Cell Recognition and the Immune System: AQA A Level Biology Exam Qu

18 questions · 47 marks · about 61 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2024 · Q01.1 · 3 marks

0 1 . 1 In the following passage, each numbered space can be filled with a biological term.

Each type of cell has specific molecules on its _____(1)_____ that identify it. An antibody is a _____(2)_____ with two _____(3)_____ binding sites. Antibodies are made and released by _____(4)_____ cells.

Vaccines can provide protection for individuals and populations against disease. The response to a vaccine is an example of _____(5)_____ immunity.

_____(6)_____ immunity occurs when a large proportion of a population becomes immune to a disease.

Write the correct biological term beside each number below that matches the space in the passage.

[3 marks]

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

Question 2 · A level Paper 3 · June 2023 · Q06.1 · 2 marks

0 6 . 1 Give **two** types of cell that can stimulate an immune response.

[2 marks]

1 _____

2 _____

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Question 3 · AS Paper 1 · November 2020 · Q03.1 · 3 marks

0 3 . 1 Describe how a phagocyte destroys a pathogen present in the blood.

[3 marks]

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1 0 Read the following passage.

Sizes of populations of normal intestinal bacteria are usually controlled by T cells that are produced slowly and in small numbers by the immune system. These T cells do not normally survive for very long. As a result, they do not release large amounts of cytokines. Cytokines are chemicals that can cause swelling of the lining of the intestines.

Crohn's disease is a long-lasting disease that causes swelling of the lining of the intestines. It is believed that Crohn's disease can be caused by a loss of tolerance to normal intestinal bacteria, as shown by an unusually large response by T cells. This response can be triggered by pathogenic bacteria in the intestines of people with a genetic tendency to Crohn's disease.

Some people's Crohn's disease can be controlled by a drug called 5-aminosalicylic acid (5-ASA) that reduces swelling. Another drug called 6-mercaptopurine (6-MP) may also be used. 6-MP inhibits an enzyme required to make adenine and guanine. This is effective because most cells can recycle nucleotides, but T cells are not able to do so.

Use information from the passage and your own knowledge to answer the questions.

1 0 . 1 The Crohn's disease symptom of swelling of the lining of the intestines could be triggered by pathogenic bacteria in the intestines (lines 6–10).

Suggest how.

[3 marks]

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Question 5 · AS Paper 1 · June 2016 · Q07.1 · 4 marks

0 7 . 1 Human papilloma virus (HPV) is the main cause of cervical cancer. A vaccine has been developed to protect girls and women from HPV.

Describe how giving this vaccine leads to production of antibody against HPV.

[4 marks]

Question 6 · information from earlier in the question

0 3 In Europe, viruses have infected a large number of frogs of different species. The viruses are closely related and all belong to the Ranavirus group.

Previously, the viruses infected only one species of frog.

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Question 6 · A level Paper 3 · November 2020 · Q03.4 · 3 marks

0 3 . 4 Describe how the B lymphocytes of a frog would respond to vaccination against Ranavirus.

You can assume that the B lymphocytes of a frog respond in the same way as B lymphocytes of a human.

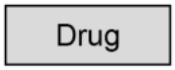
Do **not** include details of the cellular response in your answer.

[3 marks]

Question 7 · AS Paper 1 · June 2024 · Q07.1 · 2 marks

0 7 . 1 A drug is delivered to diseased body cells by a monoclonal antibody. The monoclonal antibody is attached to a drug to form an antibody–drug complex (ADC).

Figure 8



Complete **Figure 8** to show a monoclonal antibody attached to the drug.

Label **one** structural feature of the monoclonal antibody in your drawing of the ADC.

[2 marks]

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Question 8 · AS Paper 2 · June 2019 · Q04.1 · 2 marks

0 4 . 1 Describe and explain the role of antibodies in stimulating phagocytosis.

Do **not** include details about the process of phagocytosis.

[2 marks]

Question 9 · A level Paper 1 · June 2018 · Q07.1 · 2 marks

0 7 . 1 When a person is bitten by a venomous snake, the snake injects a toxin into the person. Antivenom is injected as treatment. Antivenom contains antibodies against the snake toxin. This treatment is an example of passive immunity.

