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)   1.   Chromatids do not separate;

              Accept 'chromosomes' for chromatids but reject ***homologous*** *chromosomes.*

        2.   Non-disjunction;

2

(b)   1.   Extra chromosome in gamete/egg/sperm/zygote

OR

All cells derived from a single cell/zygote;

              Accept mutation for extra chromosome.

        2.   (Body cells) produced by mitosis;

2

(c)   Cells with extra chromosome (are produced) from cells with mutation

OR

Cells with correct number (of chromosome are produced) from cells without mutation;

1

(d)   Automarked question – Correlation coefficient;

(Box 1)

Answer key: A – Correlation coefficient

1

(e)   1.   (More) blood moves from left to right ventricle (as left ventricle has thicker muscle);

        2.   Greater <u>volume</u> of blood to lungs

OR

(Higher blood pressure) in pulmonary artery;

2

[8]

Q3.

(a)   After first meiotic division – **B**;

After second meiotic division – **E**;

2

(b)   (Similarities)

1.   (Both populations) have (variation due to) independent segregation/assortment (of chromosomes/chromatids);

2.   (Both populations) have (variation due to) random fertilisation (of gametes);

3.   Both (populations) have (further) mutations;

(Difference)

4.   Crossing over causes variation in non-mutant only;
        Comparison can be implied
        Max 2 *for similarities*

3 max

[5]

Q4.

(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 <u>polypeptide</u>

    OR

    Quaternary structure formed by interactions/bonds between <u>polypeptides</u>;
    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]

Q5.

(a) 1.   DNA replication (during late interphase);
     2.   Two divisions;

*Accept for 'two divisions', meiosis I **and** meiosis II
OR examples of stages, e.g. anaphase I **and**
anaphase II*

*Accept description that clearly indicates two
divisions*

Ignore references to stage names (except above)

Accept annotated diagrammatic representations

     3.   Separation of homologous chromosomes (in first division);

Accept annotated diagrammatic representations

Reject 'diploid cells' once.

     4.   Separation of (sister) chromatids (in second division);

Accept annotated diagrammatic representations

Reject 'diploid cells' once.

*Accept 'chromosomes' for 'chromatids' but reject
homologous chromosomes*

     5.   Produces 4 (haploid) cells/nuclei;

Accept 'gametes' for cells

4 max

(b) Correct answer for 2 marks, 18–19;;
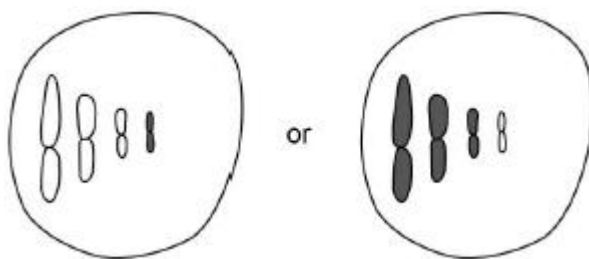
Accept for 1 mark,

0.06–0.07 / (½)^4 / $\frac{1}{16}$ (correct probability)
OR

16 (correct number of arrangements);

2

(c)

Four chromosomes shaded correctly;

Accept chromosomes in any order

Reject evidence of 2 chromatids per chromosome

1

(d) Mitosis;

1

[8]

Q6.

(a)   1.   Attachment proteins attach to receptors;

For 'attachment protein' accept gp41/gp120/ glycoprotein but ignore 'receptor protein' (on virus)

Accept bind for attach

2.   (Viral) nucleic acid enters cell;

Accept references to engulfment OR injection for enters

Ignore references to virus DNA/RNA incorporated into cell genome/nucleus/chromosomes

Accept RNA/DNA/genetic material for 'nucleic acid'.

3.   Nucleic acid replicated in cell

   OR

   Reverse transcriptase makes DNA from RNA;

*Accept RNA/DNA/genetic material for 'nucleic acid'.*

4.   Cell produces (viral) protein/capsid/enzymes;

Accept capsomeres OR reverse transcriptase for protein

5.   Virus assembled and released (from cell);

Accept lysis OR burst OR bud off OR emerge for released

3 max

(b)   One mark for each column;;

Feature	Cell cycle involving	
	Mitosis	Binary fission
Replication of linear DNA	✓	
Replication of circular DNA		✓
Produces 2 daughter cells	✓	✓
Produces 4 daughter cells		
Happens in prokaryotic cells		✓
Happens in eukaryotic cells	✓	

2

(c)
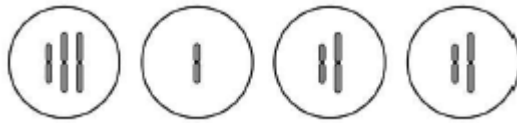
OR

OR

OR

1.   2 cells on left correct, ignore differences in chromosome length in drawn cells;

1.   2 cells on right correct, ignore differences in chromosome length in drawn cells;

2

(d)   (Conclusion not valid because)

1.   (MM1) 197/197.1;

   and

2.   (MM2) 83/82.8;
   OR

   Correct answer for 2 marks,

114 − 114.3 (correct difference between MM1 and MM2)

Accept for 1 mark

259.2 **and** 345.6 (using total population size)

OR

MM2 is 86/86.4 bigger (using population totals)

2

[9]