



EXAM PAPERS PRACTICE

Voice of the Genome -4

Name: _____

Class: _____

Date: _____

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also

Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Voice of the Genome -4

Type: Mark Scheme

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful



Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none">• hydrophilic region (of phospholipid) orientated towards water (1)• (and) hydrophobic regions away from the water (1)• (but need the two layers as) { water-based / aqueous } solution either side of the cell membrane (1)	<p>ALLOW phosphate head / polar region</p> <p>ALLOW hydrocarbon chain / fatty acid tails</p> <p>e.g. separating tissue fluid from cytoplasm</p>	(3)

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none">• increased diffusion distance / decreased surface area (1)• reduced (rate of) gas exchange (1)		(2)



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Q3.

Question Number	Answer	Mark
(i)	<p>The only correct answer is C – polynucleotides and phospholipids</p> <p><i>A is incorrect because phosphate is not in cellulose</i></p> <p><i>B is incorrect because polysaccharides do not contain phosphate</i></p> <p><i>D is incorrect because phosphate is not in polysaccharides</i></p>	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>An explanation that makes reference to three of the following</p> <ul style="list-style-type: none">• the stems contain starch or cellulose(1)• enzymes are { secreted / released } by the microorganisms (1)• which break down the glycosidic bonds(1)• which releases glucose that is used by the microorganisms in respiration (1)	<p>ALLOW lignin</p> <p>ALLOW enzymes from microorganisms digest(starch/ cellulose)</p>	(3)

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Q4.

Question number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none">values substituted into the equation (1)correct answer (1)	<u>Example of calculation:</u> $(30 \times 9) \div 0.5$ $= 540$ Correct answer with no working gains full marks	(2)
(ii)	<ul style="list-style-type: none">calculation of the difference using the value from (i) (1)correct answer (1)	<u>Example of calculation:</u> $2124 - 540 (= 1584)$ $1584 / 2124 \times 100 = 74.6\% \text{ or } 75\%$ ECF full marks if calculated correctly for value other than 540 Correct answer with no working gains full marks	(2)



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Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	A (K)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	C (M)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	D (N)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(iv)	<ul style="list-style-type: none">measures width on diagram (1)correct answer (1)	<p><u>Example of calculation</u> (500 x width of K) ÷ length of bar = 940 nm</p> <p>Allow full marks for correct answer with no working</p>	(2)



Q6.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to the following</p> <ul style="list-style-type: none">• oxygen enters the cells by diffusion (1)• change in shape {reduces surface area to volume ratio /increases diffusion distance} (1)• therefore gas exchange decreases / less oxygen enters the cells (1)		(3)





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Q7.

Question Number	Answer	Additional guidance	Mark
	<p>An answer the makes reference to four of the following:</p> <ul style="list-style-type: none">• both have same volume (1)• animal A has a larger surface area (1)• animal A has a larger surface area to volume ratio (1)• so sufficient (surface area in animal A) for diffusion (1)• distance to cells in centre of A is shorter than for B allowing {quicker/sufficient} diffusion / shorter diffusion distance (in A) (1)	<p>ALLOW both have a volume of 64 mm^3</p> <p>ALLOW converse ALLOW figures given (e.g. 168 mm^2 v 96 mm^2) or difference given as 72 mm^2</p> <p>ALLOW {168:64 / 2.6:1} compared to {96:64 / 1.5:1}</p> <p>ALLOW converse</p> <p>ALLOW converse</p>	<p>(4)</p>



Q8.

Question Number	Answer	Mark
	<p>The only correct answer is A - DNA which codes for a different amino acid</p> <p><i>B is incorrect because DNA does not code for monosaccharides</i></p> <p><i>C is incorrect because the change is not in RNA</i></p> <p><i>D is incorrect because the change is not in RNA and it does not code for monosaccharides</i></p>	(1)

Q9.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to the following</p> <ul style="list-style-type: none">• siRNA binds to the mRNA (from the mutated allele) (1)• mRNA cannot bind to ribosome (1)• tRNA is prevented from binding with mRNA(1)• {polypeptide / protein} not synthesised (1)• (no development of porphyria) as the faulty enzyme is not produced (1)	<p>ALLOW amino acids not brought to mRNA</p> <p>ALLOW functioning gene transcribed instead</p>	Expert (4)



