

Q1.

3 (a) Correct letter order on Question Paper:

A - nucleus;
C - mitochondria; B - RER;
D - Golgi apparatus;
E - cell surface membrane;

max 4

R. process statements instead of letters

(b) secrete/release/produce/make antibodies;

1

A. immunoglobulins

R. memory cells unless linked to antibody production

(c) nucleus/nuclear envelope/nuclear membranes/nucleolus;
no cell wall;

have organelles/named visible organelles; (golgi/mitochondrion/
RER) R. more organelles

larger (cell);

fixed ribosomes/ribosomes attached to E.R./no free
ribosomes;

max 2

[Total 7]

Q2.

- 6 (a)** mitosis / mitotic division; **R** cell division / cytokinesis **1**
- (b)** clone; **1**
- (c)** T cell receptor is correct / exact / perfect match / fit / complementary to antigen; **R** corresponds / identical / same ref to different / wrong shapes of receptors on J and / or L; ref to specificity; **2 max**
- (d)** *N.B. Mark first role given either*
- helper cells*
 secrete / release / produce, cytokines / lymphokines / hormones;
 to stimulate B cells to, divide / develop into plasma cells;
 (which) produce antibodies;
 (and) stimulate macrophages to carry out phagocytosis / (idea of);
- or*
- cytotoxic / killer T cells*
 seek out / find / bind to (foreign) antigens on host cells / pathogens;
 destroy, host cells / intracellular parasites / virally infected cells / viruses;
 attach to surface of cells / 'punch holes' into cells;
 release toxic substances / interferons / hydrogen peroxide (into cells); **R** enzymes **2 max**
-
- (e) (i)** carcinogen / mutagen; **R** all other responses **1**
- (ii)** T cells do not recognise antigens;
 no immune response / weak immune response / no secondary immune response;
 no / few antibodies produced;
 no / few T killer cells produced;
 susceptible / vulnerable to / increased likelihood of, infection / disease / opportunistic infections;
R refs to cancer / autoimmune disease **2 max**
- [Total: 9]**

Q3.

- 5 (a) **A** passive artificial ;
B active artificial ;

if artificial omitted score one mark if passive and active are correct

[2]

(b) mark (i) and (ii) together

(i) antibody, destroyed/broken down ;
antibody excreted ;

(ii) no antigen entered body ;
no immune response ;
no, (active) B cells/plasma cells/memory cells ;
no antibody made ;

AVP ; e.g. further detail of lack of immune response /
no stimulation of B cells by T helper cells/no cloning

[max. 3]

(c) *line drawn on graph to show*

increase occurs faster than in primary response ;

higher peak of concentration than in primary response ;

[2]

- (d) antibody is specific (for tetanus) ;
further detail ; e.g. variable region
always some (circulating) antibody molecules, linked with qual ;

[max. 2]

[Total: 9]

Q4.

2 (a) allow immunoglobulin for antibody

structure	name of structure	function of structure within plasma cell
A	nucleus ; A (eu)chromatin R heterochromatin R chromosome	ref. gene(s) / genetic information / genetic material / DNA, (coding) for, antibody / protein / polypeptide ; transcription (occurring) / mRNA synthesis ; AW (ref. antibodies) <i>allow ecf for nucleolus</i>
B	mitochondrion ; A mitochondria	provides / synthesises / produces / makes, ATP (for antibody synthesis / exocytosis) ; <i>treat as neutral other uses of ATP</i> <i>allow ecf for lysosomes</i>
C	rough endoplasmic reticulum ; ignore RER	synthesis / modification / processing / transport, of, antibody / protein / polypeptide ; A translation <i>allow ecf for Golgi or SER or ER</i>

[max 6]

(b) (i) 1 part of the immune response ; A primary / secondary, response

many plasma cells

- 2 to produce high, concentration / level / AW, of, antibody / immunoglobulin ;
3 (high concentration antibody so) more effective against pathogens / AW ;

identical plasma cells

- 4 specific / particular / AW, to an, antigen / epitope ;
in context of antibodies or plasma cells
5 antibody (molecules) produced are all the same ; A ora, qualified
6 only the gene coding for particular antibody, switched on / transcribed / expressed ;

[max 3]

(ii) *accept from annotated diagrams*

*cell cycle stages are not required for mark points 1, 3, 4 and 7
 reject if incorrect mitotic stage given for these mark points*

