

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	<u>Plasmodium</u> ;	1	Look for correct spelling of generic name but do not penalise the use of lower case initial letter. We are not looking for specific name(s), so IGNORE species name. So e.g. <i>Plasmodium falciparum</i> should be credited but NOT <i>P. falciparum</i> / <i>P. vivax</i> / <i>P. ovale</i> / <i>P. malariae</i>
1	(a)	(ii)	<u>female</u> <i>Anopheles</i> ;	1	CREDIT phonetic spelling but genus must be correct
1	(a)	(iii)	hepatocyte / liver (cell) ; erythrocyte / red blood (cell) ;	1 max	If a choice of answers is given do not credit unless both are valid. DO NOT CREDIT 'RBC' as this is not a name

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1	(b)	<p>1 <u>humoral</u> response ;</p> <p>2 (B) cell / lymphocyte , has antigen receptor / carries antibody on its surface ;</p> <p>3 specific to / matches / complementary to , only one <u>antigen</u> ;</p> <hr/> <p>4 <u>clonal selection</u> ;</p> <p>5 selection / activation , of , appropriate / specific , B lymphocyte / B cell ;</p> <p>6 by , macrophages / antigen presenting cells / dendritic cells / T helper cells / cytokines / interleukins ;</p> <hr/> <p>7 <u>clonal expansion</u> ;</p> <p>8 (selected cell) divides by mitosis / clones ;</p> <hr/> <p>9 (B) cell , differentiate / specialise ;</p> <p>10 (B cells) form , plasma / effector , cells ;</p> <p>11 (which) secrete / produce , antibodies ;</p> <p>12 antibodies are , specific / complementary , to <u>antigen</u> ;</p> <p>13 (B cells) form memory cells ;</p> <p>14 Either (memory cells) long-lived / remain in circulation / remain in body / provide immunological memory or (provides) secondary response or faster / stronger , response to subsequent exposure (of same antigen / pathogen / parasite) ;</p>	7 max	<p>ACCEPT 'forms antigen-antibody complex'</p> <p>DO NOT CREDIT ref to disease alone</p>
		<p>QWC ~ correct sequence ;</p>	1	<p>Clonal selection, then clonal expansion, then differentiation (stages named or described)</p> <p>Use the QWC tool to indicate these in the correct sequence and add 1 mark to the 7max for content when all 3 stages have been addressed in the correct sequence.</p>

Question	Expected Answers	Marks	Additional Guidance
1 (c)	<p><i>Assume that candidates are answering in terms of a person <u>leaving</u> the malarial area (unless otherwise stated).</i></p> <p>no repeat infections / no further exposure (to antigen / pathogen / parasite) ; no booster / lose immunological memory ;</p> <p>limited life for memory cells / numbers of memory cells reduce / memory cells lost ; so no , secondary response / secondary response described ;</p>	2 max	<p>DO NOT CREDIT disease / malaria / bacterium / virus</p> <p>CREDIT converse points if they answer the question in the context of a person <u>staying</u> in the malarial area. e.g. repeat infections ; maintain immunological memory ; memory cells present ; secondary response available ;</p>

Question	Expected Answers	Marks	Additional Guidance
(d)	<p>different , strains / species / types (of <i>Plasmodium</i>) ; different antigens ; due to , mutation / variation ;</p> <p>more than one stage in the life cycle (within human) ; different stages have different antigens ;</p> <p>so will need , a different vaccine / components of vaccine , for each , strain / stage ;</p> <p>(parasite) concealed / hidden , in cells ; (parasite) only , exposed / in circulation , for short time ;</p> <p>AVP ;</p>	3 max	<p>DO NOT CREDIT 'disease' or 'malaria' unqualified Max 2 if they think it is a virus / bacterium</p> <p>'different strains will require different vaccines' = 2 (mp 1 & 6)</p> <p>CREDIT antigenic concealment</p> <p>e.g. antigenic , shift / drift eukaryotes have greater capacity for variation antigens (on parasite) change over time when in human</p>
Total		16	

