

GCSE Biology (9 – 1)

Monoclonal Antibodies

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/14
3	/14
4	/6
5	/9
Total	/47
%	
Grade	

Information

- The maximum mark for this paper is 47 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



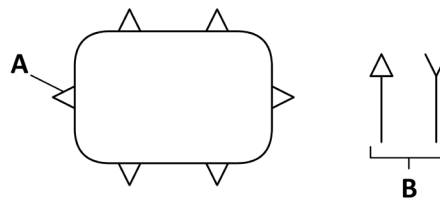
1. Monoclonal antibodies are artificially produced molecules that are designed to bind to specific targets, such as pathogens or cancer cells. Answer the following questions.
Circle the letter of the correct answer for each.

a) What type of cell produces monoclonal antibodies?

- | | | | |
|-----------------|-----------------|-------------|--------------|
| A | B | C | D |
| Red blood cells | Hybridoma cells | Nerve cells | Muscle cells |

(1 mark)

- b) The diagram with the structure labelled A shows a bacterium with proteins on its surface. The diagram labelled B shows proteins made by the human body.



Which row shows the correct combination for destroying the bacterium?

	Name of A	Name of B	Correct shape of B
A	Antibody	Antigen	
B	Antigen	Antibody	
C	Antigen	Antibody	
D	Antibody	Antigen	

(1 mark)

c) Which of the following is **not** a potential use of monoclonal antibodies?

- A** Targeting specific cancer cells for destruction.
- B** Detecting the presence of a specific hormone in a pregnancy test
- C** Curing viral infections by directly attacking viruses
- D** Delivering drugs directly to a specific site in the body.

(1 mark)

d) Monoclonal antibodies can be used to treat some cancers.

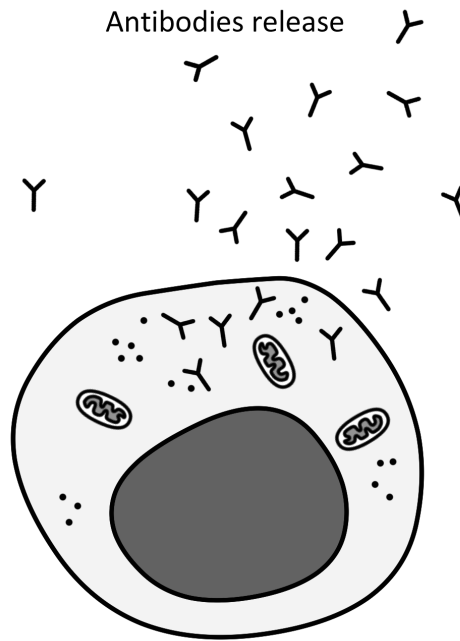
Which property of monoclonal antibodies makes them suitable as a form of treatment?

- A** Their ability to stimulate the immune system to attack any foreign substance.
- B** Their ability to bind specifically to antigens found on the surface of cancer cells.
- C** Their ability to destroy all types of cells in the body, including cancerous ones.
- D** Their ability to be produced quickly and cheaply in large quantities.

(1 mark)

(Total for Question 1 is 4 marks)

2. The body is capable of producing antibodies in response to an antigen.
The figure below shows a lymphocyte releasing antibodies.



- a) Explain what is meant by the term "monoclonal antibodies"?

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(2 marks)

- b) Describe one use of monoclonal antibodies in medical treatment.

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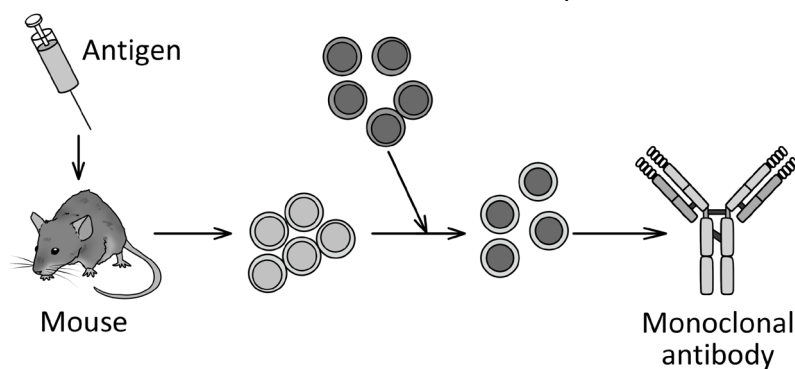
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(2 marks)

The diagram below shows how monoclonal antibodies can be produced.



c) Using the diagram and your own knowledge, explain how monoclonal antibodies are produced.

[illegible]

(6 marks)

d) Evaluate the advantages and disadvantages of using monoclonal antibodies in medical treatments.

