

WJEC (Eduqas) Biology A-level
Option 3.A: Immunology and
Disease

Questions by Topic - Mark Scheme

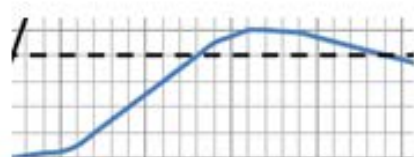
1.

Question				Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)	Vector NOT carrier	1			1		
		(ii)	(Insect repellent/loose clothing/keeping windows closed and mosquito net) prevent mosquitoes <u>biting</u> (1) Not feeding (Avoiding stagnant water means) avoiding areas where mosquitoes <u>breed</u> (1) NOT hatching	2			2		
	(b)	(i)	Any three (x1) from: A. Viruses are not cellular so do not have metabolic pathways B. A vaccine would need to target {virus infected cells/ viruses directly when in tissue fluid/blood/outside cells} C. Viruses enter host cells so they avoid recognition by host immune system/drugs may not be able to get to virus D. Drugs would interfere with host cells metabolism or damage the host cells(1) E. Antigenic variation/ or description of/ drug resistance (1)		2	1	3		
		(ii)	Need two features for 1 mark • Must be {safe/ not cause harm}/ not have side effects • must be effective/ trigger an Immune response	1			1		
	(c)		Strategy 2 more effective in long term (1) Any four (x1) from: Number 1 • Advantage: Antibodies would act quickly/ confers immediate protection (1) • <u>Placental</u> transfer will protect the baby (1) • Disadvantage: no memory cells would be produced/ no long term immunity (1) Number 2 • Advantage: the production of memory cells (1) • Reference to herd immunity (1) • Disadvantage: would take longer to act (1)		1 1 1	1 1	5		
	(d)		Accept any value $34.5 - 43.9 = 2$ marks If incorrect allow 1 mark for sight of Calculation $500/58 \times 4$ $500/58 \times 5$		2		2	2	1
	(e)	(i)	Endemic: a disease, always present {at low levels (in an area)/ frequently at a predictable rate in a specific location/ population} (1) {Surgical patients – skin open to bacteria} / {Sick/elderly patients – low levels of immunity}/ ORA (1)	1	1		2		
		(ii)	{Inhibition of/ prevent/ stop} {protein synthesis/translation} (1) Humans have different ribosomes to bacteria (1)	1	1		2		
	(f)		Any two (x1) from: Not enough people (1) Only males (1) Only done on one ethnic group (1) Needs to be tested in infected individuals (1) Use of control group/placebo (1)			2	2		2
			Question 1 total	6	9	5	20	2	3

2.

Question Option A				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)		(i)	A disease which is always present at low levels (in an area)/frequently at a predictable rate in a specific location/population (1) Epidemic – {significant/large} increase in the usual number of cases/rapid spread of infectious disease to a large number of people within a short period (1)	2			2		
			(ii)	sewage entered water supply (1) Cholera spread by drinking contaminated water/feco-oral route (1)	1	1		2		
			(iii)	Carriers/someone with the disease brought into Haiti			1	1		
	(b)		(i)	Antibodies are specific to an antigen (1) Different Strains would have different antigens (1) If no agglutination they different strains/if tested using antibodies to O1, O139 would not show agglutination/ORA(1)	1	2		3		
			(ii)	Identify the strain of <i>V.cholerae</i> in the peacekeepers in Haiti (1) Compare distribution of known strains in the {world/Nepal} to locate possible source (1)			2	2		2
			(iii)	Any three (x1)from : Antibiotics will pass through the gut before all bacteria killed (1) <i>V. cholerae</i> is Gram-negative and some antibiotics {less/not} effective/narrow spectrum (1) Kill bacteria but toxin remains (1) Antibiotic resistance (1)		1	2	3		
			(iv)	583/583.3(cm ³) 2 marks 200 x 70 = 1 mark 24		2		2	2	
	(c)		(i)	(First dose-) for a primary (immune) response and (Second dose) – for a secondary(immune) response (1) second dose acting as a booster/to increase antibody levels/increase memory cells (1)	2			2		
			(ii)	The vaccine would pass through the digestive system/ the vaccine would be in the intestine long enough/not {enough/all} absorbed/ vaccine could be broken down / stomach acid stops acid working/cwttt		1		1		
			(iii)	Any two (x1) from Safety of the patients/side effects (1) Effectiveness /the vaccine might not work (1) costs/logistics of storage issues (needing cold conditions) (1)		2		2		1
				Question 2 Option A total	6	9	5	20	2	3

3.