- 1 ref. to, duplication / replication, of centrioles (in late interphase / before prophase);
 A dividing
 R splitting
- 2 (centriole pairs) move to opposite poles in prophase ;
 accept asters or centrosomes for centrioles
- 3 (movement allows) spindle formation / organisation of spindle fibres /
 microtubule assembly / microtubule organisation / AW, (in prophase) ;
- 4 (late prophase / early metaphase / metaphase), chromosomes / centromeres,
 attach to, spindle fibres / microtubules ;
- 5 chromosomes, line up / aligned / AW, at, equator / metaphase plate ;
- 6 ref. separation of, sister / identical, chromatids, at anaphase (to poles) ;
 A sister chromatids move to opposite poles at anaphase
 A daughter chromosomes for *sister chromatids*
- 7 ref., pulling / shortening, by, microtubules / spindle fibres ; AW [max 4]

[Total: 13]

Q5.

- 2 (a) (infected) person, sneezes/coughs/talks/breathes out, (airborne)
 droplets/aerosol/moist air ;
ignore contact
 inhaled/inspire/breathed in, by uninfected, person ;
ignore transplacental transmission [2]

- (b) (i) *variable region*
 binds/attaches/combines, to antigen ;
R receptor site **R** 'fit'
 ref. to specificity ;
ignore complementary shape (to antigen)
R same/similar shape [max 2]

- (ii) *disulphide bond*
ignore ref. to hinge

 holds, polypeptides/heavy chains/long chains, together ;
ignore constant as description of chains
 maintains, tertiary/quaternary/3D, structure/shape ;
R shape unqualified [max 1]

- (iii) *constant region*
 binds to, receptors/cell (surface) membrane, on, phagocytes/macrophages ;
 antigen, marking/tagging, for, phagocytosis/macrophage action ; AW
A ref. to opsonisation
R agglutination [max 1]

[Total: 6]

Q6.

- 3 (a) (i) 2 marks for the correct answer – leeway on measurement to be decided.
- $\frac{10 \text{ mm}}{100\,000}$;
 100 nm. [2]
- (ii) Good/high, resolution. A short wavelength [1]
- (b) (T lymphocyte) makes viral, protein/enzyme;
 Cell needs more enzymes for replicating, DNA/protein synthesis/AW;
 AVP. max [1]

Q7.

- (c) (i) Mitosis. [1]
- (ii) Bone (marrow). [1]
- (iii) Antigen. [1]
- (iv) X plasma cell;
 Y antibody ; A immunoglobulin [2]
- (v) Memory cell. [1]
- Remains in, lymph node/blood/lymph/lymphatic system/body;
 Recognises next infection by same, antigen/(measles) virus;
 Secondary response;
 (More) rapid (than primary);
 Immunological memory;
 AVP. max [2]

Q8.

- (b) *phagocytes*
 ingest/engulf/digest, bacteria; R destroy/kill/phagocytosis unqualified act as APC
 (Antigen Presenting Cell) to stimulate B/T cell response; [max 1]
- T helper cells*
 secrete/release, cytokines/lymphokines;
 to activate/stimulate B lymphocytes to produce plasma cells/antibodies/memory
 cells, or stimulate/activate phagocytosis; [max 1]
- [2]
- (c) resistance; R bacteria become immune
 ref to selection of resistant bacteria;
 antibiotic, can then not be used/are ineffective/no longer kill bacteria;
 ref to multiple resistance;
- R answers that suggest people become resistant [max 2]

Q9.

- 1 (a) check column **A** and **B** for correct ref. to feature if not clear in first column e.g. gives description

feature	phagocyte (A)	plasma cell (B)
rough endoplasmic reticulum / RER <i>allow ER if rough / RER stated in next column(s) R SER</i>	small quantity / AW A few, less	large quantity / AW ; A many, more
ribosomes	few <i>or</i> ref. to free	many ; <i>or</i> not free / fixed
lysosomes	some / present / ✓	none / absent / x ;
vacuoles / vesicles / phagosomes	some / present / ✓	none / absent / x ;
nucleus	lobed / AW A irregular, not round R curved, elongated, no definite shape	round / not lobed / not irregular / AW ; A spherical, circular
Golgi (body)	absent / x	present / ✓ ;
plasma / cell (surface), membrane	with, endocytotic / pinocytotic / phagocytic / exocytotic, vesicles / vacuoles A invaginations, infoldings R indentations	without, endocytotic / pinocytotic / phagocytic / exocytotic, vesicles / vacuoles A no invaginations, no infoldings R no indentations
mitochondria	less / few / 3	more / many / 7 ;

