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

2.3

- **four**: two heavy and two light chains

2.4

- an injection of antibodies, for example antitoxin for tetanus

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

3.5

- the smallpox virus was antigenically stable, so one vaccine gave lasting immunity everywhere; it had no animal reservoir and infected people were easy to identify
- the malaria parasite is eukaryotic with many antigens, changes its antigens through its life cycle, and hides inside liver and red blood cells
- cholera bacteria live in the intestine, where antibodies in the blood cannot easily reach them, and vaccines give only short protection

3.6

- it gives flexibility, so the two binding sites can bind antigens that are different distances apart