

**QUESTIONSHEET 1**

transcription; nuclear membrane; ribosomes; rough endoplasmic reticulum; specific; transfer RNA/tRNA; codons; anticodons; peptide bonds/condensation; polypeptide; Golgi body;

**TOTAL 11****QUESTIONSHEET 2**

Feature	mRNA	tRNA
Contains anticodons	✗	✓
May contain several genes/alleles	✓	✗
Can associate with any amino acid	✗	✗
Contains uracil instead of thymine	✓	✓
A short molecule 70-90 nucleotides long	✗	✓

**TOTAL 5****QUESTIONSHEET 3**

- (a) (the unit of the genetic code that) causes the insertion of a specific amino acid into the polypeptide chain; consists of a triplet of three (adjacent) nucleotides/bases on the DNA/mRNA; any example; **max 2**
- (b) only the first two bases of a codon are important in recognising an amino acid; since there are 64 codons available for 20 amino acids/more codons than amino acids, not all codons/bases are needed; **2**
- (c) one codon follows another through the gene; if the code was overlapping the end bases of one codon would be bases for the next codon; **2**
- (d) a sequence of codons on the DNA/mRNA which code for (the assembly of) a specific polypeptide; the sequence of codons (in the gene) governs the amino acid sequence of the polypeptide; **2**
- (e) a codon which marks the end of one gene and the start of the next gene; it releases the manufactured polypeptide into the rough endoplasmic reticulum; **2**

**TOTAL 10****QUESTIONSHEET 4**

- (a) (i) A=adenine, C=cytosine, G=guanine, T=thymine; **1**
- (ii) UCAGGGUUA; **1**
- (iii) one codon follows another with no sharing of bases; **1**
- (iv) serine, glycine, phenylalanine; **1**
- (v) serine, glutamine, arginine, glycine, glycine, valine, phenylalanine, leucine (with two overlapping bases)/ serine, arginine, glycine, phenylalanine (with one base overlapping); **1**
- (b) some amino acids have more than one codon since code is redundant; more codons available than amino acids in use; **2**

**TOTAL 7**

**QUESTIONSHEET 5**

- (a) (i) 1=transcription; 2=translation; 4=protein assembly from polypeptides;  
6=release through cell membrane/exocytosis; 4
- (ii) X=ribosome; Y-Golgi body; Z=cell membrane; 3
- (iii) P is a vesicle of the rough endoplasmic reticulum but Q is a vesicle of the Golgi body;  
P contains a polypeptide molecule (from the rough ER);  
Q contains a protein (synthesised from polypeptides in Golgi body)/ref to any conjugated protein ; 3
- (b) (i) catalyses the formation of a peptide bond between amino acids; 1
- (ii) combines with specific amino acid;  
using energy supplied by ATP;  
carries amino acid into ribosome;  
attaches to appropriate mRNA codon by its anticodon; max 3
- TOTAL 14**
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**QUESTIONSHEET 6**

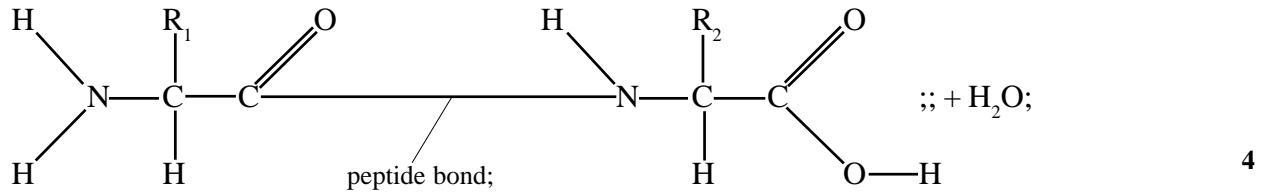
- (a) (i) A = secondary; B = primary; C = quaternary; 3
- (ii) hydrogen; sulphur/covalent; ionic; max 2
- (iii) fibrous type;  
long/based on the alpha helix; 2
- (b) (i) the primary structure is the amino acid sequence (of its polypeptide chain);  
which was governed by the codon sequence of the gene (assembling the polypeptide);  
the secondary structure is the 3D shape of the protein;  
caused by the folding and joining of the chain between amino acids (by hydrogen/sulphur bonding);  
forming shapes such as the alpha helix/beta pleated sheats; max 4
- (ii) tertiary structure is the way in which the secondary structure is folded;  
to form globular proteins;  
quaternary structure is the way in which polypeptides join together to form proteins;  
the secondary and tertiary structures are assembled on the rough endoplasmic reticulum;  
the quaternary structures assemble (mainly) in the Golgi body; max 4
- TOTAL 15**
- 

