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BIOLOGY

CELLS

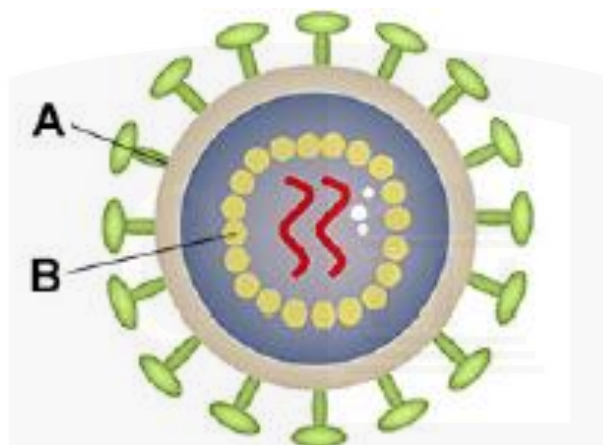
Level & Board	AQA (A-LEVEL)
TOPIC:	THE IMMUNE SYSTEM
PAPER TYPE:	QUESTION PAPER-1
TOTAL QUESTIONS	6
TOTAL MARKS	47

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The Immune System 1

1.

The human immunodeficiency virus (HIV) structure is depicted in the diagram below.



(a) Give structures A and B names. (2)

A

B

(b) Explain the HIV replication process. (4)

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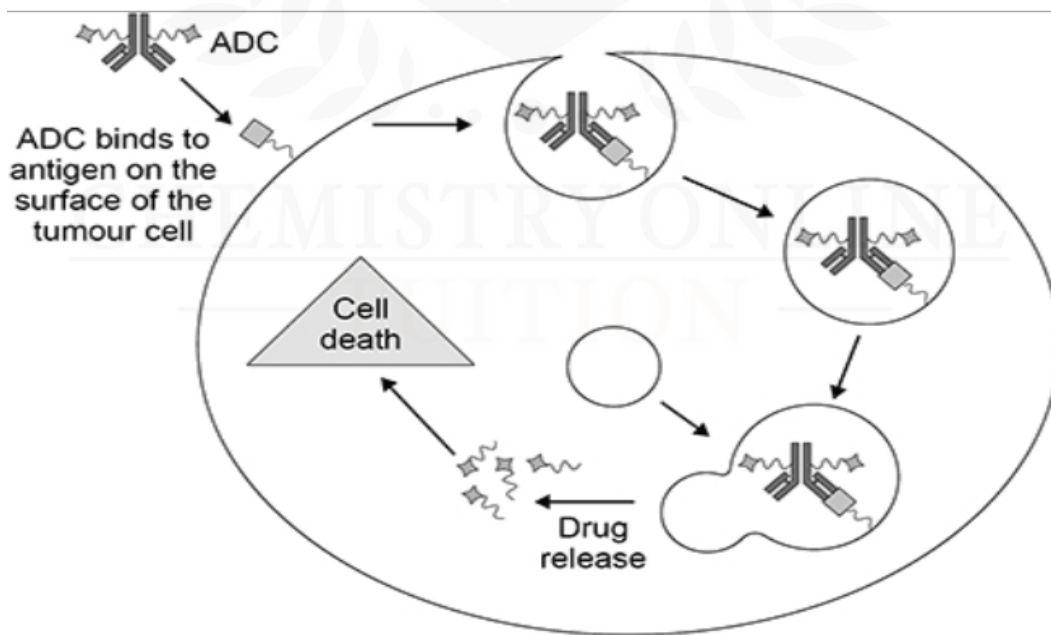
2.

(a) ADC are compounds consisting of a monoclonal antibody and a cancer medication.

How an ADC enters and destroys a tumor cell is depicted in Figure 1.

Phagocytosis and the process of entering the cell, as well as the breakdown of the antibody to release the drug, are extremely similar.

Figure 1



Give an example of how an ADC enters and destroys a tumor cell using your understanding of phagocytosis. **(3)**



(b) There are certain antigens on the surface of healthy human cells that are also present on the surface of tumor cells.

