Antibodies and vaccination

Mark Scheme 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Immunity
Sub Topic	Antibodies and vaccination
Booklet	Theory
Paper Type	Mark Scheme 5

Time Allowed : **71 minutes**

Score : **/ 59**

Percentage : **/100**

Grade Boundaries:

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

1 **(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]

(b) **(i)** ill-health / absence of well-being / abnormal condition / AW, (affecting an organism) **;**
reduced effectiveness of, functions / named function **;** AW
(illness with a set of) symptoms **;** AW **A** signs
poor / AW, physical, mental or social, well-being **;** **A** *two out of the three absence of well-being for two of the three = 2 marks* [max 2]

(ii) **1** stable virus / virus did not mutate (frequently) **;**
2 same vaccine could be used all the time **;**
3 cheap to produce / ease of production **;**
4 used a, vaccinia / harmless, virus (so people could not get smallpox) **;**
5 able to use a 'live' virus (for stronger immune response) **;** **A** live vaccine
6 vaccine, thermostable / AW **;** **A** no requirement for keeping in cold
7 vaccine easy to administer **;** **A** no need for boosters [max 2]

(iii) *cholera up to max 4*
1 transmission cycle is difficult to break**;** **A** described with example(s)
2 ref. difficulty in administering e.g. refugee camp, displaced, disaster **;**
3 poor diet, lowered immune response **;**
4 more than one strain (needs more than one type of vaccine) **;** **A** more than one type (that causes cholera) **R** constantly mutating
5 vaccine, only gives short-term protection / requiring boosters **;**
6 antigenic concealment **;**
7 qualified **;** e.g. organism in intestines, difficult for antibodies to reach
8 ref. (older or newer oral) vaccine, not successful for everyone / variable (60–65% up to 90% depending on population group) protection **;**
9 no requirement by health authorities (for vaccine) / vaccine not used by health authorities **;** AW

sickle cell
1 no vaccine available **;** **A** cannot vaccinate against sickle cell
2 not caused by pathogen / non-infectious / non-transmissible / non-communicable **;**
3 genetic / inherited, disease / AW **;** **A** caused by a mutation
4 affects all red blood cells so vaccine would lead to their destruction **;** [max 5]

[Total: 13]

2 **(a)**

vaccine } ;
macrophages

antigens | lymphocytes } ;
mitosis

plasma cells *and* T_h-lymphocytes **;**

[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]

3 **(a)** *Mycobacterium tuberculosis* / *Mycobacterium bovis* **;** (1)

(infected person) coughs / sneezes / spits / exhales / breathes out / aerosol (infection) / droplet (infection) / moist air (containing the pathogen) **;**
(uninfected person) inhales / breathes in / inspires **;**
ignore ref. to cattle
treat ref. to virus etc as neutral (2) [3]

(b) **1** ref. patient does not complete course / takes inadequate dose / stops taking when feels better **;**
2 problems with continuing supply (of antibiotics) **;**
3 not all bacteria killed **;**
4 ref. mutation to become resistant **; R** immune
5 likelihood of resistance increases if only one antibiotic used **;**
6 ref. to changes in bacterium to enable resistance **;**
7 ref. to changes in host cell (membrane structure) **;**
8 AVP **;** e.g. repeated exposure to different drug regimes (because of mp. 1)
exposure to bacteria with different resistance [max 2]

(c) **1** ref. to, worldwide incidence of TB / TB found worldwide **;** AW
2 highest, incidence / AW, (sub-Saharan) Africa / LEDC / developing countries **;**
3 problem with, vaccine / BCG, qualified **;** e.g. doesn't work well, everywhere / in Africa / in Far East
doesn't work well for all ethnic groups
less efficient with age
ref. cold chain / needs to be kept cold
knowing when enough people vaccinated
ref. to cost
R vaccine doesn't work
4 difficult to identify infected people / ref. symptomless carriers / AW **;**
5 difficulty with, contact tracing / described **;**
6 difficult to diagnose / time to diagnose (can infect others) **;**
7 ref. to transmission from animals to humans **;**
8 weakened immune systems / link with HIV/AIDS / TB is opportunistic **;**
9 ref. social factor **;** e.g. overcrowded living conditions, poor diet, remote areas
10 coordination of, vaccine / treatment **;**
11 ref. to difficulty of administering, drugs / DOTS **;**
12 lack / availability, of trained personnel **;**
13 ref. to political problems **;** e.g. war , unstable regimes, refugees, migration
14 cost, qualified with additional relevant point **;**
15 AVP **;** e.g. ref. to countries (e.g. Russia) with large area / low population density,
16 AVP **;**ref. to quarantine problems, travel qualified, other social factor [max 5]

[Total: 10]

4 **(a)** **(i)** hybridoma **;** [1]

(ii) 1 identical (antibodies) **or** produced by cloning **;**

2 variable regions / antigen binding sites, all identical **or** (antibodies) are specific to one antigen **;** [2]

(iii) *Mark text first*

1 (four) polypeptides **;** *plural*

2 two heavy **and** two light chains **;** **A** long and short

3 ref. disulphide, bridges / bonds **;**

4 ref. variable regions / binding sites **;** [3 max]

(b) **(i)** 1 HAT cannot be metabolised / AW **;**

2 HAT inhibits mutant myeloma cells / AW **;** [2]

(ii) 1 mouse spleen cells can metabolise HAT / AW **;**

2 because they have suitable enzyme **;** [2]

(iii) 1 so that only fused cells survive **or** unfused myeloma cells die **;**

2 identifies, cells to be cloned / fused cells **;** [2]

(c) 1 can be done at home / easy to use / non-invasive **;**

2 cheap **;**

3 result produced quickly **;**

4 result likely to be accurate **;**

5 can be done early in pregnancy **;**

6 safe to use **;** [4 max]

[Total: 16]

5 **(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 / lysin(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]