PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 1: BIOLOGICAL MOLECULES

DNA AND PROTEIN SYNTHESIS

SCORE	PERCENTAGE
/183	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	1. idea that the {alveoli / air sacs / lung / tissue } have been {replaced / destroyed / eq} (by the tubercle) ; 2. idea that the (tubercle / destroyed lung tissue) has reduced the (surface) area (of the lung) ; 3. breathing problems due to { gas exchange being reduced / less oxygen in blood / eq } ; 4. idea that the coughing is { due to irritation /to remove the dead tissue / eq} ; 5. blood coughed up is due to damage of (lung) blood vessels / eq ;	**1 IGNORE** blocks **4 ACCEPT** tubercle **5 IGNORE** idea that lung damage causes bleeding	**(4)**

Q2.

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)	1. idea that each amino acid needs a code ; 2. idea that {using three bases give enough codes / using less bases does not give enough codes} ; 3. idea of three bases means there can be 64 {triplets / codes / combinations / eq} ;	**Accept** codons	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	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 ;	**1. Accept** description of effect **Accept** from a description of a specific example **Accept** always results in same amino acid **Not** similar amino acid **2 NB** If mp 2 is awarded it will usually incorporate mp 1 as well = 2 marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
(c)	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 ;	**1. Not** codes, triplets	

	4. as AUU, AUC and ACU ; 5. idea that they are recognised by ribosome ; 6. idea that they signal the end of the polypeptide (chain) ; 7. reference to (during) translation ;	**6. Accept** stops the synthesis of the polypeptide / the polypeptide is finished	**(4)**

Question Number	Answer	Additional Guidance	Mark
(d)	1. ref to peptide {bond / link} ; 2. between (amino group / NH_3 / NH_4^+} and {carboxyl group / COOH / COO^-} ; 3. ref to condensation (reaction) ; 4. idea of role of {tRNA / ribosome / enzymes / correctly named enzyme} in joining amino acids together ;	**Accept** mp 1 and 2 from correctly drawn and labelled diagram **2. NB** formulae must be correct if only these are given **4. Accept** e.g. hold the amino acids next to each other, ribosome contains enzyme	**(3)**

Q3.

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)**

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

Question Number	Answer	Additional Guidance	Mark
*(d)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 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 ;	**QWC emphasis is logical sequence** **NB The mps do not have to be given in this order necessarily** **Not** tRNA carries amino acids AAU /AAC = leucine, CAG = valine, UUU = lysine **Ignore** complementary eg UUA codon and AAU anticodon **Accept** between codon and anticodon	**(5)**

Q4.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • the mutation may produce a stop codon **(1)** • therefore translation will stop {sooner / when the stop codon is reached} **(1)** **Or** • {one / several} bases deleted **(1)** • therefore the mRNA is shorter **(1)**	**Accept** no more amino acids added to the peptide / peptide synthesis stops sooner	**(2)**

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	D (proteins, nucleic acids, starch)		**(1)**

Q6.

Question Number	Answer					Additional Guidance	Mark
							(2)
	Molecule	**Mineral ions used**					
		nitrate ions only	phosphate ions only	both nitrate and phosphate ions	neither nitrate nor phosphate ions		
	amino acid	X	☐	☐	☐		
	DNA	☐	☐	X	☐		

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • to prevent DNA {replication / unwinding / unzipping} (1) • so that macrophages could not {divide / carry out mitosis} (1) • so that any division could be attributed to the T cells only / radioactive thymidine incorporate into T cells only (1)	**ACCEPT** separating **ACCEPT** number of macrophages remains constant **ACCEPT** no thymidine incorporated into the macrophage	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • {complementary to / binds to / forms H bonds with} adenine (on the DNA) (1) • forming phosphodiester bonds (with adjacent nucleotides) (1)	**ACCEPT** formation of a sugar-phosphate backbone	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to four of the following: • most (radioactive) thymidine incorporated into T cells that were the same strain as the macrophages (1) • because these cells are dividing more (1) • because {the (MHC and CD4) receptors bind together better / antigen presentation improved} (1) • due to genetic compatibility (1) • strain 2 {macrophages are better antigen presenters / T cell proliferate faster than strain 13} (1)	**ACCEPT** converse throughout **ACCEPT** more T cells if antigen is presented by macrophages from same {strain / number} guinea pig description **ACCEPT** faster mitosis **ACCEPT** better recognition **ACCEPT** self-antigens **ACCEPT** antigen presentation is more effective	**(4)**

Q8.

