A-LEVEL BIOLOGY • EXERCISE SHEET

19.2 Genetic technology applied to medicine

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

Objective

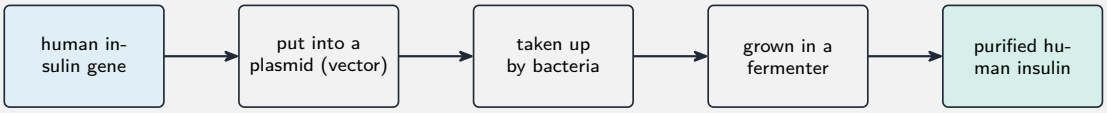
Build the skills to answer exam questions on **genetic technology applied to medicine**—**recombinant human proteins** 重组人蛋白, **genetic screening** 基因筛查, **gene therapy** 基因治疗, and their ethical issues.

You must be able to:

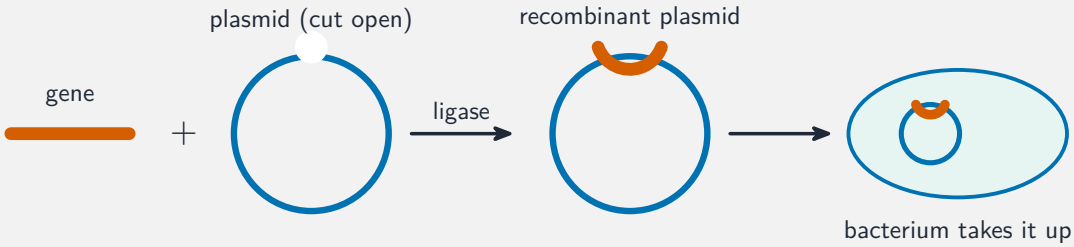
- explain the advantages of recombinant human proteins (insulin, factor VIII, ADA)
- outline genetic screening (BRCA, Huntington's, cystic fibrosis) and gene therapy (SCID)
- discuss social and ethical considerations

1 Worked examples

■ Recombinant human proteins



The insulin gene goes into bacteria, which become living factories —an exact human copy, never in short supply



A plasmid vector carries the human gene into bacteria

A human gene is placed in bacteria so they make a **recombinant** human protein—an exact copy. Advantages: it is identical to the human protein, never in short supply, and avoids using animal/donor proteins (so fewer allergic reactions or infec-

tions). Examples: **insulin** 胰岛素 (diabetes), **factor VIII** (haemophilia), **adenosine deaminase** (a faulty immune system).

■ Genetic screening and gene therapy

Genetic screening tests DNA for disease alleles before symptoms appear —e.g. **BRCA1/BRCA2** (breast cancer risk), **Huntington's disease**, **cystic fibrosis** 囊性纤维化. **Gene therapy** puts a working gene into a patient's cells —used for **SCID** (failed immune system) and some inherited eye diseases.

■ Ethics

Concerns: who may see your results; misuse by insurers/employers; safety and permanence of changes; who decides. These are weighed against the benefits.

2 Practice

2.1 State **two** advantages of using recombinant human insulin rather than insulin from animals. [2]

2.2 Name **one** disease that can be detected by genetic screening. [1]

3 Exam-style questions

3.1 Gene therapy treats a genetic disease by: [1]

- **A** giving the patient a recombinant protein
- **B** putting a working copy of a gene into the patient's cells
- **C** screening the patient's DNA
- **D** removing the faulty allele from all body cells permanently

3.2 Which is an advantage of making insulin from genetically engineered bacteria? [1]

- **A** it is slightly different from human insulin
- **B** it is identical to human insulin and never in short supply
- **C** it must be extracted from animal pancreases
- **D** it cannot be purified

3.3 (a) Explain **one** advantage of genetic screening for a person with a family history of Huntington's disease. [2]

(b) Discuss **one** ethical concern raised by genetic screening. [2]

3.4 Explain how gene therapy could help a child with SCID. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **19.2 Genetic technology applied to medicine** past-paper sheet in the Library, or try this in **Practice mode**:

- 9700/41 J25 —Q3 (medical genetics, calculation)

Solutions

2.1 any two: identical to human insulin; never in short supply; fewer allergic reactions; no risk of animal-borne infection; no ethical objection from using animals.

2.2 any one: breast cancer (BRCA1/BRCA2); Huntington's disease; cystic fibrosis.

3.1 B. Gene therapy adds a working copy of the gene to the patient's cells.

3.2 B. Engineered bacteria make insulin identical to human insulin, in unlimited supply.

3.3 (a) it lets the person know their risk before symptoms appear, so they can make informed choices about treatment, monitoring or having children.
(b) e.g. results could be misused by insurers/employers, or cause anxiety / there is no cure for Huntington's.

3.4 a working copy of the faulty gene is inserted into the child's cells; the cells then make the missing protein, restoring immune function.