11. Immunity

11.1 The Immune System

Paper 2

Marking Scheme

Q1.

(b)(i)	*allow, M. tuberculosis / pathogens / bacteria, for bacterial cells* endocytosis occurs / described ; e.g. (macrophage cell surface) membrane, surrounds / AW, bacterial cells pseudopodia, surrounds / form round / AW, bacterial cell (alveolar) macrophage / phagocyte / (phagocytic) cell, envelops / engulfs, bacterial cells ; event occurring before or after ; *e.g. before* *ref. to* chemotaxis / chemotactic response bacterial cells / bacteria / (bacterial) antigens, bind / attach / join / AW, to (macrophage cell surface), receptors / membrane **I** binding to, macrophage / cell *suggestion of* (in alveolar space) opsonisation of /antibody binding to, bacterial cells *e.g. after* membrane fusion / (phagocytic), vacuole pinches off / AW **A** vesicle for vacuole	**2**
(b)(ii)	lysosomes / lysosome ; **A** lysosomal vesicles	**1**

Q2.

(e)	macrophage/s ; **I** mature monocytes / granulocyte / phagocyte	**1**

(f)	antibody / immunoglobulin ;	**1**
(g)	*mp2 and 3 need to see knowledge that self-antigens are on, self- / body / own, cells* *any **three** from:* **1** *idea that,* next stage / after thymus, is (T-lymphocyte) release into general circulation / blood ; **2** (if released) exposure to / activation by, (self-antigens on body) cells **or** (on exposure to self-antigens), immune response occurs against (body) cells ; **ora** only (T)lymphocytes that will respond only to, pathogens / foreign substances, are, left / released **3** (if released) harm to / destruction of / kills, (body) cells ; **4** need to prevent / otherwise, formation of memory T-cells ; **5** AVP ; e.g. need to prevent / (if released) may cause, autoimmune, disease / response (otherwise) T-helper will release cytokines to, enhance / AW, immune response against (body) cells (if cytokine released) may lead to, phagocytosis of / antibodies produced against, (body) cells (otherwise) T-killer cell will release substance to kill cells *also mp3* (faulty T-lymphocytes) cannot bind to, foreign / non-self, antigens	**3**

Q3.

(c)	*any **three** from:* provides (long-term) immunity ; *context of pathogen entering the body* *ref to* secondary / fast / strong, immune response ; because of presence of increased numbers of specific T-lymphocytes ; memory T-lymphocytes, recognise / bind to / activated by, the foreign antigen ; T- helper cells secrete. cytokine / interleukins ; **I** cell-signalling molecules example of consequence of increased cytokine release ; e.g. increased phagocytosis / angry macrophages increased, B-lymphocyte / humoral, response enhance T-killer cell response	**3**

Q4.

(a)	*any **three** from:* stimulates an immune response ; (usually) protein / glycoprotein / polysaccharides ; **A** polypeptides **I** glycolipids recognised by / activates / stimulates, **and** named immune system cell ; e.g. phagocyte / macrophage / neutrophil (B- / T-) lymphocyte **I** plasma cell **A** *idea of* leads to production of antigen-presenting cell *allow correct example of response by named cell* cause production of (specific) antibodies / bind to (specific) antibodies ; **A** plasma cells releasing (specific) antibody **A** complementary shape to (antigen binding site on) antibody **A** complementary to receptors on lymphocytes example of location of non-self antigen ; **I** whole cells as non-self antigens e.g. surface of / AW, pathogens / infected cells / tumour cells / non-body cells / foreign cells bacterial, cell wall / flagella viral, capsid / protein coat / envelope AVP ; e.g. high molecular weight can be a toxin produced by a pathogen	**3**

(b)	one mark each correct column = 4 marks if 0 or 1 mark gained, check for correct row to max 2 *In the whole table:* • *if only ticks are used, assume blanks are crosses* • *if only crosses are used, assume blanks are ticks* *If there are ticks and crosses and blanks in the whole table,* **R** the columns or rows with the blank(s)	**4**

description of cell	cell of the immune system			
	B-lymphocyte	plasma cell	T-helper cell	T-killer cell
able to go through a number of cell cycles (clonal expansion)	✓	x	✓	✓
main role is to secrete cytokine during an immune response	x	x	✓	x
present during a **primary** immune response to a virus	✓ ;	✓ ;	✓ ;	✓ ;

Q5.

