

F212 Molecules, Biodiversity, Food and Health

Question		Expected Answers	Marks	Additional Guidance		
1	(a)	double helix ; anti-parallel ; sugar-phosphate ; hydrogen ;	4			
1	(b)	(i)		<p>percentages / amount , C & G similar (in all organisms) ; percentages / amount , A & T similar (in all organisms) ;</p> <p><u>different / named</u> , <u>organisms</u> have different proportions of , bases / named base / AW ;</p> <p>greatest similarity between human and grasshopper ; least similarity between <i>E coli</i> and the other three ; <i>E. coli</i> has similar proportions of all bases / <i>E.coli</i> has <u>slightly</u> more CG than AT / (named) eukaryote has more AT than CG ; comparative figs with units to support any statement ;</p>	3 max	<p>mp 1 & 2 DO NOT CREDIT ref to a single organism mp 1 & 2 IGNORE ref to complementary DO NOT CREDIT statements in context of organism size e.g. statement that human has more A than <i>E. coli</i> / human has the most AT / <i>E. coli</i> has the most CG This mark is for a general statement</p> <p>e.g. human C = 19.8% <u>and</u> G = 19.9% human A = 30.9% <u>and</u> <i>E. coli</i> A = 24.7% 'human has more A (30.9%) than wheat (27.3%)' = 2 (mp 3 & 7)</p>

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1	(b)	(ii)	(suggests) A , bonds / pairs / links / connects / joins , to T ; (suggests) C , bonds / pairs / links / connects / joins , to G ; (suggests) purine bonds to pyrimidine ; (evidence for) complementary base pairing / which bases pair with each other / base pairing rules ; suggests bases point 'inwards' rather than 'outwards' ;	2 max	IGNORE A – T or A = T unqualified IGNORE C – G or C = G unqualified ACCEPT 'bond' instead of 'pair'

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1	(c)	<p>Award 1 mark per correct row</p> <table border="1"> <thead> <tr> <th><i>feature</i></th> <th><i>DNA</i></th> <th><i>RNA</i></th> </tr> </thead> <tbody> <tr> <td><i>number of strands</i></td> <td>two / double</td> <td>one / single</td> </tr> <tr> <td><i>bases present</i></td> <td>thymine / T (+ adenine + cytosine + guanine)</td> <td>uracil / U (+ adenine + cytosine + guanine)</td> </tr> <tr> <td><i>sugar present</i></td> <td>deoxyribose</td> <td>ribose</td> </tr> </tbody> </table>	<i>feature</i>	<i>DNA</i>	<i>RNA</i>	<i>number of strands</i>	two / double	one / single	<i>bases present</i>	thymine / T (+ adenine + cytosine + guanine)	uracil / U (+ adenine + cytosine + guanine)	<i>sugar present</i>	deoxyribose	ribose	3	<p>If a choice of answers is given, do not credit unless both answers are valid (e.g. two and double strands for DNA / ribose and pentose sugar)</p> <hr/> <p>ACCEPT letters instead of names of bases Names of bases must be unambiguous, so DO NOT CREDIT adenosine / thiamine / cysteine / etc. If more bases mentioned than T and U, then all bases must be included</p> <hr/> <p>DO NOT CREDIT dioxyribose / oxyribose/ hexose / sugar IGNORE pentose</p>
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<i>sugar present</i>	deoxyribose	ribose														
1	(d)	<p>carries / transfers, the (complementary DNA) , code / <u>genetic</u> information / copy of gene ; out of the nucleus ; (transfers it) to the, ribosome / RER / site of translation ; for, protein / polypeptide, synthesis ;</p>	2 max	<p>IGNORE transcription DO NOT CREDIT ref to the <u>whole</u> DNA code / molecule</p> <p>ACCEPT 'to make protein'</p>												
Total			14													

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2	(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>
2	(a)	(ii)	<u>female Anopheles</u> ;	1	CREDIT phonetic spelling but genus must be correct
2	(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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2 (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) cells , 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
2	(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>

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2	(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			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	A hydrogen ; B <u>glycosidic</u> ;	2	DO NOT CREDIT 'H bond' as this is not a name Correct spelling only. IGNORE α or β or numbers
3	(a)	(ii)	hydrolysis / addition of water ;	1	
3	(a)	(iii)	β / <u>beta</u> , glucose ;	1	Must be qualified as β or beta or B or b
3	(b)		enzymes are <u>specific</u> ; the , carbohydrate molecules / substrates , are different <u>shapes</u> ; <u>active site</u> and substrate are complementary ; so that substrate will fit / formation of ESC ; lock and key / induced fit ;	3 max	