Explain how the treatment with antivenom works and why it is essential to use passive immunity, rather than active immunity.

[2 marks]

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Question 10 · information from earlier in the question

0 9 Read the following passage.

The placenta is a specialised exchange surface.

In the placenta, substances are exchanged between the blood of a fetus and the blood of its mother. Gas exchange for the fetus occurs in the placenta.

There is also transfer of IgG antibodies in the placenta between the mother's blood and fetal blood. These IgG antibodies protect the fetus against the pathogens that infect its mother during pregnancy. The IgG antibodies can circulate at high concentration in the mother's blood for months or years. A fetus does not produce IgG antibodies.

The UK immunisation programme vaccinates as many babies as possible to protect the UK population against pathogens such as measles viruses and tetanus bacteria. Measles viruses spread quickly from infected people. Despite the efforts of the NHS, there has been a recent increase in the number of children catching measles.

Tetanus bacteria enter the body through skin wounds. Tetanus bacteria do not spread from infected people. In order to develop good immunity against tetanus, children are given three tetanus vaccinations at regular intervals before they reach their first birthday.

Use the information in the passage and your own knowledge to answer the following questions.

Question 10 · AS Paper 1 · June 2022 · Q09.3 · 2 marks

0 9 . 3 Suggest how vaccinating as many babies as possible protects the UK **population** against pathogens such as measles viruses and tetanus bacteria (lines 9–11).

[2 marks]

Protection against measles _____

_____

_____

_____

Protection against tetanus _____

_____

_____

_____

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Question 11 · AS Paper 1 · June 2022 · Q09.5 · 2 marks

0 9 . 5 Explain why giving children more than one tetanus vaccination develops good immunity against tetanus (lines 15–17).

[2 marks]

Question 12 · A level Paper 3 · June 2024 · Q01.2 · 1 mark

0 1 . 2 There is currently no effective vaccine available for HIV.

Suggest **one** reason why.

[1 mark]

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0 1 . 3 **Table 1** shows the action of two antibiotics.

Table 1

Antibiotic	Action of antibiotic
Ciprofloxacin	Causes double-stranded DNA to break apart
Penicillin	Prevents formation of crosslinks between murein chains

Using the information in **Table 1**, explain why each antibiotic is **not** effective against HIV.

[2 marks]

Ciprofloxacin _____

_____

_____

Penicillin _____

_____

_____

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Question 14 · A level Paper 3 · November 2021 · Q02.1 · 4 marks

0 2 . 1 Describe how the human immunodeficiency virus (HIV) is replicated **once inside** helper T cells (T_H cells).

[4 marks]

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0 8 **Table 4** shows the changes in the number of HIV RNA particles and helper T cells (T_H cells) in a person infected with HIV who was not receiving any treatment.

Table 4

Time after infection / years	HIV RNA particles per cm^3 of blood	T_H cell count / cells per mm^3 of blood
0	0	1000
1	80 000	305
2	20 000	854
6	22 000	812
10	70 000	597
11	120 000	150
12	135 000	5

0 8 . 1 A scientist concluded that other infections are more likely to develop in this person after 11 years.

Use the data in **Table 4** and your own knowledge of the immune response to explain the scientist's conclusion.

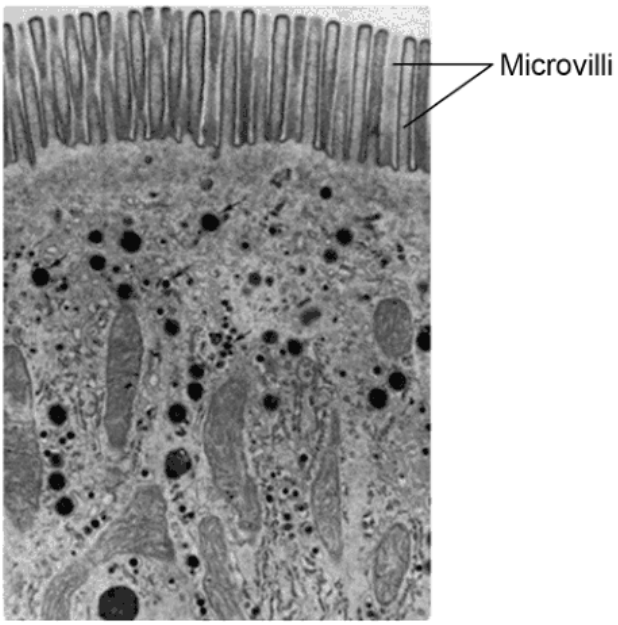
[3 marks]

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Question 16 · information from earlier in the question

0 3 **Figure 1** is an image of part of a cell lining the ileum.

