

**QUESTIONSHEET 1**

- (a) *either*  
disease organism injected into an animal stimulates production of antibodies;  
antibodies made by the animal extracted/purified from blood plasma;  
*or*  
disease organisms injected into mouse stimulates B - lymphocyte production;  
B - lymphocytes fused with cancer cells and produce monoclonal antibodies; 2
- (b) (i) disease organisms have antigens on surface;  
antigen shape recognised by antibody and reacts with it (forming a complex); 2
- (ii) binding reaction between antibody and antigen not visible;  
enzyme gives a visible reaction/means of visualising the reaction/antibody/antigen; 2
- (c) bind the antigen/disease organism to the well;  
add the blood plasma of the infected person;  
add the enzyme combined with an anti- antibody/antibody to the specific disease antibody; 3
- TOTAL 9**
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**QUESTIONSHEET 2**

- (a) (i) antigens on the dead pathogen detected by (T/B) lymphocytes;  
specific B lymphocytes clone/divide rapidly by mitosis;  
plasma cells released to blood;  
plasma cells secrete antibody into blood;  
levels fall once all antigens are destroyed; max 4
- (ii) memory cells formed by first challenge/equivalent allow even greater/faster cloning (and so greater/more antibody release); 1
- (b) influenza virus/pathogen has high rate of mutation;  
polio/tetanus pathogens have low rate of mutation;  
mutation changes antigens/proteins on surface of pathogen;  
antibodies unable to recognise changed antigens/new antibody needed to react with changed antigen; max 2
- (c) (i) antibodies against tetanus bacteria; 1
- (ii) immediate rise due to injection;  
steady fall because liver destroys the antibodies;  
lymphocytes are not stimulated/passive immunity so no new antibodies made; 2
- TOTAL 10**

**QUESTIONSHEET 3**

<b>Feature</b>	<b>Cell or cells</b>
Phagocytose bacteria in tissues	neutrophils and monocytes/macrophages;
Secrete antiviral antibodies	plasma cells;
Release histamine and serotonin in allergies	basophils and mast cells;
Manufactured in red bone marrow	neutrophils, eosinophils, basophils and monocytes; (any three for a mark)
Initially stored in the thymus gland	T-lymphocytes;
Main cell of humoral immunity	B-lymphocytes/plasma cells;
Combats effects of histamine in allergic responses	eosinophils;
Acts as a phagocyte after transformation into a tissue macrophage	monocyte;
Phagocytoses the debris of antibody-antigen reactions	eosinophils;
Differentiates into plasma cells	B-lymphocytes;
Differentiates into cytotoxic killer cells	T-lymphocytes;
Enables rapid immune response to a second infection	memory cells;
Manufactured in lymphatic tissue	B-lymphocytes, T-lymphocytes, plasma cells, memory cells, monocytes; (any three for a mark)

**TOTAL 13**

**QUESTIONSHEET 4**

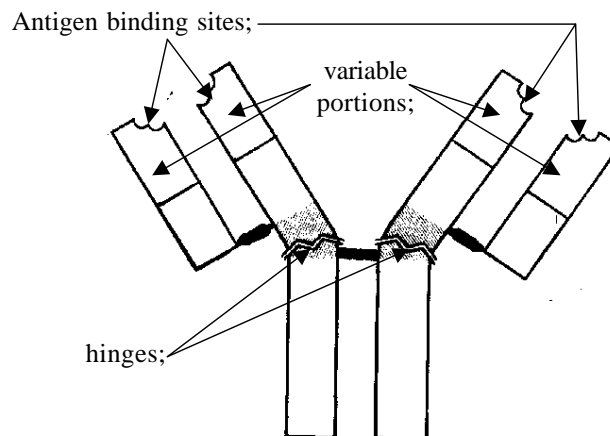
- (a) (i) an antigen;  
on the surface of a red blood cell; 2
- (ii) an antibody;  
dissolved in blood plasma; 2
- (iii) when agglutinin a comes into contact with agglutinin A/when agglutinin b comes into contact with agglutinin B;  
due to incompatible blood transfusion;

red cells are clumped together by agglutinins reacting with agglutinogens;  
ref one molecule of agglutinin combines with five molecules of agglutinin/agglutinin has a valency of five,  
which makes clumping very effective;  
clumped cells can block small blood vessels causing glomerular/kidney/heart/brain damage/other correct example/  
may result in death; **max 4**