Use this knowledge to justify why side effects from ADC treatment are common. **(2)**

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Researchers looked into the possibility of treating human breast cancer with a particular kind of ADC.

This ADC combines a medication to prevent mitosis with a monoclonal antibody. A protein on human breast cancer cells is bound by the monoclonal antibody.

Mice skin was covered in tiny fragments of human breast cancer tissue by the scientists.

The mice were then split into three groups at random by the scientists. On day 0, they handled the groups as follows.

Group G – control

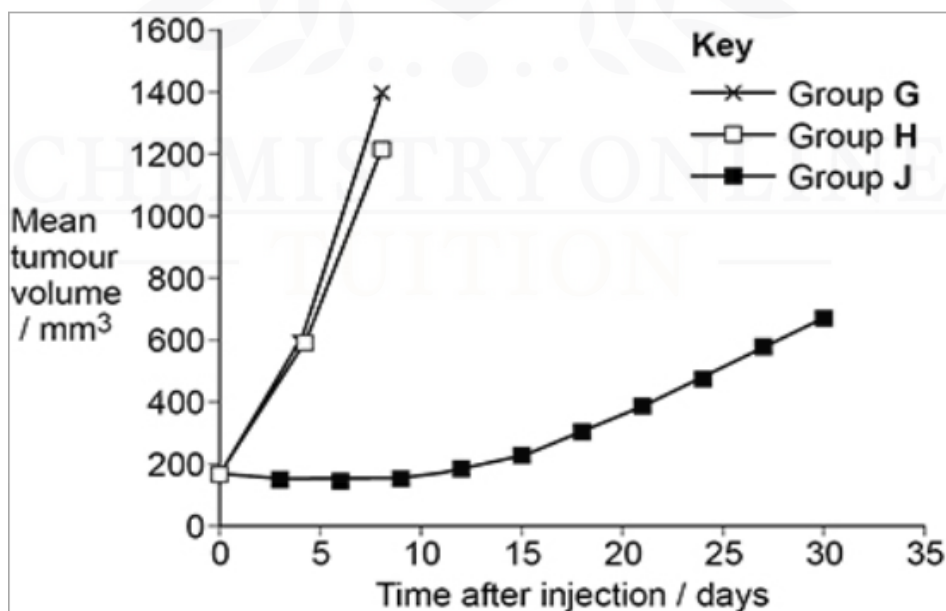
Group H – injected with monoclonal antibody only

Group J – injected with ADC (monoclonal antibody + drug).

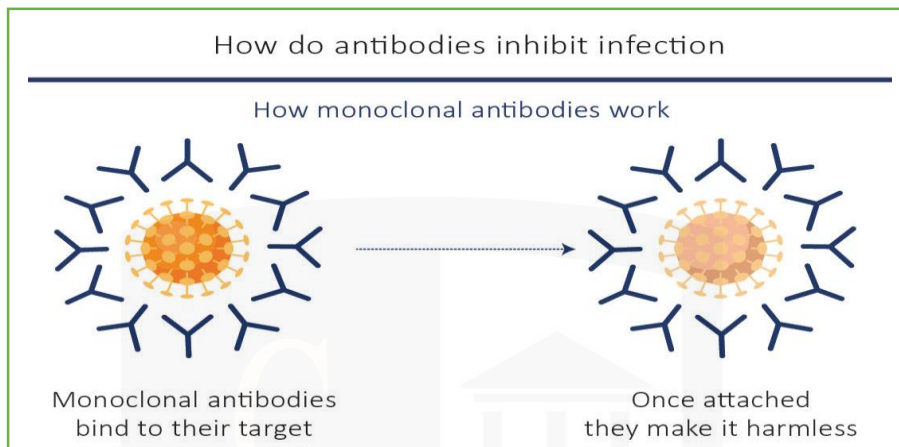
The scientists recorded the size of the tumors made from human breast cancer tissue every few days.