Question Number	Answer	Mark
(i)	**The only correct answer is C** ***A*** *is not correct because an insertion adds an additional base* ***B*** *is not correct because monosomy is a chromosome mutation* ***D*** *is not correct because translocation is a chromosome mutation*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • it will change the {amino acid sequence / primary structure } of ATP synthase **(1)** • therefore the ATP synthase active site could be a different {structure / shape } so ADP cannot {bind / bind as well} **(1)** • therefore the {channel / ATP synthase} the wrong {structure / shape} so {hydrogen ions / protons} cannot {pass through / pass through as well} **(1)** . therefore { no / less} {ATP made / oxidative phosphorylation} **(1)**	**Accept** a stop codon could result changing the {length / shape / structure} of the protein	**(3)**

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	substitution	Accept point mutation	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	1 in 50	Accept other correct probabilities e.g. 2% or 0.02	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • (excess prothrombin means) more thrombin (1) • therefore increased {conversion / catalysis} of fibrinogen to fibrin (1) • fibrin {is insoluble / traps blood cells / forms mesh / forms net} (1)	Accept if there is more fibrin it is more likely to clot	**(3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	H / hydrogen		(1)

Q11.

Question Number	Correct Answer	Additional guidance	Mark
(a)	An explanation that makes reference to the following: • {Active site changes shape / not correctly formed} and no longer an efficient 'fit' to substrate (1) • because if one amino acid is changed then these bonds cannot form (1) • because only certain amino acids (e.g. cysteine needed for S –S bonding) can form disulphide bridges/hydrogen bonds/ionic bonds (1) • and these bonds are important in the formation of a tertiary/3D protein structure (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(i)	An explanation that makes reference to the following: • (reduced activity of GA_{20} oxidase means) less active GA_{20} is produced (1) • therefore less GA_{20} means more DELLA proteins present (1) • hence more DELLA proteins means fewer transcription factors binding to growth regulator genes (1) • therefore resulting in growth regulator genes not expressed / growth less because transcription factors needed for expression of genes (1)	Less DELLA protein broken down	**(4)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(ii)	• equation $p^2 + 2pq + q^2 = 1$ (1) • $p^2 = 0.36$ so $p = 0.6$ (1) • $q = 0.4$ so $2pq = 2 \times 0.6 \times 0.4$ (1) • correct answer 48% (1)		**(4)**

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	• multiplication (1) • division (1)	2×10^{10} divisions per day x 10^{-7} mutations per division / 2×10^{10} = 20 000 000 000 ÷ 10 000 000 / = 2 000 / 2×10^{3} Correct answer gains full marks, with no working shown ALLOW one mark for 20 000 000 000 / ÷ 10 000 000 / 10×10^{6} / 1×10^{7}	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • different {R groups / disulphide bonds / hydrogen bonds / ionic bonds} (1) • therefore different secondary / tertiary structure (1) • therefore different shaped ribosome (1) • therefore streptomycin cannot bind (to ribosome) (1)		**(3)**

Q13.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • {binds to / changes shape of} the {enzyme / active site / RNA polymerase} (1) • therefore {transcription / mRNA synthesis} prevented (1) • no {proteins / polypeptides / enzymes} can be made (1)		**(3)**

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	315		**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • used in translation to make (viral) protein (1) • more RNA is produced (1)		**(2)**

Q15.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	U U U U U U G U G U G U C C A		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: (1) • poly U gives only phenylalanine, poly A gives only lysine, therefore UUU codes for phenylalanine and AAA for lysine and therefore one triplet can only code for one amino acid (1) (1) • in the mixture, more U is linked to higher % of cysteine and valine, therefore UGU and GUU are likely triplets • there are more combinations of U and G in a triplet than four, therefore one amino acid could have more than one code		**(3)**

Q16.

Question Number	Acceptable Answer	Additional Guidance	Mark
	D (mRNA)		**(1)**

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	**The only correct answer is A** **B** is incorrect because light-dependent stage takes place on thylakoid membrane and not in the stroma **C** is incorrect because light-dependent stage takes place on thylakoid membrane and not on the inner membrane **D** is incorrect because light-dependent stage takes place on thylakoid membrane and not on the outer membrane		(1) COMP
(ii)	**The only correct answer is A** **B** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the starch grain **C** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the DNA loop **D** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the inner membrane space		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(iii)	**The only correct answer is D** **A** is incorrect because translation occurs on the ribosomes and not inside the thylakoids **B** is incorrect because translation occurs on the ribosomes and not in the starch grain **C** is incorrect because translation occurs on the ribosomes and not in the DNA loop		(1) COMP