Question	Marking details	Marks Available
3. (a)	(i) 12.5 (days)	1
	(ii) Memory cells already present; Less antigen needed to stimulate immune response; More plasma cells produced in a shorter period of time;	max 2
(b)	(i) (Approximately same shape as primary immune response:)	3
	<p>Start at 0 at 40 days;</p> 	
	Some indication of a latent period + slow increase;	
	Reaches a peak similar to primary response	
	after 13 – 17 days (day 53 – 57) then decreases;	
(ii)	No prior exposure to the <u>antigen</u> ;	max 2
	Produces a primary immune response / no memory cells;	
	Has to go through a latent period;	
	Needs time to recognise foreign antigen / for clonal expansion / clonal selection / development of humoral response;	
Question 3 Total		[8]

4.

Question			Marking details	Marks Available
4	(a)		Endemic;	1
	(b)		carrier;	1
	(c)		vector;	1
	(d)		bacteriostatic;	1
	(e)		Infectious;	1
	Question 4 total			[5]

5.

Question			Marking details	Marks Available
5	(a)		sanitation/ safe disposal of sewage/ good hygiene; provision of {clean/ safe} drinking water/ bottled water; vaccine; Reject-antibiotic use/ oral rehydration therapy	Max 2
	(b)	(i)	lipoprotein; lipopolysaccharide; (Accept: porins)	2
		(ii)	X= peptidoglycan/ murein;	1
		(iii)	red/ pink,	1
		(iv)	Penicillin prevents <u>formation</u> of {cross linkages/peptidoglycan} in cell wall; (Cholera) is a gram negative bacterium; therefore has <u>very little</u> peptidoglycan; lipopolysaccharide layer protects cell from penicillin action;	3
	Question 5 Total			[9]

6.

Question			Marking details	Marks Available					
				A01	A02	A03	Total	Maths	Prac
6	(a)		Cells: There are {more than 1 000 times/ many more} microbial cells {on /in} our bodies than human cells. (1) Genomes: There are {many different/ variety} bacterial {genomes/ species} within the human body. (1) Protection: They prevent {harmful microbes/ pathogens} colonising the human body and causing disease/ outcompete pathogenic bacteria. (1)	2	1		3		
	(b)	(i)	Any three (×1) from: {engulfs the foreign microbe/ ref to phagocytosis} (1) antigenic presentation. (1) The T-cell recognises the foreign antigen (1) T cells are then activated / undergo clonal expansion (1)		3		3		
		(ii)	Killer T cells – {cause lysis of/ destroy} {target cells/ named cells}. NOT kill (1) Helper T cells – co-operate with B cells to initiate antibody response/ secretes cytokines/ B cell activation (1) Memory T cells – remain {dormant/ in circulation} until host is exposed to antigen again/ initiate secondary immune response/owtte (1) Reject reference to antibodies except in relation to B cell activation.	3			3		
	(c)	(i)	Any two (×1) from It allows the antibody to {bend/flex/distort/change shape} in order (for both arms) to bind to different antigens (1) because antigens are different distances apart on the target cell (1) antigens on different cells / cause clumping/ agglutination of bacterial cells(1)			2	2		
		(ii)	IgM can bind to more antigen than IgG / so it can agglutinate more antigen/ bind to more antigen/ form larger clumps of antigen (1)			1	1		
	(d)	(i)	1.25×10^8 or 125 000 000 = 2 marks If incorrect award 1 mark for $\frac{25 \times 100\,000}{0.02}$		2		2	2	
		(ii)	Any two (×1) from flame mouth of test tube/ flask work near updraft of Bunsen burner use sterile {pipette/ equipment}/ flame {loop/ spreader} tilt lid of Petri dish/ owtte		2				2
		(iii)	Human body temperature to culture human pathogens			1			1
		(iv)	Any two (×1) from <ul style="list-style-type: none"> Antibiotics are not specific/ Bacteriophage only infect specific bacteria (1) antibiotics cause {side effects/ phages} / have no side effects/ no allergic reactions(1) More chance of bacterial resistance with antibiotics/ Low chance of bacterial resistance to phage therapy (because bacteriophage can mutate as fast as bacteria). (1) 	1	1		2		
		(v)	Any one (×1) from The bacteriophage mutates to make infection worse/ infect human cells. Cost vs effectiveness of treatment/ religious objections Unknown side effects (1)			1	1		
			Question 6 total	6	9	5	20	2	3