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Q10.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	{Met Gly Ile} / {methionine glycine isoleucine} ;	Not other abbreviations	(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	idea that each {triplet is discrete / base is only used once in a triplet / eq} ;	Accept a description of how the code could be read if overlapping	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	<ol style="list-style-type: none">idea that each amino acid needs a code ;idea that {using three bases give enough codes / using less bases does not give enough codes} ;idea of three bases means there can be 64 {triplets / codes / combinations / eq} ;	Accept codons	(2)



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Question Number	Answer	Additional Guidance	Mark
(b)(ii)	<ol style="list-style-type: none">1. idea that {effects of mutations are reduced / the amino acid may not be altered} ;2. reference to the third base (being the one that can be changed with no effect) ;3. no effect on (resulting) {polypeptide / protein} / eq ;	<p>1. Accept description of effect Accept from a description of a specific example Accept always results in same amino acid Not similar amino acid</p> <p>2 NB If mp 2 is awarded it will usually incorporate mp 1 as well = 2 marks</p>	(2)
Question Number	Answer	Additional Guidance	Mark
(c)	<ol style="list-style-type: none">1. reference to (TAA, TAG and TGA as) stop codons ;2. occur at the end of the gene (on the DNA) / eq ;3. reference to transcribed as mRNA / eq ;	<p>1. Not codes, triplets</p>	



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	<ol style="list-style-type: none">as AUU, AUC and ACU ;idea that they are recognised by ribosome ;idea that they signal the end of the polypeptide (chain) ;reference to (during) translation ;	<p>6. Accept stops the synthesis of the polypeptide / the polypeptide is finished</p>	(4)
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Question Number	Answer	Additional Guidance	Mark
(d)	<ol style="list-style-type: none">ref to peptide {bond / link} ;between (amino group / NH_3 / NH_4^+) and {carboxyl group / COOH / COO^-} ;ref to condensation (reaction) ;idea of role of {tRNA / ribosome / enzymes / correctly named enzyme} in joining amino acids together ;	<p>Accept mp 1 and 2 from correctly drawn and labelled diagram</p> <p>2. NB formulae must be correct if only these are given</p> <p>4. Accept e.g. hold the amino acids next to each other, ribosome contains enzyme</p>	(3)

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Q11.

Question Number	Answer	Additional Guidance	Mark
(a)	A = adenine C = cytosine G = guanine T = thymine ;	Accept reasonable phonetic spellings Not: adenosine cysteine glycine thiamine, thyosine, tyrosine	(1)
(b)(i)	1. idea that each amino acid is coded for by three {nucleotides / bases} ; 2. credit quoted example / idea that 12 {nucleotides / bases} code for 4 amino acids ;	Accept in context of RNA AAT / AAC = leucine, CAG = valine, TTT = lysine	(2)
(b)(ii)	1. idea that each {triplet is discrete / each base is only used once in a triplet / eq } ; 2. idea that AAT + AAC + CAG + TTT gives 4 (distinct) {triplets / codes} ;	Accept a specific example eg the first T can only be used in code for first leucine Accept a description of how the code could be read if overlapping	(2)
(b)(iii)	1. idea that more than one code can be used for a {particular amino acid/ stop code} ; 2. AAT and AAC code for leucine ;	Accept more codes than are needed to code for all the amino acids (and stop code)	(2)
(c)	B ;		(1)



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Question Number	Answer	Additional Guidance	Mark
*(d)	<p>QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</p> <ol style="list-style-type: none"> reference to mRNA with sequence UUA UUG GUC AAA ; idea that ribosome is involved ; idea that each tRNA molecules is attached to one (specific) amino acid ; credit example of tRNA anticodon with specific amino acid reference to anticodons on tRNA {bind / link to / line up against / eq} codons on mRNA ; credit a specific example (from this DNA) ; idea of hydrogen bonds between bases (of tRNA and mRNA) ; reference to formation of peptide {bonds / links} between (adjacent) amino acids ; 	<p>QWC emphasis is logical sequence NB The mps do not have to be given in this order necessarily</p> <p>Not tRNA carries amino acids</p> <p>AAU /AAC = leucine, CAG = valine, UUU = lysine</p> <p>Ignore complementary</p> <p>eg UUA codon and AAU anticodon</p> <p>Accept between codon and anticodon</p>	(5)

Q12.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> low blood glucose levels (1) less glucose for respiration (1) less { energy / ATP } in muscle tissue (1) 		(3)



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Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: <ul style="list-style-type: none">• range of enzyme concentration (1)• control of other named variables (1)• measurement of rate of glucose production (1)	e.g. temperature, pH, concentration of substrate	(3)

Q13.