The scientists' findings are displayed in Figure 2.

Figure 2



(c) A monoclonal antibody injection of 2 mg kg^{-1} was given to the mice in Group H. The concentration of the monoclonal antibody was 500 mg dm^{-3} .



Determine the amount of antibody solution that a 23g mouse would have received an injection from the scientists. Provide your response in both standard form and dm^3 . **(2)**

_____ dm^3

(d) Provide a plausible explanation for the absence of data for Groups G and H by the eighth day. **(1)**

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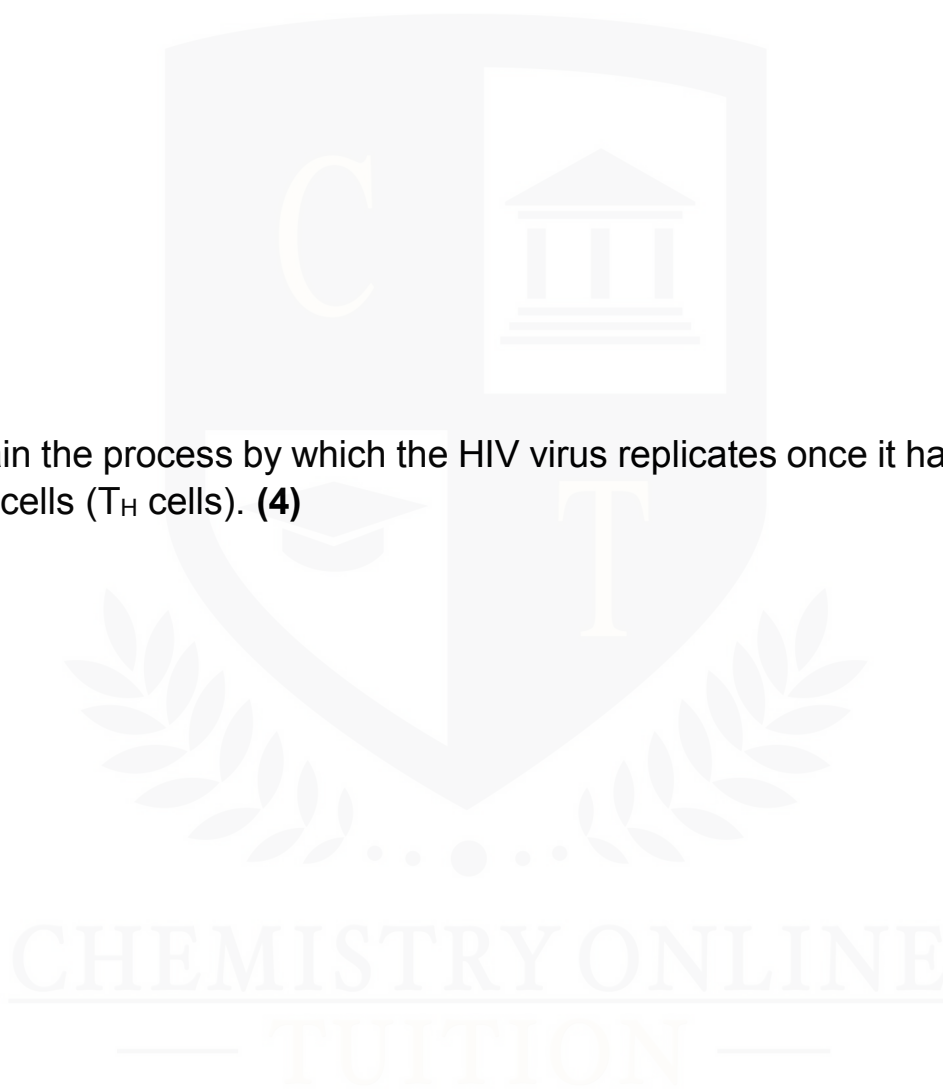
(e) Before this ADC is tested on human breast cancer patients, propose and describe two additional studies that ought to be conducted. **(2)**

1.