(c)(i)	(foreign) protein / glycoprotein, that stimulates, an immune response / production of antibodies / activation of lymphocytes ; **A** polysaccharide / molecule / foreign substance / foreign antigen	**1**

(c)(ii)	*any **four** from:* *accept T-cells for T-lymphocytes* **1** (group / clone of) T-lymphocytes have receptors complementary to an antigen ; **A** specific T-lymphocytes have receptors to an antigen **2** (specific) T-lymphocytes, bind / AW, to antigen (on surface of antigen-presenting cell / macrophage) ; **3** (selected) T-lymphocytes, divide many times (by mitosis) / undergo clonal expansion ; **4** T-helper cells secrete, cytokines / interleukins / interferon ; **5** detail of effect of cytokine ; e.g. activation of B-lymphocytes / increased phagocytosis by macrophages / 'angry' macrophages **6** T-killer cells, bind / attach, to infected cells and destroy them ; **7** detail of action of T-killer cells ; e.g. *ref. to*, perforin / granzyme / hydrogen peroxide / toxins **8** production of memory cells (in context of T-lymphocytes / T-helper cells / T-killer cells) ;	**4**

Q6.

(b)(ii)	*max 3 if described as phagocytosis of a pathogen rather than a red blood cell* *allow rbc for red blood cell* *any **four** from:* 1 endocytosis / phagocytosis ; 2 described ; e.g. red blood cell, engulfed / enveloped pseudopodia surround red blood cell *max three from* 3 forms (phagocytic) vacuole / (phagocytic) vesicle / phagosome ; 4 lysosome fuses (with phagosome) ; AW merges / joins to / combines with **I** attaches / binds to 5 (lysosome contains) hydrolytic / digestive, enzymes ; **A** hydrolases / named examples 6 digestion to produce haem and globin ; **A** amino acids for globin 7 AVP ; e.g. suggestion of, detection / recognition, of red blood cell	**4**

Q7.

(b)	*any **four** from:* tuberculosis / TB, is an opportunistic, disease / infection ; weakened immune system ; (fewer T-helper cells so a) less effective primary immune response ; (fewer helper T-cells so) less cytokine secreted ; less, phagocytosis of the pathogens / AW ; **A** *ref. to* angry macrophages fewer B-lymphocytes, stimulated / AW, to divide by mitosis and form plasma cells ; fewer antibodies secreted so fewer pathogens destroyed ; *ref. to* latent TB becoming activated ; AVP ; e.g. 'weak' / no, response to (BCG) vaccine so, fewer / no, memory cells TB is caused by, a bacterial pathogen / *Mycobacterium tuberculosis* / *Mycobacterium bovis*	**4**

Q8.

(g)	*allow virus or pathogen for HCMV* *look for ora in context of healthy immune system* *any **four** from:* **1** ref. to time delay in immune response (compared to normal) ; e.g. takes a longer time for, immune system to respond slower (secondary) immune response immune response similar to primary response **2** more time / easier / AW, for HMCV to infect cells / replicate / spread (so cause damage) ; AW **R** ref. to HCMV as, cells that reproduce / viruses that carry out mitosis *impact following primary response and after viral activation* **3** few(er), immune system cells / named, (in circulation) ; **I** fewer white blood cells e.g. fewer, macrophages / neutrophils **A** phagocytes fewer (B- and T-) memory cells **A** no memory cells *(no longer present from primary response)* fewer, (B/T,-) lymphocytes / T-helper cells / T-killer (or cytotoxic) cells *context for lymphocytes could be reduced number circulating at time of viral activation or owing to poor secondary response(compared to normal)* fewer / no, plasma cells **4,5** consequence of fewer immune system cells ;; *two marks* e.g. less chance of / AW, encounter with / recognition of / activation by, (non-self / foreign) antigen / HMCV / virus / pathogen / infected cell (fewer memory cells) ref. reduced clonal expansion / AW (so fewer lymphocytes / plasma cells)	**4**