Q18.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to two the following: • DNA strands separate (1) • antisense strand used as template (for mRNA) (1) • RNA polymerase synthesises mRNA (1)		**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description that makes reference to five of the following: • mRNA leaves through nuclear pores (1) • {translation occurs at / mRNA travels to} ribosomes / rough endoplasmic reticulum (1) • codons (on mRNA) pair with anticodons on tRNA / tRNA brings amino acid (to the ribosome) (1) • peptide bonds form between amino acids (1) • amylase enters Golgi and is {modified / processed} / amylase {is packaged into vesicles / travels in vesicles} (1) • exocytosis releases {amylase / protein} (1)	Accept protein for amylase Accept description for exocytosis	**(5)**

Q19.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. {skin / epidermis} is a barrier / eq ; 2. reference to keratin ; 3. reference to lack of receptors (for the virus) ;	**Accept** prevents entry but **not** prevents infection **NB** keratin in skin forms a barrier = 2 marks **Accept** skin has different receptors	**(2)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. idea that viruses only {infect / attach to / eq} {specific receptors / specific cells / host cells} ; 2. idea that receptors not present on {blood cells / endothelial cells / eq} ; 3. reference to {destruction / eq} of viruses by phagocytes ;	**Accept** white blood cells. neutrophils; PMN **Ignore** macrophages **Not** lymphocytes, T cells, plasma cells	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. reverse transcriptase (required) in HIV, no reverse transcriptase in cold virus ; 2. DNA formed (using RNA) in HIV, {no DNA formed / RNA used to make protein / translation} in cold virus ; 3. reference to {provirus / latency / delay in virus formation / eq} in HIV infection, {no provirus / lytic cycle / (immediate) formation of virus particles / eq} in cold virus ;	**NB** answers can be pieced together but candidates still have to state both parts of mark point	**(2)**

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. to synthesise (common cold) RNA / eq ; 2. for amino acids to bind to tRNA / eq ; 3. to synthesise (common cold) protein (capsid) / eq ;	**Accept** translation	**(2)**

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. idea of enzyme affecting {molecules in membrane / proteins / (phospho)lipids / cholesterol} ; 2. enzyme breaks {bonds / named bonds / eq} ; 3. reference to {(by) hydrolysis / hydrolytic enzymes} ; 4. credit detail of enzyme action ; 5. reference to enzyme U as {protease / lipase / cholesterase} ;	eg lowers activation energy, binding of active site to substrate (cannot credit reference to catalyst, as in stem of question) **Ignore** lysosyme	**(3)**

Q20.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • {bacteria / microbes} cannot {reproduce / undergo binary fission} (1) • (because) complementary base pairing cannot occur (1) • (because) mRNA synthesis prevented (1)	Accept bacteria cannot replicate / multiply Accept T cannot pair with A Accept no transcription occurs	**(2)**

Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	An explanation that makes reference to the following: • the three antibodies in Zmapp each bind to a specific part of the viral glycoprotein (1) • therefore the protein cannot change shape and fuse the cell membrane (1) • therefore Ebola RNA cannot enter the cell and the virus cannot replicate (1)		**(3)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • if mutation causes a change in the shape of the glycoprotein, Zmapp may not bind and will not be effective (1) • if mutation occurs in one of the other genes, the shape of the glycoprotein will not be affected and Zmapp will still be effective (1)		**(2)**

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	UGG GGU UCC GAG		**1**

Question Number	Answer	Mark
(ii)	The only correct answer is A degenerate *B is incorrect because non-overlapping refers to discrete reading frames* *C is incorrect because it simply refers to three bases* *D is incorrect because it refers to the same code in all organisms*	**1**

Q3.

Question Number	Answer	Mark
(i)	**The only correct answer is B** ***A*** *is not correct because G binds to C and U to A* ***C*** *is not correct because G binds to C and U to A* ***D*** *is not correct because G binds to C and U to A*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is C** ***A*** *is not correct because C binds to G and A binds to T on DNA* ***B*** *is not correct because C binds to G and A binds to T on DNA* ***D*** *is not correct because C binds to G and A binds to T on DNA*	**(1)**

Q4.

