

Topic 6 Biology

Booklet 1 of 3

Revision Questions

**Transcription,
Translation, DNA
Profiling & PCR**

MARK SCHEME

Question Number	Answer	Mark												
4(a)(i)	<table border="1"> <thead> <tr> <th>Statement</th><th>TRUE</th><th>FALSE</th></tr> </thead> <tbody> <tr> <td>This sequence of bases could be used as a template during translation</td><td></td><td><input checked="" type="checkbox"/></td></tr> <tr> <td>A strand of mRNA could be synthesised using this sequence</td><td><input checked="" type="checkbox"/></td><td></td></tr> <tr> <td>This sequence codes for 7 amino acids during protein synthesis</td><td><input checked="" type="checkbox"/></td><td></td></tr> </tbody> </table> <p>1 mark each correct box ;;; [crosses in both boxes for a statement = 0]</p>	Statement	TRUE	FALSE	This sequence of bases could be used as a template during translation		<input checked="" type="checkbox"/>	A strand of mRNA could be synthesised using this sequence	<input checked="" type="checkbox"/>		This sequence codes for 7 amino acids during protein synthesis	<input checked="" type="checkbox"/>		(3)
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Question Number	Answer	Mark
4(a)(ii)	<ol style="list-style-type: none"> 1. ribosomes / RER / rough endoplasmic reticulum / poly(ribo)some ; 2. descriptive feature e.g. (for ribosome or polysome) {ribosomal RNA / rRNA} / protein component / {two sub-units / large and small sub-unit} (for RER) ribosome attached to membrane ; 	(2)

Question Number	Answer	Mark
4(b)(i)	<ol style="list-style-type: none"> 1. {change / eq} in DNA ; 2. ref to {change / deletion / addition / duplication / substitution / eq} of {bases / nucleotides} ; 	(2)

Jan 2010

Question Number	Answer	Mark
4(b)(ii)	<ol style="list-style-type: none"> 1. correct reference to change in frequency of either allele e.g. mutant increases / normal decreases ; 2. idea of reproductive success of the {mutant / non-photosynthetic} individuals ; 3. (as trees develop) pond will be (more) shaded / eq ; 4. (less light means) less photosynthesis possible / eq ; 5. ref to photosynthetic individuals die / {non-photosynthetic / mutant} individuals survive ; 6. ref to pass on the {mutation / allele} (for using organic compounds) / eq ; 7. ref to more organic nutrients in pond ; 	<p>maximum (4)</p>

Jan 2010

Question Number	Answer	Mark
5(a)(i)	C ;	(1)

Question Number	Answer	Mark
5(a)(ii)	B ;	(1)

Question Number	Answer	Mark
5(a)(iii)	<ol style="list-style-type: none"> 1. (S/ suspect) 3 ; 2. (S3) matches {all / 9 / eq} of the bands in the sample ; 3. DNA profiling assumes every individual's DNA is {unique / different} / eq ; 4. apart from identical twins / eq ; 5. ref to DNA profiling analyses the {introns / non-coding blocks / STR / short tandem repeats / eq} ; 6. non-coding DNA {very variable / hypervariable / eq} ; 7. large number of {introns / non-coding blocks / eq} ; 8. idea of many {combinations / eq} (at each locus) ; 	<p>maximum (5)</p>

Jan 2010

Question Number	Answer	Mark
5(b)	<ol style="list-style-type: none"> 1. ref to DNA profiling has several stages ; 2. ref to {artefacts / contamination / eq} can arise at any stage ; 3. only {a few sequences / small portion } of DNA analysed / eq ; 4. ref to possibility of two identical profiles from unrelated individuals ; 5. {identical twins / closely-related individuals / eq} may show same profile / eq ; 	maximum (2)

Question Number	Answer	Mark
5(c)	<ol style="list-style-type: none"> 1. comparisons made between DNA from fossils and other organisms ; 2. to find genetic relationships / how closely related / eq ; 3. ref to used in {taxonomy / classification / eq} ; 4. to understand evolutionary lines / to determine common ancestor / eq ; 	maximum (2)