**QUESTIONSHEET 7**

- (a) provides energy;  
to allow amino acids to combine with tRNA;  
for the formation of peptide bonds between amino acids; max 2
- (b) peptide bonds join amino acids together;  
by condensation links/removal of water between acid and amine groups; 2
- (c) H and S bonds form between amino acids in polypeptide chains;  
allowing folding into secondary/tertiary shapes;  
also form between (separate) polypeptides joining them into the quaternary shape; max 2
- (d) adenine joins to uracil and cytosine to guanine;  
by hydrogen bonding;  
allows codon - anticodon bonding to occur between mRNA and tRNA; max 2
- TOTAL 8**

**QUESTIONSHEET 8**

- (a) (i) sulphur; phosphorus/nitrogen; 2  
 (ii) alcohol/hydroxide/amide/sulphydril; 1
- (b) (i)



allow 2 marks for formula (delete 1 mark per error)

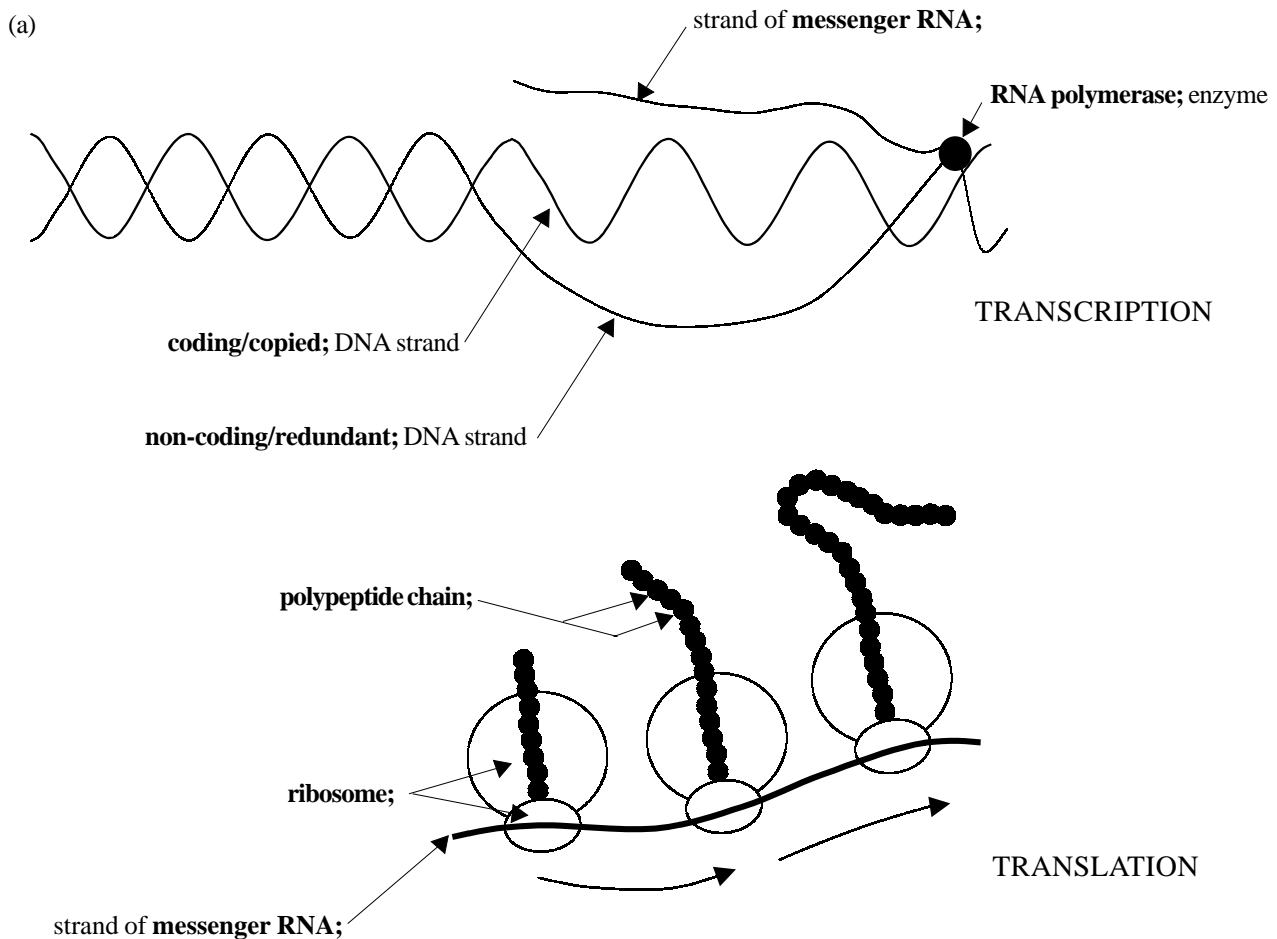
- (ii) on ribosome/rough endoplasmic reticulum; 1  
 (iii) in Golgi body; 1
- (c) three dimensional structure is held in place by hydrogen/sulphur/ionic bonds;  
 R1 and R2 contain reactive groups/hydroxide groups/sulphydril groups/other egs;  
 these can join between amino acids in the polypeptides;  
 thus cause folding and assembly (of polypeptides) into specific shapes (according to amino acid sequences); **max 3**