Question Number	Answer	Mark
	The only correct answer is B ***A*** *is not correct because glycosidic bonds join monosaccharides together* ***C*** *is not correct because peptide bonds join amino acids together* ***D*** *is not correct because phosphodiester bonds join adjacent mononucleotides together*	**(1)**

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • substitution of val for glu, which has a different { R / residual } group (1) • val (R-group) has no positive charge (1) • therefore ionic bond lost (1) • therefore tertiary structure changes (1)	Allow glu has a positive charge	**(4)**

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	• reading from graph at $1x10^{-2}$ • reading multiplied by 7.5 and divided by 100	Example of calculation: 76 % 76 ÷100 X 7.5 mm = 5.7 mm **Accept** 5700 μm **TE** for wrong reading from graph A Correct answer gains full marks 5.7 with no units = maximum 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to four of the following: • {chemical A / stopping transcription} has {less effect / smaller reduction} on pollen tube growth (1) • growth levels off when chemical A increases and growth {falls steeply / drops to zero} when chemical B increases (1) • mRNA is already present (1) • (pollen tube) growth requires production of new proteins / enzymes (1)	**Accept** converse for chemical B / stopping translation **Accept** correct mathematical comparison e.g. overall chemical A causes a 29% drop and chemical B causes a 100 % drop **Accept** transcription occurred before chemical A added **Accept** pollen tube cannot grow without synthesis of new proteins	**(4)**

Q7.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	An explanation that makes reference to the following: • correct calculation of UK population 90 and over (1) • correct calculation of number of people with mutations (1)	<u>Example of calculation</u> 0.8% of 64 million = (0.8 ÷ 100) × 64 000 000 = 512 000 1 in 5 of 512 000 = 102 400 Correct answer with no working gains full marks	**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • radioactive { thymine / thymidine / deoxyribose } is used in DNA synthesis (1) • therefore daughter cells having radioactive DNA gives a measure of growth rate (1)		**(2)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	6771		**(1)**

Q9.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	B		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	A description that makes reference to the following: • DNA polymerase to join nucleotides / bases / formation of phosphodiester bonds (1) • ligase to join DNA sections (1)		**(2)**

Q10.

Question Number	Answer	Additional Guidance	Mark

Component	Component found in a molecule of			
	both DNA and mRNA	DNA but not mRNA	mRNA but not DNA	neither DNA nor mRNA
Adenine	X	☐	☐	☐
Hydrogen bonds	☐	X	☐	☐
Pentose sugar	X	☐	☐	☐
Uracil	☐	☐	X	☐

Q11.

Question Number	Answer	Additional guidance	Mark
(a)	1. idea of less {stress / trauma / discomfort / depressed /eq} (for the animals) ; 2. idea that animals are more likely to breed in natural environment ; 3. idea that animals may require large areas ; 4. idea that problems of releasing animals back into the wild is avoided eg habituation ; 5. idea that {disease is less likely / disease will not wipe out population} ; 6. idea of allowing (natural) {interspecific relationships / communities} to exist ; 7. idea of allowing (natural) {intraspecific relationships / family / social / eq} {structure/ behaviour} ; 8. (because) large numbers of animals needed / wider gene pool / eq ; 9. idea that (natural) {diet / food / eq} available ;	**Accept** converse argument throughout **6. Accept** reference to maintaining their niche	**(3)**

Question Number	Answer	Additional guidance	Mark
***(b)**	(QWC– Spelling of technical terms *(in italics)* must be correct) 1. reference to *succession* ; 2. reference to (*forensic) entomology* ; 3. example of {insect / eq} e.g. *fly, beetle, wasp* ; 4. idea that the {types / *species* / life cycle stages} (of insects) are used ; 5. reference to {*decomposition / decay* / eq} ; 6. idea that there are different stages of {*decomposition / decay* / eq} ; 7. detail of {*decomposition / decay* / eq} e.g. production of *gases, liquefaction* of *tissue, bloating, discolouration* ; 8. reference to rate of {*succession / insect development / decomposition*} influenced by {external factor / appropriate named factor} ; 9. idea that insect and decomposition information is used to determine time of death ;	Penalise spelling once **1. Accept** in context of either insects or decomposition **3.** Named insect must be spelt correctly **6. Accept** if 2 or more stages listed **8.** Named *factor* must be spelt correctly	**(5)**

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	D phosphodiester *A is incorrect because peptide bonds are found in proteinsB is incorrect because disulfide bonds are found in proteins* *C is incorrect because glycosidic bonds are found incarbohydrates*		1
(ii)	A description that makes reference to four of: • hydrogen bonds between nucleotides broken byDNA helicase (1) • complementary nucleotides bind (1) • because {hydrogen bonds} will only form betweencytosine and guanine and adenine and thymine (1) • phosphodiester bonds are formed by DNApolymerase (1) • (the leading strand is synthesised continuously butlagging strand required) DNA ligase to join fragments (on lagging strand) (1)	**Allow** unzipped by helicase	4