Jan 2010

Question Number	Answer	Mark																				
5(a)	<table><tr><th>Description</th><th>DNA only</th><th>RNA only</th><th>Both DNA and RNA</th></tr><tr><td>Polymer formed from a single strand of nucleotides</td><td></td><td>✓</td><td></td></tr><tr><td>Pentose present in the nucleotides</td><td></td><td></td><td>✓</td></tr><tr><td>Adenine, cytosine, guanine and thymine present</td><td>✓</td><td></td><td></td></tr><tr><td>Nucleotides linked by phosphodiester bonds</td><td></td><td></td><td>✓</td></tr></table> <p>all rows correct 2 marks two or three rows correct 1 mark</p>	Description	DNA only	RNA only	Both DNA and RNA	Polymer formed from a single strand of nucleotides		✓		Pentose present in the nucleotides			✓	Adenine, cytosine, guanine and thymine present	✓			Nucleotides linked by phosphodiester bonds			✓	(2)
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Question Number	Answer	Mark
5(b)(i)	<ol style="list-style-type: none"> 1. DNA strands {separate / unzip / eq} ; 2. idea that one DNA {strand / eq} used as template (to form mRNA) / eq ; 3. from free nucleotides / eq ; 4. reference to complementary base pairing ; 5. reference to hydrogen bonding ; 6. correct reference to {RNA-polymerase / DNA helicase} ; 7. credit correct sequence of bases on {mRNA / DNA} ; 	max (3)

June 2010

Question Number	Answer	Mark
5(b)(ii)	<ol style="list-style-type: none"> 1. reference to specific amino acid attachment to tRNA ; 2. idea that anticodon (on tRNA) {attaches / binds / lines up / eq} to the {codon / triplet} on mRNA ; 3. example quoted using the information in the diagram e.g. tRNA with alanine has CGA anticodon which binds to GCU on mRNA ; 4. idea that two tRNA held in ribosome (at any one time) ; 5. reference to formation of peptide {bonds / links} (between adjacent amino acids) ; 6. reference to peptidyl transferase ; 	<p>max (3)</p>

Question Number	Answer	Mark
5(c)	<ol style="list-style-type: none"> 1. <u>stop codon</u> ; 2. used to end the {sequencing / further attachment of tRNA / eq} ; 3. release of the {polypeptide / ribosome} /eq ; 	<p>max (2)</p>

June 2010

6BI04_01

1006

Question Number	Answer	Mark
6(a)(i)	C ;	(1)

Question Number	Answer	Mark
6(a)(ii)	B ;	(1)

Question Number	Answer	Mark
6(a) (iii)	A ;	(1)

Question Number	Answer	Mark
6(b)	<ol style="list-style-type: none"> 1. idea of sequence of {bases / nucleotides} on DNA determines sequence on (pre-) mRNA ; 2. reference to complementary base pairing / stated example e.g. AU / CG / GC / TA (DNA: mRNA) ; 3. reference to formation of bonds by condensation reaction ; 4. phosphodiester {bonds / links} ; 5. reference to RNA-polymerase ; 	max (3)

Question Number	Answer	Mark
6(c)(i)	<ol style="list-style-type: none"> 1. reference to {start / stop / nonsense} (codon) ; 2. start (codon) needed to begin {polypeptide synthesis / eq} / {stop / nonsense} (codon) needed to end {polypeptide synthesis / eq} / eq ; 	(2)

Jan 2011

Question Number	Answer	Mark
6(c)(ii)	<ol style="list-style-type: none"> 1. reference to {difference / variations / eq } of {exons / mRNA} ; 2. reference to different {primary structure / sequence of amino acids} ; 3. reference to {secondary / tertiary } structure of proteins depends on primary {structure / sequence} / eq ; 4. due to {change in / different} bonds ; 5. {hydrogen / ionic / disulphide} bonds ; 6. reference to different 3D shape / eq ; 	<p>max (3)</p>

Question Number	Answer	Mark
6(a)(i)	C ;	(1)

Question Number	Answer	Mark
6(a)(ii)	D;	(1)

Question Number	Answer	Mark
6(a)(iii)	D ;	(1)

Question Number	Answer	Mark
6(b)(i)	<ol style="list-style-type: none"> 1. humans more closely related to chimp (than to orang utan and gorilla) / eq ; 2. reference to humans and chimps more closely related to orang utan than gorilla ; 3. reference to similarity of sequence indicates closeness of ancestral relationship / eq ; 4. human and chimp sequence identical / eq ; 5. orang utan has one difference, gorilla has two differences / eq ; 6. reference to {number 19 for orang utan / number 9 and 19 for gorilla} different ; 	(4)

Question Number	Answer	Mark
6(b)(ii)	<ol style="list-style-type: none"> 1. reference to similarity (of DNA) indicates closeness of relationship ; 2. because genes are sections of DNA / eq ; 3. genes are the codes for protein / eq ; 	(2)