[3 max]

- (b) (to nearest whole number) (x) 6000 :: **A** 5900 – 6100
allow 1 mark for correct working if answer incorrect / not to whole number
 e.g. length of scale bar in mm × 1000, divide by actual size
 60mm × 1000 / 10 **A** 59 – 61mm

[2]

- (c) *phagocyte*
move to sites of infection ;
ingest / engulf / pseudopodia enveloping / phagocytosis of / endocytosis of, bacteria /
microbes / pathogens / AW ;
R antigens, virus
(form) phagocytic / endocytotic, vacuoles ;
A vesicles, phagosomes
ref to lysosomes ;
enzymes / named (hydrolytic) enzymes ;
digest / hydrolyse, (bacteria / AW) ;
antigen presentation / description ; [3 max]

plasma cell
produce / secrete / release / synthesise, antibodies ; A make
into, plasma / tissue fluid / lymph ; A blood
antibodies are proteins ;
ref to, RER / ribosomes ;
specificity qualified e.g. of, antibodies / lymphocyte / plasma cell
or description e.g. each type of plasma cell produces one type of antibody ;
Golgi (body) packages antibodies / ref to formation of (Golgi) vesicles ; [3 max]

- (d) (bacteria likely to be) resistant to (at least) one antibiotic (so useless) ;
less likely to be resistant to all / chance that bacteria will develop resistance to all
antibiotics used is very small ;
ref to mutation / change to DNA ;

(bacteria are) inside cells where protected from antibiotics ;
(mycobacteria) divide / grow, slowly ;
ensures all bacteria killed / reduces below critical level ;
otherwise, bacteria remain / reservoir of infection ;
(so) prevents development of antibiotic resistance ; [4 max]

[Total: 15]

Q10.

- (iii) both made of, protein / polypeptide(s) / amino acids ;
both have
disulphide bond ;
antigen binding site ;
variable region ;
constant region ; A non-variable [2 max]

- (b) *helper cells*
secrete / release / produce, cytokines / lymphokines / hormones ;
to stimulate B cells to, divide / develop into plasma cells ;
(which) produce antibodies ;
stimulate macrophages to carry out phagocytosis ;

cytotoxic / killer T cells
seek out / find / bind to, (foreign) antigens, on host cells / pathogens ;
destroy, virally infected host cells / intracellular parasites / viruses ;
attach to surface of cells / 'punch holes' into cells / disrupt cell surface (plasma) membrane ;
(release) toxic substances / hydrogen peroxide (into cells) / interferons ;
R enzymes [4 max]

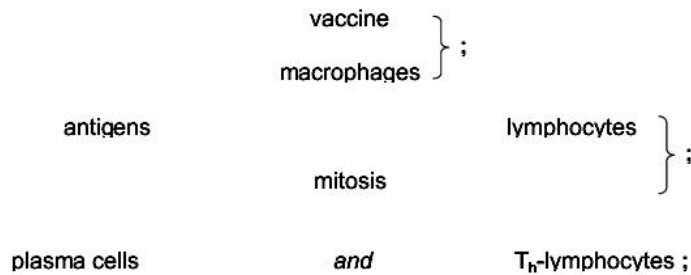
Q11.