2.

3.

(a) Explain the process by which the HIV virus replicates once it has entered helper T cells (T_H cells). **(4)**



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The most prevalent form of HIV is HIV-1. HIV-1 attaches itself to the CCR5 receptor on TH cells.

Antiretroviral therapy (ART) is used daily as part of current HIV-1 treatment to prevent virus replication. Just 59% of people living with HIV have access to ART.

Two HIV-1-positive patients, P and Q, have entered remission, meaning their HIV-1 is no longer detectable, according to scientific findings. Following a blood stem cell transplant (BSCT), this took place.

- One BSCT was administered to patient Q, and two BSCTs were given to patient P.
- The donor of all BSCTs had T_H cells devoid of the CCR5 receptor.
- Furthermore, patient Q received chemotherapy and patient P received radiation therapy. These two medical procedures are harmful.
- 16 months following BSCT, ART was stopped for both patients (P and Q).

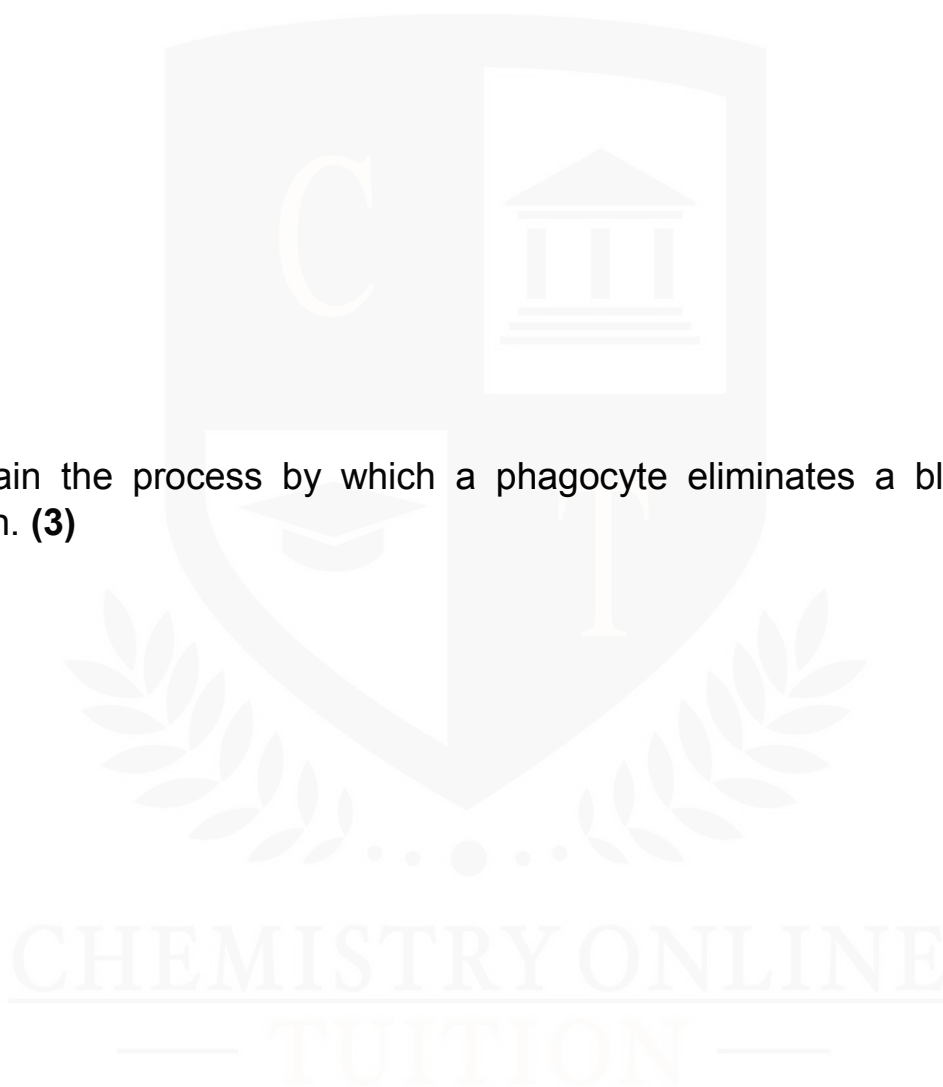
Both patients had no HIV-1 RNA in their plasma, no HIV-1 DNA in their T_H cells, and no CCR5 on their T_H cells eighteen months after stopping antiretroviral therapy.