Question		Answer	Marks	Guidance	
2	(a)		3	DO NOT CREDIT if letter is unclear DO NOT CREDIT if more than one letter is given DO NOT CREDIT if an incorrect letter is given DO NOT CREDIT if an incorrect letter is given	
		Characteristics are passed on to the next generation			W ;
		There is a struggle for existence			Y and Z ;
		Individuals with beneficial characteristics are among the few who survive			X and Y and Z ;
	(b)	MRSA / it, is harder to treat / may become untreatable ; potential for, disease outbreak / epidemic / pandemic / killing many people ; developing new / more powerful, <u>antibiotics</u> , is expensive / takes time ;	2 max	ACCEPT MRSA / it, can't be killed (by antibiotics) ACCEPT antibiotics will no longer work on, MRSA / it IGNORE new antibiotics are hard to discover	

Question			Answer		Marks	Guidance
2	(c)		1	fossils show that organisms have changed over time ;	3	1 CREDIT many fossil organisms dissimilar from modern organisms 2 ACCEPT idea of fossils in chronological order 3 e.g. <i>Archaeopteryx</i> / <i>Tiktaalik</i> / horse 3 general trend from, small / simple, to, large / complex
			2	<i>idea that</i> fossils or rocks can be dated ;		
			3	<i>idea of</i> fossils showing intermediate forms / sequences ;		
			Total		8	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	genes / genetic / mutation ; environment(al) ;	2	Mark the first answer on each line IGNORE inherited / DNA
3	(a)	(ii)	1 no defined categories ; 2 range of values / intermediate values ; 3 influenced by, environment / many genes / genes and environment ; 4 quantitative / has to be measured / cannot be counted ;	3 max	2 ACCEPT ref to bell-shaped curve / binomial distribution 3 ACCEPT any ref to 3 or more genes 4 ACCEPT metric
3	(a)	(iii)	B ;	1	DO NOT CREDIT if more than one letter is given
3	(a)	(iv)	1 growth too rapid ; 2 increased susceptibility to, disease / named abnormality ; 3 <u>inbreeding</u> ; 4 reduces <u>gene pool</u> / <u>genetic</u> variation / <u>genetic</u> diversity ;	2 max	2 e.g. bone / skeletal abnormalities or low immunity 3 DO NOT CREDIT if implies inbreeding causes mutations 4 IGNORE refs to biodiversity

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3	(a)	(v)	<p>1 maintain biodiversity ;</p> <p>2 aesthetic (reasons) / tourism ;</p> <p>3 ethical (reasons) ;</p> <p>4 part of a food chain / web ;</p> <p>5 maintain / increase <u>gene pool</u> ;</p> <p>6 genetic resource / availability to breed with domestic chickens ;</p>	2 max	<p>3 ACCEPT religious</p> <p>4 ACCEPT food source for local population</p> <p>6 CREDIT description, e.g. 'source of desirable genes' or 'source of genetic variation'</p> <p>6 ACCEPT specific example of genetic resource e.g. disease resistance / strong bones / longevity / heat tolerance / idea of domesticating wild population</p>