- 1 (a) (i) circle around one or two variable regions ; [1]
- (ii) line(s) between **one** light polypeptide and **one** heavy polypeptide,
line(s) between the two heavy polypeptides ;
maximum of six lines in each site [1]
- (iii) 1 (disulfide) bonds are between, cysteine(s) / cysteine residues ;
A between R groups S-H S-H
2 covalent bond ;
3 strong bond / not easily broken ;
4 hold, polypeptides / chains / protein , together ; R proteins / strands
5 (in protein with) tertiary / quaternary (structure) ;
6 maintain shape / stop loss of shape / prevent deforming ;
A 3D structure R structure unqualified [3 max]
- (b) 1 secreted / synthesised / produced / released, by, plasma cells / B lymphocytes / B cells ;
2 combines / AW, with, antigens / pathogens / toxins / viruses / bacteria / microbes ;
A 'bonds with' / 'sticks to' / 'attaches to' R 'disease'
3 ref to, specificity / described ; *in context of antibody / B cells / antigen*
4 variable region is antigen binding region ; R 'receptors on antibodies'
5 neutralises toxins / antitoxin(s) ;
6 lysis of pathogens / described / lysis(s) ; R breaks down
7 prevents viruses entering cells ;
8 clumps / agglutinates / aggregates / AW, bacteria ; R 'coagulation'
9 opsonisation / opsonins ; A enable recognition
10 coats / AW, bacteria to facilitate phagocytosis ; *only in context 8 or 9*
11 receptors on phagocytes for constant regions (of antibodies) ; [4 max]
- (c) 1 (carrier / channel protein for) facilitated diffusion / described ;
A action of (co-) transport protein described
2 (carrier protein for) active transport / described ;
3 cell recognition / distinguishing self from non-self / act as antigens / AW ;
4 receptor ; A binding site qualified in terms of, hormones / neurotransmitters / cytokines /
cell signalling molecules ;
5 T-cell receptor / described ;
6 cell (to cell) adhesion / described ;
7 enzyme ;
8 form (hydrogen) bonds with, water / fluid surroundings, to stabilise membrane ; [3]

[Total: 12]

Q12.

4 (a)



[3]

no ecf from (a) to (b)

(b) 1 active (artificial) immunity ;

2 memory cells / immunological memory ;

3 *idea that* many specific, B-cells / T-cells / lymphocytes, in the body ;
A large(r) clones of specific, B- / T-cells *or* lymphocytes

actual invasion by the pathogen

4 fast secondary (immune) response ;

5 fast increase in antibodies / immediate production of antibodies ;
ignore incorrect type of cell secreting antibodies

6 high(er) concentration of antibodies are produced ; **A** more antibodies produced

7 pathogen destroyed before person becomes ill / AW ; **R** antigen

A pathogen do not, increase in number / infect cells / AW

[max 3]

(c) *two points to look for*

(if) most / sufficient / many / AW, people / children, immunised / vaccinated ;
A herd immunity

reduces the pool of infected, people / children, in the, community / population ;

A fewer people can catch disease and be source of infection

A protects those unvaccinated as, disease / illness, does not spread

A less chance of transmission

A pathogen cannot develop in immunised people

A reduced exposure to pathogen

[max 2]

[Total: 8]

Q13.

4 (a) R if mark points are in context of secondary response

sensitised / activated / AW, by (foreign) antigen / epitope ; *accept once only*
correct ref. specificity ; *accept once only*
production of memory cells ; *accept once only*

T lymphocytes

(T-helper / Th) secrete, cytokines / lymphokines ;
(T-helper / Th) stimulate, B cells to divide ; **A** stimulate humoral response
(T-killer / Tk / T-cytotoxic / Tc) secrete, perforin / hydrogen peroxide / AW ;
A toxins

R hormones

(T-killer / Tk / T-cytotoxic / Tc) kill / destroy / AW, non-self cells / pathogens / infected cells ;
(T-surpressor / Ts) ref., surpresses / reduces, response (on recovery) ;

B lymphocytes

formation of plasma cells ;
antibody production ;

[max 4]

(b) no more antigen / AW ;

(remaining) antibodies, removed from the blood / broken down (in the liver) ;

R excreted

plasma cells, are short-lived / begin to die / are not replaced ;

no more antibody produced ;

AVP ; e.g. detail of removal / macrophage engulfs, digested, peptide bonds broken [max 3]

(b) no more antigen / AW ;

(remaining) antibodies, removed from the blood / broken down (in the liver) ;

R excreted

plasma cells, are short-lived / begin to die / are not replaced ;

no more antibody produced ;

AVP ; e.g. detail of removal / macrophage engulfs, digested, peptide bonds broken [max 3]

(c) line drawn continuous with that provided ;

and rising more steeply before day 55 ; *should start to rise from day 40 / should rise more steeply initially / should not remain as a plateau from day 40*

reaches higher than primary response between day 45-55 and, peaks / plateaus ;

must not go below the day 40 antibody concentration

[3]

[Total: 10]

Q14.

