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

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

Feature	Cell or cells
Phagocytose bacteria in tissues	neutrophils and monocytes/macrophages;
Secrete antiviral antibodies	plasma cells;
Release histamine and serotoninin 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 agglutinogen A/when agglutinin b comes into contact with agglutinogen 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 agglutinogen/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**

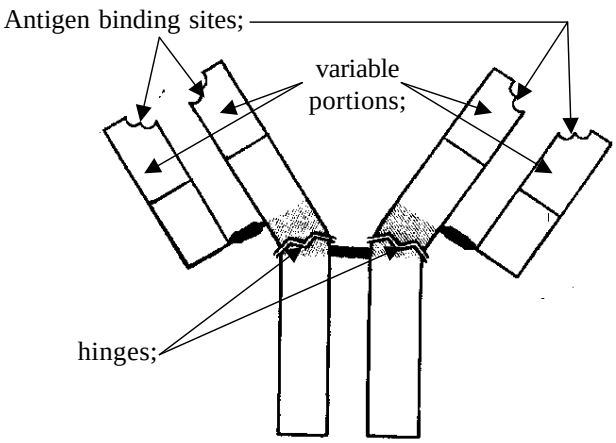
(b) (i) group B into group A;
group A into group B;
group AB into group A;
group AB into group B;
4

(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)



3

(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; **2**

(iii) better 'clumping'/agglutination ability/can clump together up to five antigenic structures/virions/bacteria/red cells/
other correct example; **1**

(b) (i) plasma cells; **1**

(ii) 2000 x 60 x 60 x 24 ; = 172,800,000 (antibody molecules day^{-1}) ; (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 chemotaxic 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/basically 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, β-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 <u>accidentally</u> obtained due to exposure to a particular antigen (during the normal course of life);
artificially acquired immunity is the result of an <u>intentional</u> 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 German measles measles diphtheria tuberculosis tetanus polio	lung cancer ; diabetes mellitus ; schizophrenia ; asthma ; cystic fibrosis ; HIV ; 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