7.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Both for one mark. • Mucus traps (bacteria) and Cilia moves it NOT microvilli	1			1		
	(b)		• Penicillin {inhibits/stops} the formation of cross linkages (between molecules of peptidoglycan) (1) NOT break cross linkages • {The wall is weakened / when osmotic changes occur} the cells lyse (1) • (Gram negative) cell walls have extra layers of lipopolysaccharide/ lipoprotein (1)		3		3		
	(c)	(i)	Any two (x1) from: the temperature (of incubation) (1) the length of time of incubation (1) the thickness of the agar in the plates (1) plating density of bacteria/ uniformity of plating (1) pH/ oxygen levels/ species of bacteria/ nutrient concentration (1)			2	2		2
		(ii)	Largest {size of zone of inhibition / clear zone/ diameter/ radius/ area} (1)		1		1		
		(iii)	A,B,C are bacteriostatic and D is bactericidal (1) Accept description of modes of action If bacteriostatic: there will be growth/ If bactericidal: no growth/ dead (1)		1	1	2		
	(d)		One from why: Needs host cell {for reproduction/ for metabolic processes}(1) Virus has no organelles/ metabolic pathways of its own (1) Uses cell metabolic pathways for reproduction (1) One from Effects: Kills the cell by {cell lysis/ production of toxic substances (1)}	2			2		
	(e)	(i)	0.35-0.40 and 1.5 (1) Ignore decimal places		1		1	1	
		(ii)	Any three (x1) from: • clonal selection B cell/ antigenic recognition/ antigenic presentation activating B cells(1) • B cell undergoes clonal expansion / mitosis of B cells/ cloning (1) • Differentiates into plasma cells (1) • that {secrete/ produce} the specific antibody (1)	2	1		3		
		(iii)	null hypothesis = There is no significant difference in the concentration of antibodies in the blood samples before and after vaccination/ any difference in the concentration of antibodies in the blood samples before and after vaccination is due to chance		1		1		
		(iv)	The null hypothesis should be rejected, there is a significant difference in concentration of antibodies (before and after the vaccines)/ only 5% probability that it is due to chance/ ORA		1		1		1
		(v)	1.4-1.6 Accept if subtract original concentration e.g. $1.6 - 0.4 = 1.2$			1	1	1	
		(vi)	If fourfold increase is less than or equal to 1.5: = Yes successful If fourfold increase is more than 1.5: = Not successful (1) Mutation/ Antigen variability / change in nucleic acid base sequence / change in amino acid sequence of (glyco)protein / change in tertiary structure, or in shape of protein / existing antibodies do not match / new ones have to be produced (1)	1		1	2		
			Question 7 total	6	9	5	20	2	3