6 (a) bone marrow ; [1]

(b) (i) **A** = macrophage / APC ; **A** monocyte
B = B, lymphocyte / cell ;
C = T, lymphocyte / cell ;

allow one mark if lymphocyte given for both B and C but not qualified or incorrectly qualified [3]

(ii) thymus ; [1]

(c) *max 4 if no reference to, antigen / non-self*

foreign / AW, antigens are non-self ;
non-self / foreign antigens, induce immune response ; AW ora

macrophage / APC (A)
phagocytosis / described ;
cuts up / AW, bacterium / pathogen ;
presents antigens / becomes antigen presenting cell / antigens on cell surface ;

B/T, cells (B and C)
antigen recognition by lymphocytes ;
(with) complementary / specific, receptors / immunoglobulins (B) / antibodies (B) ;
divide by mitosis ; **A** clonal expansion
ref. formation of memory cells (for secondary response);

T_h cells (C)
secrete cytokines to stimulate B cells ;
cytokines stimulate macrophages ;

T_c/k cells (C)
ref. destroy pathogen / AW ;
produce perforin / AW ;

B cells (B)
B cells become plasma cells ;
(plasma cells) secrete antibodies ;

AVP ; e.g.
macrophages, non-specific / faster response
ref. specificity of, lymphocytes / B and T cells
antibody variable region is the antigen binding site ;

[5 max]

[Total: 10]

Q15.

- 2 (a) 'cell' is not required as it is in the stem of the question
- (i) macrophage ; **A** antigen-presenting cell **R** mycrophage [1]
 - (ii) neutrophil ; **A** PMN / polymorphonuclear leucocyte [1]
 - (iii) T-killer / T_K / T-cytotoxic / T_C , lymphocyte ; **A** cell for lymphocyte [1]
 - (iv) memory B- lymphocyte ; **A** cell for lymphocyte [1]

Q16.

- (b) transcription (of specific genes) ; **A** reference to gene switching
protein / polypeptide, synthesis ; **A** translation
production of haemoglobin ;
further detail ; e.g. assembly of quaternary structure
(production of) carbonic anhydrase ;
loss of, mitochondria / named organelles ;
loss of nucleus ;
adopts biconcave disc shape ; [max 3]
- (c) occurs in both primary and secondary (immune) responses ;
selected / specific / AW ;
lymphocytes / B -cells / T-cells / divide (by mitosis) ;
clonal expansion / described in terms of producing, clone / many cells ;
A idea that different types of immune cell can result
reference mitosis in memory cells (for rapid) secondary response ; [max 3]
- (d) *T helper / Th*,
secrete, cytokines / interleukins ;
activate B-lymphocytes to, divide / form plasma cells ; **A** idea that leads to enhanced
antibody levels
enhances / AW, phagocyte / macrophage, response ; **A** angry macrophages ;
- T cytotoxic / Tc / T killer / Tk*
attach to / kill / AW, infected cells / damaged cells / tumour cells / cells with non-self
antigens / AW;
mechanism of killing ; e.g. perforin
- T memory / Tm*
already exposed to antigen ;
reference to role in secondary response ;
- AVP ; ; e.g. T suppressor cells
function of suppressor cells [max 3]

Q17.

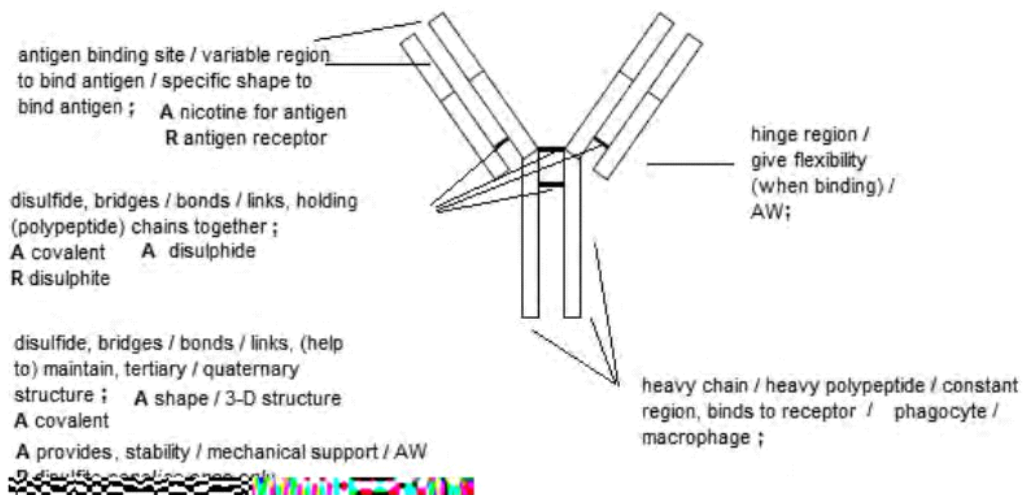
(ii) allow microorganisms or named type of microorganism or infectious agent for pathogens