- (b) (i) group B into group A;  
group A into group B;  
group AB into group A;  
group AB into group B; 4
- (ii) agglutinins a and b will not clump the red cells in A, B or AB blood;  
because they are greatly diluted by the greater blood volume of the recipient;  
would only become a problem if large volumes were transfused; **max 2**

**TOTAL 14****QUESTIONSHEET 5**

(a) (i)



- (ii) antigenic groups may vary slightly in their distances apart (on the bacterium/virus/red cell/other example);  
hinges allow antibody structure to adjust for this/antibody can still attach to antigenic sites; 3
- (iii) better 'clumping'/agglutination ability/can clump together up to five antigenic structures/virions/bacteria/red cells/  
other correct example; 2
- (b) (i) plasma cells; 1
- (ii)  $2000 \times 60 \times 60 \times 24$ ; = 172,800,000 (antibody molecules day<sup>-1</sup>); (units are in the question so not essential to answer) 2

**TOTAL 9**

**QUESTIONSHEET 6**

- (a) (i) macrophages congregate in regions of infection in the tissues/ref chemotactic attraction;  
engulf bacteria and digest them/ref to lysozyme activity;  
carry antigens into lymph nodes/spleen/nearest lymphatic tissue;  
present antigens to T-cells/bind to T-cells with HLA receptors and present antigen to T-cell;  
thus enable T-cells in lymphatic tissue to become activated by antigens (from elsewhere in the body); **max 4**
- (ii) means that thousands/millions of cells are available to destroy/disable the antigen;  
since they are genetically identical they will all recognise/react against the (specific) antigen; **2**
- (b) (i) leave lymph nodes/spleen/lymphatic tissue/lymph flow/blood stream and move to site of infection;  
ref amoeboid action/chemotaxis;  
congregate/collect around bacteria and secrete cytotoxic chemicals over them;  
ref to specific cytotoxins/lymphotoxin/perforin;  
also secrete chemicals/lymphokines that stimulate development of more killer T-cells/attract macrophages to the infection; **max 3**
- (ii) retain the memory of the antigen allowing a rapid response if a second infection occurs/  
gives long term immunity against the antigen; **1**
- (iii) produce an interleukin/lymphokine that induces production of more killer T-cells/aid B-cells/  
plasma cells to develop/produce more antibodies; **1**

**TOTAL 11****QUESTIONSHEET 7**

Feature	T-cells	B-cells
May produce antibodies	✗	✓ ;
Are classed as small lymphocytes	✓	✓ ;
Develop in the thymus	✓	✗ ;
May secrete interferon	✓	✗ ;
Give passive immunity to the organism which possesses them	✗	✗ ;
Give active immunity to the organisms which possesses them	✓	✓ ;

**TOTAL 6**

**QUESTIONSHEET 8**

- (a) diphtheria bacilli are stable and do not mutate/rarely mutate into new (antigenic) forms;  
 influenza viruses constantly mutate to produce new (antigenic) forms;  
 new strains of virus appear every few months;  
 thus memory cells for diphtheria antigens are effective throughout life but memory cells against influenza may not recognise the new strains; **max 3**
- (b) smallpox virus showed little variation (antigenically) across the world/basicallly all the same strain/vaccines were available against all strains;  
 smallpox victims could be easily isolated thus preventing cross infections (of people not yet immunised when cases did occur);  
 difficult to prevent cross infection with cholera/tuberculosis which is in contaminated water/food supplies/malaria with a mosquito vector;  
 these organisms have a higher mutation rate which changes their (antigenic) structure more frequently than smallpox; **max 3**
- (c) colostrum/breast milk contains many antibodies produced in the mother;  
 these can be absorbed by the baby via the stomach (from the milk);  
 they can persist in the baby's body for several weeks;  
 giving short term immunity/passive immunity against many diseases/prevalent diseases; **max 3**
- (d) antibodies/killer T-cells are produced against the Streptococci;  
 some cell surfaces of the infected person may antigenically resemble the Streptococci;  
 for example,  $\beta$ -cells of the islets of Langerhans/thyroid cells/glomeruli;  
 thus body's own antibodies/killer T-cells may destroy these body tissues; **max 3**

