

Antibodies and vaccination

Mark Scheme 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Immunity
Sub Topic	Antibodies and vaccination
Booklet	Theory
Paper Type	Mark Scheme 1

Time Allowed : 65 minutes

Score : / 54

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) *batch/penicillin*
- 1 nutrients, decrease/run out ;
 - 2 so, secondary metabolite/penicillin, made ;
 - 3 fermenters can be used (after cleaning) for different process ;
 - 4 if problem occurs only one batch affected ;
 - 5 needs little, monitoring/attention (once set up) ;
 - 6 *continuous/mycoprotein*
 - 6 (fungus) kept in, exponential/log, phase (of growth) ;
 - 7 (so) high, biomass/yield/production rate ;
 - 8 little/no, downtime ;
 - 9 small, vessels/space, required;
 - 10 cost-effectiv ;

[max 8]

- (b)
- 1 mouse is injected with an antigen ;
 - 2 wait for immune response to occur ;
 - 3 clonal selection ; **A** description e.g. antigen binds to, specific/virgin, B cell
 - 4 clonal expansion ; **A** description e.g. mitosis/division/cloning of B cells
 - 5 B-lymphocytes/plasma cells, are extracted ;
 - 6 from the mouse's spleen ;
 - 7 fused with, cancer/myeloma/tumour, cells ;
 - 8 hybridoma cells formed ;
 - 9 hybridoma cells producing antibodies are identified ;
 - 10 cultured on a large scale (to secrete monoclonal antibodies) ;

[max 7]

[Total:15]

- 2 (a) (gives) flexibility / described, e.g. *ref. to*, changing orientation / movement to bind antigen / allows binding when two antigens are apart / allows each antigen binding site to move independently ;
A (acts as) hinge region [1]
- (b) (i) antigen binding sites / bind to antigen / both bind to same (type of) antigen ;
A other terms for binding e.g. attaches to antigen *ignore ref. to receptor* [1]
- (ii) binding to phagocyte / monocyte / macrophage / neutrophil / B-lymphocyte / named cell type with Fc receptor ;
A gives class of antibody / determines the class of antibody ; [max 1]
- (c) *secreted*
 (antibodies need to be) soluble (to function) ; **AW** e.g. needs to be transported in, aqueous / watery plasma
 located on surface
 (**X** is region required to) hold / anchor / **AW**, (antibody), in membrane / phospholipid bilayer ;
ref. hydrophobic core / fatty acid tails of phospholipids hydrophobic ;
 interaction provides, stability / anchorage / **AW** ;
ref. hydrophobic region of antibody will have tendency to move back into membrane as repelled by, hydrophilic / watery, exterior solution ; [max 2]
- (d) (i) one / 1 ; [1]
- (ii) folding / coiling (to form tertiary structure) ;
ref. interaction of, side chains / R groups (of amino acids) ; **R** react
two of ionic / electrovalent, bond
 hydrogen bond
 disulfide bonds
 hydrophobic interaction
 Van der Waal's (forces) ; *one mark only for any two*
 hydrophobic, side chains / R-groups / amino acids, in centre / **AW** ;
A hydrophobic region faces, towards centre / **AW**
or
 amino acids with hydrophilic R groups face, outwards / watery environment / **AW** ;
A hydrophilic amino acids *for hydrophilic R groups* [max 2]
[Total: 8]

- 3 (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]

CHEMISTRY ONLINE
— TUITION —

- 4 (a) causes (mainly) linked to habits during life of person / AW ;
result of choices made by person / AW ;
example ;
e.g. (tobacco) smoking / exposure to asbestos at work [max 2]
- (b) *pathogen* = virus ;
ignore Morbilli / measles
transmission: aerosol, infection / transmission or droplet, infection / transmission ;
A aerosol route described from infected to uninfected
ignore contact [2]
- (c) (infected), visitors / immigrants / returning residents, from countries where measles occurs ;
unvaccinated people returning from travel abroad ;
reduction in vaccination rates ;
percentage cover too low ;
change in reporting pattern ;
existing vaccine no longer, effective / AW ;
AVP ;
e.g. mutation of virus produces new antigens, vaccines ineffective
increase in malnourished children, no immune response to vaccine [max 1]

[Total: 5]

CHEMISTRY ONLINE
— TUITION —

5 (a) *Vibrio cholerae* ;

[1]

- (b) 1 binding / AW, to, active site / site other than active site / allosteric site ;
2 further detail / consequence of, binding ;
 if binds to active site
 complementary shape to active site
 similar shape to substrate **A** same shape **A** similar structure
 competes with substrate for active site
 if binds to other site
 changes shape of active site
 shape of substrate no longer complementary to active site
 enzyme-substrate / ES, complex (already in active site)
 cannot make product
 for both types of binding
3 substrate unable, to enter / bind to, active site ;
 A fewer / no, enzyme-substrate / ES, complexes form
4 AVP ; e.g.
 ref. to decreased enzyme activity, qualified e.g. less ATP produced /
 lower respiration rate
 preference for, permanent / irreversible, inhibitor (to maximise effect)
 correct ref. to concentration of inhibitor and effect

[max 3]

(c) (i) 2.70 / 2.71 ;;

1 mark if answer incorrect but correct calculation
5 143 / 190 130

[2]

(ii) max 3 if no reference to particular regions

for differences in cases *accept ora for mark points*

- 1 idea of overall greater exposure to contaminated, water / food ;
- 2 no, safe (drinking) water sources / bottled water / water treatment plants ;
- 3 lack of hygiene, qualified ; e.g. hands not washed after defaecation
- 4 faeces / sewage, mixing with drinking water / onto crops; **A** poor sanitation
- 5 insufficient / poor access to, (oral cholera) vaccines ;
- 6 vaccine less effective in some areas ;
- 7 lack of education about the way cholera is transmitted ;
- 8 differences in effectiveness of surveillance and reporting ;
- 9 qualified ref. to, natural disasters / wars / refugee camps ;

for differences in fatality rates

- 10 increase in, antibiotic / drug, resistant strains (in some areas) ;
- 11 lack of, health services / drugs / antibiotics / ORT / skilled personnel ;
 A lack of medicines
- 12 AVP ;

[max 4]

[Total: 10]

- 6 (a) (i) quaternary (structure) ; [1]
- (ii) alpha / α , helix ; [1]
- (b) (i) facilitated diffusion ; [1]
- (ii) osmosis ;
 increasing, ion / solute, concentration in lumen (of intestine) lowers water potential ; or a water follows, from a high(er) to a low(er) water potential / down a water potential gradient; [3]
- (c) (i) *must have ref. to organism at least once to gain max*
 bacteria / pathogen / *V. cholerae*, in faeces (of infected person) / in sewage containing faeces (from infected people) ; AW
 bacteria / pathogen / *V. cholerae*, ingested / taken in orally (by uninfected person), in (contaminated) food / water ;
A faecal – oral route for one mark if previous two mps not given [2]
- (ii) general ref. to problems associated with increased numbers of people and lack of infrastructure ;
 examples ;;
 e.g. problem providing, safe / uncontaminated, drinking water ;
 faeces / sewage, mixing with drinking water ; **A** no / poor, sanitation
 unable to practise good hygiene ; **A** example e.g. hands not washed after defaecation
 infected people sharing latrines with uninfected / AW ;
 lack of, medical care / treatment, leading to larger pool of infected people (at any one time)
 lack of, health services / drugs / antibiotics / ORT / skilled personnel
 unable to supply sufficient vaccines
 lack of food / poor diet, so vaccines less effective
- credit relevant examples linked to a particular type of disaster* [max 2]

[Total: 10]