Question Number	Answer	Additional Guidance	Mark
(a)	<ol style="list-style-type: none">1. proteins consist of amino acids joined together by peptide bonds;2. credit reference to named bonds (between R groups) involved in holding {3D structure / eq} ;3. carbohydrates consist of {monsaccharides / glucose / eq} ;4. reference to glycosidic {bonds / eq} between (adjacent) {glucose / eq} molecules ;		(3)



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Question Number	Answer	Additional Guidance	Mark
(b)	<ol style="list-style-type: none">idea that the drugs could {bind to / alter shape of} {glycoproteins / gp120} ;idea that drugs bind to {receptors / antigens} on membrane / eq ;called CD4 (antigen / molecules) ;preventing virus attaching to T (helper / CD4⁺) cells / eq ;		(3)

Question Number	Answer	Additional Guidance	Mark
*(c)	<p>(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none">reference to reverse transcriptase ;idea of formation of (viral) DNA ;from (viral) RNA ;reference to integrase ;idea of integration of (viral) DNA into (host) DNA ;idea that {T helper cells / eq} would be {destroyed / killed / burst / eq} (by virus particles leaving cell) ;idea that more T (helper) cells would become infected ;	<p>QWC focussing on clarity of expression</p> <ol style="list-style-type: none">reject idea that RNA is {turned into / converted into} DNAACCEPT idea of {latency / formation of provirus / eq}	(5)



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Q14.

Question Number	Answer	Additional Guidance	Mark
(a)	<ol style="list-style-type: none">1. (structure G is {glycoprotein / gp120} ;2. used for {attachment / eq} to CD4 (molecules / receptors /antigens) ;3. on T helper {cells / lymphocytes} ;	<ol style="list-style-type: none">1. IGNORE gp 41 and gp 160 and other wrong numbers3. ACCEPT macrophages / dendritic cells / CD4 cells	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	<ol style="list-style-type: none">1. they are globular proteins ;2. it has an active site ;3. idea of {charged R groups on outside of molecules / composed of many small R groups} ;	<ol style="list-style-type: none">2. idea of active site R groups enable binding of substrate3. idea of hydrophilic on the outside	(3)



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Question Number	Answer	Additional Guidance	Mark
* (b)(ii)	<p>(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none">1. idea that drugs would prevent viral replication ;2. idea that T (helper) {cells / lymphocytes} will not be { killed / burst / destroyed}(by virus particles leaving cell) ;3. idea of {inhibition / eq} of reverse transcriptase ;4. idea that (viral) DNA could not be made;5. from the (viral) RNA ;6. idea of {inhibition / eq} of integrase ;7. idea that (viral) DNA cannot integrate into (host) {DNA / genome} / eq ;	<p>QWC emphasis on clarity of expression</p> <ol style="list-style-type: none">1. ACCEPT description of virus formation3. ACCEPT drugs prevent action of reverse transcriptase4. reject idea that RNA is {turned into / converted into} DNA6. ACCEPT drugs prevent action of integrase7. ACCEPT idea that drugs would prevent {latency / formation of provirus / eq} ;	<p>(5)</p>



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Q15.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to four of the following:</p> <ul style="list-style-type: none">• the structure of the enzyme is determined by the sequence of amino acids (1)• { tertiary structure / globular shape } provides an active site (1)• active site complementary to { (part of) phospholipid / ester bond } (1)• to break { ester bonds / bonds between glycerol and fatty acids } (1)• relevant detail concerning bonding { within the enzyme molecule / between enzyme and substrate } (1)	<p>ALLOW primary structure for sequence of amino acids</p> <p>e.g. hydrophilic R groups / hydrophobic R groups</p>	<p>(4)</p>



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Q16.