**TOTAL 12**

**QUESTIONSHEET 9**

- (a) 1. beta cells of islets (of Langerhans);  
 2. chief/zymogen/stomach cells;  
 3. erythroblasts/erythrocytes/red cells;  
 4. plasma cells/B lymphocytes;  
 5. anterior pituitary (cells); 5
- (b) insulin and somatotropin/some antibodies; 1
- (c) (i) regulator gene synthesises repressor protein;  
 this attaches to DNA preventing transcription;  
 repressor protein is removed from DNA by reacting with a stimulating/inducing chemical;  
 this allows transcription to proceed and so proteins/enzymes can be synthesised (in response to stimulating/inducing chemical); **max 3**
- (ii) antibodies; 1  
 (iii) virus/bacterial infection/allergy/transplant/or equivalent; 1  
 (iv) lack of iron/ folic acid/ vitamin B<sub>12</sub>/cyanocobalamin/gene mutation; 1

**TOTAL 12**

**QUESTIONSHEET 10**

7

- (b) (i) genetic code on DNA is copied into mRNA;  
double helix of DNA unwinds (in region to be copied);  
complementary nucleotides line up along coding strand of DNA;  
A to U and C to G;  
assemble together to make a complementary strand of mRNA;  
under influence of RNA polymerase;  
mRNA unzips from DNA template and passes to ribosomes; **max 5**
- (ii) ATP provides energy;  
specific amino acids attach to tRNA by condensation;  
at opposite end to anticodon; **max 2**
- (iii) ribosome attaches to first two codons on mRNA;  
this allows first two tRNA molecules to couple into place;  
by codon - anticodon bonding/hydrogen bonds form;  
the amino acids carried on these tRNAs can join by a peptide bond/ to form a dipeptide;  
ribosome then moves to next codon;  
releasing tRNA<sub>1</sub> but enabling tRNA<sub>3</sub> to enter with its amino acid;  
tripeptide forms;  
process continues until stop-go codon is reached which allows polypeptide to be released into RER;  
ref to peptide synthetase; **max 6**

(allow alternative description where ribosome only covers one codon at a time).