(b) Utilize the provided data to assess BSCT efficacy in treating HIV infections. **(5)**

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4.

(a) Explain the process by which a phagocyte eliminates a bloodborne pathogen. **(3)**



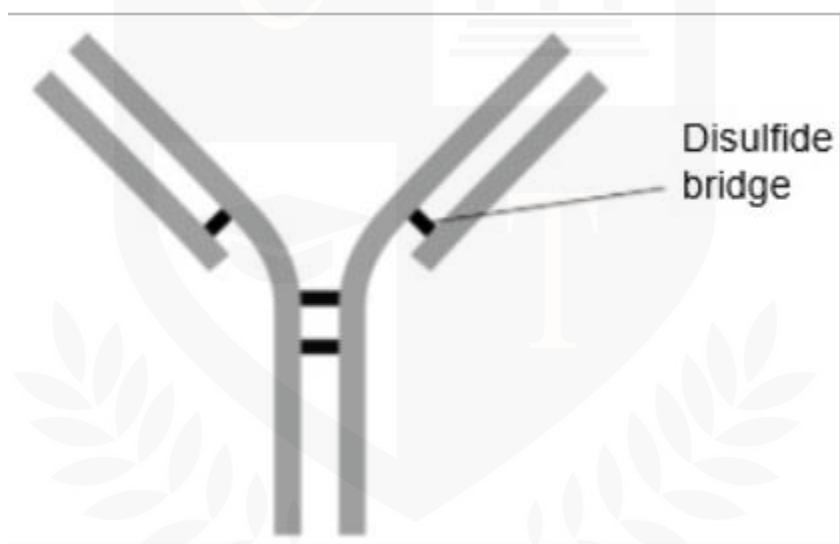
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(b) Name two cell types that, aside from pathogens, have the ability to elicit an immune response. **(2)**

1.

2.

(c) The structure of an antibody is depicted in the diagram below.



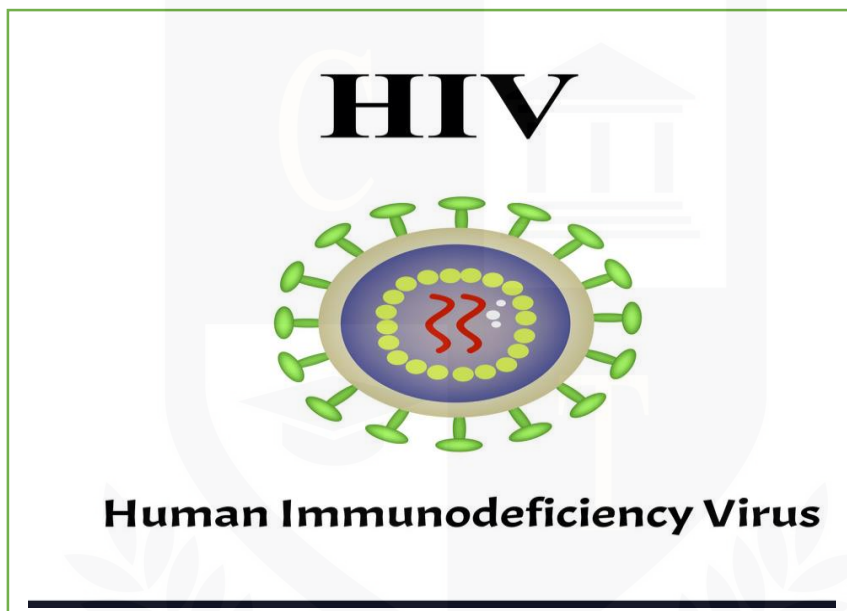
To indicate the location where an antigen-antibody complex forms, mark the diagram above with an X. **(1)**

(d) The above diagram labels a disulfide bridge.