Question Number	Answer	Mark
6(b)(iii)	<ol style="list-style-type: none"> 1. reference to source of DNA sample, e.g. blood, saliva, semen ; 2. reference to small samples of DNA can be amplified by PCR ; 3. reference to use of (restriction / eq) enzymes to {break / eq} DNA ; 4. reference to use of {electro potential / potential difference / eq} ; 5. reference to {treatment / staining / eq} ; 6. show up as {bands / bars / eq} ; 7. reference to the {number of bands / eq} that match indicates similarity of the DNA ; 	(3)

Question Number	Answer	Mark
1(a)	Substance X = (DNA)primer(s) ; Substance Y = (mono)nucleotide(s) ; Substance Z = DNA strand(s) ;	(3)

Question Number	Answer	Mark
1(b)(i)	A ;	(1)

Question Number	Answer	Mark
1(b)(ii)	C ;	(1)

Question Number	Answer	Mark
1(b)(iii)	B ;	(1)

Question Number	Answer	Mark
1(c)(i)	1. Idea that human enzymes will not work at {high / these/ above 37°C eq} ; 2. reference to {denaturation /change in shape of active site}(at temperatures in PCR) ;	(2)

Question Number	Answer	Mark
1(c)(ii)	<ol style="list-style-type: none">1. (xylem / wood) made of dead material / has no {living material / cytoplasm / cell contents / nuclei / mitochondria} / eq ;2. no {DNA / nucleic acid} present / eq ;	(2)

Jan 2012

Question Number	Answer	Mark
8(a)	<ol style="list-style-type: none"> 1. (Double-stranded because made of) two strands ; 2. (strands joined) by hydrogen bonds (between bases) ; 3. (polynucleotide) of {many / eq} nucleotides ; 4. (nucleotides) linked by phospho(di)ester bonds / eq ; 	(3)

Question Number	Answer	Mark
*8(b) QWC	<p>Take into account quality of written communication when awarding the following points.</p> <ol style="list-style-type: none"> 1. idea of sequence of bases {forming the genetic code / determines the amino acid sequence} ; 2. idea that one triplet codes for an amino acid; 3. ref to (DNA) acting as a template ; 4. reference to transcription OR detail of transcription e.g. DNA unzips, mRNA synthesis ; 5. idea that mRNA moves from nucleus to cytoplasm / eq ; 6. reference to translation OR detail of translation e.g. role of ribosome, codon-anticodon interaction ; 7. idea that tRNA carries an amino acid ; 8. ref to formation of peptide bonds between amino acids ; 9. idea that primary structure is the {sequence /order / eq} of amino acids ; 10. comment on post-transcriptional modification of mRNA (between transcription and translation)e.g. removal of introns, splicing ; 	(5)

Question Number	Answer	Additional guidance	Mark
3(a)(i)	<ol style="list-style-type: none"> reference to {polymerase chain reaction / PCR} ; polymerase (enzyme) {added / eq }; idea of need for primers and nucleotides ; {90-98} (°C) → {50-65} (°C) → {70-75} (°C) ; idea that cycle needs to be repeated {several times / to make several copies of DNA / eq}; 	1. Accept as a ref to PCR machine	(4)

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	(DNA) {profiling / fingerprinting / (gel) electrophoresis} ;	Ignore Southern blotting, PCR Accept DNA profile / DNA fingerprint	(1)

Question Number	Answer	Additional guidance	Mark
3(b)	1. idea of work appearing in a (Scientific) journal or being presented at a conference ; 2. idea that validity or reliability is considered ; 3. by other scientists / ref to peer review ;	1. Accept publishing a paper, scientific meeting	(2)

Question Number	Answer	Additional guidance	Mark
3(c)(i)	<ol style="list-style-type: none"> reference to different {conditions / environments /eq} (in each region) ; idea of different selection pressures ; idea of {restricted gene flow / separate gene pools} ; reference to reproductive isolation; 	<p>1. Accept appropriate named factor e.g. temperature</p> <p>3. Ignore different allele frequency</p>	(2)

Jan 2013

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	<ol style="list-style-type: none"> 1. idea of different {alleles/ gene pool} ; 2. idea that this leads to {new / different} phenotypes ; 3. idea of new {allele / gene} can be {advantage / disadvantage} ; 4. reference to (advantageous) {(mutated) gene / (new) allele} passed onto offspring ; 	<p>1. Ignore allele frequency</p> <p>2. Accept traits / characteristics / features</p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)	A = adenine C = cytosine G = guanine T = thymine ;	Accept reasonable phonetic spellings Not: adenosine cysteine glycine thiamine, thyosine, tyrosine	(1)

Question Number	Answer	Additional Guidance	Mark
5(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)

