

11.1 Antibody Production & Vaccination

Question Paper

Course	DP IB Biology
Section	11. Animal Physiology (HL Only)
Topic	11.1 Antibody Production & Vaccination
Difficulty	Medium

Time allowed: 60
Score: /46
Percentage: /100

Question 1a

a)
Define the term 'antigen'.

[2 marks]

Question 1b

b)
In humans the ABO system of blood typing is based on red blood cell antigens. The table below contains some information about the antigens involved in ABO blood types.

Blood group	Antigens present on the surface of red blood cells	Could receive a blood transfusion from blood group(s):
A	Type A	A or O
B	Type B	1
AB	Types A and B	2
O	None	O

Identify the groups marked **1** and **2** from which blood groups B and AB could safely receive a blood transfusion.

[2 marks]

Question 1c

c)
Explain the blood transfusion options, shown in the table in part b), available to a person with type O blood.

[2 marks]

Question 1d

d)

Antibodies are proteins that bind to specific non-self antigens. Individuals with type B blood have antibodies that will bind to type A antigens.

Suggest which type(s) of antibodies would be found in the blood of an individual with type **O** blood and in the blood of an individual with type **AB** blood.

[2 marks]

Question 2a

a)

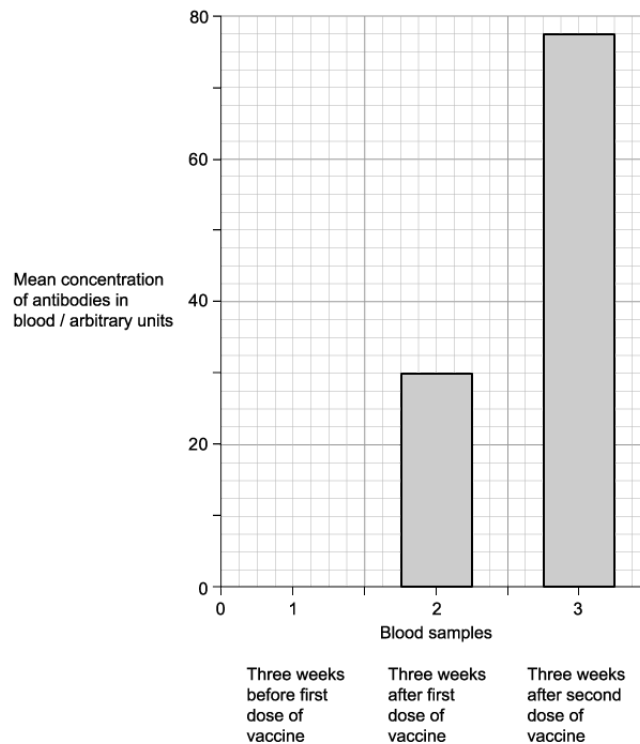
A medical researcher vaccinated a group of adult patients against human papillomavirus (HPV). He gave each patient two doses of vaccine five months apart. The researcher tested three samples of blood from each of the patients for antibodies against HPV.

Sample 1: taken 3 weeks before the first dose of vaccine

Sample 2: taken 3 weeks after the first dose of vaccine

Sample 3: taken 3 weeks after the second dose of vaccine

The results are shown in the graph below.



Calculate the percentage increase in the mean concentration of antibodies in the blood between samples 2 and 3.

[2 marks]

Question 2b

b)

In a trial for a new, improved version of the vaccine in part a), a doctor gave the new vaccine to a group of adult volunteers, following the same procedures.

Suggest **two** factors the doctor should have considered when selecting adult volunteers for this trial.

