

11.2 Antibodies and vaccination

Name: _____ Class: _____ Date: _____

Total: 13 marks

KEY WORDS monoclonal antibodies • vaccine • immunity
• hybridoma • active immunity

Objective

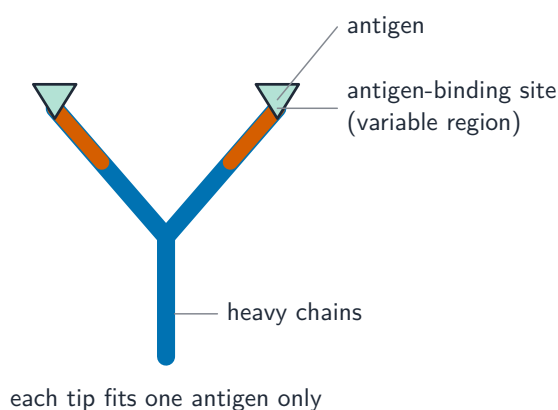
Build the skills to answer exam questions on **antibodies and vaccination** – antibody structure, **monoclonal antibodies**, types of **immunity**, and **vaccination**.

You must be able to:

- relate antibody structure to function and outline the hybridoma method
- distinguish active/passive and natural/artificial immunity
- explain how vaccines and vaccination programmes give long-term immunity

1 Key knowledge and worked examples

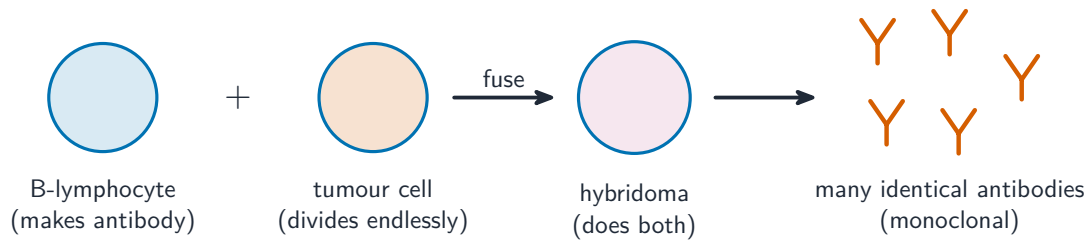
■ Antibody structure and function



The two tips are variable regions that bind one specific antigen

An antibody is a Y-shaped protein; its two **variable regions** bind one antigen only. Antibodies clump pathogens together, mark them for phagocytes, and block toxins.

■ Monoclonal antibodies



A hybridoma pours out one identical (monoclonal) antibody

A **hybridoma** = a B-lymphocyte (makes the wanted antibody) fused with a tumour cell (divides endlessly). Uses: **diagnosis** (e.g. pregnancy test) and treatment (carry drugs to target cells).

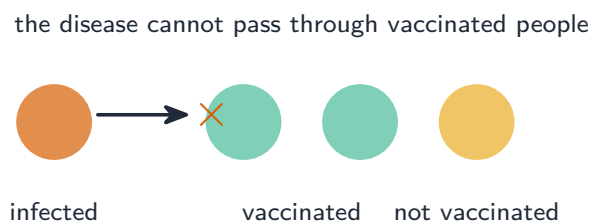
■ Types of immunity

	natural	artificial
active	after an infection (your body responds)	vaccination (safe dose of antigen)
passive	antibodies passed from mother to baby	injection of ready-made antibodies

active = your body makes its own antibodies (slow, long-lasting);
passive = ready-made antibodies given (fast, short-lived)

Active immunity lasts (your body responds); passive is fast but short (ready-made antibodies)

■ Vaccination and herd immunity



When enough people are vaccinated, the pathogen cannot reach the few who are not

A **vaccine** contains antigens that trigger a primary response and make memory cells – long-term immunity without illness. If enough people are vaccinated, **herd immunity** protects the rest.

2 Practice

2.1 State the part of an antibody that binds the antigen, and explain why it binds only one antigen. [2]

2.2 State one difference between active and passive immunity. [1]

3 Exam-style questions

3.1 Which is an example of **passive natural** immunity? [1]

- ☐ **A** recovering from chickenpox
☐ **B** being given a vaccine
☐ **C** antibodies passing from a mother to her baby in breast milk
☐ **D** being injected with ready-made antibodies

3.2 Why does passive immunity not last long? [1]

- ☐ **A** the antibodies are the wrong shape
☐ **B** no memory cells are produced
☐ **C** the antigens are destroyed
☐ **D** phagocytes remove the antibodies

3.3 (a) Outline how monoclonal antibodies are produced by the hybridoma method. [3]

(b) State **one** use of monoclonal antibodies in medicine and explain how their specificity is important. [2]

3.4 Explain how a vaccination programme can protect even people who have not been vaccinated. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- the variable region / antigen-binding site; its shape is complementary to one antigen only

2.2

- active immunity is made by your own body and is long-lasting; passive immunity uses ready-made antibodies and is short-lived

3.1 C

- Antibodies passing from mother to baby = passive (ready-made) and natural

3.2 B

- No memory cells are made, so the immunity is short-lived

3.3

(a)

- an animal is given the antigen so it makes B-lymphocytes producing the wanted antibody; these are fused with tumour cells to form hybridomas; the hybridomas both make the antibody and divide endlessly, giving many identical antibodies

(b)

- e.g. diagnosis (pregnancy test) or carrying drugs to cancer cells; the antibody binds only the target molecule/cell, so it is specific and does not affect others

3.4

- vaccinating enough people means the pathogen cannot pass easily between them; so it cannot reach the unvaccinated people – this is herd immunity