Question Number	Answer	Mark
(i)	<p><i>The only correct answer is D because there is RNA in the cytoplasm, nucleus and mitochondria 1, 2 and 3</i></p> <p><i>A is incorrect because there is also RNA in the nucleus and mitochondria</i></p> <p><i>B is incorrect because there is also RNA in the nucleus</i></p> <p><i>C is incorrect because there is also RNA in the cytoplasm (as tRNA, mRNA or in ribosomes)</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to two of the following:</p> <ul style="list-style-type: none">• (lactate is) { oxidized to form / converted to } pyruvate (1)• (pyruvate is) converted to { glucose / glycogen } (1)• (pyruvate / glucose) used in respiration (1)	<p>ALLOW glucose produced from the lactate</p> <p>ALLOW correct named stage e.g. glycolysis for glucose or link reaction for pyruvate</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none">• dipeptide correctly drawn with peptide bond (1)• water molecule released (1)		(2)



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Q17.

Question Number	Answer	Mark
(i)	<p><i>The only correct answer is B 3 and 4 only</i></p> <p><i>A is incorrect because 1 and 2 do not transport charged molecules or ions across membranes</i></p> <p><i>C is incorrect because 1 and 2 do not transport charged molecules or ions across membranes and 4 does transport</i></p> <p><i>D is incorrect because 1 and 2 do not transport charged molecules or ions across membranes</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p><i>The only correct answer is D 1, 2, 3 and 4</i></p> <p><i>A is incorrect because 3 and 4 also have both these regions</i></p> <p><i>B is incorrect because 1 and 2 also have both these regions</i></p> <p><i>C is incorrect because 4 also has both these regions</i></p>	(1)

Question Number	Answer	Mark
(iii)	<p>D - $\times 5\,000\,000$</p> <p><i>The only correct answer is D – $(2.5 \div 5) \times 10^7$</i></p> <p><i>A is incorrect</i></p> <p><i>B is incorrect</i></p> <p><i>C is incorrect</i></p>	(1)



Q18.

Question Number	Answer	Mark
(i)	<p>The only correct answer is B - $2.5 \times Q$</p> <p><i>The only correct answer is B because 50% of the base pairs are A-T with 2 hydrogen bonds and 50% C-G with 3 hydrogen bonds making a mean of $2.5 \times Q$</i></p> <p><i>A is incorrect because $2.0 \times Q$ is only correct if all base pairs were A-T</i></p> <p><i>C is incorrect because it assumes that each base in a pair has 4 hydrogen bonds and all the base pairs are A-T</i></p> <p><i>D is incorrect because it assumes that each base in the A-T base pair has 4 hydrogen bonds and each base in the G-C has 6 hydrogen bonds</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none">• (different mutations) will have different effects on the protein produced (1)• chloride ion transport affected by the extent of changes to the (CFTR) protein (1)• varying the { stickiness / thickness } of the mucus (1)	<p>ALLOW absence of protein / different { folding / tertiary structure / shape } of the protein</p> <p>ALLOW faulty CFTR protein has less impact on chloride ion transport than a missing CFTR protein</p>	(2)



Q19.

Question number	Answer	Mark
	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>Reference to role of ions in</p> <ul style="list-style-type: none">• nerve conduction• release of neurotransmitters• muscle contraction <p>Mention of</p> <ul style="list-style-type: none">• passive diffusion through ion channels• active transport against concentration gradients <p>Examples of ion transport</p> <ul style="list-style-type: none">• active transport – sodium potassium pump• hydrogen ions in chemiosmosis• calcium channels in pre-synaptic knob• sodium and potassium channels in neurones <p>Idea that ions moving down a concentration gradient can do work</p> <ul style="list-style-type: none">• ATP synthase in chemiosmosis• cotransporters <p>Ion channels in disease</p> <ul style="list-style-type: none">• chloride channels in cystic fibrosis• credit any other sensible suggestions• <p>Ideas around control</p> <ul style="list-style-type: none">• lots of different genes/proteins involved in transporting ions across membranes• specificity of channels for particular ions• control of opening and closing of different channels	<p>(9)</p>



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Level	Marks		Additional Guidance
0	0	No awardable content	
1	1-3	<p>Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.</p> <p>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>	<p>simple description of data provided</p> <p>or</p> <p>discussion of one aspect from specification e.g. role of ions in action potentials / muscle contraction / mucus production</p>
2	4-6	<p>Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.</p> <p>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion shows some linkages and lines of scientific reasoning with some structure.</p>	<p>Level 1 criteria plus</p> <p>discussion of another aspects from specification including consideration in {disease / ill-health} in at least one</p>
3	7-9	<p>Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.</p> <p>Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.</p>	<p>Level 2 criteria plus</p> <p>appropriate use of data from tables linked to health or disease</p> <p>or</p>



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		The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	attempt at higher level reasoning e.g explaining role of (ion gradients / active transport of ions) expanding on role of mutations in disease beyond cystic fibrosis / discussion of channel specificity or evolution of variety of channels with many functions
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Q20.