8.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		A disease which is always present at low levels (in an area)/ frequently at a predictable rate in a specific location (1)	1			1		
8	(b)	(i)	A – disulphide bridge/disulphide bond B – Antigen binding site C – Light chain D – Heavy chain All 4 correct = 3 marks, 3 correct = 2 marks, 2 correct = 1 mark	3			3		
		(ii)	Antigen –initiates an {immune response/production of antibodies} (1) Antigen-antibody complex- a <u>specific</u> antibody bound to an antigen/ complementary antibody (1)	2			2		
	(c)	(i)	<u>Memory cells</u> (must make IgG during the secondary response/ after second exposure/clonal expansion)(1)		1		1		
		(ii)	Any 2 x (1) from: • The bacteria may have antigenic variation/surface proteins / reference to mutations (1) • (IgM produced again as) no memory cells to new antigen (1) • Primary response each time (1)			2	2		
	(d)	(i)	Delay in detection of bacterial antigen /reference to latent period/clonal selection (1) IgG not produced straight away / IgG non existent until day 7/ Time is needed to produce and secrete antibodies (1)		2		2		
		(ii)	Any 5 x (1) from: A. Antibodies maybe already attached to the bacteria/antigen/ a substance within the plasma (1) B. Different strain of bacteria which is not recognised by the test (1) C. more than one type of antigen on the surface of the bacteria (1) D. antibodies not at detectable levels/ Variation amongst peoples' immune response/ colour change not detectable (1) E. Enzyme not functioning/denatured (1) F. lack of control of variables e.g. pH/ temperature/ volume of sample (1)		2	3	5		
	(e)	(i)	35-38 °C and it is a human pathogen/ similar to body temperature (1)		1		1		1
		(ii)	380/ 380.13/ 379.94 mm ² = 2 marks Allow the following for 1 mark 380 (no units) (22/2) ² x 3.14 = (11) ² x 3.14 =		2		2	2	
		(iii)	The zone of inhibition is a perfect circle/ radius is the same all the way round (1)		1		1		
			Question 8 total	6	9	5	20	2	3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)	Skin (connective tissue) / skin flora (bacteria) / blood clotting / inflammation/ phagocytes / macrophage lysozyme/ stomach acid/ low pH in stomach Any 3 for 1 mark	1			1		
		(ii)	{Many organisms/ named organism} live {in/on} the (human) body	1			1		
		(iii)	Cell lysis / cell bursts	1			1		
		(iv)	Any three × (1) from: • {Macrophages/ phagocytes} {engulf virus infected cell / carry out phagocytosis}/ antigen presentation (1) • clonal expansion/ T cells {proliferate/divide many times} / (1) • Cytokines stimulate phagocytosis (1) • Killer T cells cause cell lysis (1)	1	2		3		
	(b)	(i)	• Antibiotics can act on {cell wall of bacteria/ or description of/ hydrolyse peptidoglycan} (1) • Antibiotics affect {metabolism/protein synthesis} by bacterial cell (1) • Viruses don't have a {cell wall / metabolism} so not affected by antibiotics (1)	2		1	3		
		(ii)	7250 (mg) (2) If incorrect award 1 mark for any combination of three parts of equation $25\text{mg} \times 14.5 \times 2 \times 10$		2		2	2	
		(iii)	Amoxycillin is bactericidal + {as the bacterial numbers are reduced / has killed bacteria} (1) Tetracycline is bacteriostatic + {as it has prevented replication/no cell death/cell numbers remain constant} (1)			2	2		
		(iv)	Any two × (1) from: Same {concentration/ dosage} of antibiotics (1) same composition of {culture media/agar}/ named constituent of {culture media/agar} (1) Same strain of <i>S. pyogenes</i> (1) pH (1) NOT incubation temperature/ oxygen		2		2		2
		(v)	Human pathogen / (close to human) body temperature		1		1		1
	(c)	(i)	• May be {rapid/ high} mutation rate in rhinovirus /antigens change/viruses are antigenically labile (1) • Many {strains/serotypes/ antigenic types} of rhinovirus (1) • Vaccines would need to contain antigens from all strains (to provide complete immunity) (1) • Each antigen must produce a strong immune response/be highly antigenic / be immunogenic(1)		1	2	3		
		(ii)	Religious objections/ safety fears/ side effects/ individual rights/ some people may be too ill for vaccination e.g. due to HIV-AIDS or Chemotherapy		1		1		
			Question 9 total	6	9	5	20	2	3

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|---------|---|---|
| 10. (a) | gram negative; | 1 |
| (b) | via faecal – oral route/faeces of infected person to mouth of uninfected person/via contaminated water/food/flies; | 1 |
| (c) | water not absorbed/reabsorbed/water lost from body;
low conc. of solutes/ions in blood;
low blood volume;
dehydration;
poor nerve conduction;
poor heart activity/failure; | 3 |
| (d) | sewage treatment/ better sanitation;
clean water supply/chlorination;
good food hygiene;
transmission cycle broken; | 2 |
| (e) (i) | stops growth/division/protein synthesis; | 1 |
| (ii) | resistance of bacterium; Reject immune can recover with ORT only; | 2 |

11. (a) (i) reaches maximum later/ quicker response/ longer latent period;
higher maximum/ more antibodies (in saliva);
decreases after 6/7 weeks;
ref. comparative figures; 3 max
- (ii) antibodies made of protein; 2 max
required to make new antibodies/ lack of protein/ no or fewer antibodies;
process is energy dependent;

(Total 5 marks)

12. (a)	memory cell;	1
	Allows fast/greater production of antibodies/ secondary immune response will be quicker when encountered again (not: responds quicker unequal.)	1
(b) (i)	Killer cells kill/destroy foreign cells/bacteria/cells infected with virus (not-kills virus/attacks virus infected body cell)	1
(ii)	Phagocytosis/engulf virus or ingests/digests/engulf pathogens	1
(iii)	<u>Stimulate</u> phagocytosis/activity of cell Y/produces more phagocytes (not: triggers....)	1
(c)	<u>Complementary</u> shape of virus and (variable region of) antibody enabling them to join/fit together/Any concept of <u>binding</u> sites	1
		(Total 6 marks)