Figure 1



Question 16 · AS Paper 2 · June 2022 · Q03.3 · 3 marks

0 3 . 3 The protein ZO-1 is found on the surface of ileum cells.

A scientist used an anti-ZO-1 monoclonal antibody to identify ileum cells in a sample of intestine observed using an optical microscope.

Suggest how the monoclonal antibody helped the scientist to identify ileum cells in the sample of intestine.

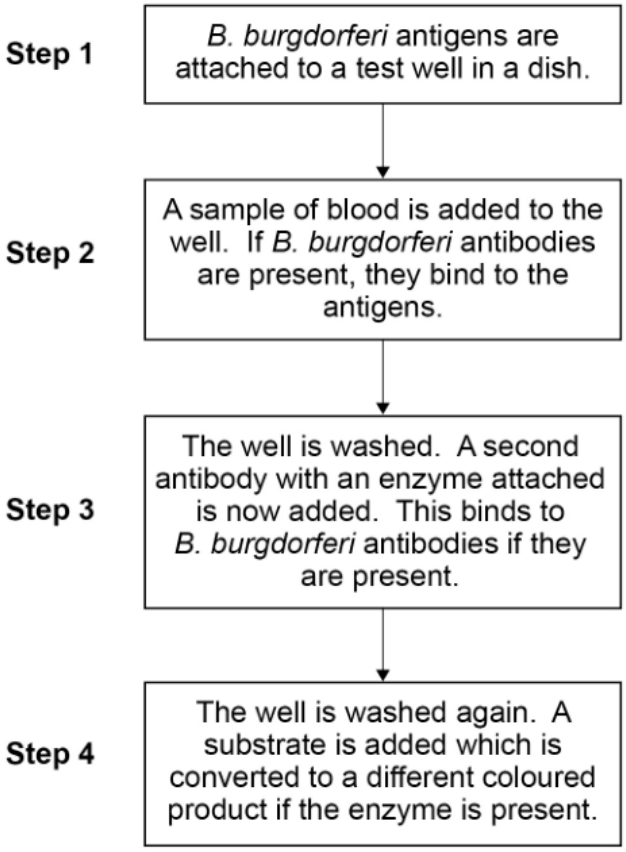
[3 marks]

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0 8 Lyme disease is most frequently caused by the bacterium *Borrelia burgdorferi*. Lyme disease can be difficult to diagnose.

Figure 5 shows an ELISA test that is used to find out if a person has antibodies to *B. burgdorferi*.

Figure 5



A false positive in this test is a result which incorrectly indicates that antibodies to *B. burgdorferi* are present.

0 8 . 1 Failure to thoroughly wash the well in **Step 4** can result in a false positive.

Explain why.

[2 marks]

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Question 18 · AS Paper 1 · June 2023 · Q06.4 · 4 marks

0 6 . 4 Human papilloma virus (HPV) is transmitted through sexual contact.

More than 95% of cervical cancers (which only affect females) are due to HPV infection. HPV infection of other tissues increases the risk of cancer but this is rare compared with cervical infection.

A vaccine is available that is over 80% effective at preventing HPV infection, if given before the person has been exposed to HPV. There is evidence of herd immunity when more than 50% of the population have been vaccinated.

Evaluate whether 10- to 12-year-old boys should be given the HPV vaccine.