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3	(c)	(i)	<p>pH <u>much</u> , higher / less acidic , than optimum (for enzyme 2) ;</p> <p>change in charge of active site ; hydrogen / ionic , bonds <u>break</u> ;</p> <p>tertiary structure / 3D shape / active site shape , altered ; enzyme / tertiary structure , <u>denatured</u> ;</p> <p>substrate no longer fits active site / ESC does not form ;</p>	3 max	<p>Needs idea of <u>much</u> greater or <u>too</u> high DO NOT CREDIT just 'higher than' or 'above' DO NOT CREDIT too / more , alkaline</p> <p>DO NOT CREDIT peptide / disulphide , bonds break DO NOT CREDIT in context of heat / vibration IGNORE ref to denaturing active site IGNORE ref to denaturing active site DO NOT CREDIT kill / die 'substrate doesn't bind to enzyme' is not quite enough</p>
3	(c)	(ii)	<p><i>Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers</i></p> <p>temperature ; substrate <u>concentration</u> ; enzyme <u>concentration</u> ;</p>	2 max	IGNORE ref to time

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3 (d)	<p>Marking points 2 – 6 can be applied to the standard solutions or the sample</p> <p>1 using , standard / known , concentrations (of reducing sugar) ;</p> <p>2 <u>heat</u> with , Benedicts (solution) / $\text{CuSO}_4 + \text{NaOH}$;</p> <p>3 (use of) same volumes of solutions (each time) ;</p> <p>4 (use of) excess Benedicts ;</p> <p>5 changes to , green / yellow / orange / brown / (brick) red ;</p> <p>6 remove precipitate / obtain filtrate ;</p> <p>7 calibrate / zero , colorimeter ;</p> <p>8 using , a blank / water / unreacted Benedicts ;</p> <p>9 use (red) filter ;</p> <p>10 reading of , transmission / absorbance ;</p> <p>11 more transmission / less absorbance , of filtrate = more sugar present ; ora</p> <p>12 (obtain) <u>calibration</u> curve ;</p> <p>13 <u>plotting</u> , transmission / absorbance , against (reducing) sugar concentration ;</p> <p>14 use reading of unknown sugar solution and read off graph to find conc. ;</p>	6 max	<p>e.g. serial dilutions</p> <p>ALLOW boil / $> 80^\circ\text{C}$ DO NOT CREDIT warm DO NOT CREDIT amount / quantity</p> <p>CREDIT description of method e.g. filtering / centrifuging & decanting</p> <p>ACCEPT 'measure how much light , does / does not , pass through'</p> <p>If precipitate is clearly indicated as being present in sample, ALLOW 'less transmission / more absorbance , = more sugar present'</p>
	Total	18	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	likely to become extinct / on the verge of extinction / numbers are not sustainable / numbers too low for survival of species / numbers drop below 10% of (original) population ;	1	DO NOT CREDIT 'may' / 'might' / 'could' become extinct CREDIT 'die out' or 'wiped out' instead of extinct
4	(a)	(ii)	133 333 ; ;	2	Award 2 marks for a correct answer, even if no working shown. ALLOW 1 mark for seeing 133 333.3333... if answer is incorrectly rounded or not rounded to a whole number. If the answer is incorrect ALLOW 1 mark for $\frac{4000 \times 100}{3}$
4	(b)	(i)	painkiller still being used ; <i>in captivity – allow reverse argument for in the wild</i> fed uncontaminated food / keep away from painkiller ; health of individuals monitored / treated for disease ; eggs (artificially) incubated / young hand reared ; reduced mortality of young ; provision of mate / females breeding can be manipulated ; protection , from hunting / predation ; competition reduced (between , individuals / species) ;	4 max	IGNORE ref to controlling diet or nutrition e.g. hormones / artificial insemination / artificial selection 'safer environment' is not quite enough

