Mark schemes

Q1.

(a) (Has) phosphate

OR

(Has) deoxyribose

OR

(Has) hydrogen bonds;

Ignore the number of hydrogen bonds

Accept both contain a pyrimidine/single ring (structure)

Accept 'H bonds'

1

(b) Correct answer of 8×10^{-6} **OR** 8.3×10^{-6}

= **2 marks**;;

Incorrect answer of

0.000 008 3 (correct answer but not in standard form) = **1 mark**

OR

8.3×10^{-8} (correct division using correct number of G-C pairs, and in standard form, but not shown as a percentage) = **1 mark**

OR

Correct answer in incorrect standard form; eg 83×10^{-7} = **1 mark**

OR

1.2×10^{9} (correct number of G-C pairs in the genome in standard form) = **1 mark;**

Accept any number of decimal places that round to 8.3

2

(c) 1. Substitution (mutation occurred):

2. (Only) one nucleotide/base pair is changed (in a gene)

OR

(Only) one (DNA) triplet/codon changed;

3. Same amino acid (coded for);
Reject same amino acid is produced
Accept one amino acid changed

4. (Because) DNA/genetic code is degenerate;
Accept a description of degenerate code
can be awarded together, e.g 'different codons/ triplets code for the same amino acid' = MP3 and MP4

5. (So) tertiary structure is not changed;

6. (Change) could be in an intron;

7. Removed during splicing;

4 max

(d) 1. No (functional) enzyme/**X**;

2. (So) more/faster cell cycles;
Ignore 'cell cycle isn't slowed down' on its own

3. More(frequent) DNA replication

OR

DNA replication not delayed;
Accept 'faster DNA replication'

4. (So) mutations (more likely to) occur in DNA replication;

3 max

[10]

Q2.

(a)

mRNA	tRNA
1. (Has) codon(s)	(Has) anticodon;
2. No hydrogen/H bonds/base pairs	Has hydrogen/H bonds/base pairs;
3. No amino acid binding site	Has amino acid binding site;
4. Linear/straight/not folded	'Clover (leaf' shape)/ folded;
5. Long/many nucleotides/bases	Short/few nucleotides/ bases;

Must be comparisons

Accept description of binding site, eg amino acid only bound to tRNA

Accept mRNA cannot carry an amino acid, tRNA can

3 max

(b) Phe, Arg, Ala;

Reject if order is different

1

(c) (Name of mutation)

1. (Single base) substitution;

(Change in DNA)

2. Guanine to thymine

OR

G to T

OR

GCC to TCC;

Marks can be achieved in any section

Reject thiamine

(Explanation)

3. (So) Arg (still) present

OR

No change in amino acid;

Reject amino acids are formed

4. (So) no change in primary structure

OR

(So) no change in tertiary structure

OR

(So) no change in active site (shape);

4

[8]

Q3.

21-25	Extended Abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16-20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.
11-15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.
6-10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1-5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	Definition
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question.	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. 'Several' here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (eg importance) at A-level standard.

Phosphorus-containing substances and their importance in biological systems.

- 3.1.3 Lipids
- 3.1.5.1 Structure of DNA and RNA
- 3.1.5.2 DNA replication
- 3.1.6 ATP
- 3.1.8 Inorganic ions
- 3.2.1.1 Structure of eukaryotic cells
- 3.2.2 All cells arise from other cells
- 3.2.3 Transport across cell membranes
- 3.3.3 Digestion and absorption
- 3.4.1 DNA, genes and chromosomes
- 3.4.2 DNA and protein synthesis
- 3.4.3 Genetic diversity can arise as a result of mutation or during meiosis
- 3.4.4 Genetic diversity and adaptation
- 3.4.7 Investigating diversity
- 3.5.1 Photosynthesis
- 3.5.2 Respiration
- 3.5.4 Nutrient cycles
- 3.6.2.1 Nerve impulses
- 3.6.2.2 Synaptic transmission
- 3.6.3 Skeletal muscles
- 3.6.4.2 Control of blood glucose concentration (cyclic AMP)
- 3.6.4.3 Control of blood water potential
- 3.8.1 Alteration of the sequence of bases in DNA can alter the structure of proteins
- 3.8.2.1 Most of a cell's DNA is not translated
- 3.8.2.2 Regulation of transcription and translation
- 3.8.3 Using genome projects
- 3.8.4.1 Recombinant DNA technology

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q4.

(a) Similarities

1. Polymers of nucleotides;
   Accept 'chain' for polymer

2. (Nucleotide has) pentose, (nitrogen-containing organic) base and a phosphate (group);
   Accept in correct context
   'ribose/deoxyribose' for pentose

3. Cytosine, guanine and adenine (as bases);

4. Have phosphodiester bonds;

Differences

5. Deoxyribose v ribose;

6. Thymine v uracil;

7. Long v short;
   Accept DNA longer
   Ignore 'large' and 'small'

8. Double helix/stranded v single stranded;

6 max

(b) Similarities

1. Double membrane;

2. Both contain (circular) DNA;

3. Both contain ribosomes;
   Ignore numbers in front of ribosomes

Differences

4. Thylakoids/lamellae/grana v cristae;

5. Stroma v matrix;

6. Pigments v no pigments;
   Accept 'chlorophyll v no chlorophyll'

7. Starch grains v no starch grains;
   Max 3 marks for differences

4 max

[10]

Q5.