[4 marks]

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Mark schemes

Question 1 · A level Paper 3 · June 2024 · Q01.1 · 3 marks

01.1	1. (Cell-surface) membrane 2. Protein 3. Antigen 4. Plasma 5. Active 6. Herd;;;	3 max (3 x AO1)	6 correct = **3 marks** 4–5 correct = **2 marks** 2–3 correct = **1 mark** 0–1 correct = **0 marks** 2. Accept immunoglobulin or glycoprotein 2. Ignore tertiary 2. Ignore polypeptide 3. Accept complementary/specific 3. Ignore identical 5. Ignore artificial 5. Ignore primary

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Question 2 · A level Paper 3 · June 2023 · Q06.1 · 2 marks

06.1	1. Pathogens **OR** Cells from an organism of a different species; 2. Cells from other organisms of the same species; 3. Abnormal body cells; 4. Antigen-presenting cells;	2 max (2 x AO1)

Reject toxins

1. Accept named examples of pathogens
1. Accept bacteria/fungi
1. Ignore viruses
2. Accept named appropriate cells from other organisms of the same species
2. and 3. Ignore B cells/T cells
3. Accept cancer cells
3. Accept cell infected with virus

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Question 3 · AS Paper 1 · November 2020 · Q03.1 · 3 marks

03.1	1. Engulfs; 2. Forming vesicle/phagosome **and** fuses with lysosome; 3. Enzymes digest/hydrolyse;	3	1. Accept endocytosis **OR** Description 1. Ignore 'taken in' 3. Accept lysozymes for 'enzymes'

Question 4 · AS Paper 1 · June 2018 · Q10.1 · 3 marks

10.1	1. (Presence of) antigen of the (pathogenic) bacteria; 2. (Causes) more T cells produced / faster T cell production; 3. Against (the pathogen and) normal bacteria; 4. (Long lasting as) cells do not die / live for longer; 5. (More) cytokines / chemicals causing swelling are produced;	3 max

1. Assume bacteria are pathogenic unless otherwise stated

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Question 5 · AS Paper 1 · June 2016 · Q07.1 · 4 marks

07.1	1. Vaccine/it contains antigen (from HPV); 2. Displayed on antigen-presenting cells; 3. Specific helper T cell (detects antigen and) stimulates specific B cell; 4. B cell divides/goes through mitosis/forms clone to give plasma cells; 5. B cell/plasma cell produces antibody;	4 max

1. Term ‘antigen’ may be first mentioned with point 2

2. Accept named example, e.g. macrophage/phagocyte/B cells

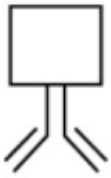
3. Accept ‘helper T cell with receptor on surface’ for ‘specific’ and B cells with receptor/antibody on surface that bind to antigen for ‘specific’

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03.4	1. B cell (antibody) binds to (viral) specific/complementary receptor/antigen; 2. B cell clones **OR** B cell divides by <u>mitosis</u>; 3. <u>Plasma cells</u> release/produce (monoclonal) <u>antibodies</u> (against the virus); 4. (B/plasma cells produce/develop) memory cells;	3 max

1. Accept <u>B cell</u> forms antigen-antibody complex
2. Accept B cell undergoes clonal selection/expansion

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07.1	1. 'Y'-shaped (antibody) linked to rectangle with exposed arms of 'Y'; For example  2. Disulfide bridge/bond **OR** Antigen binding site **OR** Variable region **OR** Non variable/constant region **OR** Light chain **OR** Heavy chain **OR** Hinge region **OR** Polypeptide;	2 (2 x AO1)

1. Accept 'Y' shape with 4 chains touching anywhere on the 'constant' region of the antibody.

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04.1	1. Bind to antigen **OR** Are markers; 2. (Antibodies) cause clumping/agglutination **OR** Attract phagocytes;	2	1. Accept opsonin for 'marker' 1. Accept form (antibody-antigen) complexes/are complementary to antigen 2. **Reject** clotting

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Question 9 · A level Paper 1 · June 2018 · Q07.1 · 2 marks

07.1	1. (Antivenom/Passive immunity) antibodies bind to the toxin/venom/antigen and (causes) its destruction; 2. Active immunity would be too slow/slower;

2	1. For ‘bind’ accept ‘attach’, ignore ‘attack’. 1. For ‘destruction of toxin’ accept agglutination or phagocytosis. 1. Ignore reference to antibodies ‘neutralising toxin/stopping damage’ 1. Reject reference to ‘killing’ toxin/venom. 2. Accept ‘passive immunity is faster’, not simply ‘passive immunity is fast’.

