in a process called fermentation. What is fermentation?

A form of anaerobic respiration where simple sugars are turned into the alcohol ethanol and the gas carbon dioxide.

2. Write a word and a balanced symbolic equation to show the fermentation reaction that forms wine from grapes.

a. *glucose* \longrightarrow *ethanol* + *carbon dioxide*



- a. How could you show that the gas produced during fermentation is carbon dioxide gas?

Bubble it through limewater, if the gas is carbon dioxide the lime water will turn milky or chalky.

3. At what temperature is fermentation normally carried out? Give a reason for your answer.

Around $37^{\circ}C$, this is the optimum temperature at which the yeast will convert glucose into ethanol and carbon dioxide gas.

4. What type of organism is yeast?

A fungus

5. Explain why fermentation is not carried out at 10°C and at 70°C.

Too slow at 10°C and at 70°C the yeast will be killed.

6. Fermentation of grapes to make wine is a batch process. What does this mean?

A batch process is one whereby an item is made in a series of steps one after the other. Once one step finishes then the next one begins. The steps are carried out in order. The raw materials move through various steps before getting to the final product.

7. Ethene gas is produced in the chemical industry by cracking large hydrocarbon molecules obtained from crude oil. This cracked gas or ethene can be turned into ethanol in a continuous process called direct hydration.

a. Write word and balanced symbolic equations to show the direct hydration of ethene gas.

Ethene_(g) + steam_(g) → ethanol

$C_2H_4(g) + H_2O(g) \longrightarrow C_2H_5OH(g)$

b. Direct hydration is a continuous process, what does this mean?

A continuous process is where the product is made in an uninterrupted production line.

c. Direct hydration is more efficient than traditional fermentation; explain why.

- No waste products produced, a single product is obtained.
- Ethanol can be made continuously as long as the ethene and steam are supplied.
- Fewer people and less energy required.

d. The ethanol produced by traditional fermentation ends up in alcoholic drinks, what uses are made of the ethanol produced by direct hydration?

- Used in solvents, disinfectants, fuels, industrial processes.

d. Give examples of advantages and disadvantages of fermentation and direct hydration.

- Direct hydration is non-renewable, it relies on ethene from crude oil.
- Direct hydration is more efficient, less wasteful in terms of energy needed to produce the alcohol.
- Fermentation will supply more jobs and support local economy.
- Fermentation is slow and energy intensive.

8. Increasing amounts of crops are being grown to produce biofuels.

a. What are biofuels? Name 3 biofuels.

Biofuels are fuels that are produced from biomass (plants, algae or animal wastes). Biofuels are often considered to be a source of renewable energy.

Examples include:

- Ethanol made from corn.
- Biodiesel made from vegetable oils such as oilseed rape.
- Biogas - extracted from animal wastes and slurry.

- b. The use of biofuels is often described as being a carbon neutral process. Explain what the term carbon neutral means.

A process where the amount of CO_2 emitted to the atmosphere is balanced by the amount removed from the atmosphere.

- c. Why might biofuels not be carbon neutral after all?

Additional CO_2 is emitted into the atmosphere when the crop for the biofuel is harvested and processed. Need to consider CO_2 emissions for transport of biofuels and crops to produce them. Also if forest is cleared to produce the crops needed for biofuels then additional CO_2 released by burning the forest and destroying it. Also trees cannot take in carbon dioxide if they are chopped down! They will release it. Also additional CO_2 released by use of fertilisers to crop crops. Production of fertilisers require large amounts of energy which will emit large amounts of CO_2 .

- d. Why do many people object to the use of crops to produce biofuels?

Crops should be grown to feed the growing world population. Not to produce fuel for cars and trucks. Not ethical for rich nations to use crops for fuel when poorer nations have starving populations.