

Solutions

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

2.1

- an antigen is a **molecule with its own specific shape** that the body recognises as foreign
- it is found on the **surface** of the pathogen

2.2

- the pathogen is **destroyed directly**
- or it is **marked**, so that a **phagocyte** engulfs and destroys it

2.3

- a **lymphocyte**

2.4

- **C, D, B, A**
- one mark for C first and A last, the second for the whole order being right

2.5

- **passive immunity**
- the baby's own body did **not** make these antibodies, so **no memory cells** are produced
- the antibodies are broken down and are not replaced, so the protection fades after a few months

2.6

- the bacterium is swallowed in contaminated water and reaches the **small intestine**
- it produces a **toxin**
- the toxin causes **chloride ions** to be secreted into the intestine, so **water moves in by osmosis**
- the result is **diarrhoea**, with loss of water and ions from the blood

3.1 D

- the antibodies were made in another body, so this is **passive** immunity
- the patient's own lymphocytes were never stimulated, so **no memory cells** were made, which rules out **A, B** and **C**

3.2

(a)

- the second response is **faster** – the antibody concentration starts to rise sooner
- the second response is **larger** – it reaches a much higher concentration; it also lasts longer

(b)

- the first dose produced **memory cells**
- the memory cells **recognise the antigen at once**, so no time is lost finding the right lymphocyte
- they divide and produce antibodies **more quickly and in much greater quantity**

(c)

- the weakened pathogen still carries its **antigens**, which have the same shapes
- so lymphocytes are still stimulated to make antibodies and memory cells, but the pathogen is too weak to cause the disease

3.3

(a)

- a **bacterium**
- transmitted **indirectly, in contaminated water**

(b)

- untreated sewage carries the cholera bacterium from an infected person's faeces
- treating it stops the bacterium reaching the **drinking water supply**
- so the pathogen cannot be transmitted to a new **host**, and the number of new infections falls

(c)

- vaccinated people produce antibodies and memory cells, so they do not become infected
- with most of the population immune, there are very few people the bacterium can infect and multiply in
- so it is far less likely to be passed on, and an unvaccinated person is unlikely to meet it

(d)

- the injected antibodies were made in another body, so this is **passive** immunity and **no memory cells** are produced
- the patient's own lymphocytes were never stimulated, so there is no long-term protection and the same pathogen can infect them again

(e)

- find the decrease, then divide by the **original** number

$$\frac{4200 - 150}{4200} \times 100 = \frac{4050}{4200} \times 100 = \mathbf{96.4\%}$$

- dividing by 150 instead of 4200 is the usual mistake; the percentage change is always out of the starting value