Question Number	Answer	Additional Guidance	Mark
5(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)

Question Number	Answer	Additional Guidance	Mark
5(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)

Question Number	Answer	Additional Guidance	Mark
5(c)	B ;		(1)

Question Number	Answer	Additional Guidance	Mark
5*(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"> 1. reference to mRNA with sequence UUA UUG GUC AAA ; 2. idea that ribosome is involved ; 3. idea that each tRNA molecules is attached to one (specific) amino acid ; 4. credit example of tRNA anticodon with specific amino acid 5. reference to anticodons on tRNA {bind / link to / line up against / eq} codons on mRNA ; 6. credit a specific example (from this DNA) ; 7. idea of hydrogen bonds between bases (of tRNA and mRNA) ; 8. 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)

Question Number	Answer	Additional Guidance	Mark
*3(a)(i)	<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"> multiple copies of DNA made / eq ; using {PCR / <i>polymerase chain reaction</i>} ; credit any correct detail of PCR ; reference to <i>restriction</i> {enzymes / <i>endonucleases</i>} to produce DNA {fragments / eq} ; reference to (<i>gel</i>) <i>electrophoresis</i> ; idea of {loading / eq} the DNA onto the {<i>gel</i> / named <i>gel</i>} ; idea that an {<i>electric current</i> / charge} is applied ; reference to use of {<i>dye</i> / <i>fluorescent tag</i> / <i>UV light</i> / <i>Southern blotting</i> / <i>gene probes</i> / <i>radioactive labelling</i> / eq} ; 	<p>QWC emphasis on spelling</p> <ol style="list-style-type: none"> IGNORE refs to amplification, large amounts e.g. step 1: 90 to 95 °C, step 2: 50 to 65 °C, step 3: 70 to 80 °C, use of {<i>primers</i> / DNA <i>polymerase</i> / <i>nucleotides</i>}, many repetitions e.g. <i>agarose</i>, <i>agar</i> ACCEPT apply <i>potential difference</i> 	(6)

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	1. idea of comparing total number of {bands / eq} ; 2. idea of comparing position of {bands / eq} ; 3. idea of comparing {size / width} of {bands / eq} ;	ACCEPT idea of comparing bands for 1 mark if mps 1, 2 or 3 cannot be awarded ACCEPT bars / blocks	(3)

Question Number	Answer	Additional Guidance	Mark
3(b)	1. {scientific / peer reviewed} {papers / journals / magazines / article} ; 2. (scientific) {conferences / lecture / forums} ; 3. media reports ;	3. e.g. TV, radio, newspaper, internet	(2)

Question Number	Answer		Additional Guidance	Mark																								
8(a)	<table><thead><tr><th></th><th>Fibrous</th><th>Globular</th></tr></thead><tbody><tr><td>1.</td><td>insoluble / large</td><td>Soluble / small ;</td></tr><tr><td>2.</td><td>hydrophobic on outside</td><td>hydrophilic on outside ;</td></tr><tr><td>3.</td><td>mainly secondary structure</td><td>3D /folded / compact shape / tertiary / eq ;</td></tr><tr><td>4.</td><td>repeated amino acid sequences</td><td>little repetition ;</td></tr><tr><td>5.</td><td>structural / eq</td><td>enzymes / hormones / eq</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></tbody></table>			Fibrous	Globular	1.	insoluble / large	Soluble / small ;	2.	hydrophobic on outside	hydrophilic on outside ;	3.	mainly secondary structure	3D /folded / compact shape / tertiary / eq ;	4.	repeated amino acid sequences	little repetition ;	5.	structural / eq	enzymes / hormones / eq							<p>Do not piece together</p> <p>3 ACCEPT chains / straight proteins IGNORE quaternary</p>	(3)
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*8(b)	<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. reference to {<i>post-transcriptional modification / splicing</i>} (of mRNA) ; 2. reference to <i>spliceosomes</i> ; 3. reference to {removal / eq} of <i>introns</i> ; 4. idea that different {number / length} of <i>exons</i> are put together (in the different sexes) ; 5. idea that the length of the <i>mRNA molecules</i> will be different (for males and females) ; 6. idea that the longer mRNA will have more <i>codons</i> ; 7. and therefore more <i>amino acids</i> will be coded for ; 8. reference to (during) <i>translation</i> ; 9. idea of removal of some amino acids post-translation ; 	<p>QWC emphasis is on correct spelling of biological terms</p> <p>1 ACCEPT post-transcriptional changes</p> <p>7 ACCEPT converse</p> <p>8 in the context of Mp7 ACCEPT converse</p>	(6)