IGCSE BIOLOGY • EXERCISE SHEET

10.1 Diseases and immunity

Name: _____ Class: _____ Date: _____ **Total: 28 marks**

KEY WORDS pathogen 病原体 • ions 离子 • antibodies 抗体 • disease 疾病 • active immunity 主动免疫

Objective

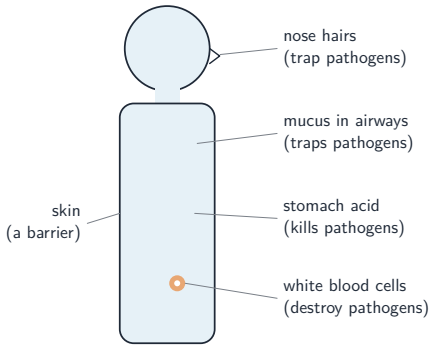
Build the skills to answer exam questions on **diseases and immunity** 疾病与免疫 — **pathogens** 病原体, the body's **defences** 防御, **antibodies** 抗体, **vaccination** 疫苗接种, and active vs passive immunity.

You must be able to:

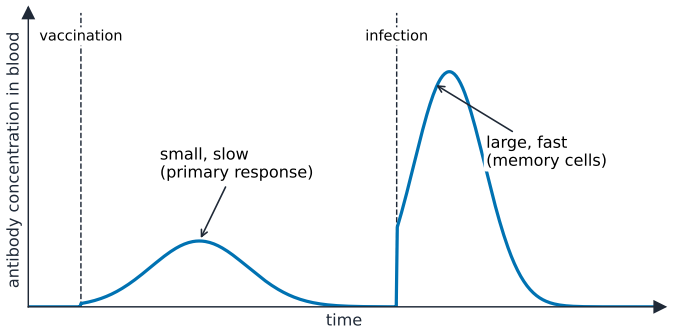
- define pathogen and transmissible disease; list the body's defences
- explain antigens/antibodies and how vaccination works
- compare active and passive immunity

1 Worked examples

Defences and vaccination



Defences: skin, nose hairs, mucus, stomach acid, white blood cells



vaccine: primary + memory · reinfection: rapid secondary

Vaccination makes memory cells → a fast, large response if the real pathogen arrives (active immunity)

- **passive immunity** (placenta, breast milk): short-term, no memory cells.

The defences, in the order the marks are given

Pathogen 病原体: an organism that causes disease. A **transmissible disease** passes from one host to another, directly (touch, body fluids) or indirectly (contaminated food or water, air, an insect vector).

The body's defences, in two layers.

- **Mechanical and chemical barriers, which act against every pathogen:** the skin as a physical barrier; hairs in the nose; **mucus** trapping pathogens in the airways, with cilia sweeping it up; stomach acid killing what is swallowed; tears containing enzymes.
- **The white blood cells, which act against a specific pathogen: phagocytes** 吞噬细胞 engulf and digest pathogens; **lymphocytes** 淋巴细胞 make **antibodies** 抗体 whose shape is complementary to the pathogen's **antigen** 抗原, so they bind to it and mark it for destruction or make the pathogens clump together.

Active and passive immunity. Active immunity comes from the body making its own antibodies, after an infection or a vaccination; it is slow to start but long-lasting, because memory cells remain. **Passive** immunity comes from receiving antibodies made elsewhere, such as through the placenta or breast milk; it is immediate but short-lived, because no memory cells are made.

Worked example (how a vaccine works). Describe how a vaccine gives long-term protection.

1. The vaccine puts a weakened, dead or partial pathogen, carrying its antigens, into the body.

2. Lymphocytes recognise the antigens and make specific antibodies against them.
3. **Memory cells** remain in the blood afterwards.
4. If the real pathogen enters later, the memory cells make antibodies faster and in larger amounts, so the person does not become ill.

Controlling the spread of a disease: clean water supplies, hygienic food preparation, waste disposal and sewage treatment, personal hygiene such as hand washing, and vaccination programmes. When enough people are vaccinated, **herd immunity** protects those who cannot be, because the pathogen cannot find enough hosts to spread through.

2 Practice

2.1 Define a pathogen. [1]

2.2 State two of the body's defences against pathogens. [2]

2.3 State two mechanical barriers that stop pathogens entering the body. [2]

2.4 Explain why an antibody against measles does not protect against influenza. [2]

2.5 Give two methods of controlling the spread of a disease carried in water. [2]

3 Exam-style questions

3.1 An antibody is able to bind to one pathogen because its shape is: [1]

- **A** the same as the antibody
- **B** complementary to the pathogen's antigen
- **C** larger than the pathogen
- **D** always changing

3.2 A child is vaccinated against measles.

(a) Describe how the vaccine gives long-term protection. [3]

(b) State the difference between active and passive immunity. [2]

3.3 A country runs a vaccination programme against a viral disease.

(a) Describe how the vaccine produces long-term protection. [4]

(b) Explain why the protection is described as active immunity. [2]

(c) A newborn baby receives antibodies in its mother's breast milk. Name this type of immunity and explain why it lasts only a few months. [3]

(d) Describe how a phagocyte destroys a pathogen that has entered the blood. [2]

(e) When most of the population is vaccinated, unvaccinated people also become less likely to catch the disease. Explain why. [2]

Solutions

2.1 an organism that causes disease.

2.2 any two of: skin; nose hairs; mucus; stomach acid; white blood cells.

2.3 Any two of: the skin as a physical barrier; hairs in the nose; mucus in the airways trapping pathogens; cilia sweeping mucus away.

2.4 An antibody has a shape complementary to one particular antigen; the measles and influenza viruses carry different antigens, so the measles antibody cannot bind to the influenza virus.

2.5 Any two of: treating and chlorinating the water supply; treating sewage so it does not reach drinking water; boiling water before drinking; hand washing.

3.1 B. An antibody's shape is complementary to the pathogen's antigen.

3.2 (a) the vaccine's antigens make lymphocytes produce antibodies; and memory cells form; if the real pathogen arrives, the memory cells make antibodies fast, so you don't become ill.
(b) active immunity is made by your own body (long-term, memory cells); passive immunity comes from another body's antibodies (short-term, no memory cells).

3.3 (a) The vaccine introduces a weakened, dead or partial pathogen carrying its antigens; lymphocytes recognise the antigens and make specific antibodies against them; memory cells remain, so if the real pathogen enters later, antibodies are made faster and in larger quantities and the person does not become ill.
(b) The person's own lymphocytes make the antibodies, and memory cells remain afterwards, so the protection is long lasting.
(c) Passive immunity; the antibodies were made by the mother, not the baby; the baby makes no memory cells, and the antibodies are gradually broken down, so the protection fades.
(d) The phagocyte engulfs the pathogen, taking it inside the cell; enzymes then digest and destroy it.
(e) There are too few people left who can catch and pass on the pathogen, so it cannot spread easily and the unvaccinated are unlikely to meet an infected person, which is herd immunity.