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3	(b)	(i)	<p>1 reduces / prevents (infectious) disease ;</p> <p>2 prevent, problems / named problem, with gut ;</p> <p>3 digest food more, efficiently / easily / quickly ;</p> <p>4 greater proportion of, food / energy, can contribute to growth ;</p> <p>5 reduce risk of transmitting, pathogens / named pathogen, to humans ;</p>	2 max	<p>Mark the first two answers only</p> <p>1 IGNORE illness</p> <p>2 e.g. diarrhoea</p> <p>4 ACCEPT faster growth as AW for contribute to growth 4 IGNORE larger chickens</p> <p>5 ACCEPT 'meat less likely to be infected with bacteria'</p>
3	(b)	(ii)	<p>1 (antibiotic) resistant, pathogens / bacteria ;</p> <p>2 antibiotics kill useful, <u>bacteria</u> ;</p> <p>3 <i>idea of:</i> antibiotic passing into <u>human</u> food ;</p>	1 max	<p>1 ACCEPT microorganisms / microbes 1 IGNORE germs 1 DO NOT CREDIT immune</p> <p>2 DO NOT CREDIT if any ref to viruses</p>
			Total	13	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	X ;	1	
4	(a)	(ii)	<p>1 substrate / PABA, and, inhibitor / sulfonamide, similar shape;</p> <p>2 able to, bind / fit into / block, <u>active site</u> ;</p> <p>3 (shape) <u>complimentary</u> to <u>active site</u> ;</p> <p>4 both have, hex / benzene / 6-C, (ring) ;</p> <p>5 both have, NH₂ / amine ;</p> <p>6 correct ref to a difference between sulfonamide and PABA ;</p>	3 max	<p>1 ACCEPT similar structure DO NOT CREDIT same shape</p> <p>3 DO NOT CREDIT refs to PABA and sulfonamide being complementary to each other or to the enzyme (alone)</p> <p>6 e.g. only sulfonamide contains S sulfonamide has 1 more NH₂ group sulfonamide has SONH₂ but PABA has N₂ only PABA has COOH group</p>
4	(b)	(i)	<p><i>without inhibitor</i></p> <p>1 more, PABA / substrate, molecules enter <u>active site</u> ;</p> <p>2 more, enzyme substrate complexes / ESCs, formed ;</p> <p>3 at low concentration not all active sites occupied / at high concentration all active sites occupied ;</p> <p>4 achieves / reaches, max (turnover) rate / V_{max} ;</p> <p>5 (at high substrate concentration) enzyme concentration limiting ;</p>	3 max	<p>1 ACCEPT more successful collisions between substrate and active site</p> <p>3 ACCEPT active sites filled / no free active sites DO NOT CREDIT active sites run out</p> <p>4 ACCEPT 'cannot work any quicker' DO NOT CREDIT 'optimum rate' or 'rate levels off'</p>

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4	(b)	(ii)	<p><i>with inhibitor</i></p> <p>1 inhibitor / sulfonamide, can, fit / block / bind to / compete for, <u>active site</u> ;</p> <p>2 (occupies it) for a short time / temporary / reversibly ;</p> <p>3 fewer active sites available (for substrate) / AW ;</p> <p>4 (idea of) more substrate reduces chance of inhibitor getting in;</p>	2 max	<p>3 ACCEPT substrate can't access active site</p> <p>4 ACCEPT more ESC formed in context of overcoming inhibition / substrate can out-compete inhibitor</p>
4	(c)		<p>1 mutation ;</p> <p>2 sulfonamide is <u>selective</u>, agent / pressure ;</p> <p>3 resistant survive / non resistant die ;</p> <p>4 (resistance) allele / gene / mutation, passed to, offspring / next generation ;</p> <p>5 (happens) over many generations ;</p> <p>6 AVP ;</p>	4 max	<p>DO NOT CREDIT immune for any mark point</p> <p>3 IGNORE refs to (survivors) breed / reproduce ;</p> <p>5 IGNORE refs to time. Look for generations</p> <p>6 e.g. mutation is, random / spontaneous allele / gene, passed on by, plasmids / horizontal transmission</p>
4	(d)	(i)	<p><u>bacteria</u>, killed / destroyed / cannot grow / lyse, in presence of antibiotic ;</p>	1	<p>DO NOT CREDIT 'antibiotic works better' or 'there are no bacteria there' or 'bacteria are broken down'</p>
4	(d)	(ii)	streptomycin ;	1	IGNORE '4' as it is the number rather than the name

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4	(d)	(iii)	<p>1 cheap / AW ;</p> <p>2 (test is) quick to carry out / (deals with several antibiotics) at same time / AW ;</p> <p>3 (idea of) allowing early treatment of patient ;</p> <p>4 (idea of) compares antibiotics under same conditions ;</p> <p>5 (correct antibiotic first time) to prevent antibiotic resistance developing ;</p>	3 max	<p>DO NOT CREDIT responses which simply refer to selecting the best antibiotic</p> <p>2 DO NOT CREDIT speed of antibiotic action</p>
4	(e)		<p>(new) drugs come from (named) organisms ;</p> <p>biodiversity is reducing ;</p> <p>habitats / named habitat, destroyed / lost ;</p> <p><u>reason</u> for habitat destruction ;</p>	2 max	<p>ACCEPT plants / animals / fungi / species / etc.</p> <p>ACCEPT deforestation / natural environment <u>lost</u></p> <p>e.g. global warming logging fuel crops construction / industrialisation mining fishing pollution tourism</p> <p>ACCEPT any other valid reason that will destroy natural habitats but not general statements such as 'human development' or 'business'</p>
			Total	20	