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

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**

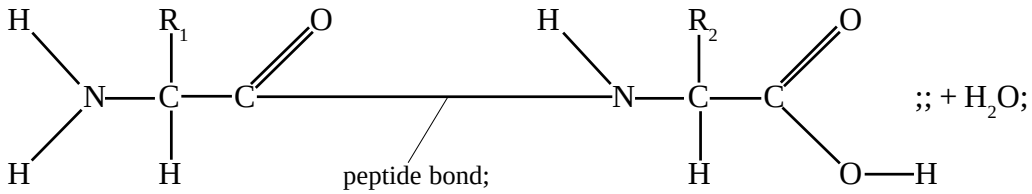
TOTAL 8

QUESTIONSHEET 8

(a) (i) sulphur; phosphorus/nitrogen; **2**

(ii) alcohol/hydroxide/amide/sulphydril; **1**

(b) (i)



4

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;
Rl 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**

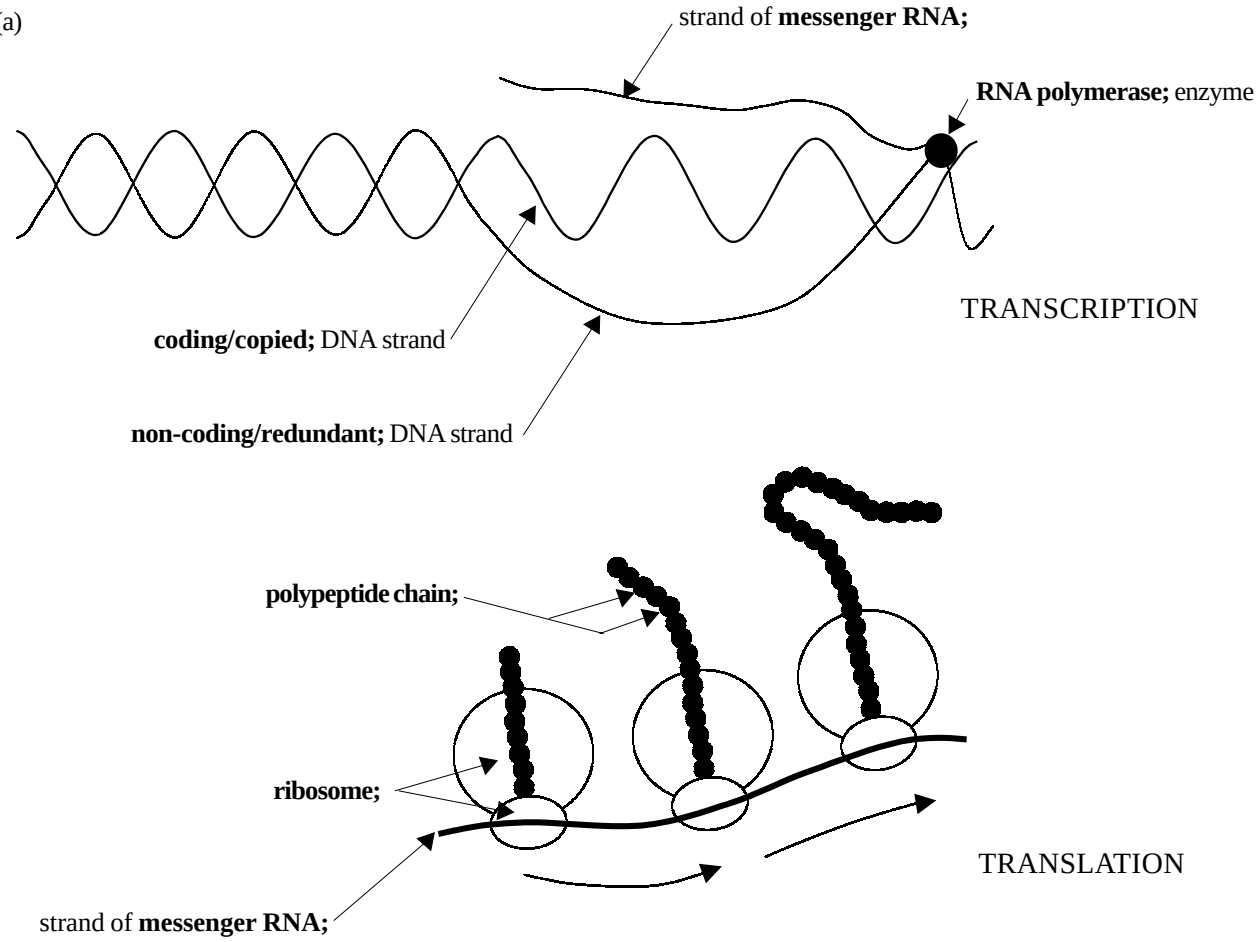
(iii) virus/bacterial infection/allergy/transplant/or equivalent; **1**

(iv) lack of iron/ folic acid/ vitamin B_{12} /cyanocobalamin/gene mutation; **1**

TOTAL 12

QUESTIONSHEET 10

(a)



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(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 $tRNA_1$ but enabling $tRNA_3$ 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 <u>daughter</u> DNA during (semi-conservative) replication; **2**

(b) nucleus; assembly of <u>messenger</u> 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**

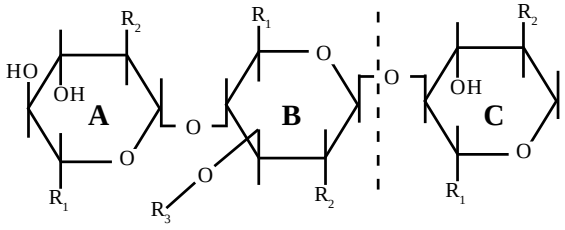
TOTAL 8

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/ $-H_2PO_3-/(H_3PO_4)$; **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

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