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BIOLOGY

CELLS

Level & Board	AQA (A-LEVEL)
TOPIC:	THE IMMUNE SYSTEM
PAPER TYPE:	SOLUTION - 2
TOTAL QUESTIONS	8
TOTAL MARKS	67

The Immune System - 2

1.

(a) Monoclonal antibodies are antibodies which are produced by a single clone of a specific white blood cell. They are specific to one binding site on one protein antigen (the molecules that are found on the surface of pathogens) so they are able to target specific cells.

(b) Some monoclonal antibodies mark cancer cells so that the immune system will better recognize and destroy them. An example is rituximab, which binds to a protein called CD20 on B cells and some types of cancer cells, causing the immune system to kill them.

(c) Antibodies bind to complementary antigens to form an antibody-antigen complex. A second antibody with an enzyme attached is added then the second antibody attaches to antigen. The substrate is added and the colour changes.

2.

(a) Antibodies each contain two antigen-binding sites which means they can bind to two pathogens at the same time. This causes pathogens to become clumped together. Phagocytes can then engulf and digest lots of pathogens at the same time, which makes phagocytosis more efficient.

(b) 111

(c)

- Mean antibody concentration increases
- 1st injection only protects some mice
- 2nd/3rd injection protects all mice
- No mice protected after 180 days

(d) Inject vaccine containing meningitis antigen again immune response is quicker than 1st injection.

3.

(a) In case of snakebites, the antivenom administered to the patient contains preformed antibodies against the snake venom. So, treatment of snakebite with antisnake venom is artificially acquired passive immunity.

OR

- Antivenom/Passive immunity antibodies bind to the antigen and causes its destruction
- Active immunity would be too slow

(b)

- It is because different form of antigen
- Different antibodies needed in the antivenom

(c) Horses as more antibodies can be collected 4550 vs 26 blood collected.

(d)

To ensure that the animal does not suffer from the venom

OR

The animal does not have pathogen that could be transferred to humans.

(e)

- B cells specific to the venom reproduce by mitosis;
- B cells produce plasma cells and memory cells
- The second dose produces antibodies (in secondary immune response) in higher concentration and quickly
  OR
- The first dose must be small so the animal is not killed

4.

(a) It inhibits the enzyme that synthesises DNA from HIV RNA. This does not destroy HIV in the body but stops or slows the development of AIDS. In the past, some people who took AZT on its own eventually developed AIDS. Some of the HIV in their bodies had become resistant to AZT.

OR

- Person infected with HIV has HIV DNA in their DNA
- New HIV particles still made
- AZT inhibits reverse transcriptase
- AZT stops these new HIV particles from forming new HIV DNA
- Stops destruction of more / newly infected T cells

- So immune system continues to work and AIDS does not develop

(b) The standard treatment consists of a combination of drugs (often called "highly active antiretroviral therapy" or HAART) that suppress HIV replication. The combination of drugs is used in order to increase potency and reduce the likelihood of the virus developing resistance.

OR

- AZT continues to work as a drug
- Because HAART prevents the spread of AZT-resistant HIV to rest of the human population

5.

(a) Virus engulfed by phagocyte broad immune response, destroyed using lysosomes hydrolysis and viral antigens presented on cell membrane (trigger specific immune response e.g. anti-bodies).

OR

Phagosome / vesicle fuses with lysosome

Virus destroyed by lysozymes / hydrolytic enzymes

Peptides / antigen from virus are displayed on the cell membrane

(b) Helper T cells bind to the antigen on the antigen-presenting phagocyte. This helper T cell stimulates a specific B cell to undergo clonal selection and these cells then form plasma cells that release antibodies specific to the viral antigen that was presented.

OR

Antibody against virus, antigen will bind to collagen results destruction of human cells/collagen.

6.

(a) Antigens are molecules present on the surface of cells, which trigger an immune response. Antigens include proteins on cell surface membranes. The immune system detects antigens in order to identify a cell. Antigens are typically unique and specific to particular cells and are also specific to particular pathogens.

(b) Antibodies, also known as immunoglobulins, are proteins produced by the immune system in response to foreign substances, such as viruses or bacteria. Their function is to recognize and neutralize these harmful substances, called antigens, by binding to them and marking them for destruction.

(c)

35÷2x100

1750%

(d) Sample 1 was taken 2 weeks before the first dose of the vaccine was given, so no antibodies were present as the patients hadn't encountered the virus yet and the patients had no resistance to the poliomyelitis yet. Sample 2 was taken 2 weeks after the first does of the vaccine was given, so there are some antibodies present as a primary response to the vaccine, produced from plasma cells which were B-cells that expanded to become plasma cells. Sample 3 was taken 2 weeks after the second dose of the vaccine was given, so the memory cells produce more antibodies and do so more rapidly than before.

7.

(a) Vaccines provide a dead/inactive form of bacterial meningitis. Phagocytes such as macrophages recognise the antigens of bacterial meningitis as foreign so engulf the pathogen forming a phagosome. The lysosome of the macrophage fuses with the phagosome to form a phagolysosome.

OR

Antibody produced from identical/cloned plasma cells.

(b)

(8)

(a) Vaccines contain weakened or inactive parts of a particular organism (antigen) that triggers an immune response within the body. Newer vaccines contain the blueprint for producing antigens rather than the antigen itself.

OR

- Vaccine contains antigen from pathogen
- Macrophage presents antigen on its surface
- T cell with complementary receptor protein binds to antigen
- T cell stimulates B cell
- With complementary antibody on its surface
- B cell secretes large amounts of antibody
- B cell divides to form clone all secreting / producing same antibody

(b)

- Active involves memory cells, passive does not
- Active involves production of antibody by plasma cells / memory cells
- Passive involves antibody introduced into body from outside / named source
- Active long term, because antibody produced in response to antigen
- Passive short term, because antibody given is broken down
- Active can take time to develop / work, passive fast acting.

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