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	*An answer that makes reference to:* • correct indication of selection of RNA virus (for TMV) (1) • correct use of graph to identify intercept between0.000001 and 0.0005 (1)	**Allow** correct use of standard form e.g. 10^{-4} **Allow** ecf for correct use of y axis withwrong selection of virus type correct answer gets both marks	**2**
(ii)	*An answer that makes reference to three from:* • as genome size increases, mutation rate decreases (1) • RNA / ss DNA /ss nucleic acid has a higher mutationthan ds DNA (1) • because it is single stranded template so does notproduce copies with complementary bases / is lessstable (1) • viruses have a higher mutation rate than bacteria / eukaryotes (1)	**Allow** converse / allow correlation **Allow** eukaryotes have lowest mutation rates **Allow** RNA viruses have highest mutation rates	**3**

Q14.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	UUA		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • 18 bases code for six amino acids (1) plus any two from: • because genetic code is made up of triplets of bases (1) • because the code is degenerate, some amino acids can have more than one code (1) • because of non-overlapping code (1)		**(3)**

<table>
<tr><th>Question Number</th><th colspan="2">Indicative content</th></tr>
<tr><td>*(iii)</td><td colspan="2">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.
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.
Frame shift effect due to addition / deletion
Replace amino acid due to substitution
No effect on amino acids due to substitution
Degeneracy of code due to substitution
Shorter due to stop codon
Consequence for protein structure explained</td></tr>
<tr><th>Level</th><th>Mark</th><th>Descriptor</th></tr>
<tr><td></td><td>0</td><td>No awardable content</td></tr>
<tr><td>Level 1</td><td>1-2</td><td>Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.

Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.

The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.</td></tr>
<tr><td>Level 2</td><td>3-4</td><td>Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.

Consequences are discussed, which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.

The discussion shows some linkages and lines of scientific reasoning with some structure.</td></tr>
<tr><td>Level 3</td><td>5-6</td><td>Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.
Consequences are discussed, which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.
The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.</td></tr>
</table>

Q15.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • (a mutation results in) a different sequence of amino acids (1) • therefore different R groups / side chains (1) • resulting in changes to { ionic / hydrogen bonding / disulphide bridges } (1) • change in shape of active site causing a change in enzyme activity (1)		**(4)**

Q16.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is: **D** phosphodiester *A is incorrect as this bond is found in lipids* *B is incorrect as this bond is found in carbohydrates* *C is incorrect as this bond pair bonds nucleotides*		**1 comp**

Q17.

Question Number	Answer	Additional Guidance	Mark
1(b)	A description that makes reference to the following points: • {DNA polymerase} {joins the sugar phosphate backbone (between nucleotides) / forms phosphodiester bonds / joins adjacent nucleotides} (1) • DNA {ligase} {joins fragments of DNA / short pieces of DNA / Okazaki fragments} (1) • DNA {helicase} {breaks hydrogen bonds / unzips double helix / separates strands} (1)	**Accept** {RNA primase} makes {RNA to start replication of DNA}	**3 expert**

Q18.

Question Number	Answer	Additional Guidance	Mark
	A calculation that makes reference to the following points: • correct calculation of percentage cytosine (1) • correct calculation of number of nucleotides (1)	15 % cytosine 15 % of 10 000 = **1500** Correct answer with no working gains full marks **One mark** for 15 %	**2 grad**

Q19.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • composed of protein and RNA (1) • (arranged in) two {(sub) units / parts} (1)	**ACCEPT** large and small subunit / 60S and 40Ssubunit / 50S and 30S subunit	(2)
(ii)	An answer that makes reference to two of the following: • translation (1) • to hold the tRNA on the mRNA (1) • whilst peptide bonds form to join (adjacent) amino acids together(1)		(2)

Q20.

Question Number	Answer	Additional Guidance	Mark
	1. idea that the {alveoli / air sacs / lung / tissue } have been {replaced / destroyed / eq} (by the tubercle) ; 2. idea that the (tubercle / destroyed lung tissue) has reduced the (surface) area (of the lung) ; 3. breathing problems due to { gas exchange being reduced / less oxygen in blood / eq } ; 4. idea that the coughing is { due to irritation /to remove the dead tissue / eq} ; 5. blood coughed up is due to damage of (lung) blood vessels / eq ;	**1 IGNORE** blocks **4 ACCEPT** tubercle **5 IGNORE** idea that lung damage causes bleeding	**(4)**