5.2 Selective breeding engineering and cloning

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Build the skills to answer exam questions on **selective breeding, genetic modification and cloning** 、 : breeding plants and animals with useful features, making transgenic organisms, human insulin from bacteria, micropropagation and cloning mammals.

You must be able to:

- describe how selective breeding produces useful plants and animals
- describe how a gene is put into bacteria using enzymes and a vector
- explain the advantages and risks of GM organisms
- calculate the growth of bacteria in a fermenter

1 Key knowledge and worked examples

■ Changing organisms

idea	rule
restriction enzyme	cuts DNA at a particular base sequence, leaving sticky ends
ligase	joins pieces of DNA together
vector	carries the gene into the cell: a plasmid or a virus
transgenic	an organism containing a gene from another species
micropropagation	many identical plants grown from small pieces of one plant, on agar with nutrients and hormones
doubling	number after n divisions = start $\times 2^n$

Worked example 1: doubling. Bacteria divide every 20 minutes. How many are there after 4 hours, from one bacterium?

1. Known: $4 \times 60 \div 20 = 12$ divisions.
2. Rule: start $\times 2^n$.

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3. Numbers: 1×2^{12}.
4. Result: 4096 **bacteria**.

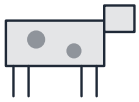
Worked example 2: percentage gain. After 10 generations of breeding, mean milk yield rises from 6000 to 7500 litres a year. Find the gain.

1. Known: old 6000; new 7500.
2. Rule: change ÷ old ×100.
3. Numbers: $1500 \div 6000 \times 100$.
4. Result: 25%.

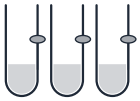
Answer shapes: in an evaluation, give benefits **and** risks, then a judgement.

2 Practice

2.1 Give **two** features that farmers might selectively breed for in dairy cattle. [2]



2.2 Give **one** advantage and **one** disadvantage of micropropagation. [2]



2.3 Name **one** genetically modified crop and the benefit of its new gene. [2]



3 Exam-style questions

3.1 Describe how a farmer could use selective breeding to produce a high-yielding variety of wheat. [3]



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3.2 Human insulin is made by genetically modified bacteria grown in large fermenters. In the past, insulin came from the pancreases of pigs. Some information is shown in the table.

(a) The bacteria divide every 30 minutes. Calculate the number of bacteria after 5 hours, starting from one. [2]



	pigs	GM bacteria
same as human insulin	no	yes
amount made	limited	large
cost	higher	lower

(b) Describe how the human insulin gene is put into a bacterium. [3]

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(c) Use the table to give **three** advantages of insulin from GM bacteria. [3]

(d) The same company sells pest-resistant GM maize seed. Evaluate the growing of GM crops. [6]

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