**TOTAL 12****QUESTIONSHEET 9**

- (a) (i) antigen in lymph/blood/plasma;  
 attaches to antibody on B-cell in lymph node/spleen;  
 B-cell processes/modifies antigen and presents it on the cell membrane;  
 presented antigen and self HLA antigen can then be recognised by receptors on helper T-cell;  
 this produces substances which stimulate mitosis and differentiation of B-cells/activates B-cells; **max 4**
- (ii) many cells produced so that immune response is bigger/sufficient to counter large quantities of antigen;  
 all cells genetically identical so that they respond to the same antigen/immune response is focussed on same antigen; **2**
- (iii) secrete specific antibody against antigen;  
 antibody molecules are released from lymph node/spleen into lymph/blood;  
 each cell can release up to 2000 antibody molecules per second for about five days/huge quantities of antibodies are released; **max 2**
- (iv) retain memory of specific antigen so that a quicker/ more forceful response can occur to a second infection by the same antigen; **1**
- (b) the primary response involves the activation/multiplication of lymphocytes and elimination of the antigens;  
 takes 7 – 10 days to develop/ levels of antigen rise slowly/ lasts about two weeks;  
 the secondary response involves activation of (long lived) memory cells;  
 takes 2-3 days to develop/levels of antigen rise much higher/can last for months; **max 3**

**TOTAL 12**

**QUESTIONSHEET 10**

- (a) chicken pox infection in babies/children is not serious/usually mild/relatively short lasting/very frequent;  
and gives excellent life long immunity;  
measles/polio are killer diseases/cause serious long term damage;  
thus must give vaccination against these to prevent infection/reduce impact of infection; **max 3**
- (b) infection from tetanus bacteria/spores can set up a rapid infection;  
which could be fatal;  
secondary immune response to tetanus takes time/several days to become effective;  
especially if booster immunisations have been missed;  
thus the antibody is injected to give immediate passive immunity/immediate protection; **max 3**
- (c) non-infectious allergens such as inhaled pollen;  
can provoke the acute inflammatory reaction;  
in which basophils/mast cells release histamine to make blood vessels more leaky/more dilated leading to nasal congestion;  
antihistamines will neutralise the histamine thus reducing the unpleasant effects/symptoms; **max 3**
- (d) epitomes/chemical nature of antigens are similar for cowpox and smallpox;  
thus antibodies against cowpox will be effective against smallpox;  
epitomes/chemical nature of antigens are different for chickenpox and smallpox;  
thus previous infection by chickenpox/chickenpox antibodies will not protect against smallpox infection; **max 3**

**TOTAL 12****QUESTIONSHEET 11**

- (a) ready made antibodies are transferred to the individual;  
across the placenta from mother to foetus/baby in womb;  
in milk from mother to baby during breast feeding;  
ref to tetanus/rabies antibody given after possible infection/anti snake venom antibodies;  
gives short term immune protection only/lasts only a few weeks;  
but can give protection until acquired immunity develops; **max 4**
- (b) (i) naturally acquired immunity is accidentally obtained due to exposure to a particular antigen (during the normal course of life);  
artificially acquired immunity is the result of an intentional exposure to an antigen through immunisation; **2**
- (ii) viruses: polio; measles; rubella/German measles; **max 2**  
bacteria: diphtheria, whooping cough, tetanus; tuberculosis; **max 2**  
(accept other examples if correct)

(c)

protection by vaccination	no protection by vaccination
whooping cough	lung cancer ;
German measles	diabetes mellitus ;
measles	schizophrenia ;
diphtheria	asthma ;
tuberculosis	cystic fibrosis ;
tetanus	HIV ;
polio	AIDS ;

(diseases can be in any order, but delete a mark for each error or omission)

**7****TOTAL 17**

**QUESTIONSHEET 12**

- (a) (i) no response visible from first injection for 10 days, response to second injection visible at 3 - 4 days;  
much higher levels of antibody appeared (in the plasma/blood) after the second injection;  
antibody titre/level falls fairly sharply after 20 days from the first injection, persists/does not fall much after second injection; **3**
- (ii) memory cells can be immediately activated after second injection allowing a rapid response;  
after first injection B-cells must receive and modify the antigen and interact with helper T-cells before activation  
(and this takes time);  
after first injection a few activated B-cells must undergo many mitoses to produce a clone of several million (antibody producing)  
plasma cells;  
several million memory cells probably exist and only need a few mitoses to produce the needed number of plasma cells;  
thus more plasma cells means more antibody molecules produced more quickly (after second injection);  
larger number of antibody molecules means that they will persist longer/take longer to be recycled by liver; **max 4**
- (a) body cells have many surface antigens which differ from person to person;  
these can provoke an immune response when foreign tissue is transplanted into another person;  
resulting in T-cell immunity/cellular immunity/production of killer T-cells;  
which will destroy/damage the transplanted tissue;  
tissues to be transplanted must have antigens which closely match those of the recipient; **max 3**

**TOTAL 10**