IGCSE BIOLOGY • EXERCISE SHEET

21.2 Biotechnology

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

KEY WORDS fermenter 发酵罐 • penicillin 青霉素 • biofuel 生物燃料 • biotechnology 生物技术 • yeast 酵母

Objective

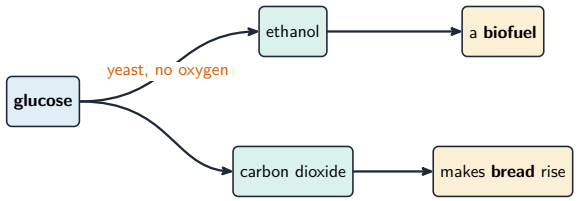
Build the skills to answer exam questions on **biotechnology** 生物技术 — **yeast** 酵母 (biofuel/bread), industrial **enzymes** 酶, and **fermenters** 发酵罐.

You must be able to:

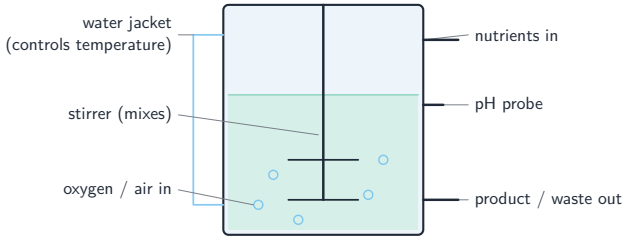
- describe how yeast makes ethanol and carbon dioxide
- give the uses of pectinase, washing-powder enzymes and lactase
- state the conditions controlled in a fermenter

1 Worked examples

Yeast and fermenters



Yeast respires anaerobically → ethanol (biofuel) and carbon dioxide (makes bread rise)



A fermenter grows microbes with the conditions controlled — e.g. to make insulin, penicillin, mycoprotein

- **pectinase:** more/clearer fruit juice; **lactase:** lactose-free milk.

2 Practice

2.1 Name the two products yeast makes by anaerobic respiration. [2]

2.2 State the use of pectinase. [1]

3 Exam-style questions

3.1 Biological washing powders contain enzymes that: [1]

- **A** make stains
- **B** digest stains at lower temperatures
- **C** colour clothes
- **D** kill bacteria

3.2 A fermenter is used to grow microbes.

(a) State two conditions that must be controlled in a fermenter. [2]

(b) Name one useful product made in a fermenter. [1]

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(a) Explain the role of yeast in making bread, and in making biofuel, naming the product that matters in each case. [4]

(b) State **two** reasons why enzymes in washing powder are useful, and explain why such a powder should not be used at very high temperature. [3]

(c) Describe how lactose-free milk is produced using an enzyme. [2]

(d) Name **three** conditions that must be controlled inside a fermenter, and explain why each matters. [6]

Solutions

2.1 ethanol; carbon dioxide.

2.2 it breaks down cell walls to release more (and clearer) fruit juice.

3.1 B. The enzymes digest stains, even at lower temperatures.

3.2 (a) any two of: temperature; pH; oxygen; nutrient supply; waste removal.
(b) any of: insulin; penicillin; mycoprotein.

3.3 (a) In bread, the yeast respires anaerobically and produces **carbon dioxide**; the bubbles of gas are trapped in the dough and make it rise. In biofuel, the same anaerobic respiration is used for the **ethanol**; the ethanol is distilled off and burned as fuel.
(b) They break down stains that water alone cannot remove — protease digests protein stains such as blood, and lipase digests fatty stains. At very high temperature the enzymes are **denatured**: the shape of the active site changes so the substrate no longer fits, and they stop working.
(c) The enzyme **lactase** is added to the milk, or the milk is passed over lactase immobilised on beads; the lactase breaks the lactose down into glucose and galactose, which lactose-intolerant people can digest.
(d) **Temperature** — a water jacket keeps it at the optimum; too low and the reaction is slow, too high and the enzymes denature. **pH** — monitored and corrected, because enzymes work only over a narrow pH range and are denatured outside it. **Oxygen supply** — sterile air is bubbled through and a paddle stirs, so the organisms can respire aerobically and grow quickly, and the contents stay evenly mixed. (Also accept nutrient supply, or sterility to keep unwanted microorganisms out.)