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4	(b)	(ii)	<p>maintain / increase , <u>genetic</u> variation / gene pool ;</p> <p>reduce risk of , inbreeding / breeding between related birds ; different 'races' of vulture in different areas / geographical variation / different subspecies ; less likely all contaminated with painkiller ; less risk of losing all individuals due to , disease / natural disaster / human action ;</p>	3 max	<p>In the context of the vultures, rather than 'biodiversity' CREDIT different alleles DO NOT CREDIT different genes CREDIT ora for idea of promoting outbreeding ALLOW ref to types of (white-backed) vulture</p>
4	(c)		<p>reason or explanation ; ; ;</p> <p><i>Suitable examples include but are not limited to:</i></p> <ul style="list-style-type: none"> • maintains biodiversity • part of food chain / part of ecosystem / part of food web / scavengers • have a right to existence / moral reason • specific religious reason • give pleasure / beautiful creatures • ecotourism • useful product / source of medicine / medical research • genetic resource • saves clearing up / remove carcasses • prevents disease • keeps , rat / dog , population down 	3	<p>CREDIT any three valid suggestions. <i>Ignore the numbers on the answer lines.</i> <i>Mark as prose and award points as they arise.</i></p> <p>The idea of research must be qualified</p>

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5	(a)	(i)	nucleus / nuclei ;	1	<i>If more than 1 answer given = 0</i>
5	(a)	(ii)	<i>mildew ...</i> (usually) chitin / not cellulose (cell) , wall ; <u>external</u> digestion / secretes enzymes <u>externally</u> ; heterotrophic / saprophytic / saprotrophic / saprobiont ; no , plastids / chloroplasts / amyloplasts ; spores ; hyphae / mycelium ; multi-nucleate / coenocytic / aseptate ;	2 max	<i>If 1st statement INCORRECT, max 1</i> Must be external or outside or equivalent CREDIT syncytium / syncytial
5	(a)	(iii)	<i>pear tree ...</i> <u>cellulose</u> cell walls ; multicellular ; has , chloroplasts / plastids / chlorophyll / photosynthetic pigment ; (photo)autotrophic / <u>performs</u> photosynthesis ;	2 max	<i>If 1st statement INCORRECT, max 1</i> IGNORE any references to vacuoles or other organelles 'makes its own food' is not enough
5	(a)	(iv)	Proto <u>ct</u> ista / Proto <u>ct</u> ist(s) ; Animalia / animal(s) ;	2	CREDIT in either order DO NOT CREDIT Protista / Protist <i>look for the 'c'</i>

Question			Expected Answers	Marks	Additional Guidance
5	(b)	(i)	<p><u>discontinuous</u> ;</p> <p>single / few , genes ;</p> <p><u>qualitative</u> ;</p> <p>discrete categories / either low or high resistance / no intermediates ;</p> <p>no / small / little , environmental effects ;</p>	<p>1</p> <p>2 max</p>	<p>CREDIT at any point in the answer</p> <p>IGNORE genetic</p> <p>CREDIT a description of discontinuous variation (to max 2) even if the type of variation given is incorrect.</p> <p>CREDIT '<u>large</u> / only , genetic effect'</p>
5	(b)	(ii)	<p>artificial <u>selection</u> / <u>selective</u> breeding ;</p> <p>cross / breed , Iranian / resistant , wheat with , high yield / UK , wheat ;</p> <p>method to prevent self , pollination / fertilisation ;</p> <p>select , best offspring / offspring with good yield <u>and</u> resistant ;</p> <p>(back) cross to high yield (UK) wheat / interbreed best offspring / interbreed offspring with both characteristics ;</p> <p>idea of breeding (and selecting) for many generations ;</p>	<p>3 max</p>	<p>IGNORE country incorrectly linked to characteristic as long as the correct cross has been described</p> <p>e.g. removing anthers / bag stigma</p>

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5	(c)	<p>genetic variation ;</p> <p>(due to) mutation ; (mutation is) spontaneous / random / pre-existing ;</p> <p>(due to) <u>sexual</u> reproduction ; mildew fungus produces large numbers of , spores / gametes / offspring ;</p> <p>wheat resistance acts as a <u>selection pressure</u> ; (individuals that overcome resistance) have selective advantage / are more likely to survive ; pass on , mutation / (mutated) allele (to offspring) ;</p> <p>increase in allele frequency (of allele to overcome resistance) ;</p>	4 max	<p>IGNORE 'survival of the fittest' as this is not an explanation</p> <p>CREDIT ora for those with selective disadvantage</p> <p>ALLOW gene DO NOT CREDIT characteristic / ability</p>
		Total	17	