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. *Plasmodium falciparum* should be credited but **NOT** *P. falciparum* / *P. vivax* / *P. ovale* / *P. malariae*
1	(a)	(ii)	<u>female</u> *Anopheles* **;**	**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

Question			Expected Answers	Marks	Additional Guidance
1	(b)	1	humoral response ;		
		2	(B) cell / lymphocy , has antigen receptor / carries antibody on its surface ;		
		3	specific to / matches / complementary to , only one antigen ;		
		4	clonal selection ;		
		5	selection / activation , of , appropriate / specific , B lymphocyte / B cell ;		
		6	by , macrophages / antigen presenting cells / dendritic cells / T helper cells / cytokines / interleukins ;		
		7	clonal expansion ;		
		8	(selected cell) divides by mitosis / clones ;		
		9	(B) cel , differentiate / specialise ;		
		10	(B cells) form , plasma / effector , cells ;		
		11	(which) secrete / produce , antibodies ;		**ACCEPT** 'forms antigen-antibody complex'
		12	antibodies are , specific / complementary , to antigen ;		
		13	(B cells) form memory cells ;		
		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) ;	**7 max**	**DO NOT CREDIT** ref to disease alone
			QWC ~ correct sequence ;	**1**	Clonal selection, then clonal expansion, then differentiation (stages named or described) 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.

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

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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><td>Characteristics are passed on to the next generation</td><td>W</td><td>;</td></tr>
<tr><td>There is a struggle for existence</td><td>Y and Z</td><td>;</td></tr>
<tr><td>Individuals with beneficial characteristics are among the few who survive</td><td>X and Y and Z</td><td>;</td></tr>
</table>
</td><td>3</td><td>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</td></tr>
<tr><td></td><td>(b)</td><td></td><td>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 ;</td><td>2 max</td><td>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</td></tr>
</table>

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	*idea that* fossils or rocks can be dated **;**		**2 ACCEPT** idea of fossils in chronological order
			3	*idea of* fossils showing intermediate forms / sequences **;**		**3** e.g. *Archaeopteryx* / *Tiktaalik* / horse **3** general trend from, small / simple, to, large / complex
				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 2 3 4	no defined categories ; range of values / intermediate values ; influenced by, environment / many genes / genes and environment ; 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 2 3 4	growth too rapid ; increased susceptibility to, disease / named abnormality ; <u>inbreeding</u> ; 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

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

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

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	X ;	1	
4	(a)	(ii)	**1** substrate / PABA, **and**, inhibitor / sulfonamide, similar shape**;** **2** able to, bind / fit into / block, active site **;** **3** (shape) complimentary to active site **;** **4** both have, hex / benzene / 6-C, (ring) **;** **5** both have, NH_2 / amine **;** **6** correct ref to a difference between sulfonamide and PABA **;**	**3 max**	**1 ACCEPT** similar structure **DO NOT CREDIT** same shape **3 DO NOT CREDIT** refs to PABA and sulfonamide being complementary to each other or to the enzyme (alone) **6** e.g. only sulfonamide contains S sulfonamide has 1 more NH_2 group sulfonamide has $SONH_2$ but PABA has N_2 only PABA has COOH group
4	(b)	(i)	*without inhibitor* **1** more, PABA / substrate, molecules enter active site **;** **2** more, enzyme substrate complexes / ESCs, formed **;** **3** at low concentration not all active sites occupied / at high concentration all active sites occupied **;** **4** achieves / reaches, max (turnover) rate / V_{max} **;** **5** (at high substrate concentration) enzyme concentration limiting **;**	**3 max**	**1 ACCEPT** more successful collisions between substrate and active site **3 ACCEPT** active sites filled / no free active sites **DO NOT CREDIT** active sites run out **4 ACCEPT** 'cannot work any quicker' **DO NOT CREDIT** 'optimum rate' or 'rate levels off'

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

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