(g)	(fewer plasma cells) lower concentration of antibodies **A** no antibodies (as no plasma cells) **A** longer time for antibody, production / concentration to build up (fewer T-helper cells) less cytokine released **A** effect of cytokine *if spelling of cytokine* rejected (fewer T-killer cells) fewer infected cells killed / **A** perforin / granzymes / hydrogen peroxide, not released (fewer phagocytes) less phagocytosis for antigen presentation	

Q9.

(a)	*any two from* 1 (MG is an) autoimmune, disease / disorder / condition ; **A** autoimmunity **R** autoimmune system 2 (disease in which) failure to distinguish / AW, between self and, non-self ; **A** between self and, non-self / foreign, antigens 3 (so, at neuromuscular junctions) ref. immune response occurs against / antibody produced against, self-antigens / receptors qualified (see list); **A** antibodies, bind to / block / attack / AW examples of receptors cell surface muscle cell ACh / neurotransmitter neuromuscular junction postsynaptic 4 *idea that* defective lymphocytes not destroyed (during development) ;	**2**

Q10.

(e)	*any **two** from:* (high count owing to), cancerous / uncontrolled mitosis of, white blood cells ; **A** malignant cells **A** uncontrolled division white blood cells (in child with leukaemia) cannot, function (in immunity) / protect / example of function ; **A** undifferentiated / unspecialised (so) weakened immune system (and more likely of developing measles) ; AW vaccination is, less effective / not effective / gives weak immune response ; secondary immune response, does not occur / too slow (after vaccination) ; AVP ; has memory cells but clonal expansion, does not occur / is faulty	**2**

Q11.

(c)(i)	*any **two** from:* break down / digest / hydrolyse / AW, pathogen / foreign material / AW ; *ref. to* containing hydrolytic / digestive / named, enzymes ; **A** hydrolases fuse with the, phagosome / phagocytic vacuole / AW ;	**2**

Q12.

(b)	*max 4 if no ref. to, (mature) B-lymphocytes / plasma cells, producing / secreting, antibodies* *any five from:* *ref. to* fusion of lysosomes releasing hydrolytic enzymes ; intracellular digestion / described ; e.g. hydrolysis of, (named) cell wall components / proteins / nucleic acids / lipids *ref. to* processing antigens to present on, cell surface membrane / cell surface ; **A** macrophage becomes an, antigen presenting cell / APC ; antigen, recognition / binding, by, B-lymphocytes / T-lymphocytes ; detail ; e.g. clonal selection / have receptors complementary to antigen / specificity of, B-lymphocytes /T- lymphocytes to (non-self) antigen ; **A** immunoglobulin / antibody as receptor for B-lymphocytes clonal, expansion / proliferation ; **A** described e.g. divides by mitosis to form a clone of cells B-lymphocytes, mature to / form, plasma cells that secrete antibodies ; T-helper cells release cytokines ; Cytokine action ; e.g. stimulates, humoral / B-lymphocyte, response	**5**

(c)	*any three from:* long-term immunity ; B and T memory cells remain in the body for, a long time / a lifetime ; memory cells for secondary (immune) response ; secondary response is faster / more effective (than primary immune response) ; (so) higher concentration antibodies / quicker production antibodies ; *Idea of* more (specific) memory cells in the body than (specific) lymphocytes before primary response ; increase chance that pathogen encountered more rapidly (to mount a response) ; AVP ; e.g. pathogen destroyed before symptoms of illness are caused	**3**

Q13.