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Question 10 · AS Paper 1 · June 2022 · Q09.3 · 2 marks

09.3	(Against measles) 1. (To achieve) herd immunity to reduce spread; (Against tetanus) 2. No herd immunity **OR** Skin wounds are common (in children);	2 (2 x AO2)	1.Accept 'herd effect' for herd immunity 2. Accept Only protects the individual

Question 11 · AS Paper 1 · June 2022 · Q09.5 · 2 marks

09.5	1. (Production of) more memory cells; 2. (So) higher concentration of antibodies (in blood) **OR** (So) more rapid production of antibodies (on further infection);	2 (2 x AO2)	Ignore active immunity 2. Accept More antibodies (in blood)

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Question 12 · A level Paper 3 · June 2024 · Q01.2 · 1 mark

01.2	1. (High rate of) mutation; 2. (High) genetic diversity; 3. HIV in cells could (still) spread infection; 4. HIV (DNA) embeds/inserts itself in **host DNA**; 5. Lack of funding/money (for research/development); 6. HIV causes fewer T cells, **so** immune response (to the vaccine) does not happen;	1 max (1 x AO2)

1. Accept antigenic variability **OR** descriptions of antigenic variability
6. Accept 'HIV destroys/kills T cells' for 'HIV causes reduced T cells'
6. Accept 'so B cells not activated' for 'so immune response (to the vaccine) does not happen
6. Ignore immune cells destroyed

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01.3	**(Ciprofloxacin)** 1. (HIV) has RNA **OR** (HIV) does not have DNA; **(Penicillin)** 2. (HIV) has no cell wall **OR** (HIV) does not contain murein;	2 (2 x AO2)	1. Ignore any prefixes to RNA 1. Reject references to single stranded DNA 2. Reject any references to incorrect viral structures, eg viruses have a cell membrane **OR** a cell wall made of chitin

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02.1	1. RNA converted into DNA using reverse transcriptase; 2. DNA incorporated/inserted into (helper T cell) DNA/chromosome/genome/nucleus; 3. DNA transcribed into (HIV m)RNA; 4. (HIV mRNA) translated into (new) HIV/viral proteins (for assembly into viral particles);

4	1. Reject 'messenger' or 'm' before RNA 3. Accept descriptions of transcription 4. Accept descriptions of translation 4. Accept named viral protein, eg capsid 4. Reject viral cells

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08.1	1. (After 11 years) there is a **large** decrease in the number of helper T-cells **OR** (After 11 years) there are few/low number of helper T-cells; 2. (So) fewer B cells divide by mitosis **OR** (So) fewer B cells undergo clonal selection; 3. (So) fewer plasma cells produce antibodies;	3 (3 x AO3)

1. Allow other words for large eg significant/big

2.and 3. Accept 'no' for fewer

2. Accept clonal expansion

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03.3	1. ZO-1 is located in cell (surface) membrane; 2. Antibody is complementary (to ZO-1); 3. (So) binds/attaches to the ZO-1/protein; 4. (Cells identified with) dye/stain/ fluorescent marker linked to antibody;	3 max (3 x AO2)

2. and 3. Reject 'active site' once
3. Accept 'forms antigen-antibody complex'
4. Accept attachment of coloured substance to antibody, but 'colour production' on its own is insufficient.
4. 'Marker' on its own is insufficient.

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08.1	1. (Second antibody with) enzyme remains; 2. (So substrate converted to) coloured product;	2
		(2 x AO2)

1. Accept any description of antibody with enzyme
remaining eg ‘not washed out’.

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06.4	For: 1. Needs to be given early (age 10-12) before exposure to HPV; 2. Will reduce transmission to girls (for when they are older); 3. Boys can be infected with HPV **OR** (Vaccination) prevents HPV infection; 4. (Need boys) to ensure herd immunity **OR** (Need boys) to be above 50% vaccinated; 5. Boys can have increased risk of cancer (from HPV infection); Against: 6. Boys at less risk of cancer (from HPV infection) than females **OR** Cervical cancer only affects females; 7. May be side effects from vaccine;	4 max (4 x AO3)

Max 3 for mark points 1-5

1. Accept ‘Needs to be given before sexual activity’

2. Accept ‘spread’ for ‘transmission’

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