[2 marks]**Question 2c**

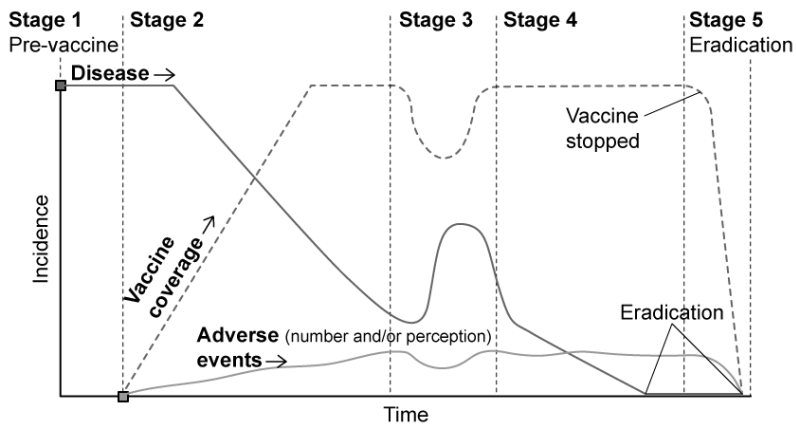
c)

Explain the differences in antibody concentration between the three blood samples in the graph in part a).

[4 marks]

Question 3a

a)
The graph below shows the events that take place during the progression of a vaccination programme.



Suggest what the 'adverse events' labelled in the graph might be.

[1 mark]

Question 3b

b)
Reaching the end of stage 5 in the graph in part a) is rare, and has so far only been accomplished for smallpox.

Outline why it has not been possible to complete stage 5 for any diseases other than smallpox.

[4 marks]

Question 3c

c)

The smallpox vaccine was developed by Edward Jenner after he inoculated 9-year-old James Phipps with cowpox virus.

Explain how James Phipps developed plasma cells in response to the cowpox inoculation.

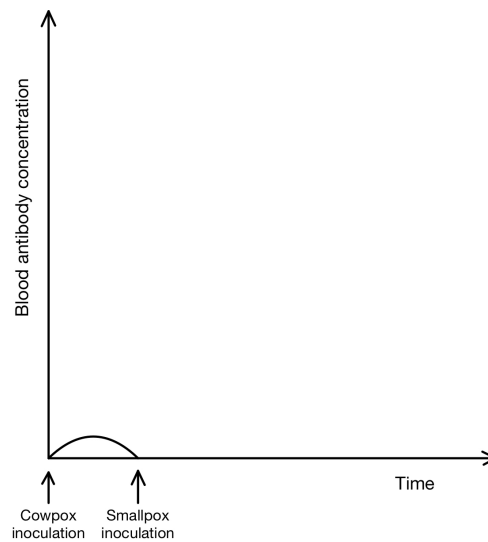
[2 marks]

Question 3d

d)

The graph below shows James Phipps' antibody production in response to inoculation with cowpox.

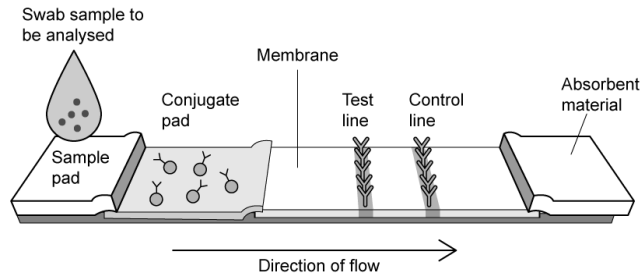
Sketch a curve on the graph to show his antibody production in response to later inoculation with smallpox.



[1 mark]

Question 4a

a)
SARS-CoV-2 is the virus that causes COVID-19. The image below shows the structure of a rapid test strip used to test for the presence of SARS-CoV-2 antigens in a person's nose and throat cells.



Describe what would happen in the region labelled 'conjugate pad' if an individual infected with SARS-CoV-2 placed a sample on the sample pad.

[2 marks]

Question 4b

b)
Explain how the sample mentioned in part a) would give a positive result on the test line.

[2 marks]

Question 4c

c)
State the function of the control line on the test shown in part a).

[1 mark]

Question 4d

d)

Several vaccines have been developed against SARS-CoV-2. One of the vaccines contains genetic material that allows an individual's cells to synthesise SARS-CoV-2 antigens.

Suggest how this vaccine initiates the specific immune response against SARS-CoV-2.

[2 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

a)

Explain the role of histamines in an allergic response.

[4 marks]

Question 5b

b)

Describe how tumour cells can be used in the production of monoclonal antibodies.

[5 marks]

Question 5c

c)

Explain how antibodies combat infection.

[6 marks]