(b)(i)	*any **three** from:* vaccination stimulates an immune response ; antigen presentation, qualified ; e.g. TSA engulfed by, phagocyte / named phagocyte antigen binds to, specific / complementary, receptor, on, T-lymphocyte / cytotoxic T cell / killer T cell ; clonal expansion ; **A** described e.g. divides by mitosis to form a clone (receptor on) cytotoxic T cell / killer T cell, binds to TSA on tumour cell ; release of, perforin / hydrogen peroxide (to kill tumour cell) ; **A** other named e.g. granzymes AVP ; e.g. causes lysis of the cell	**3**

Q14.

(c)	*any **three** from:* *large numbers of B-lymphocytes / plasma cells (in primary immune response)* **1** large quantity of (specific) antibody, produced / released **or** (large quantity of) antibody to form antibody-antigen complexes / to bind antigen (for phagocytosis) / AW ; *large numbers of memory B-lymphocytes so* **2** provide long term immunity / memory cells long-lived / provides immunological memory ; **A** remain in, circulation (for a long time) AW **3** able to produce fast(er), secondary (immune) response ; **A** second response will be fast(er) **A** immune response faster on second encounter (with antigen / pathogen) / AW **4** higher concentration / faster production, of antibodies (than primary response) ; **I** 'more' alone **5** person does not have, symptoms / become ill (of / from, same disease) ; **A** presence of same, pathogen / antigen, does not cause disease **6** AVP ; memory cells can (divide to) produce plasma cells more plasma cells present than primary response able to form more memory cells	**3**

(d)	*any **two** from:* immune response / antibodies produced, against, self antigens ; **I** immune system attacks self **A** autoimmunity / autoimmune disease *idea that* faulty B-lymphocytes not destroyed ; **A** *ref. to* T-lymphocytes *if in correct context* (specific) antibody, binds to / acts on / AW, self-antigen / receptor, on the (cell surface membranes of) muscle cells / at neuromuscular junction ; **A** antibody binds to acetylcholine receptors *ref. to* consequence to muscle cells ; e.g.(nerve) impulse conduction impaired action of transmitter substance hindered	**2**

Q15.

(a)	*two from* *ref.to* non-self / foreign (antigen) ; ***one** from* activation / AW, of lymphocytes ; *ref. to* specificity ; *ref. to* immunological memory ;	**2**
(b)(i)	*three from* (B-) lymphocytes respond / immune response, to self antigens (on muscle cell surface) / antibody produced by, B-lymphocytes / plasma cells ; **A** failure to distinguish between self and non-self antibody binds to receptor ; antibody has complementary shape to receptor ; **A** idea of specificity cell signalling molecule / neurotransmitter / AW, unable to bind to receptor ; reactions / AW, within cells, not triggered / described ;	**3**

Q16.

(c)(ii)	*three from:* 1 specificity / specific (in correct context) ; 2 (B / T, -) lymphocytes have receptors complementary to antigen ; **A** immunoglobulins / antibody *as receptors for B-lymphocyte* **A** surface molecules *as receptors for T-lymphocytes* 3 (different) antigens, stimulate / activate / AW, (different) B-lymphocytes / T-lymphocytes ; **A** antigens stimulate an immune response 4 *idea that* different antibodies, synthesised / produced / AW, for different (O) antigens / O polysaccharides / lipopolysaccharides ; 5 memory cells will, not respond to different antigen / only respond to same antigen / AW ; 6 different O-antigens can, be composed of different sugars ; **A** can have different shapes	**3**

Q17.

(b)(i)	*three from:* 1 failure to distinguish between self and non-self / AW ; 2 specific B-,lymphocytes / cells, are not destroyed (during development) ; 3 antibodies are produced against, cell surface / ACh, receptors on, muscle cell / neurones / nerve cells ; 4 antibodies, bind to / block, receptors ; **A** antibody–antigen, binding / complex *if receptors already given* 5 AVP ; any detail related to the disease e.g. (chemical) transmitter molecules / acetylcholine, cannot bind (to receptor) impulses are not transmitted across synapse / neurones cannot send impulses ref. to causing, muscle weakness / muscle fatigue ref. to neuromuscular junction does not function	**3**