**TOTAL 20**

**QUESTIONSHEET 11**

(a) thymine; adenine + cytosine + guanine + uracil;	2
(b) peptide bonds/condensation; hydrogen bond/ionic bonds; sulphur bonds;	3
(c) mRNA; codons; anticodons; tRNA;	4
(d) polypeptides; polypeptides; lipids/fats; carbohydrates/sugars;	4
<b>TOTAL 13</b>	

**QUESTIONSHEET 12**

(a) (i) two amino acids must be present to join together (by peptide bonds); because each tRNA carries a specific amino acid two tRNA molecules must be present (at the same time);	2
(ii) the joining of the acid and amine groups of (adjacent) amino acids (to form a peptide bond); requires the presence of the specific enzyme to catalyse it;	2
(iii) amino acids require activation energy; to react with tRNA (to form the amino acid -tRNA complexes); and to react with other amino acids to form peptide bonds/polypeptides;	<b>max 2</b>
(iv) these codons have no corresponding tRNA molecules; thus as the ribosome passes over them the synthesised polypeptide is released (to the RER);	2
<b>TOTAL 8</b>	

**QUESTIONSHEET 13**

(a) nitrate ions are absorbed by root hairs; actively/uses ATP; reduced to nitrite ions by nitrate reductase; reduced to ammonium ions by nitrite reductase; ammonium ions react with keto-acids to make amino acids; these can undergo transamination to make other amino acid types;	<b>max 4</b>
(b) nitrogen fixing bacteria/Rhizobium in root nodules; make amino acids which also become available to the plant; ref. mutualistic association;	<b>max 2</b>
<b>TOTAL 6</b>	

**QUESTIONSHEET 14**

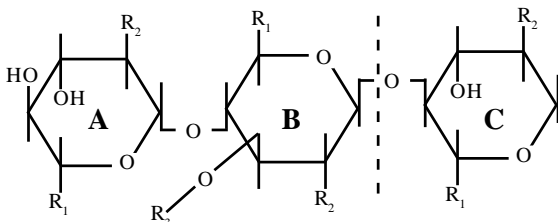
- (a) GUA CAU UUA ACU CCU GAA GAG ;; (1 mark off per error) 2
- (b) glutamic acid has two codons;  
only the first two bases in a codon are needed for amino acid recognition; 2
- (c) (i) (CTT would become CAT which codes for) valine which would replace glutamic acid at that point; 1
- (ii) sickle cell anaemia; 1
- (iii) wrong amino acid would mean alteration to hydrogen/ionic/sulphur/cross bonding;  
thus altering 3D shape of the haemoglobin/protein; 2
- TOTAL 8**

**QUESTIONSHEET 15**

- (a) nucleus; assembly of daughter DNA during (semi-conservative) replication; 2
- (b) nucleus; assembly of messenger RNA during transcription; 2
- (c) mitochondrion; allows continued ATP synthesis for energy supply/removes H from respiratory chain/or equivalent; 2
- (d) ribosome; catalyses formation of peptide bonds between adjacent amino acids; 2
- TOTAL 8**

**QUESTIONSHEET 16**

- (a) A – mRNA/messenger RNA;  
B – ribosome;  
C – lysozyme/polypeptide; 3
- (b) hydrogen bonds/sulphur bonds/ionic bonds;  
between amino-acid side chains/R groups; 2
- (c) between residues B and C across the glycosidic bond; 1



- (d) lysozyme/enzyme molecule has a complex shape/is folded;  
folding/shape is genetically determined/instructions are in genes;  
translation is conversion of code into sequence of amino acids;  
part of molecule acts as active site;  
shape of active site confers specificity;  
polysaccharide fits into/bonds with/has complementary shape to active site; max 4