What part does the disulfide bridge play in the formation of an antibody quaternary structure? **(1)**

5.

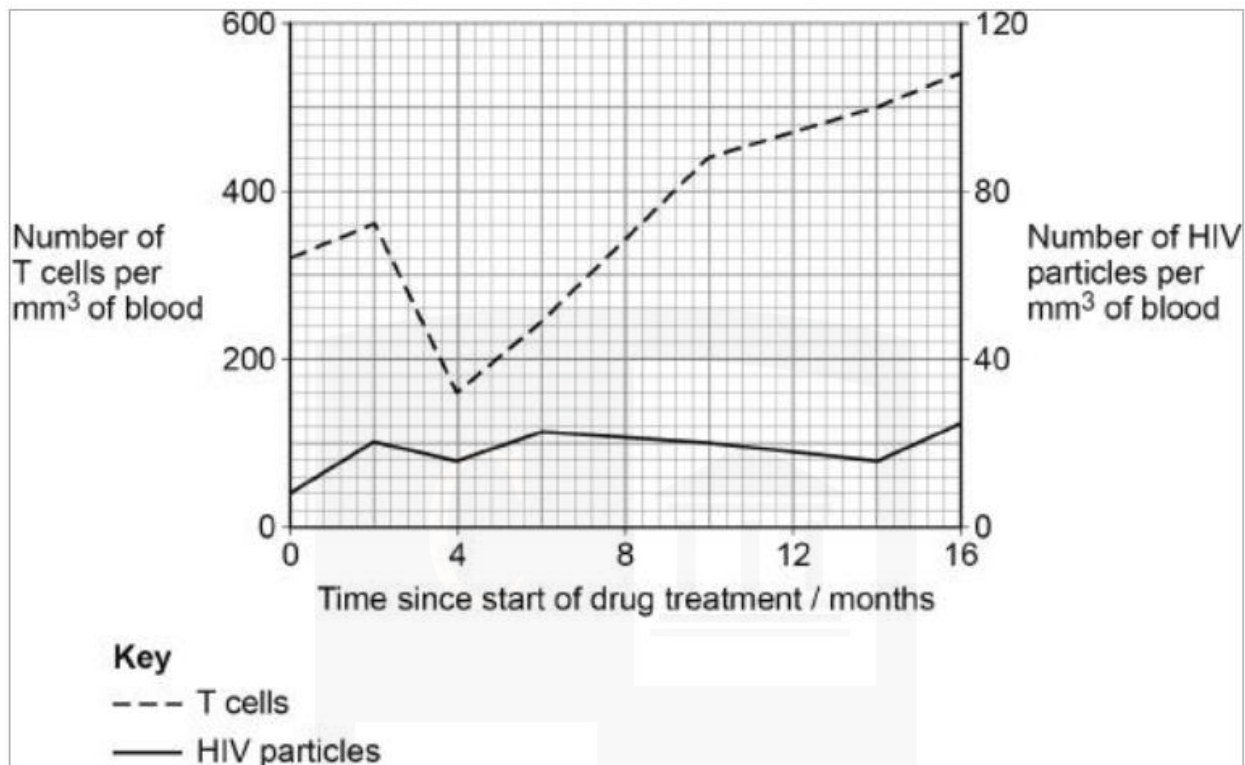
(a) Describe how HIV influences an individual's ability to produce antibodies when they develop AIDS. (3)



(b) A physician counted the T cells and HIV particles in a patient blood after determining the impact of a medication. The graph below displays the results.

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When there are fewer than 200 cells per millimeter³ of T cells, AIDS symptoms manifest.

Make use of all this information to assess the medication's efficacy in treating AIDS. (5)

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6.