Question Number	Answer	Additional guidance	Mark
	<p>An answer the makes reference to four of the following:</p> <ul style="list-style-type: none">• use pH buffers at a range of pH values below 7 (1)• provide an excess of ATP (1)• (use) F-6-P at an appropriate concentration (1)• suitable variable controlled (1)• measure quantity of F-2,6-BP produced per unit time (1)	<p>e.g. 2 mmol dm⁻³ (values between 1 and 2.5 mmol dm⁻³)</p> <p>e.g. {enzyme / phosphofructokinase } concentration / temperature</p> <p>ALLOW measure change in concentration of F-2,6-BP / phosphate incorporated</p>	(4)



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Q21.

Question Number	Answer	Additional guidance	Mark
	<p>An answer the makes reference to three of the following:</p> <ul style="list-style-type: none">no offspring from the cross between weary and upright lettuce had the weary phenotype (1)the ratio of weary to upright lettuce in the F_2 generation was 1: 3 (1)the chi-squared test value was below the critical value (1)result not statistically different from expected result (1)	<p>ALLOW none of the F_1 generation had the weary phenotype / all the F_1 generation were upright</p> <p>ALLOW {25% / $\frac{1}{4}$ / 27.7%} of the F_2 generation were weary lettuce</p> <p>ALLOW less than a critical value of 3.84</p> <p>IGNORE degrees of freedom or incorrect cv</p> <p>ALLOW the null hypothesis can be accepted</p>	<p>(3)</p>



Q22.

Question Number	Answer	Additional Guidance	Mark
(a)	C (phospholipid)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(i)	rhodopsin		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(ii)	(cis) retinal		(1)





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Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none">opsin released causing sodium ion channels to be blocked (1)which causes hyperpolarisation in the rod cell (1)causing action potential in bipolar cell (results in action potential in the optic nerve) (1)		(3)

Q23.

Question Number	Answer	Additional guidance	Mark
(i)	<p>A description that makes reference to the following</p> <ul style="list-style-type: none">sequence of amino acids (1)joined together by peptide bonds (1)		graduate (2)



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Question Number	Answer	Additional guidance	Mark
(ii)	<p>A description that makes reference to five of the following</p> <ul style="list-style-type: none">• folding of protein inside the {rough endoplasmic reticulum / rER } (1)• bonds formed between R groups (1)• rER {forms / packages proteins in} vesicles (1)• vesicles transport the protein to the Golgi apparatus (1)• protein modified in Golgi apparatus (1)• detail of modification (1)	<p>ALLOW formation of named bonds</p> <p>ALLOW processed</p> <p>e.g. carbohydrates/sugar molecules added / prosthetic group</p>	Expert (5)



Q24.

Question number	Answer	Additional guidance	Mark
	<p>A description that makes reference to the following</p> <ul style="list-style-type: none">• (mineral ions) are taken up by active transport (1)• through carrier proteins (1)• this requires {energy / ATP} (1)	<p>IGNORE channel ALLOW protein pumps</p>	<p>Expert (3)</p>





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Q25.

Question Number	Answer	Mark
(i)	The only correct answer is –A <i>amino acids</i> B is incorrect because nitrates are not found in cellulose C is incorrect because nitrates are not found in starch D is incorrect because nitrates are not found in sucrose	Computer (1)

Question Number	Answer	Mark
(ii)	The only correct answer is –C <i>nucleic acids</i> A is incorrect because phosphate is not found in cellulose B is incorrect because phosphate is not found in chlorophyll D is incorrect because phosphate is not found in sucrose	Computer (1)

Question Number	Answer	Mark
(iii)	The only correct answer is – C <i>chlorophyll</i> A is incorrect because magnesium is not found in amino acids B is incorrect because magnesium is not found in cellulose D is incorrect because magnesium is not found in starch	Computer (1)