- 1 recognise, non-self/ foreign, antigens, (on pathogen) ;
- 2 receptors (on macrophage) bind antigens (on pathogen) ;
- 3 (or), pathogen /AW, adheres / 'sticks', to (cell surface) membrane ;
- 4 infolding of (macrophage cell surface) membrane around/engulf/phagocytosis of, pathogen ; **R** engulf antigen
- 5 vacuole/vesicle/ phagosome, forms ;
- 6 ref. to lysosomes ;
- 7 hydrolytic/digestive/named, enzymes ;
e.g. lysozyme/protease/nuclease
A pathogen broken down by enzymes
- 8 hydrolysis of named compound(s) ;
- 9 ref. to destroying/killing, pathogen ;
- 10 ref. to antigen presentation ;
accept idea even though does not occur in alveoli

[max 4]

Q18.

6 (a) labels to correct areas, mark to max 3



AVP ; e.g.
light and heavy polypeptide chain, ref. forming variable region / different primary structure(s) giving different shapes ;
heavy / polypeptide, chain constant region gives antibody class ; AW

[max 3]

Q19.

- 1 (a) (i) variable region / antigen binding site ; A antigen binding region
A light, polypeptide / chain R antigen receptor [1]
- (ii) disulfide ; I bridge
A disulphide R disulfite / covalent [1]
- (iii) two or more / more than one , polypeptide(s) / tertiary structure(s) ;
R any specific number of polypeptide on its own
R more than one type of polypeptide / many polypeptides
R more than two / several, polypeptides
I ref to prosthetic group [1]
- (b) 1 antigen recognised as / AW, non-self / foreign ;
accept once for macrophage, B-lymphocyte or T-lymphocyte
A non-self / foreign, antigen leads to immune response
2 *idea of phagocytosis leading to antigen presentation ;*
3 antigen (on pathogen or APC) binding to, receptor / membrane, of B-cell(s) /
B-lymphocyte(s) ; A clonal selection of B-lymphocytes occurs
4 (helper) T-cell / T-lymphocyte, activate B-cells ; I killer T-cells
A release cytokines to stimulate B-cells
5 B-cells / B-lymphocytes, divide by mitosis ; A replicates / proliferates by mitosis
A clonal expansion of B-cells
6 plasma cells, formed / AW ;
7 plasma cells / B-cells / B-lymphocytes, produce / secrete / AW, antibody /
immunoglobulin / Iq ; [max 4]
- (c) *parasite / Plasmodium / pathogen / protoctist / protist / protozoan must be mentioned at least
once somewhere in the answer to gain any marks
e.g. 'malaria / disease has many antigens' = 0*
- if malaria is caused by a virus / bacterium penalise once only*
- 1 (malarial) parasite / pathogen / *Plasmodium*, (is eukaryotic) has many genes ;
A has greater genetic complexity of smallpox / AW
2 different (malarial) parasite, species / strains / AW, have different antigens ;
R 'strands'
3 (malarial) parasite has different antigens in different stages of its life cycle ;
4 (malarial) parasite / *Plasmodium*, switches antigens / idea of antigens changing during
infection / different genes coding for antigens switching on / AW ;
R 'active sites' of antigens changing
R 'antigens mutate'
5 parasite / antigen / stages of the life cycle, inside (host / liver / red blood) cells ; [max 2]

[Total: 9]

Q20.

- (b)** *must be in context of B-lymphocytes / B-cells / plasma cells*
max 3 if T-cells

secondary response A ora

presence of memory cells / AW (giving larger numbers) ;

ref. increased chance of, encountering antigen / antigen presentation / clonal selection ;

ref. larger numbers cells following, clonal expansion / AW (cf primary response) ;

(so) shorter duration for onset of antibody production ;

(so) higher antibody concentration ;

secondary response antibody production (by plasma cells) lasts longer ;

AVP ; e.g. faster rate, plasma cell / antibody, production, ref. longer-life of cells

involved in secondary response

[max 4]

[Online Classes : Megalecture@gmail.com](mailto:Megalecture@gmail.com)
www.youtube.com/megalecture
www.megalecture.com