Numerous species of frogs have been infected by viruses in Europe. The viruses all fall under the Ranavirus group and are closely related to one another.

The viruses used to only infect a single species of frog.

(a) Hypothesize and describe how the viruses came to be able to infect frogs of different species. **(2)**

(b) The viruses genomes may provide information that scientists can use to create a vaccine.

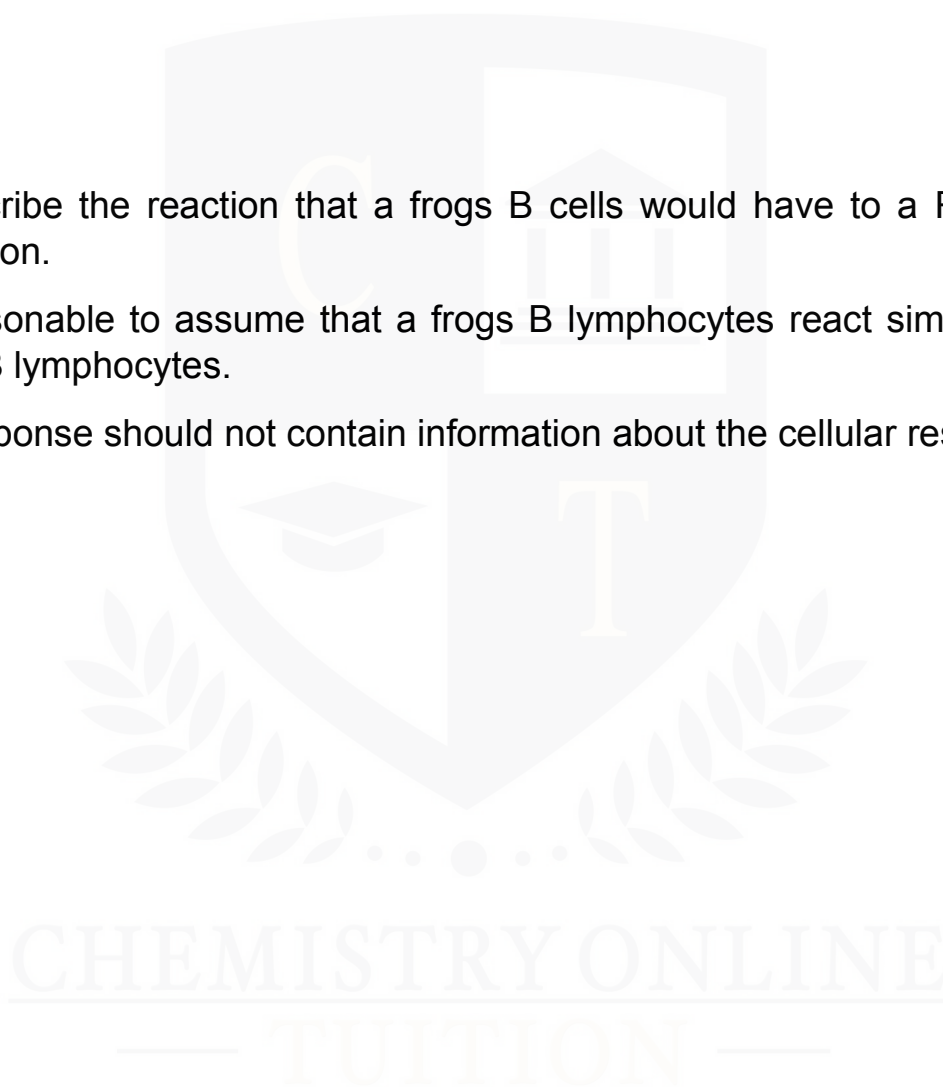
Describe how. **(2)**

(c) Describe the reaction that a frogs B cells would have to a Ranavirus vaccination.

It is reasonable to assume that a frogs B lymphocytes react similarly to a human B lymphocytes.

Your response should not contain information about the cellular response.

(3)



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- Founder & CEO of Chemistry Online Tuition Ltd.
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