**TOTAL 10**

**QUESTIONSHEET 17**

- |              |   |              |
|--------------|---|--------------|
| (a) (i)      | transcription;  | 1            |
|              | (ii) RNA polymerase;  | 1            |
|              | (iii) CCG;  | 1            |
|              | (iv) translation;   | 1            |
| (b)          | provide energy;<br>for joining of tRNA and an amino acid;<br>formation of peptide bonds;  | <b>max 2</b> |
| (c)          | DNA double strand, RNA single strand;<br>DNA contains deoxyribose, RNA contains ribose;<br>DNA contains thymine, RNA contains uracil; | 3            |
| <b>TOTAL</b> |   | <b>9</b>     |

**QUESTIONSHEET 18**

- |         |  |              |
|---------|--|--------------|
| (a) (i) | deoxyribose/pentose sugar molecules;<br>joined by phosphate bonds/bridges;<br>between carbons 1 and 3 (of adjacent sugars);<br>phosphate molecules are of orthophosphate type/ $-\text{H}_2\text{PO}_3^-/(\text{H}_3\text{PO}_4)$ ;  | <b>max 3</b> |
|         | (ii) nitrogenous bases bonded onto (carbon 5 of) the sugars;<br>by condensation links;<br>ref to adenine, guanine, cytosine and thymine;<br>ref complementary base pairs, adenine to thymine, guanine to cytosine;<br>(opposite) base pairs joined by hydrogen bonds;<br>A to T by two H bonds, C to G by three H bonds;   | <b>max 4</b> |
| (b)     | sequences of bases make up the genetic code;<br>unit of code is a codon which is a triplet of three adjacent nucleotides/bases;<br>a codon codes for the insertion of a specific amino acid into the polypeptide/protein;<br>a gene is made up of a sequence of many codons along the DNA molecule;<br>a gene codes for the synthesis of a specific polypeptide/protein;<br>the amino acid sequence of the polypeptide is governed by the gene codon sequence;<br>ref to code being non-overlapping;<br>ref to code being degenerate/containing more information than is needed;<br>ref to code being universal/same in all life forms;<br>ref to introns/non-coding lengths of DNA within genes/exons as the coding lengths of DNA; | <b>max 6</b> |

**TOTAL 13**

**QUESTIONSHEET 19**

- (a) when lactose is absent gene i becomes active;  
gene i codes for the synthesis of a repressor protein;  
the repressor protein binds to the operator site;  
this blocks the process of transcription of genes z, y and a (onto messenger RNA);  
since it blocks the action of RNA polymerase/will not allow RNA polymerase to move along DNA (from the promoter region);  
thus genes z, y and a are repressed/cannot synthesize their enzymes; **max 4**
- (b) lactose acts as an inducer;  
when it is present it binds to the repressor protein;  
changes the shape/chemical nature of the repressor protein so that it will not attach to the the operator region;  
RNA polymerase can now pass along genes z, y and a, (thus allowing transcription to occur);  
once transcribed to the mRNA the genes can translated at the ribosomes to synthesize the enzymes; **max 4**
- (c) ionising radiation/correct named type of radiation;  
chemical carcinogen/mutagen/correct named chemical mutagen; **2**

**TOTAL 10**

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**QUESTIONSHEET 20**

- (a) DNA polymerase;  
helix;  
unwind/unzip;  
hydrogen;  
nitrogenous/exposed/purine and pyrimidine/bases;  
thymine;  
cytosine;  
nucleoplasm/nuclear sap/nucleus;  
semi-conservative;  
parental/primer/original; **10**
- (b) (i) complementary thymine must also be 36%;  
thus the other two bases must add up to 28%;  
since they are complementary, guanine must be 14%;  
and cytosine must be 14%; **4**
- (ii) no;  
because the intron regions of the gene are not transcribed/are cut out/  
only the exon/coding lengths are included in the mRNA; **2**

**TOTAL 16**