

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) UCAGGGUUUA; **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**
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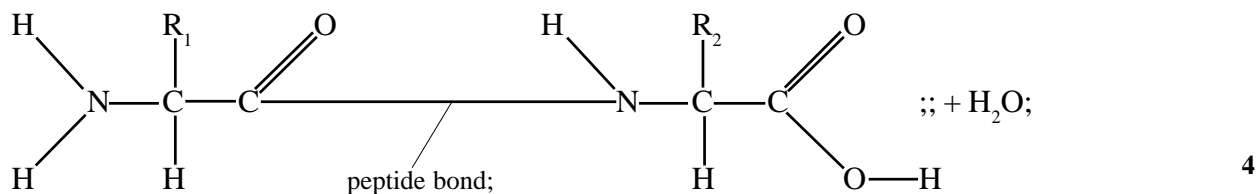
QUESTIONSHEET 7

- (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)

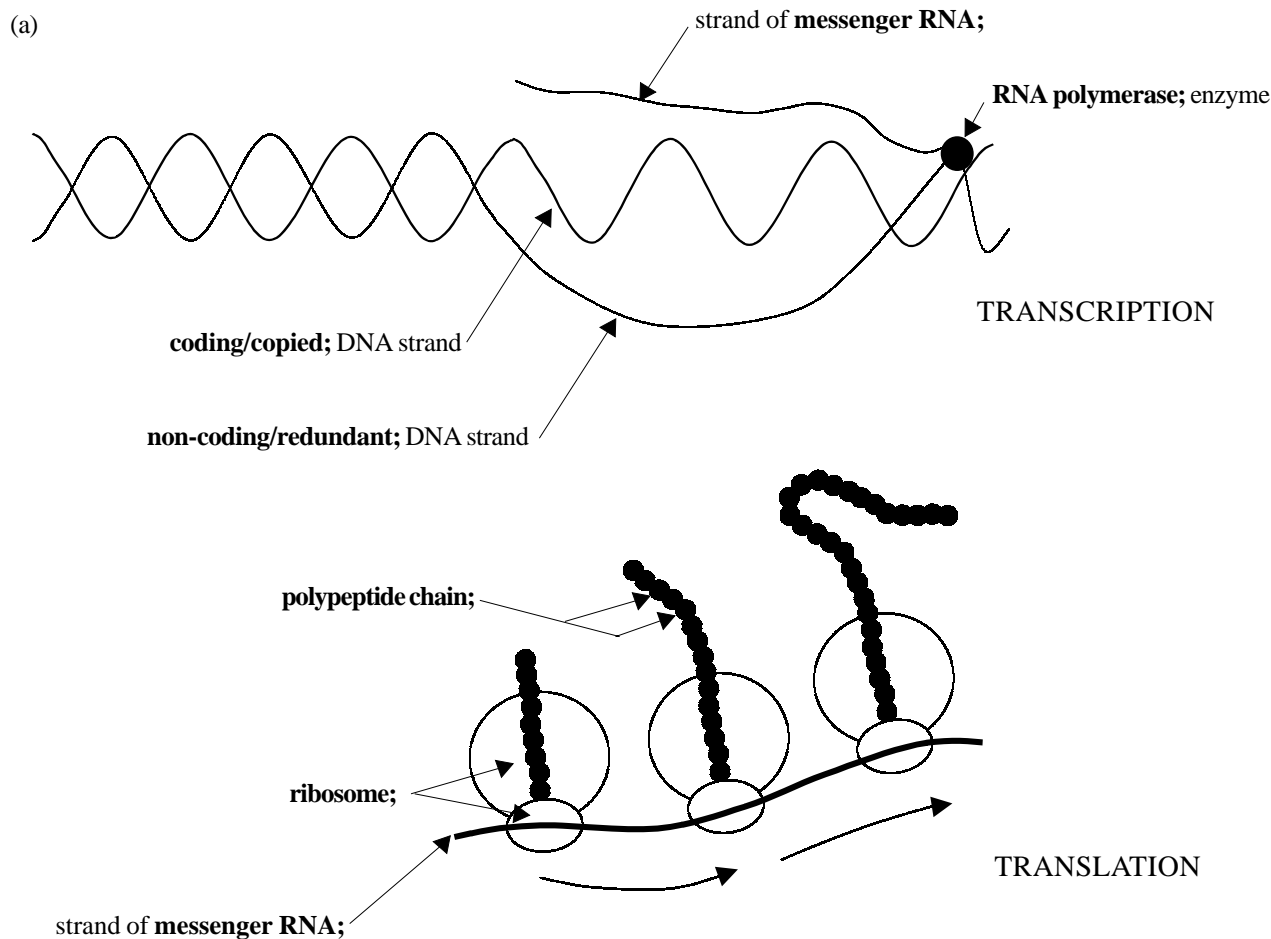
- (ii) on ribosome/rough endoplasmic reticulum; 1
- (iii) in Golgi body; 1
- (c) three dimensional structure is held in place by hydrogen/sulphur/ionic bonds;
 R1 and R2 contain reactive groups/hydroxide groups/sulphydril groups/other egs;
 these can join between amino acids in the polypeptides;
 thus 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 B₁₂/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 tRNA₁ but enabling tRNA₃ 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
TOTAL	13

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;	max 2
(iv) these codons have no corresponding tRNA molecules; thus as the ribosome passes over them the synthesised polypeptide is released (to the RER);	2
TOTAL	8

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;	max 4
(b) nitrogen fixing bacteria/Rhizobium in root nodules; make amino acids which also become available to the plant; ref. mutualistic association;	max 2
TOTAL	6

QUESTIONSHEET 14

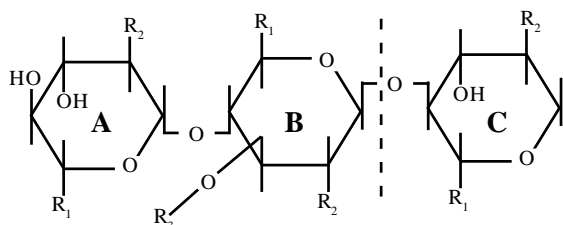
- (a) GUA CAU UUA ACU CCU GAA GAG ;; (1 mark off per error) 2
- (b) glutamic acid has two codons;
only the first two bases in a codon are needed for amino acid recognition; 2
- (c) (i) (CTT would become CAT which codes for) valine which would replace glutamic acid at that point; 1
- (ii) sickle cell 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;
for joining of tRNA and an amino acid;
formation of peptide bonds; | max 2 |
| (c) DNA double strand, RNA single strand;
DNA contains deoxyribose, RNA contains ribose;
DNA contains thymine, RNA contains uracil; | 3 |
| TOTAL 9 | |

QUESTIONSHEET 18

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

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 promotor 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**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