[illegible]

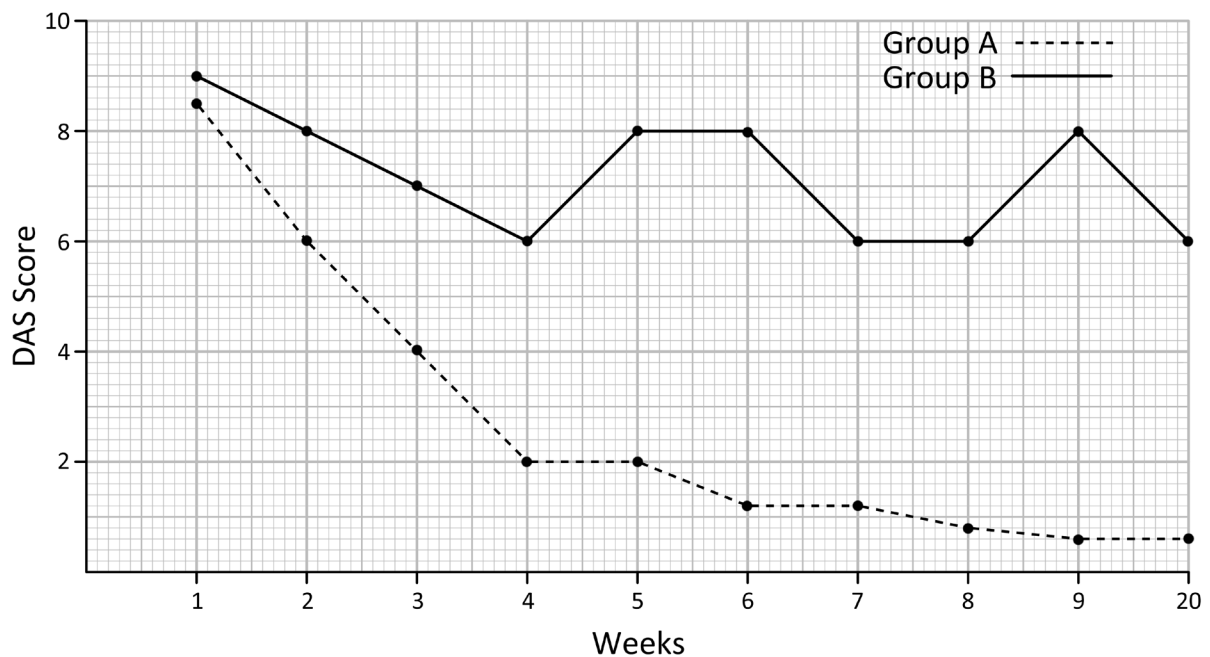
(4 marks)

(Total for Question 2 is 14 marks)

3. A group of scientists are investigating the effectiveness of a new monoclonal antibody (mAb-X) in treating rheumatoid arthritis, an autoimmune disease that causes inflammation in the joints. They conduct a clinical trial with two groups of patients:
- **Group A:** Receives mAb-X in addition to standard rheumatoid arthritis medication.
 - **Group B:** Receives a placebo (an inactive substance) in addition to standard rheumatoid arthritis medication.

The scientists measure the "Disease Activity Score" (DAS) for each patient, which indicates the severity of their arthritis. A lower DAS score indicates less disease activity and less inflammation.

The mean DAS scores for each group are recorded over a 10 week period and shown in the graph below.



- a) Describe the trend in the mean DAS score for both Group A and Group B over the 10 week period?

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(2 marks)

- b) Based on the data in the graph, what conclusions can be made about the effectiveness of mAb-X in treating rheumatoid arthritis? Explain your reasoning.

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(3 marks)

- c) Suggest **one** reason why the mean DAS score in Group B (placebo) decreased slightly over the 10 week period, even though they did not receive the monoclonal antibody treatment.

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(1 mark)

- d) Identify **one** ethical consideration that scientists should consider when conducting clinical trials of new medical treatments like mAb-X.

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(1 mark)

- e) Monoclonal antibody technology can also be used in pregnancy tests and in the treatment of cancer. Explain how monoclonal antibodies are used to test for pregnancy.

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(4 marks)

- f) The use of monoclonal antibodies to treat cancer has advantages over the use of traditional chemotherapy and radiotherapy. Explain the benefits of using monoclonal antibodies to treat cancer.

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(3 marks)

(Total for Question 3 is 14 marks)

4. A person who is living with late stage HIV infection may develop AIDS.
Scientists have successfully produced monoclonal antibodies for HIV.
The monoclonal antibodies can be used to treat early stage HIV to prevent the development of AIDS.

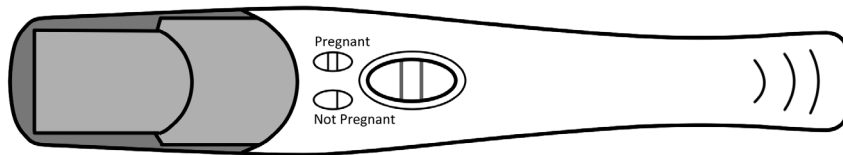
Describe how the monoclonal antibody for HIV can be produced.

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no margins, text, or other markings.

(6 marks)

(Total for Question 4 is 6 marks)

5. Pregnancy tests commonly use monoclonal antibodies.
The figure below shows a pregnancy test showing a positive result.



- a) What specific molecule in the urine does the monoclonal antibody in a pregnancy test target?

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(1 mark)

- b) Explain why it is important that the monoclonal antibody used in a pregnancy test is very specific to this molecule.

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(2 marks)

- c) Describe how a typical pregnancy test stick uses monoclonal antibodies to indicate a positive result.

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(4 marks)

- d) State **two** advantages of using monoclonal antibodies for medical treatments.

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(2 marks)

(Total for Question 5 is 9 marks)