(a) 1. Amino acids joined by peptide bond(s);

2. (By) condensation reaction(s);

3. Secondary structure is formed by hydrogen bonding;

Accept alpha helix OR β-pleated sheet for 'secondary structure'

4. Tertiary structure formed by interactions (between R groups);

Accept 3° for tertiary

5. Quaternary structure contains >1 polypeptide

OR

Quaternary structure formed by interactions/bonds between polypeptides;

4 and 5 Accept for 'interactions', hydrogen bonds OR disulfide bridges OR ionic bonds OR hydrophobic OR hydrophilic interactions

Ignore peptide

5

(b) 1. Polymer of nucleotides;

Accept 'polynucleotide'

2. (Nucleotide) consists of deoxyribose, phosphate and an organic/nitrogenous base;

Accept 'phosphoric acid' for phosphate

3. Phosphodiester bonds (between nucleotides);

4. DNA double helix held by H bonds

OR

2 strands held by H bonds;

5. (Hydrogen bonds/pairing) between adenine, thymine **and** cytosine, guanine;

Ignore bases identified with letters (A, T, G, C)

Reject adenosine and cysteine

6. DNA is associated with histones/proteins;

7. (During mitosis/when visible) chromosome consists of two chromatids joined at a centromere;

Accept correctly annotated diagram(s) for equivalent marking points

6 max

(c) 1. Independent segregation of homologous chromosomes/pairs;

If no marks awarded accept one principle mark 'Meiosis producing cells that are genetically different (from one another)'

For 'independent' accept 'random'

For 'segregation' accept 'assortment'

2. Crossing over between homologous chromosomes/pairs;

Accept 'within bivalent' for 'between homologous pair'

3. Random fertilisation of gametes;

Ignore 'random mating'

Accept 'random fusion' for 'random fertilisation'

4. (Produces) new combinations of <u>alleles</u>;

Accept as an additional mark point

(Produces) new combinations of maternal and paternal chromosomes

Ignore reference to epigenetics

4

[15]

Q6.

(a) 1. RNA/rRNA;

2. Protein;

Reject tRNA and mRNA

Ignore amino acids

2

(b) 1. DNA has deoxyribose, mRNA has ribose;

2. DNA has thymine, mRNA has uracil;

3. DNA long**,** mRNA short;

4. DNA is double stranded, mRNA is single stranded

Accept 'double helix' for 'double stranded' <u>and</u> 'single helix' for 'single stranded'

5. DNA has hydrogen bonds, mRNA has no hydrogen bonds

OR

DNA has (complementary) base pairing, mRNA does not;

4 max

Must be comparisons

Ignore splicing/introns

[6]

Q7.

(a) **DNA v tRNA**

1. Deoxyribose v ribose;
2. Double-stranded v single-stranded;

Accept double helix for double stranded

3. Many nucleotides v few;

Accept longer v shorter

4. Thymine v uracil;

Ignore T and U

5. Linear v clover leaf (structure)

OR

Double helix v clover (leaf structure);

Accept description of clover leaf structure.

Accept straight for linear

6. Does not bind to amino acid v does bind to amino acid;

Accept attach/carry/have binding site for 'bind to'

7. No exposed bases v anticodon;

3 max

Apply list rule

(b) 1. Use centrifuge/centrifugation at slow/low/increasing (sequence of) speed(s);

2. Large/dense organelles (removed) in (first/early) pellet

OR

Less dense organelles (removed) in supernatant

OR

Small organelles (removed) in supernatant;

Accept descriptions of supernatant and pellet, eg liquid and sediment/bottom of tube

Accept light for small

Accept ribosomes for small organelles

Accept more dense OR heavy for large

Accept named large organelle in pellet, eg mitochondria

2

Ignore homogenate OR filtering

Ignore cold, isotonic, buffered

(c) (Tube **A**)

1. (Ribosomes bound to) rough endoplasmic reticulum;

Do not credit ER/rER the first time used if endoplasmic reticulum not given

2. (Are) denser/heavier so move further;

Accept, free ribosomes are lighter so form a band higher in tube OR do not move as far

For 'heavier/lighter' accept 'denser/less dense'.

Accept settle lower OR are lower down OR at bottom OR in pellet, for move further

(Tube **B**)

3. (Only free ribosomes because) membrane/phospholipids/endoplasmic reticulum dissolved (by detergent);

Do not credit ER/rER the first time used if endoplasmic reticulum not given

Accept broken down for dissolved

Ignore damaged for dissolved

3

Award marks across A and B

[8]